

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Tuesday, 13 July 2021 3:47 pm  
**To:** [REDACTED] Ian Angus; Marine  
**Cc:** HUHA Helping You Help Animals; ingrid [REDACTED];  
**Subject:** Veterinary update for orca calf 13/07/21  
**Attachments:** Orca calf update 13-07-21.docx

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet [REDACTED] from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by [REDACTED] also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.  
Kind regards,

[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

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1) miCurrent medical assessment

- Blood tests:
  - Performed in-house at Wellington Zoo: biochemistry, PCV/TP, manual white cell count.
  - Awaiting results from veterinary laboratory: Complete blood count and blood parasite check, fibrinogen, lactate, total iron.
    - These results will take 2-3 days.
  - RESULTS SO FAR: our interpretation of the in-house testing is that there is mild-moderate anaemia present. There does not appear to have been recent significant blood loss from any external wounds, so the main possible causes we're considering for this at the moment are: blood parasites, gut parasites, other underlying disease. Anaemia can cause weakness and illthrift.
  - There are no indications that there is capture myopathy present.
  - **We are awaiting** a second opinion from cetacean vets on the interpretation of these blood results.
- Physical exam:
  - Superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin.
  - He also has several deep lacerations near his tail fluke laterally to his spine.
  - On 12/07/21 at 6pm the animal was tilting to the right, variable amounts but up to 45 degrees. On the morning of 13/7/21 the tilting was still occasionally visible. Preliminary recommendations by cetacean vets are that possible reasons for this are: looking up and evaluating the situation (ie behavioural), myopathy (temporary or more severe), or tilting secondary to lung injury.
  - **We are awaiting** assessment of tilting videos by cetacean vets for additional opinions on this.
- Blow hole swabs:
  - Awaiting results from veterinary laboratory: blow hole cytology/culture (aerobic bacterial culture and fungal culture).
    - These results will take 3-6 working days for bacterial culture, and longer for fungal culture.
- Summary: our two main medical concerns as at 13/07/21 are the mild-moderate anaemia and the observed tilting. Further lab results and further cetacean vet opinions are pending to give better estimates of diagnosis and prognosis for these conditions.

Cetacean vets suggest: "The assumption is the calf stranded primarily due to maternal separation then weakness from malnutrition and inability to maintain itself at sea. However, that is not necessarily the case. There may be any number of additional problems with the calf that led to stranding and then there are the problems associated with stranding including muscle damage, pulmonary issues and even kidney damage and heart disease as with a capture myopathy scenario."

- To do:
  - **Please can someone try to collect us a faecal sample** when he passes one? It can be put in a clean (not necessarily sterile) container with a lid.
  - **Can someone please confirm our estimated age** for the animal? From memory I think someone told me 4-6 months?

2) Proposed medical/nutrition plan moving forward

For the period that the animal is away from his mother, he will require careful supportive care to maintain his strength and his health. The following are recommendations compiled from a range of cetacean vet recommendations. **Further information is pending and may result in updates to the following.**

- Closely monitor the animal's respiratory rate and the animal's behaviour and demeanour.
  - o In general.
  - o Before handling/feeding.
  - o Immediately after handling/feeding.
- Fluids
  - o His daily fluid requirements are 40-80ml/kg/d.
  - o We assume that there is a degree of dehydration present, so we will aim for >8L fluids per day (for an estimated 200kg body weight).
  - o For 12/07/21: 1L electrolyte solution by stomach tube at 7pm.
  - o For 13/07/21: 2L electrolyte solution by stomach tube at 9am, 2L by stomach tube at 1pm, 3L at 5pm (if this volume is tolerated), 3L at 9pm (if this volume is tolerated).
    - We initially started at 1-2L because we were carefully testing his stomach capacity, but advice has been he'll probably hold 3L so we plan to increase the volume this evening (13/07/21).
- Feeding plan
  - o We have an orca hand rearing formula sent through from Sea World in the US. We won't be able to find all of the ingredients here, but they have advised that some ingredients can be omitted or substituted for short term use.
  - o For 13/07/21 we will continue to just give fluids by mouth (no food).
  - o From the first feed on 14/07/21 we will start to introduce formula at a dilute rate. Dilution and frequency of feeds TBC, but based on preliminary feeding recommendations this will likely be recommended to be ~5 times a day (not overnight).
- Additional medications
  - o Cetacean vets have advised that we administer:
    - Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
    - Antibiotics by intramuscular injection twice a day. A long acting antibiotic was given on the afternoon of 12/07/21. A new antibiotic will be started on the morning of 14/07/21 and continue as twice a day injections from then on.
- Strength and fitness
  - o Allow the animal to swim in different directions, including circling in one direction and then in the other direction – to prevent overuse of some muscles and cramps. Possibly increase space available to increase amount/type of movements able to be exhibited – if safe and practical to do so.

3) Advice regarding management of disease between orca calf and humans, in both directions.

Some diseases of cetaceans can affect humans and vice versa, even if the cetacean/human that is the source of the disease appears clinically well. To reduce the potential for disease spread to or from cetaceans, we recommend:

- Wearing gloves and facemasks when in proximity to the animal.
- Washing hands carefully after being in proximity to the animal.
- Washing hands carefully prior to eating when on the response site.
- Minimising the number of people in proximity to the animal at all times.
- Use a foot bath when going in and out of the water.
- No dogs or other domestic animals on-site.
- Incorporate the above instructions into volunteer inductions at shift changes.
  
- (Work in progress: wetsuit cleaning protocols/recommendations).

[Redacted]

**From:** [Redacted]  
**Sent:** Wednesday, 14 July 2021 4:36 pm  
**To:** [Redacted]  
**Cc:** HUHA Helping You Help Animals; [Redacted]  
**Subject:** RE: Additional contact for regular vet-DOC meets - HUHA

**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

Thanks [Redacted]. You'll be in [Redacted] hands for the rest of this week, but happy to keep [Redacted] and others in the loop...and likewise. The more we're communicating, the smoother it's likely to be for everyone.

Cheers,

[Redacted]

[Redacted]

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**From:** [Redacted]@wellingtonzoo.com>  
**Sent:** Wednesday, 14 July 2021 4:25 pm  
**To:** [Redacted]  
**Cc:** HUHA Helping You Help Animals [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>  
**Subject:** Additional contact for regular vet-DOC meets - HUHA

Hi [Redacted]

Thanks so much for the catch up today! As discussed, for the video meeting on Friday 16<sup>th</sup> July at 1:30pm and for all the technical meetings moving forward, please can you include [Redacted] from HUHA as well? Her team includes two vets that are on-site at the orca calf facility much more than our team is, so will be very useful to loop in as they will be in a good position to provide observations and data on the calf. I've cc'd her here ('HUHA Helping You Help Animals' <[Redacted]>).

Thanks so much!  
Kind regards,

[Redacted]

[Redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

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[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Wednesday, 14 July 2021 6:47 pm  
**To:** [REDACTED] Ian Angus; Marine; [REDACTED];  
**Cc:** HUHA Helping You Help Animals; ingrid [REDACTED]; [REDACTED]  
**Subject:** Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

1) **Medical findings**

**Lab tests:**

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - o Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

**Physical exam:**

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also will several deep lacerations near his tail fluke laterally to his spine.
- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

**Fluids:**

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

**Feeding:**

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.

3) Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4) Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

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---

From: [Redacted]  
Sent: 13 July 2021 15:47

To: [Redacted]; iangus@doc.govt.nz; marine@doc.govt.nz

Cc: HUHA Helping You Help Animals [Redacted]; [Redacted]  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>

Subject: Veterinary update for orca calf 13/07/21

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet Gina from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by Gina also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

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[REDACTED]

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Thursday, 15 July 2021 9:52 am  
**To:** [REDACTED]  
**Subject:** FW: Testing of orca calf

Hullo,

Some helpful info from [REDACTED] below, so at this stage we won't test the calf for brucellosis or toxoplasmosis.

Thanks!

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
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200 Daniell Street | Newtown | Wellington 6021

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---

**From:** [REDACTED]@massey.ac.nz>  
**Sent:** 15 July 2021 09:26  
**To:** [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Testing of orca calf

Hi again [REDACTED]

Just to summarise our conversation re testing for Brucella and Toxo:

- Since we need to minimise interventions for this calf, my recommendation is based on whether the results of the tests would make a difference to the treatment plan.
- If the calf was seropositive for either toxo or brucella, this would indicate exposure rather than active disease. We know that a high proportion of cetaceans are seropositive for these pathogens, and the vast majority are subclinical or latent infections.
- If this calf had active disease from either pathogen you would be seeing indicators of this on clinical biochem/haematology, and these parameters would be much more useful in determining disease status/prognosis than serology would be.
- We also need to note that most serological testing for these agents has not been validated in cetaceans, and the tests can be very unreliable.
- If the calf tested positive for either agent, there is really no effective way to treat him, so from that perspective a positive result wouldn't change the plan.
- He wouldn't be able to transmit either agent to people, even if he were positive.
- We know that both agents are already present in the marine environment and in cetaceans in New Zealand, so even if positive he wouldn't pose an increased risk to other orca if he is returned to his pod. Also, toxoplasma can't be spread between cetaceans, other than in pregnant females, so he isn't a risk for spreading toxo.

Overall, I don't think there is much to justify doing these tests at this stage. If there is extra serum available after the baseline health assessment testing has been done you could freeze it for later testing if anything should change, although I feel this would be more scientifically interesting than practically useful.

Hope this helps

[REDACTED]

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**From:** [REDACTED]@wellingtonzoo.com>

**Sent:** Thursday, 15 July 2021 8:32 AM

**To:** [REDACTED]@massey.ac.nz>

**Subject:** RE: Testing of orca calf

Thank you, [REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

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---

**From:** [REDACTED]@massey.ac.nz>

**Sent:** 15 July 2021 08:30

**To:** [REDACTED]@wellingtonzoo.com>

**Subject:** RE: Testing of orca calf

Now is good. What's the best number to get you on?

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**From:** [REDACTED]@wellingtonzoo.com>

**Sent:** Thursday, 15 July 2021 8:29 AM

**To:** [REDACTED]@massey.ac.nz>

**Subject:** Re: Testing of orca calf

Anytime before 1pm is good. Could do now if you're free?

Thank you :)

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**From:** [REDACTED]@massey.ac.nz>

**Sent:** Thursday, July 15, 2021 8:24:37 AM

**To:** [REDACTED]@wellingtonzoo.com>

**Subject:** RE: Testing of orca calf

Hi [REDACTED]

I'm so glad DOC have got you guys involved!

It would be great to talk this through. Let me know when is a good time for you and we could do a phone call

[REDACTED]

[REDACTED] PhD, Diplomate ACVP, BVSc (Dist), BSc

Professor of Veterinary and Marine Mammal Pathology  
Deputy Head of School and Dean of Postgraduate Studies  
Tāwharau Ora - School of Veterinary Science  
Massey University

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[\[REDACTED\]@massey.ac.nz](mailto:[REDACTED]@massey.ac.nz)

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**From:** [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>  
**Sent:** Thursday, 15 July 2021 7:56 AM  
**To:** [REDACTED] <[\[REDACTED\]@massey.ac.nz](mailto:[REDACTED]@massey.ac.nz)>  
**Cc:** [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>;  
[REDACTED]  
**Subject:** Testing of orca calf

Hi [REDACTED]

We've been asked to assist DOC with their response to the orca calf currently housed at Plimmerton boat club, by providing veterinary advice on the health of the calf. Ashley has managed to get some blood from the calf on a couple of occasions, and we intend to take semi-regular blood samples to monitor it's health for the period that it will be in care. As you can imagine, there are a lot of different factors that DOC are considering around the plan for this little calf, and our team's role at this stage is to establish the health of the calf as best as possible, and maintain it's health while the search for the pod continues.

Other than a few skin lacerations and abrasions, we haven't found anything abnormal on brief physical exam, CBC and biochem. The calf seems relatively bright and seems to be behaving normally as well as we can assess. The team on-site are going to attempt to collect us a faecal sample. It is receiving supportive care and fluids, and the team have also just started feeding it a cetacean formula to help provide it's caloric requirements.

I'm reading through an American document on best practices for marine mammal response, rehabilitation and release, which has reminded me of a few additional diseases of concern of cetaceans that we have not tested for yet. I was wondering if I could please ask you some questions about this? Do you think it would be possible to test blood from this individual for brucella and toxoplasmosis? Do you think this would be useful for our scenario, and are there any additional concerns that might arise with performing this testing do you know?

Thanks so much for your thoughts!

Kind regards,

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Thursday, 15 July 2021 4:44 pm  
**To:** [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** RE: [EXTERNAL] Re: Stranded orca calf in New Zealand  
**Attachments:** PN2115671\_SB\_CHEM Orca.PDF

Hey all,  
Quick update from the site this morning medically – no change in faecal output since formula started, Toa seems comfortable and unchanged in his demeanour. Wasn't really listing at all this morning while I was there (about 3 hours), but would occasionally turn briefly to his side so pretty happy this continues to be behavioural. I've attached a blood film interpretation from our pathology lab that I thought may be of interest. Welcoming any comments!  
Cheers

[Me tiaki, kia ora!](#)

[REDACTED] BVSc (Hons)  
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**From:** [REDACTED]@SeaWorld.com>  
**Sent:** 15 July 2021 14:05  
**To:** [REDACTED]@vanaqua.org>; [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@massey.ac.nz>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@SeaWorld.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
**Subject:** Re: [EXTERNAL] Re: Stranded orca calf in New Zealand

I agree with [REDACTED]. We will often give nystatin orally TID in combination with ab therapy if an animal will be on treatment for several weeks, if short-term then not indicated.

Initially it was thought that he was listing, however from the videos, I saw him list to both sides, roll and appeared to be looking at people on the outside of the circle causing him to tilt to the side...so I did not consider it significant. Is he still doing behavior or do are you seeing any other postural abnormalities?

His history of why he stranded was suspect, so we thought it best to cover him empirically...as pneumonia/ bacterial infection, parasite migration, algal toxin, malnutrition and trauma are the most common causes of health compromise that leads to animals stranding. His clinical signs and minimum data base diagnostics rule-out many differentials, and it's possible we won't know what caused him to strand.

Hope for the best,



On Jul 14, 2021, at 6:25 PM, [REDACTED]@vanaqua.org> wrote:

Hi there,

Yes that sounds good on the meds. As for antifungals, yes they may be indicated with long term antibiotic therapy especially when more than one antibiotic has been used and of course the concurrent steroid is also a factor to consider. Kinda like in any species. But I would not automatically start it for this case. You have been pretty conservative with both Ab and steroid use. If there is an indication I would not hesitate but I see none for now.

Great work with this calf everyone.

Best wishes,



<VanAqua-300px\_9ae645ef-f355-45be-b66f-2816dd0c5fb8.png>

[REDACTED] **DVM, MSc, DACZM**  
Head Veterinarian & Director, Animal Health

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[<twitter-18-blk\\_a1f1f5e9-0546-48c2-9556-34d0b8e37d6a.png>](#)  
[<instagram-18-blk\\_be3f2e8d-0a56-4df9-873e-010b73748a56.png>](#)  
[<youtube-18-blk\\_3f426358-b249-4f28-90bb-a659dbcd0f3a.png>](#)

Vancouver Aquarium  
845 Avison Way, Vancouver, BC, Canada V6G 3E2

This email and any files transmitted with it are confidential and intended solely for the use of the individual or entity to whom they were addressed. If you have received this email in error, please notify us immediately.

On Jul 14, 2021, at 6:16 PM, [REDACTED]@wellingtonzoo.com> wrote:

Thank you [REDACTED], and thank you everyone so much for your help and support so far, it's been just an incredible help and we're so grateful.

He's had three doses of dex at 0.05mg/kg IM SID, so we'll give him a half dose tomorrow (0.025mg/kg IM) and then stop entirely, if you're happy with that as well?

At this stage we're planning on continuing the enrofloxacin 5mg/kg IM BID for a total of 7 days and then stopping, unless you recommend continuing on with this for longer (or shorter)?

I've had it mentioned to me by one of our biologists that antibiotic use in cetaceans often results in fungal infections, and that some people like to administer antifungals concurrently. I can't find any references to support this, so I was wondering if I could please run this (possibly silly) question past you as well please?

I've just had a quick look over the CBC and blood smear examination result that has come through from the lab and I can't see any abnormalities (will have a closer look soon). The blowhole cytology is also normal and shows no signs of inflammation.

Thanks again for all your support.

Kind regards,

[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
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From: [REDACTED] <[\[REDACTED\]@massey.ac.nz](mailto:[REDACTED]@massey.ac.nz)>

Sent: 15 July 2021 12:36

To: [REDACTED] <[\[REDACTED\]@SeaWorld.com](mailto:[REDACTED]@SeaWorld.com)>

Cc: [REDACTED] <[\[REDACTED\]@vanaqua.org](mailto:[REDACTED]@vanaqua.org)>; [REDACTED]

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<

Subject: Re: [EXTERNAL] Re: Stranded orca calf in New Zealand

Thank you [REDACTED]; that all makes sense. Will work on going slowly and see how he does.

---

From: [REDACTED] <[\[REDACTED\]@SeaWorld.com](mailto:[REDACTED]@SeaWorld.com)>

Date: Wednesday, 14 July 2021 at 5:39 PM

To: [REDACTED] <[\[REDACTED\]@massey.ac.nz](mailto:[REDACTED]@massey.ac.nz)>

Cc: [REDACTED] <[\[REDACTED\]@vanaqua.org](mailto:[REDACTED]@vanaqua.org)>; [REDACTED]

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[REDACTED] <[\[REDACTED\]@SeaWorld.com](mailto:[REDACTED]@SeaWorld.com)>; [REDACTED]

[REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED]

[REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED]

Subject: Re: [EXTERNAL] Re: Stranded orca calf in New Zealand

Hi [REDACTED]

The 100% formula should provide all caloric requirements and hydration, so I think you can phase out the electrolyte if the calf is receiving the full amount of formula. A lot is dependent on how the calf is processing the formula, input=output, in fecal consistency (ie. Formula Pooh) and weight gain.

Changes to phase out electrolytes or volume are best done incrementally by 25-50%. Sounds like he should be able to handle more volume, based on the initial tubing, but as formula is thicker it will take more to metabolize the formula. It seems that he should be able to tolerate more volume based on initial tubing volumes.

The formula sent is a species guideline, and adjustments can be made to meet each individual's needs based on environmental differences. Please feel free to share with the local team and make necessary adjustments to ensure adequate hydration, which can be observed with changes in fecal consistency and general behavior. We will often monitor weight gain with neonates that are being fed formula to ensure adequate growth...I know this will be difficult in your scenario, however you could get consistent girth and length measurements to estimate growth rate.

I would probably phase out the steroid with decreasing doses...it is probably no longer needed.

Hope that makes sense? Let me know if I left anything out or you have additional questions,

█

On Jul 13, 2021, at 10:00 PM, █  
█ [@massey.ac.nz](mailto:massey.ac.nz) wrote:

Sorry—lastly the blood glucose taken on site this morning was 6.5 mmol/L.

---

**From:** █ [@massey.ac.nz](mailto:massey.ac.nz)

**Date:** Wednesday, 14 July 2021 at 4:56 PM

**To:** █ [@SeaWorld.com](mailto:SeaWorld.com)

**Cc:** █ [@vanaqua.org](mailto:vanaqua.org), █

█ [@wellingtonzoo.com](mailto:wellingtonzoo.com),

█ [@SeaWorld.com](mailto:SeaWorld.com),

█ [@wellingtonzoo.com](mailto:wellingtonzoo.com),

█ [@wellingtonzoo.com](mailto:wellingtonzoo.com),

**Subject:** Re: Stranded orca calf in New Zealand

Blood results from today attached! 😊

---

**From:** █ [@massey.ac.nz](mailto:massey.ac.nz)

**Date:** Wednesday, 14 July 2021 at 4:55 PM

**To:** █ [@SeaWorld.com](mailto:SeaWorld.com)

**Cc:** █ [@vanaqua.org](mailto:vanaqua.org), █

█ [@wellingtonzoo.com](mailto:wellingtonzoo.com),

█ [@SeaWorld.com](mailto:SeaWorld.com),

█ [@wellingtonzoo.com](mailto:wellingtonzoo.com),

█ [@wellingtonzoo.com](mailto:wellingtonzoo.com),

**Subject:** Re: Stranded orca calf in New Zealand

Thank you so much for your quick response and advice!

We ran a second biochem on the calf today which I've attached the results of. The biggest changes were a slight increase in PCV suspected to be secondary to dehydration and a decrease in TP. For the most part everything looks ok still. We have extra whole blood and serum saved as well. On the photo, the numbers written in parentheses were from his first blood test on the 12<sup>th</sup>.

We also started tube feeding formula this morning. We have started with introducing very small amounts of slurried formula so he only received 500 ml at each feeding today (with four total feedings or 1.6 L slurry). The initial feeding was diluted to 50% strength and each subsequent feeding has been increased by 25% strength each time so he is now getting 100% strength feeds (although these are being given with 2.5 liters of vytrate at the same time at the moment).

I've done a rough nutritional calculation for the version of the formula that we are making which gave a calorie content of approximately 5881 cal/4 L (which is one batch of recipe). Meaning he has only received ~2352 calories of feed today. This is obviously well under the recommended amount of 120 kcal/kg/day. We are wondering how quickly we should be increasing the volume of formula fed to safely meet his metabolic requirements. In the orca formula document you sent previously you mentioned not feeding greater than 13.5 L/day. Based on our formula and an estimated weight of ~200 kg he would need 16 L/day to meet his requirements. A related question is whether you have any advice around phasing out vytrate and replacing it with just formula. The formula itself is quite high water content so we were wondering if we should only be relying upon it for hydration.

Our intended feed roster for tomorrow was using 500 ml full strength formula with 2.5 liters of vytrate 4 times during the day. I know it was recommended that we feed every 2 hours and with a vet on site all day that is something we can start doing to help ramp up his caloric intake. The team on-site is closely monitoring faecal output as well.

In regards to the formula recipe that you sent, we are considering starting to get help making it from some of the on-site vet team we have been collaborating with. Obviously we have diverged from your original recipe based on what is available to us, but we wanted to check to see if you are comfortable with us sharing the recipe for our version of your formula with that team.

For medications, the calf is receiving 5 mg/kg enrofloxacin BID and 0.05 mg/kg dexamethasone SID. We are not administering any other meds at this time.

Apologies for the lengthy email—I hope all that made sense!



Thank you so much once again and we look forward to hearing back!

[REDACTED]

---

**From:** [REDACTED] <[\[REDACTED\]@SeaWorld.com](mailto:[REDACTED]@SeaWorld.com)>

**Date:** Wednesday, 14 July 2021 at 4:17 PM

**To:** [REDACTED] <[\[REDACTED\]@massey.ac.nz](mailto:[REDACTED]@massey.ac.nz)>

**Cc:** [REDACTED] <[\[REDACTED\]@vanaqua.org](mailto:[REDACTED]@vanaqua.org)>, [REDACTED]

[REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>,

[REDACTED] <[\[REDACTED\]@SeaWorld.com](mailto:[REDACTED]@SeaWorld.com)>,

[REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>,

[REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>,

**Subject:** Re: Stranded orca calf in New Zealand

[REDACTED]

Actually [REDACTED] commented that for this guy you could probably start lower on a midazolam dose since it is really just for an anxiolytic, recommend go with 0.1-0.15 mg/kg IM...should be plenty.

[REDACTED]

On Jul 13, 2021, at 6:02 PM, [REDACTED] <[\[REDACTED\]@seaworld.com](mailto:[REDACTED]@seaworld.com)> wrote:

Hi [REDACTED]

While transport in stretcher suspended in water transport unit is recommended, transport out-of-water can be done but recognize it will cause more cardiopulmonary stress to the animal. I would look into getting a 2-3" memory foam mattress for additional comfort on the mattress, provide pectoral fin cut-outs as you have done for the mattress.

We and others have transported dolphins for advanced diagnostics (i.e. CT) for up to 4 hrs out-of-water on padded stretchers with "wetting" methods to keep skin moist. We've had adult killer whales out-of-water during procedures for up to 2 hours without significant compromise.

I would have hand sprayers or water pump sprayers (found at hardware store), towels, additional foam padding or pieces of closed-cell

foam/foam mattress, waterproof sunscreen (zinc can trap heat at skin surface and lead to sloughing), in case of sun exposure or provide adequate shade during transport.

Monitor respirations, respiratory effort, heart rate (sometimes easier to see or palpate than listen to), vocals or lack thereof. Keep skin moist at all times, check pressure points if on mattress or areas that may rub.

Depending on air temp and wind, he should be able to maintain body temp, however, if you have a cable thermistor for rectal temperature that may be useful to determine if he needs thermal support (emergency space blankets are handy).

Emergency medical kit – standard ER meds, injectable midazolam (can cause respiratory depression, dose 0.5 mg/kg IM), flumazenil 0.02 mg/kg IV/IM, butorphanol (0.1 mg/kg IM, can cause respiratory depression), naltrexone 0.1 mg/kg IM, doxopram

I can send you more specifics on dosage, if you need it...

Others may have additional suggestions, that's what's on the top of my head at moment.

How are the feedings going?

██████████

---

**From:** ██████████  
██████████ [@massey.ac.nz](mailto:██████████@massey.ac.nz)>  
**Sent:** Tuesday, July 13, 2021 4:27 PM  
**To:** ██████████  
**Cc:** ██████████  
██████████ [@vanaqua.org](mailto:██████████@vanaqua.org)>; ██████████  
██████████ [@SeaWorld.com](mailto:██████████@SeaWorld.com)>; ██████████  
██████████ [@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>; ██████████  
██████████ [@SeaWorld.com](mailto:██████████@SeaWorld.com)>; ██████████  
██████████ [@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>; ██████████  
██████████ [@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>  
**Subject:** Re: [EXTERNAL] Re: Stranded orca calf in New Zealand

Hello everyone,

We completed our morning treatments and got a second blood sample. At the moment we are working on developing plans to attempt a possible relocation with all the parties involved here and have been asked to provide input on the veterinary aspect of welfare of the calf during transport and relocation.

There are a number of aspects of this scenario that are concerning (and certainly something we have

no experience with ourselves) so are wondering if you have any advice to give regarding monitoring the health and welfare of this animal during the process (for example time he can safely be kept out of the water and what support is needed ie wet towels, zinc oxide if transported during day?) We can monitor basic vitals such as respiratory rate during this process but are hoping for any additional advice or recommendations.

In terms of a setup for transport we are still waiting on a sling so at the moment what we have is mattresses with areas cut out for his pectoral fins to slot into. He would be transported on this on the back of a boat out to the area of attempted release. There would be designated people to keep him wet as well. This setup would only be used if there was an attempted release prior to the arrival of a sling.

I realize this is quite a difficult attempt to coordinate and we sincerely appreciate any and all input you may have.

██████████

On 13/07/2021, at 8:40 PM, ██████████

██████████ wrote:

Not sure how often you will be getting blood, but can add in a sed rate (erythrocyte sedimentation rate) to have a very crude assessment of inflammation while all other diagnostics are pending. In a pinch, I have used capillary tubes and then kept them undisturbed as vertical as possible for an hour - after which you measure the "drop" in RBC (or the "volume" of plasma). You won't be able to compare to any reference value, but it can be very helpful at tracking trends over time - an increasing rate of sedimentation is suggestive of worsening inflammatory disease somewhere.

As ██████████ said, keep going! Nice work so far.

██████████

Sent from my iPhone

Case No: PN2115671 - Chemistry - Issue 1

**Case No: PN2115671**

**Report To:** Wellington Zoo  
200 Daniel Street  
PO: P1078657  
Wellington 6021

**Species:** Marine Mammal  
**Breed:** Unknown

**Age:** 4 MONTH(S)  
**Sex:** Male

**Submitted By:** Wellington Zoo Trust  
**Submitter ref:** P1093382

**Date Sent:** 12/07/2021 11:43  
**Date Received:** 14/07/2021 11:43  
**Date Tested:** 15/07/2021 13:15

**Owner:** Wellington Zoo  
200 Daniell Street

**Animal/Herd:** TOA

All client, owner and animal details supplied by the submitter.

Tests Requested:  
2 x EDTA - Complete Blood Count + Fibrinogen  
1 x Smear - Cytology Smear (up to 6 slides)  
1 x Swab - Aerobic Culture  
1 x Plasma - Iron [serum]

**Chemistry**

	TOA X10704	Units	Ref Interval
Serum Iron	10.00	µmol/L	

The test was performed by an approved referral laboratory.

**VETERINARY INTERPRETATION:**

Serum iron reference values for Orca are 3.5 - 24.8 µmol/L (ZIMS/species 360), thus there is no support for iron deficiency as a cause of anaemia for this calf. I have also reviewed the blood film for this case, and there is also no morphologic support for iron deficiency on the CBC data or smear examined.

The PCV for this case (39%) was marginally decreased when correlated with the reference below, for Orca calves (0-3 years-old, PCV 40.8-42.1).

Of note for this case was the morphology of reticulocytes, with both aggregate and punctate forms noted. This is a feature normally seen in felines, and I have not seen reports of this finding in other papers I have searched for in Orca.

Aggregate reticulocytes were 2% in this case, which is in range (high normal) for this age group (reticulocytes 1.7-2.0 %). This correlates with only mild polychromasia seen on the routine stain. Thus the blood film may suggest a mild, borderline regenerative, anaemia. This can occur with chronic disease/inflammation or potentially a resolving anaemia.

If we add in the punctate (more mature reticulocyte forms), this brings the total reticulocytes to 11%.

When we interpret cats we only count the aggregate reticulocytes in assessing regenerative responses, as they represent active marrow release. In cats, punctate reticulocytes may stay in circulation for up to 21 days.

I do not know if this is the same for Orca, but it seems a reasonable assumption given the marginal decrease in PCV and mild polychromasia for this calf.

Thank you for the opportunity to review such an unusual species.

**Reference:**

Effects of age, sex, and season on the variation in blood analytes of a clinically normal ex situ population of killer whales (orcinus orca). Nollens et al. Vet Clin Path (48) 2019.

██████████  
BSc BVSc MVS MANZCVS Diplomate ACVP  
Registered Specialist in Veterinary Clinical Pathology  
Phone ██████████  
Email: ██████████@gribbles.co.nz

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Case No: PN2115671 - Chemistry - Issue 1

Test methodology references are available on request.

(Note: Results apply only to samples received, on an as found basis. Reference intervals are standard Gribbles Veterinary reference intervals.)

**Signed**



**Signed**



**Report Date:** 15/07/2021 13:53

**Final**

**Report Fee (ex GST): \$21.40**

Gribbles Veterinary Pathology make every effort to collect, analyse and report the results of tests accurately and promptly but accepts no responsibility for any factors which influence the results that are beyond our control. This report should not be reproduced except in full. All sample identification supplied by the submitter.

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>

**Sent:** Thursday, 15 July 2021 6:02 pm

**To:** [REDACTED]; Ian Angus; [REDACTED]

**Cc:** HUHA Helping You Help Animals; Ingrid [REDACTED]

**Subject:** Veterinary update for orca calf 15/07/21

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!

### 1) Current medical findings

#### Lab tests:

- We have a few results back from the lab:
  - o Complete blood count and blood parasite check – normal (but see below)
  - o Fibrinogen levels (one way of testing for inflammation) – normal
  - o Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - o Total blood iron levels – normal
  - o The lab's interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we'll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - o Lactate, blow hole swab culture (fungal and bacterial).

#### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

### 2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.
  - o Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!)

Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - o So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).
- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

3) Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4) Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

[REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com)  

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From: [REDACTED]

Sent: 14 July 2021 18:47

To: [REDACTED]; iangus@doc.govt.nz; marine@doc.govt.nz;

Cc: HUHA Helping You Help Animals [REDACTED]; ingrid [REDACTED];  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>;  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>;  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>

Subject: Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

1) Medical findings

Lab tests:

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - o Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.



Fluids:

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

Feeding:

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.

3) Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4) Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

PH

E ██████████@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com)  

---

From: ██████████

Sent: 13 July 2021 15:47

To: ██████████

██████████ [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz)

Cc: HUHA Helping You Help Animals ██████████ [ingrid](mailto:ingrid) ██████████; ██████████

[redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]  
[redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]  
[redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>

**Subject: Veterinary update for orca calf 13/07/21**

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet [redacted] from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by [redacted] also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,

[redacted]

[redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

PH [redacted]

E [redacted]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) | 

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Friday, 16 July 2021 2:46 pm  
**To:** [REDACTED] HUHA Helping You Help Animals; [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** RE: DOC and vet team catch up  
**Attachments:** X10704 Toa.pdf

Hey all,

Please see attached ZIMS record. All lab results that we've received so far have been written in.

[Me tiaki, kia ora!](#)

[REDACTED] BVSc (Hons)  
Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph [REDACTED]  
E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com)  



---

**From:** [REDACTED]  
**Sent:** 16 July 2021 12:43  
**To:** HUHA Helping You Help Animals [REDACTED]  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
**Subject:** RE: DOC and vet team catch up

I think that's fine. Talk with you all then.

---

**From:** HUHA Helping You Help Animals [REDACTED]  
**Sent:** Friday, 16 July 2021 12:29 pm  
**To:** Lydia Uddstrom [REDACTED]  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
**Subject:** Re: DOC and vet team catch up

Hi All

We are just doing measurements and preparing a feed now so we will be available for the 1.30pm chat.

Are we OK to invite three of our rotating HUHA Vets who are off site today [REDACTED] and [REDACTED].

I will be on site with [REDACTED]

Speak soon

[REDACTED]  
CEO/Founder  
HUHA Trust  
[REDACTED]

On Wed, 14 Jul 2021, 9:11 pm [REDACTED] wrote:

Hi everyone,

Getting a meeting in all our diaries.

Purpose – update all on how the day to day care of the calf is going and evaluate the health parameters being collected.

Discuss any additional support and information needs.

Thanks all for your hard work – talk soon!

[REDACTED]

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## Microsoft Teams meeting

**Join on your computer or mobile app**

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15/07/2021

Clinical note

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	OY 1M 14D

Date	Time	Note	Author
15/07/2021	00:00		
Significant	Private	Active Problems	
No	No	~	

Note Subtype: General

Notes/Comments

Advice regarding testing for toxoplasmosis and brucellosis from [REDACTED] at Massey University - SUMMARY: not currently required or recommended.

Hi again [REDACTED]

Just to summarise our conversation re testing for Brucella and Toxo:

- Since we need to minimise interventions for this calf, my recommendation is based on whether the results of the tests would make a difference to the treatment plan.
- If the calf was seropositive for either toxo or brucella, this would indicate exposure rather than active disease. We know that a high proportion of cetaceans are seropositive for these pathogens, and the vast majority are subclinical or latent infections.
- If this calf had active disease from either pathogen you would be seeing indicators of this on clinical biochem/haematology, and these parameters would be much more useful in determining disease status/prognosis than serology would be.
- We also need to note that most serological testing for these agents has not been validated in cetaceans, and the tests can be very unreliable.
- If the calf tested positive for either agent, there is really no effective way to treat him, so from that perspective a positive result wouldn't change the plan.
- He wouldn't be able to transmit either agent to people, even if he were positive.
- We know that both agents are already present in the marine environment and in cetaceans in New Zealand, so even if positive he wouldn't pose an increased risk to other orca if he is returned to his pod. Also, toxoplasma can't be spread between cetaceans, other than in pregnant females, so he isn't a risk for spreading toxo.

Overall, I don't think there is much to justify doing these tests at this stage. If there is extra serum available after the baseline health assessment testing has been done you could freeze it for later testing if anything should change, although I feel this would be more scientifically interesting than practically useful.

Hope this helps

[REDACTED]

Animal Care Staff Medical Summary

~

Calendar Items

Date	Title	Assigned To	Done
~	~	~	~

Clinical note

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	OY 1M 14D

Date	Time	Note	Author
15/07/2021	00:00		
Significant	Private	Active Problems	
No	No	~	

Note Subtype: General

Notes/Comments

Update sent to DOC, zoo management, HUHA and Whale Rescue today:

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!

- Current medical findings

## Lab tests:

- We have a few results back from the lab:
  - Complete blood count and blood parasite check – normal (but see below)
  - Fibrinogen levels (one way of testing for inflammation) – normal
  - Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - Total blood iron levels – normal
  - The lab's interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we'll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Lactate, blow hole swab culture (fungal and bacterial).

## Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

- Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.
  - Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!).

## Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).
- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

## Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

## Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.
- Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

- Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

██████

**Animal Care Staff Medical Summary**

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Calendar Items			
Date	Title	Assigned To	Done
~	~	~	~

14/07/2021

Clinical note

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 13D

**Date** 14/07/2021 **Time** 13:38 **Note Author** [REDACTED]

**Significant** No **Private** No **Active Problems** ~

**Subjective**

See previous - stranded orca calf currently being floated with supportive care in between two piers at Plimmerton. Overnight reported to be resting well, took feeds yesterday via tube with no concerns. Previous concerns re: listing while swimming. Cetacean veterinarians from the US have read descriptions and seen videos of this calf and suspect this is behavioural (looking around at surroundings) as he is able to swim upright as well. Volunteers have been alternating swim direction to try and have him going either way 50% of the time.

**Objective**

QAR, BCS unchanged, oral exam WNL - gums pink, CRT<2  
 Left eyes appears clear, though clear viscous mucus being produced and forming a string from the eye, did not visualise right eye  
 Superficial abrasions on tail flukes, dorsal fin, around head, and previously mentioned abrasions

**Assessment**

Stranded calf currently refloated and being looked after by few teams  
 Attempts being made to find pod  
 Medically appears sound to our current knowledge with the tests we've done so far

**Plan**

Bloods taken for repeat PCV/TP, biochem - see ZIMS record.

Formula recipe - makes 4L:

- 6 cups Milligans lamb milk replacer (300 g powder with 1.5 liters water)
- 3000 mg dicalcium phosphate
- 1000 mg Taurine
- 1100 ml water
- 1100 ml 0.9% NaCl injection
- 120 ml 50% Dextrose
- 200 ml salmon oil
- 0.7 kg filleted sardines and viscera
- 3 mazuri tablets

Feeding schedule:

- 14/07
- 8am - 250ml formula mixed with 250ml vytrate, chased with 2.5 L (to make 3L total)
- 12pm - 375ml formula mixed with 125ml vytrate, chased with 2.5L (to make 3L total)
- 4pm & 8pm - 500ml formula chased with 2.5L (to make 3L total)

15/07

8 AM	12 PM	4 PM	8 PM
500 ml formula (100% strength)	500 ml formula (100% strength)	500 ml formula (100% strength)	500 ml formula (100% strength)
2.5 liters vytrate	2.5 liters vytrate	2.5 liters vytrate	2.5 liters vytrate
3 liter total volume	3 liter total volume	3 liter total volume	3 liter total volume

In between these set tubing times it is acceptable to attempt bottle feeding with a maximum volume of 500 ml each feed at a frequency of every 2 hours (ensuring that the correct volume (2 L) of formula is available for tubings).

Meetings ongoing re: plan for this orca. Pod being searched for.

**Animal Care Staff Medical Summary**

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Calendar Items

Date	Title	Assigned To	Done
~	~	~	~

**Sample**

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 13D

Sample Detail

<b>Collection Date/Time</b>	14/07/2021 08:00
<b>Sample Type</b>	Serum
<b>Anatomical Source/Tissue</b>	FLUKE TAIL
<b>Collection Method</b>	Phlebotomy
<b>Collected By</b>	[REDACTED]
<b>Reason</b>	Recheck/Follow-up
<b>Exclude from reference intervals</b>	No

Sample Quality

<b>Color</b>	Colorless
<b>Color Intensity</b>	~
<b>Clarity</b>	Clear
<b>Additional Characteristics</b>	~
<b>Degraded</b>	No

Pre-Sampling Conditions

<b>Fasting Duration</b>	> 48 hours
<b>Restraint Type</b>	Physical
<b>Activity</b>	Low activity

Initial Holding Conditions

<b>Initial Holding Temp.</b>	Ambient
<b>Initial Holding Duration</b>	<= 10 hours

Sample History

Date	Sample ID / Sample GSN	Status	Laboratory / Test Order / Test Results
14/07/2021	~/~	Available	~/~/~

Notes

~

Calendar Items

Date	Title	Assigned To	Done
~	~	~	~

**Sample**

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 13D

Sample Detail

<b>Collection Date/Time</b>	14/07/2021 08:00
<b>Sample Type</b>	Whole Blood
<b>Anatomical Source/Tissue</b>	FLUKE TAIL
<b>Additives/Preservatives</b>	EDTA
<b>Collection Method</b>	Phlebotomy
<b>Collected By</b>	[REDACTED]
<b>Reason</b>	Recheck/Follow-up
<b>Exclude from reference intervals</b>	No

Sample Quality

<b>Additional Characteristics</b>	~
<b>Degraded</b>	No

Pre-Sampling Conditions

<b>Fasting Duration</b>	> 48 hours
<b>Restraint Type</b>	Physical
<b>Activity</b>	Low activity

Initial Holding Conditions

<b>Initial Holding Temp.</b>	Ambient
<b>Initial Holding Duration</b>	<= 10 hours

Sample History

Date	Sample ID / Sample GSN	Status	Laboratory / Test Order / Test Results
14/07/2021	~/~	Available	WELLINGTON/2/2



Notes  
~

Calendar Items

Date	Title	Assigned To	Done
~	~	~	~

**Sample**

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 13D

Sample Detail

<b>Collection Date/Time</b>	14/07/2021 08:00
<b>Sample Type</b>	Plasma
<b>Anatomical Source/Tissue</b>	FLUKE TAIL
<b>Additives/Preservatives</b>	Heparin, Lithium
<b>Collection Method</b>	Phlebotomy
<b>Collected By</b>	[REDACTED]
<b>Reason</b>	Recheck/Follow-up
<b>Exclude from reference intervals</b>	No

Sample Quality

<b>Color</b>	Colorless
<b>Color Intensity</b>	~
<b>Clarity</b>	Clear
<b>Additional Characteristics</b>	~
<b>Degraded</b>	No

Pre-Sampling Conditions

<b>Fasting Duration</b>	> 48 hours
<b>Restraint Type</b>	Physical
<b>Activity</b>	Low activity

Initial Holding Conditions

<b>Initial Holding Temp.</b>	Ambient
<b>Initial Holding Duration</b>	<= 10 hours

Sample History

Date	Sample ID / Sample GSN	Status	Laboratory / Test Order / Test Results
14/07/2021	~/~	Available	WELLINGTN/12/12

Notes  
~

Calendar Items

Date	Title	Assigned To	Done
~	~	~	~

**Test & Result**

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 13D

Test Request Detail

<b>Date Requested</b>	14/07/2021
<b>Requested By</b>	[REDACTED]
<b>Analysis Start Date &amp; Time</b>	14/07/2021 12:45
<b>Analysis By</b>	[REDACTED]
<b>Analysis Equipment</b>	~
<b>Insufficient Sample</b>	No

Sample Quality

<b>Color</b>	Colorless
<b>Color Intensity</b>	~
<b>Clarity</b>	Clear
<b>Consistency</b>	~
<b>Additional Characteristics</b>	~
<b>Degraded</b>	No

Notes/Comments  
~

Test Requests & Test Results						
Test	Primary Result	Expected Results (Based on Best Available Match) Type: Min- Max   Mean [Median] N (Animals)	Evaluation	Excl'd. from RI	Clinical Finding	Reviewed
Total Protein (R)	58 g/L	Insufficient data	~	No	~	No
Albumin unspecified	50 g/L	Not calculated	~	~	~	No
Alk. Phos.	652 U/L	Global sp RI: 96 - 1,017   363 [339] N=88 (4)	~	No	No	No
AST	95 U/L	Global sp RI: 17 - 58   41 [41] N=46 (4)	High	No	No	No
Ca	2.53 mmol/L	Global sp RI: 2.0 - 2.4   2.1 [2.1] N=79 (4)	High	No	No	No
GGT	14 U/L	Global sp RI: 1 - 18   9 [9] N=58 (4)	~	No	No	No
Total Protein	58 g/L	Global sp RI: 68 - 90   78 [78] N=81 (4)	Low	No	No	No
Globulin	8 g/L	Insufficient data	~	No	~	No
BUN	13.5 mmol/L	Global sp RI: 6.6 - 16.9   11.6 [11.6] N=91 (4)	~	No	No	No
Creatine Kinase	250 U/L	Global sp RI: 52 - 274   138 [125] N=89 (4)	~	No	No	No
Phos	2.4 mmol/L	Global sp RI: 1.50 - 2.59   2.12 [2.14] N=84 (4)	~	No	No	No
Mg	0.78 mmol/L	Insufficient data	~	No	~	No

Sample Detail (GSN: S-WMK21-014097)			
<b>Collection Date/Time</b>	14/07/2021 08:00	<b>Collection Method</b>	Phlebotomy
<b>Sample Type</b>	Plasma	<b>Collected By</b>	[REDACTED]
<b>Anatomical Source/Tissue</b>	FLUKE TAIL	<b>Reason</b>	Recheck/Follow-up
<b>Additives/Preservatives</b>	Heparin, Lithium	<b>Exclude from reference intervals</b>	No

Test & Result						
Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 13D

Test Request Detail	
<b>Date Requested</b>	14/07/2021
<b>Requested By</b>	[REDACTED]
<b>Analysis Start Date &amp; Time</b>	14/07/2021 12:35
<b>Analysis By</b>	[REDACTED]
<b>Analysis Equipment</b>	~
<b>Insufficient Sample</b>	No

Sample Quality	
<b>Color</b>	Colorless
<b>Color Intensity</b>	~
<b>Clarity</b>	Clear
<b>Consistency</b>	~
<b>Additional Characteristics</b>	~
<b>Degraded</b>	No

Notes/Comments  
~

Test Requests & Test Results						
Test	Primary Result	Expected Results (Based on Best Available Match) Type: Min- Max   Mean [Median] N (Animals)	Evaluation	Excl'd. from RI	Clinical Finding	Reviewed
HCT	35 %	Global sp RI: 34.8 - 43.5   39.3 [39.0] N=59 (4)	~	No	No	No
Glucose (strip)	6.5 mmol/L	Not calculated	~	~	~	No

Sample Detail (GSN: S-WMK21-014098)

<b>Collection Date/Time</b>	14/07/2021 08:00	<b>Collection Method</b>	Phlebotomy
<b>Sample Type</b>	Whole Blood	<b>Collected By</b>	[REDACTED]
<b>Anatomical Source/Tissue</b>	FLUKE TAIL	<b>Reason</b>	Recheck/Follow-up
<b>Additives/Preservatives</b>	EDTA	<b>Exclude from reference intervals</b>	No

13/07/2021

Clinical note

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 12D

Date	Time	Note Author
13/07/2021	00:00	[REDACTED]
<b>Significant</b>	<b>Private</b>	<b>Active Problems</b>
No	No	~

Note Subtype: General

Notes/Comments

Clinical summary sent to DOC, responders and management today:

- Current medical assessment
- Blood tests:
  - Performed in-house at Wellington Zoo: biochemistry, PCV/TP, manual white cell count.
  - Awaiting results from veterinary laboratory: Complete blood count and blood parasite check, fibrinogen, lactate, total iron.
    - These results will take 2-3 days.
  - RESULTS SO FAR: our interpretation of the in-house testing is that there is mild-moderate anaemia present. There does not appear to have been recent significant blood loss from any external wounds, so the main possible causes we're considering for this at the moment are: blood parasites, gut parasites, other underlying disease. Anaemia can cause weakness and illthrift.
  - There are no indications that there is capture myopathy present.
  - **We are awaiting** a second opinion from cetacean vets on the interpretation of these blood results.
- Physical exam:
  - Superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin.
  - He also has several deep lacerations near his tail fluke laterally to his spine.
  - On 12/07/21 at 6pm the animal was tilting to the right, variable amounts but up to 45 degrees. On the morning of 13/07/21 the tilting was still occasionally visible. Preliminary recommendations by cetacean vets are that possible reasons for this are: looking up and evaluating the situation (ie behavioural), myopathy (temporary or more severe), or tilting secondary to lung injury.
  - **We are awaiting** assessment of tilting videos by cetacean vets for additional opinions on this.
- Blow hole swabs:
  - Awaiting results from veterinary laboratory: blow hole cytology/culture (aerobic bacterial culture and fungal culture).
    - These results will take 3-6 working days for bacterial culture, and longer for fungal culture.
  - Summary: our two main medical concerns as at 13/07/21 are the mild-moderate anaemia and the observed tilting. Further lab results and further cetacean vet opinions are pending to give better estimates of diagnosis and prognosis for these conditions.

Cetacean vets suggest: "The assumption is the calf stranded primarily due to maternal separation then weakness from malnutrition and inability to maintain itself at sea.

However, that is not necessarily the case. There may be any number of additional problems with the calf that led to stranding and then there are the problems associated with stranding including muscle damage, pulmonary issues and even kidney damage and heart disease as with a capture myopathy scenario."

- To do:
  - **Please can someone try to collect us a faecal sample** when he passes one? It can be put in a clean (not necessarily sterile) container with a lid.
  - **Can someone please confirm our estimated age** for the animal? From memory I think someone told me 4-6 months?
- Proposed medical/nutrition plan moving forward

For the period that the animal is away from his mother, he will require careful supportive care to maintain his strength and his health. The following are recommendations compiled from a range of cetacean vet recommendations. **Further information is pending and may result in updates to the following.**

- Closely monitor the animal's respiratory rate and the animal's behaviour and demeanour.
  - In general.
  - Before handling/feeding.
  - Immediately after handling/feeding.
- Fluids
  - His daily fluid requirements are 40-80ml/kg/d.
  - We assume that there is a degree of dehydration present, so we will aim for >8L fluids per day (for an estimated 200kg body weight).
  - For 12/07/21: 1L electrolyte solution by stomach tube at 7pm.
  - For 13/07/21: 2L electrolyte solution by stomach tube at 9am, 2L by stomach tube at 1pm, 3L at 5pm (if this volume is tolerated), 3L at 9pm (if his volume is tolerated).
    - We initially started at 1-2L because we were carefully testing his stomach capacity, but advice has been he'll probably hold 3L so we plan to increase the volume this evening (13/07/21).
  - Feeding plan
    - We have an orca hand rearing formula sent through from Sea World in the US. We won't be able to find all of the ingredients here, but they have advised that some ingredients can be omitted or substituted for short term use.
    - For 13/07/21 we will continue to just give fluids by mouth (no food).
    - From the first feed on 14/07/21 we will start to introduce formula at a dilute rate. Dilution and frequency of feeds TBC, but based on preliminary feeding recommendations this will likely be recommended to be ~5 times a day (not overnight).

- Additional medications
  - Cetacean vets have advised that we administer:
    - Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
    - Antibiotics by intramuscular injection twice a day. A long acting antibiotic was given on the afternoon of 12/07/21. A new antibiotic will be started on the morning of 14/07/21 and continue as twice a day injections from then on.
  - Strength and fitness
    - Allow the animal to swim in different directions, including circling in one direction and then in the other direction – to prevent overuse of some muscles and cramps. Possibly increase space available to increase amount/type of movements able to be exhibited – if safe and practical to do so.

• Advice regarding management of disease between orca calf and humans, in both directions.

Some diseases of cetaceans can affect humans and vice versa, even if the cetacean/human that is the source of the disease appears clinically well. To reduce the potential for disease spread to or from cetaceans, we recommend:

- Wearing gloves and facemasks when in proximity to the animal.
- Washing hands carefully after being in proximity to the animal.
- Washing hands carefully prior to eating when on the response site.
- Minimising the number of people in proximity to the animal at all times.
- Use a foot bath when going in and out of the water.
- No dogs or other domestic animals on-site.
- Incorporate the above instructions into volunteer inductions at shift changes.
- (Work in progress: wetsuit cleaning protocols/recommendations).

**Animal Care Staff Medical Summary**

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Calendar Items

Date	Title	Assigned To	Done
~	~	~	~

12/07/2021

Sample

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 11D

Sample Detail

<b>Collection Date/Time</b>	12/07/2021 00:00
<b>Sample Type</b>	Serum
<b>Anatomical Source/Tissue</b>	~
<b>Collection Method</b>	~
<b>Collected By</b>	██████████
<b>Reason</b>	~
<b>Exclude from reference intervals</b>	No

Sample Quality

<b>Color</b>	~
<b>Color Intensity</b>	~
<b>Clarity</b>	~
<b>Additional Characteristics</b>	~
<b>Degraded</b>	No

Pre-Sampling Conditions

<b>Fasting Duration</b>	24-48 hours
<b>Restraint Type</b>	Physical
<b>Activity</b>	Low activity

Initial Holding Conditions

<b>Initial Holding Temp.</b>	~
<b>Initial Holding Duration</b>	~

Sample History

Date	Sample ID / Sample GSN	Status	Laboratory / Test Order / Test Results
12/07/2021	~/~	Available	WELLINGTON/15/15

Notes

~

Calendar Items

Date	Title	Assigned To	Done
~	~	~	~

Sample

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 11D

Sample Detail

Collection Date/Time	12/07/2021 00:00
Sample Type	Whole Blood
Anatomical Source/Tissue	~
Additives/Preservatives	~
Collection Method	~
Collected By	[REDACTED]
Reason	~
Exclude from reference intervals	No

Sample Quality

Additional Characteristics	~
Degraded	No

Pre-Sampling Conditions

Fasting Duration	24-48 hours
Restraint Type	Physical
Activity	Low activity

Initial Holding Conditions

Initial Holding Temp.	~
Initial Holding Duration	~

Sample History

Date	Sample ID / Sample GSN	Status	Laboratory / Test Order / Test Results
12/07/2021	~/~	Available	GRIBBSLNZ/15/15

Notes

~

Calendar Items

Date	Title	Assigned To	Done
~	~	~	~

Sample

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 11D

Sample Detail

Collection Date/Time	12/07/2021 00:00
Sample Type	Whole Blood
Anatomical Source/Tissue	~
Additives/Preservatives	~
Collection Method	~
Collected By	[REDACTED]
Reason	~
Exclude from reference intervals	No

Sample Quality

Additional Characteristics	~
Degraded	No

Pre-Sampling Conditions

Fasting Duration	24-48 hours
Restraint Type	Physical
Activity	Low activity

Initial Holding Conditions

Initial Holding Temp.	~
Initial Holding Duration	~

Sample History

Date	Sample ID / Sample GSN	Status	Laboratory / Test Order / Test Results
12/07/2021	~/~	Available	WELLINGTON/9/9

Notes

~

Calendar Items

Date	Title	Assigned To	Done
~	~	~	~

Sample

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 11D

Sample Detail	
Collection Date/Time	12/07/2021 00:00
Sample Type	Serum
Anatomical Source/Tissue	~
Collection Method	~
Collected By	[REDACTED]
Reason	~
Exclude from reference intervals	No

Sample Quality	
Color	~
Color Intensity	~
Clarity	~
Additional Characteristics	~
Degraded	No

Initial Holding Conditions	
Initial Holding Temp.	~
Initial Holding Duration	~

Pre-Sampling Conditions	
Fasting Duration	24-48 hours
Restraint Type	Physical
Activity	Low activity

Sample History			
Date	Sample ID / Sample GSN	Status	Laboratory / Test Order / Test Results
12/07/2021	~/~	Available	WELLINGTON/11/11

Notes	
~	

Calendar Items			
Date	Title	Assigned To	Done
~	~	~	~

**Sample**

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 11D

Sample Detail	
Collection Date/Time	12/07/2021 00:00
Sample Type	Other fluid, secretion or exudate
Anatomical Source/Tissue	~
Additives/Preservatives	~
Collection Method	~
Collected By	[REDACTED]
Reason	~
Exclude from reference intervals	No

Sample Quality	
Color	~
Color Intensity	~
Clarity	~
Consistency	~
Degraded	No

Initial Holding Conditions	
Initial Holding Temp.	~
Initial Holding Duration	~

Sample History			
Date	Sample ID / Sample GSN	Status	Laboratory / Test Order / Test Results
12/07/2021	~/~	Available	GRIBBSLNZ/1/0

Notes	
Blow hole swab	

Calendar Items			
Date	Title	Assigned To	Done
~	~	~	~

**Test & Result**

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 11D

Test Request Detail	
Date Requested	12/07/2021
Requested By	[REDACTED]
Analysis Start Date & Time	~
Analysis By	[REDACTED]
Analysis Equipment	~
Insufficient Sample	No

Sample Quality	
Color	~
Color Intensity	~
Clarity	~
Consistency	~
Additional Characteristics	~
Degraded	No

Notes/Comments

Serum Iron 10.00 µmol/L

The test was performed by an approved referral laboratory.

**VETERINARY INTERPRETATION:**

Serum iron reference values for Orca are 3.5 - 24.8 µmol/L (ZIMS/species 360), thus there is no support for iron deficiency as a cause of anaemia for this calf. I have also reviewed the blood film for this case, and there is also no morphologic support for iron deficiency on the CBC data or smear examined. The PCV for this case (39%) was marginally decreased when correlated with the reference below, for Orca calves (0-3 years-old, PCV 40.8-42.1). Of note for this case was the morphology of reticulocytes, with both aggregate and punctate forms noted. This is a feature normally seen in felines, and I have not seen reports of this finding in other papers I have searched for in Orca. Aggregate reticulocytes were 2% in this case, which is in range (high normal) for this age group (reticulocytes 1.7-2.0 %). This correlates with only mild polychromasia seen on the routine stain. Thus the blood film may suggest a mild, borderline regenerative, anaemia. This can occur with chronic disease/inflammation or potentially a resolving anaemia. If we add in the punctate (more mature reticulocyte forms), this brings the total reticulocytes to 11%. When we interpret cats we only count the aggregate reticulocytes in assessing regenerative responses, as they represent active marrow release. In cats, punctate reticulocytes may stay in circulation for up to 21 days.

I do not know if this is the same for Orca, but it seems a reasonable assumption given the marginal decrease in PCV and mild polychromasia for this calf.

Thank you for the opportunity to review such an unusual species.

Test Requests & Test Results						
Test	Primary Result	Expected Results (Based on Best Available Match) Type: Min- Max   Mean [Median] N (Animals)	Evaluation	Excl'd. from RI	Clinical Finding	Reviewed
Albumin unspecified	36 g/L	Not calculated	~	~	~	No
Alk. Phos.	878 U/L	Global sp RI: 96 - 1,017   363 [339] N=88 (4)	~	No	No	No
ALT	19 U/L	Global sp RI: 7 - 18   13 [13] N=83 (4)	High	No	No	No
Amylase	<5 U/L	Global sp RI: 1 - 10   2 [1] N=65 (4)	~	No	No	No
Tot. Bili.	5 µmol/L	Global sp RI: 0.9 - 1.1   1.0 [1.0] N=50 (4)	High	No	No	No
BUN	12.8 mmol/L	Global sp RI: 6.6 - 16.9   11.6 [11.6] N=91 (4)	~	No	No	No
Ca	2.77 mmol/L	Global sp RI: 2.0 - 2.4   2.1 [2.1] N=79 (4)	High	No	No	No
Phos	3.00 mmol/L	Global sp RI: 1.50 - 2.59   2.12 [2.14] N=84 (4)	High	No	No	No
Creatinine	95 µmol/L	Global sp RI: 64 - 171   118 [127] N=86 (4)	~	No	No	No
Glucose	7.4 mmol/L	Global sp RI: 3.41 - 8.20   6.40 [6.50] N=89 (4)	~	No	No	No
Na	153 mmol/L	Global sp RI: 150 - 159   155 [155] N=80 (4)	~	No	No	No
K	6.9 mmol/L	Global sp RI: 3.3 - 4.6   3.7 [3.7] N=81 (4)	High	No	No	No
Total Protein	61 g/L	Global sp RI: 68 - 90   78 [78] N=81 (4)	Low	No	No	No
Globulin	25 g/L	Insufficient data	~	No	~	No
Iron	10 µmol/L	Global sp RI: 5.4 - 25.1   11.9 [11.0] N=86 (4)	~	No	No	No

Sample Detail (GSN: S-WMK21-014084)			
Collection Date/Time	12/07/2021 00:00	Collection Method	~
Sample Type	Serum	Collected By	[REDACTED]
Anatomical Source/Tissue	~	Reason	~
Additives/Preservatives	~	Exclude from reference intervals	No

Test & Result

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 11D

Test Request Detail

**Date Requested** 12/07/2021  
**Requested By** ██████████  
**Laboratory** GRIBBLSNZ  
**Analysis Start Date** 12/07/2021  
**Analysis Equipment** ~  
**Insufficient Sample** No

Sample Quality

**Color** ~  
**Color Intensity** ~  
**Clarity** ~  
**Consistency** ~  
**Additional Characteristics** ~  
**Degraded** No

Notes/Comments

@HEADER  
 ACCESSION PN2115671  
 REPORT HAEM  
 REPORTSTATUS FINAL  
 OWNER Wellington Zoo  
 SUBREF P1093382  
 SPECIES Marine Mammal  
 BREED Unknown  
 SEX Male  
 AGE 4 MONTH(S)  
 SENT 12/07/2021 11:43:34 AM  
 RECEIVED 14/07/2021 11:43:34 AM  
 SIGNEDDATE 14/07/2021 5:45:22 PM  
 SUBMITTER Wellington Zoo Trust  
 TECHNICIAN SWELTA  
 LABORATORY Gribbles Veterinary Pathology Ltd- Palmerston North  
 LABADDR1 840 Tremaine Ave  
 LABADDR2 Palmerston North  
 REPORTFEE 47.00

@RESULTS  
 TOA X10704 RBC 3.42 X 10<sup>12</sup>/L  
 TOA X10704 HB 134 G/L  
 TOA X10704 HCT 0.39 L/L  
 TOA X10704 MCV 113 FL  
 TOA X10704 MCH 39 PG  
 TOA X10704 MCHC 345 G/L  
 TOA X10704 RETAB 218.88 X 10<sup>9</sup>/L  
 TOA X10704 RETPC 6.4 %  
 TOA X10704 NRC 1 /100LEU  
 TOA X10704 WBC 7.1 X 10<sup>9</sup>/L  
 TOA X10704 NEUT 83 %  
 TOA X10704 NEUTAB 5.9 X 10<sup>9</sup>/L  
 TOA X10704 BAND 1 %  
 TOA X10704 BANDAB 0.1 X 10<sup>9</sup>/L  
 TOA X10704 LYMPH 13 %  
 TOA X10704 LYMPHAB 0.9 X 10<sup>9</sup>/L  
 TOA X10704 MONO 3 %  
 TOA X10704 MONOAB 0.2 X 10<sup>9</sup>/L  
 TOA X10704 FIB 2 G/L

@COMMENTS  
 FILM COMMENTS:  
 Red cells show Anisocytosis 2+ Macrocytes 2+,Stomatocytes1+,  
 Howell Jolly Bodies1+  
 Both punctate and aggregate forms have been counted whilst performing the manual reticulocyte count.  
 No Haemoparasites seen.  
 Moderate numbers of reactive lymphocytes with clumped chromatin and markedly basophilic cytoplasm present.  
 Platelets are clumped and we are unable to provide a platelet count however they appear adequate in number and normal in morphology.  
 Increased numbers of large platelets present.

VETERINARY INTERPRETATION:  
 The blood film has been reviewed the erythrocytes showed moderate anisocytosis and mild polychromasia. No parasites were seen in either the erythrocytes or the leukocytes.  
 There was nothing on the blood smear to suggest whether the mild anaemia was due to haemolysis or blood loss.

██████████  
 BVSc(Hons), MMedVet (CLD), PhD  
 e-mail: ██████████@gribbles.co.nz  
 ██████████

HAEMATOLOGY - GENERAL performed and reported by Gribbles Veterinary, Tremaine Ave, Palmerston North  
 HAEMATOLOGY - SPECIAL performed and reported by Gribbles Veterinary, Tremaine Ave, Palmerston North  
 Reference Ranges and Method Reference will be supplied on request  
 Testing Requested  
 1 x Complete Blood Count + Fibrinogen  
 1 x Complete Blood Count + Fibrinogen  
 1 x Complete Blood Count + Fibrinogen  
 @END



Test Requests & Test Results

Test	Primary Result	Expected Results (Based on Best Available Match) Type: Min- Max   Mean [Median] N (Animals)	Evaluation	Excl'd. from RI	Clinical Finding	Reviewed
RBC [a]	3.42 *10 <sup>12</sup> cells/L	Global sp RI: 3.11 - 3.97   3.57 [3.60] N=80 (4)	~	No	No	No
HGB [a]	134 g/L	Global sp RI: 126 - 160   143 [143] N=97 (4)	~	No	No	No
HCT	0.39 ratio	Insufficient data	~	No	~	No
MCV	113 fL	Local RI: 105.9 - 123.8   114.5 [114.7] N=122 (4)	~	No	No	No
MCH	39 pg	Local RI: 36.9 - 50.2   41.4 [40.8] N=93 (4)	~	No	No	No
MCHC	345 g/L	Local RI: 326 - 421   363 [360] N=93 (4)	~	No	No	No
WBC [m]	7.1 *10 <sup>9</sup> cells/L	Insufficient data	~	No	~	No
Neutrophil % [a]	83 %	Insufficient data	~	No	~	No
Neutrophil count [a]	5.9 *10 <sup>9</sup> cells/L	Insufficient data	~	No	~	No
Band % [a]	1 %	Insufficient data	~	No	~	No
Band count [a]	0.1 *10 <sup>9</sup> cells/L	Insufficient data	~	No	~	No
Lymphocyte % [a]	13 %	Insufficient data	~	No	~	No
Lymphocyte count [a]	0.9 *10 <sup>9</sup> cells/L	Insufficient data	~	No	~	No
Monocyte % [a]	3 %	Insufficient data	~	No	~	No
Monocyte count [a]	0.2 *10 <sup>9</sup> cells/L	Insufficient data	~	No	~	No

Sample Detail (GSN: S-WMK21-014087)

<b>Collection Date/Time</b>	12/07/2021 00:00	<b>Collection Method</b>	~
<b>Sample Type</b>	Whole Blood	<b>Collected By</b>	[REDACTED]
<b>Anatomical Source/Tissue</b>	~	<b>Reason</b>	~
<b>Additives/Preservatives</b>	~	<b>Exclude from reference intervals</b>	No

Test & Result

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 11D

Test Request Detail	
<b>Date Requested</b>	12/07/2021
<b>Requested By</b>	[REDACTED]
<b>Analysis Start Date &amp; Time</b>	~
<b>Analysis By</b>	[REDACTED]
<b>Analysis Equipment</b>	~
<b>Insufficient Sample</b>	No

Sample Quality	
<b>Color</b>	~
<b>Color Intensity</b>	~
<b>Clarity</b>	~
<b>Consistency</b>	~
<b>Additional Characteristics</b>	~
<b>Degraded</b>	No

Notes/Comments

~

Test Requests & Test Results

Test	Primary Result	Expected Results (Based on Best Available Match) Type: Min- Max   Mean [Median] N (Animals)	Evaluation	Excl. from RI	Clinical Finding	Reviewed
Albumin unspecified	53 g/L	Not calculated	~	~	~	No
Alk. Phos.	777 U/L	Global sp RI: 96 - 1,017   363 [339] N=88 (4)	~	No	No	No
AST	85 U/L	Global sp RI: 17 - 58   41 [41] N=46 (4)	High	No	No	No
Ca	2.52 mmol/L	Global sp RI: 2.0 - 2.4   2.1 [2.1] N=79 (4)	High	No	No	No
GGT	12 U/L	Global sp RI: 1 - 18   9 [9] N=58 (4)	~	No	No	No
Total Protein	61 g/L	Global sp RI: 68 - 90   78 [78] N=81 (4)	Low	No	No	No
Globulin	9 g/L	Insufficient data	~	No	~	No
BUN	11.7 mmol/L	Global sp RI: 6.6 - 16.9   11.6 [11.6] N=91 (4)	~	No	No	No
Creatine Kinase	478 U/L	Global sp RI: 52 - 274   138 [125] N=89 (4)	High	No	No	No
Phos	2.86 mmol/L	Global sp RI: 1.50 - 2.59   2.12 [2.14] N=84 (4)	High	No	No	No
Mg	0.97 mmol/L	Insufficient data	~	No	~	No

Sample Detail (GSN: S-WMK21-014088)

<b>Collection Date/Time</b>	12/07/2021 00:00	<b>Collection Method</b>	~
<b>Sample Type</b>	Serum	<b>Collected By</b>	[REDACTED]
<b>Anatomical Source/Tissue</b>	~	<b>Reason</b>	~
<b>Additives/Preservatives</b>	~	<b>Exclude from reference intervals</b>	No

Test & Result

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 11D

Test Request Detail

<b>Date Requested</b>	12/07/2021
<b>Requested By</b>	[REDACTED]
<b>Analysis Start Date &amp; Time</b>	13/07/2021 13:15
<b>Analysis By</b>	[REDACTED]
<b>Analysis Equipment</b>	~
<b>Insufficient Sample</b>	No

Sample Quality

<b>Color</b>	~
<b>Color Intensity</b>	~
<b>Clarity</b>	~
<b>Consistency</b>	~
<b>Additional Characteristics</b>	~
<b>Degraded</b>	No

Notes/Comments

Occasional spherocytes  
Anisocytosis  
Possible cytoplasmic inclusion in RBC (approx 2 seen over whole count)

Test	Primary Result	Expected Results (Based on Best Available Match) Type: Min- Max   Mean [Median] N (Animals)	Evaluation	Excl'd. from RI	Clinical Finding	Reviewed
HCT	29 %	Global sp RI: 34.8 - 43.5   39.3 [39.0] N=59 (4)	Low	No	No	No
Est. WBC count	4.06 *10 <sup>9</sup> cells/L	Insufficient data	~	No	~	No
Monocyte % [m]	3 %	Global sp RI: 0.0 - 7.1   2.3 [2.0] N=98 (4)	~	No	No	No
Monocyte count [m]	0.12 *10 <sup>9</sup> cells/L	Insufficient data	~	No	~	No
Lymphocyte % [m]	18 %	Global sp RI: 6.9 - 36.7   20.8 [20.0] N=97 (4)	~	No	No	No
Lymphocyte count [m]	0.73 *10 <sup>9</sup> cells/L	Insufficient data	~	No	~	No
Est. Thrombocytes	Adequate		~	~	~	No
Neutrophil count [m]	3.2 *10 <sup>9</sup> cells/L	Insufficient data	~	No	~	No
Neutrophil % [m]	79 %	Global sp RI: 54.8 - 90.6   74.4 [74.0] N=97 (4)	~	No	No	No

Sample Detail (GSN: S-WMK21-014083)			
<b>Collection Date/Time</b>	12/07/2021 00:00	<b>Collection Method</b>	~
<b>Sample Type</b>	Whole Blood	<b>Collected By</b>	██████████
<b>Anatomical Source/Tissue</b>	~	<b>Reason</b>	~
<b>Additives/Preservatives</b>	~	<b>Exclude from reference intervals</b>	No

Animal Type	GAN	Preferred ID	Taxonomy	Sex	Birth Date	Age
Individual	WMK21-09326	X10704	Orcinus orca/Killer whale	Male	01/06/2021	0Y 1M 11D

Test Request Detail	
<b>Date Requested</b>	12/07/2021
<b>Requested By</b>	██████████
<b>Laboratory</b>	GRIBBLSNZ
<b>Analysis Start Date</b>	12/07/2021
<b>Analysis Equipment</b>	~
<b>Insufficient Sample</b>	No

Sample Quality	
<b>Color</b>	~
<b>Color Intensity</b>	~
<b>Clarity</b>	~
<b>Consistency</b>	~
<b>Additional Characteristics</b>	~
<b>Degraded</b>	No

Notes/Comments  
Case No: PN2115671

Description. Two smears were submitted and examined from the blowhole. Both smears contained moderate numbers of angular, individual squamous epithelial cells which had a large amount of moderately basophilic cytoplasm with distinct cytoplasmic boundaries. Most were anucleate but some were nucleated with a low nucleus to cytoplasm ratio. All the cells contained variably sized circular to oval eosinophilic cytoplasmic inclusions and variable numbers of melanin granules. No inflammatory cells or micro-organisms were seen. Interpretation. No cytological abnormalities. Discussion. There was no indication of inflammatory disease. Since all the epithelial cells contained the eosinophilic inclusions, they appeared to be normal for epithelial cells from this location and could be mucin or keratohyaline granules. Cytological examination and comment by ██████████, BVSc (Hons), MMedVet (CLD), PhD.

Test	Primary Result	Expected Results (Based on Best Available Match) Type: Min- Max   Mean [Median] N (Animals)	Evaluation	Excl'd. from RI	Clinical Finding	Reviewed
Wet mount/water PCM	~		~	~	~	~

Sample Detail (GSN: S-WMK21-014085)

<b>Collection Date/Time</b>	12/07/2021 00:00	<b>Collection Method</b>	~
<b>Sample Type</b>	Other fluid, secretion or exudate	<b>Collected By</b>	[REDACTED]
<b>Anatomical Source/Tissue</b>	~	<b>Reason</b>	~
<b>Additives/Preservatives</b>	~	<b>Exclude from reference intervals</b>	No

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Friday, 16 July 2021 6:33 pm  
**To:** [REDACTED]  
**Subject:** Re: Orca Calf 'Toa'

Great thanks [REDACTED] that's in line with what I'd planned to do! Cheers

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---

**From:** [REDACTED]  
**Sent:** Friday, July 16, 2021 5:42:21 PM  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Orca Calf 'Toa'

Hi [REDACTED]

I think we have the vet side of things well covered with orca experts though very lovely of them to offer support as well (have felt a bit bad going over them straight to the USA teams). If any of you wanted to update them you are welcome, but I would suggest not putting that additional pressure on yourselves and pointing them towards the regular DOC updates instead.

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Friday, 16 July 2021 5:01 PM  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** Fwd: Orca Calf 'Toa'

Hey guys,

[REDACTED] was a couple of years below me at vet school and just sent me the below email regarding Toa. I assume we don't need any further assistance given that we're getting plenty of advice from US vets? I'm all for advice but I feel like we have had heaps! Happy to ask for their advice too though of course, pending what you guys think.

Are we able to provide her an update as per the latter part of her email, or just refer her to the DOC updates?

Cheers

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**From:** [REDACTED]@vrtp.com.au>  
**Sent:** Friday, July 16, 2021 4:57:13 PM  
**To:** [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@vrtp.com.au>  
**Subject:** Orca Calf 'Toa'

Hi [REDACTED]

Just wanted to reach out to see who the best person was within Wellington Zoo in relation to Sea World offering our support to assist you guys in any way that we can. Happy to supply veterinary assistance over the phone and/or on the ground as required.

We have been getting a sensational amount of requests in relation to 'Toa' the Orca calf so any updates that you have for us would be greatly appreciated.

Hop all is well,

Regards

██████████ | Veterinarian | ██████████ [@vrtp.com.au](mailto:vrtp.com.au)  
Sea World | Sea World Drive, Main Beach QLD 4217 | [seaworld.com.au](http://seaworld.com.au)



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[REDACTED]

---

**From:** [REDACTED]  
**Sent:** Friday, 16 July 2021 9:33 pm  
**To:** [REDACTED] Ian Angus  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Yeah that was my immediate analysis of the length as well. Ingrid assured us it was an accurate length as was taken in the pool.... Still waiting to hear back from the overseas experts.

---

**From:** [REDACTED]  
**Sent:** Friday, 16 July 2021 8:10 PM  
**To:** [REDACTED] Ian Angus  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hi all-  
Just a quick note about the length listed below. If that's accurate, we have to consider that this calf is much younger than 4-6 months. Below is a snip of the length vs. age data that Ingrid provided in 2016 to estimate the age of the Tauranga orca calf. If this animal is only 215 cm long, it's shorter than any of the animals listed, even the lengths at birth.

This is important context both with respect to long-term planning purposes (i.e. can we commit to caring for it until it's weaned) and the likelihood of the calf bonding to human caregivers.

Cheers,  
[REDACTED]

LOCATION	SEX	AGE YEARS	LENGTH + (other details)	SOURCE
ICELAND		Stillborn (16 months)	225	(Katsumata et al., 2006)
CAPTIVITY		At birth	231	(Duffield and Miller, 1988)
Various		At birth	232	(Clark et al., 2000)
CAPTIVITY		At birth	236	(Duffield and Miller, 1988)
CAPTIVITY	F	At birth	240	<a href="http://www.orcapod.wikia.com/wiki/Category:Vicky">www.orcapod.wikia.com/wiki/Category:Vicky</a>
NORWAY		At birth	240	(Christensen, 1984)
Worldwide		At birth	250	(Ford, 2008)
JAPAN		2 months	270	(Amano et al., 2011)
JAPAN		Neonate	274	(Nishiwaki and Handa, 1958)
NORTH ATLANTIC	F	2 (estimated)	274	(Katsumata et al., 2006)
PACIFIC	M	1	277	(Myrick et al., 1988)
NORTH ATLANTIC	F	+ 1	287	(Myrick et al., 1988)
ICELAND	F	2	290	(Duffield et al., 1995)
PACIFIC	F	3	290	(Myrick et al., 1988)
ICELAND	F	2	312	(Duffield et al., 1995)
ICELAND	F	2	295	(Duffield et al., 1995)
ICELAND	F	2	300	(Duffield et al., 1995)
PACIFIC	F	2	312	(Duffield et al., 1995)
PACIFIC	F	2	323	(Duffield et al., 1995)
PACIFIC	F	3	335	(Myrick et al., 1988)
NORTH ATLANTIC	F	??	343 (MORGAN capture 23 June 2010)	Niels van Elk (2010) Dolfinarium Harderwijk
ICELAND	F	4	350	(Duffield et al., 1995)
NORTH ATLANTIC	M	3	350	(Myrick et al., 1988)
ICELAND	F	4	351	(Duffield et al., 1995)
NORTH ATLANTIC		3.3-3.9	350 (calculated from Clark (3.50 - 2.32) / 0.36 = 3.3 years & her maximum age would be (3.50 - 2.32) / 0.30 = 3.9 years)	(Clark et al., 2000)
NORTH ATLANTIC	F	5	350	(Duffield and Miller, 1988)
PACIFIC	M	3+	354	(Myrick et al., 1988)
NORTH ATLANTIC	F	?? +1	365 (growth since June 2010 = 22 cm) (MORGAN 23 June 2011)	pers com. Steve Hearn, Dolfinarium Harderwijk
PACIFIC	F	3	366	(Duffield et al., 1995)
ICELAND	F	6	370	(Duffield et al., 1995)

From: HUHA Helping You Help Animals <[contact.huha@gmail.com](mailto:contact.huha@gmail.com)>

Sent: Friday, 16 July 2021 3:50 pm

To: [REDACTED]  
Cc: [REDACTED] <[@wellingtonzoo.com](mailto:@wellingtonzoo.com)>;

[REDACTED] Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>;

[REDACTED] ingrid <[@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [REDACTED]



[redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>

**Subject:** Re: Veterinary update for orca calf 15/07/21

Lovely to Meet you all today.

Just an update on the water quality and turnover plan. FENZ have been tasked with implimenting this under Ingrids supervision. We will collect hose schedule data on our trailer wall.

We are applying three different hose types/strengths each from a different direction. They will be turned on and flow intermittently every hour. The reason for varying hose strength and size as well as the intermittent turn on and off is to use them as an enrichment tool as well as a way to turn over water improving quality. There are overflow holes in place.

**Total length 2.12**

Girth infront fin 1.42

Girth behind fin 1.17

More info to follow as as we receive it.

Cheers

[redacted]  
HUHA

On Thu, 15 Jul 2021, 6:32 pm [redacted] wrote:

Hi [redacted]

Thank you again for another comprehensive update! Sounds like all is stable which is great news.

Thank you to the wider team as well for all your hard work with this little calf.

Kindest regards,

[redacted]

---

**From:** [redacted]@wellingtonzoo.com>

**Sent:** Thursday, 15 July 2021 6:01 PM

**To:** [redacted]  
[redacted] Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [redacted]

**Cc:** HUHA Helping You Help Animals [redacted] ingrid [redacted] <ingrid [redacted]>  
[redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]  
[redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]  
[redacted]@wellingtonzoo.com>

**Subject:** Veterinary update for orca calf 15/07/21

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!

## 1. Current medical findings

### Lab tests:

- We have a few results back from the lab:
  - Complete blood count and blood parasite check – normal (but see below)
  - Fibrinogen levels (one way of testing for inflammation) – normal
  - Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - Total blood iron levels – normal
  - The lab's interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we'll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Lactate, blow hole swab culture (fungal and bacterial).

### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

- Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!)

#### Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).
- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

#### Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

#### Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

#### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

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---

From: [Redacted]

Sent: 14 July 2021 18:47

To:

[Redacted]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz); [Redacted]

Cc: HUHA Helping You Help Animals

[ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [Redacted]

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[REDACTED]@wellingtonzoo.com>;

[REDACTED]@wellingtonzoo.com>;

[REDACTED]@wellingtonzoo.com>;

[REDACTED]@wellingtonzoo.com>

**Subject:** Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

## 1. Medical findings

Lab tests:

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also will several deep lacerations near his tail fluke laterally to his spine.
- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

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His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

Fluids:

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

Feeding:

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.

### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

### 4. Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

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---

**From:** [Redacted]  
**Sent:** 13 July 2021 15:47

**To:** [Redacted]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz)

**Cc:** HUHA Helping You Help Animals [Redacted] [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [Redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [Redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [Redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [Redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [Redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)

**Subject:** Veterinary update for orca calf 13/07/21

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet [REDACTED] from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by [REDACTED] also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,

[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

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[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Friday, 16 July 2021 5:02 pm  
**To:** [REDACTED]; lan Angus;  
**Cc:** HUHA Helping You Help Animals; ingrid [REDACTED]; [REDACTED];  
**Subject:** RE: Veterinary update for orca calf 15/07/21  
**Attachments:** Toa Feed Schedule 17.7.21.docx

Hello again, slight update to tomorrow's feed schedule (see attached).

[REDACTED] [BA DVM](#)  
Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
E [REDACTED]@wellingtonzoo.com

---

**From:** [REDACTED]  
**Sent:** Friday, 16 July 2021 4:07 pm  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]; lan Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]  
**Cc:** HUHA Helping You Help Animals [REDACTED]; ingrid [REDACTED]; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again to everyone!

Thank you all for your amazing continued care of the little calf! I'm just continuing on with a further update on how Toa is doing following the discussion from earlier this afternoon. I'll try to only include new information in this update. Please add anyone I may have forgotten to include!

Due to the change in weather, Toa was moved into a temporary pool yesterday around 5 PM. The move went smoothly and took 20-30 minutes. There have not been any changes noted in his behaviour since changing to the pool and his medical treatments and tubings are taking place at the same intervals. At the moment there is no filtration system in place so, as an alternative, the pool is being continuously filled with sea water via a pump and draining out excess water through holes in the side. The plan is to only keep Toa in the pool until it is safe enough to return him to the sea pen.

As we have increased the concentration of formula being fed, it was observed that Toa is beginning to show a few signs of abdominal discomfort immediately after feeds. He will cramp up and sink to the bottom of the pool briefly. This began last night and happened again this afternoon. In order to hopefully combat this we have come up with the solution of feeding him more frequently throughout the day (every 2 hours instead of every 4) so that he is getting smaller volumes of formula at each feed (but will still receive the same total daily volume). We will still try to increase his volume of formula fed by 50% each day in order to start increasing his caloric intake. It has been difficult to assess the frequency and consistency of his faecal output due to the murkiness/turbulence of water from weather. With increased

In terms of ongoing monitoring, we will continue to do what [REDACTED] has already discussed (semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour) but

may also consider adding in blow hole chuff cultures at least once but could repeat if any indication (we need to source the appropriate petri dish to collect these and confirm with Gribbles how it will need to be submitted), urine samples from first thing in morning prior to tubing to check UA and USG (this could be less frequent, maybe every 3 days or so), and body length and girth measurements (and possibly weights! if a suitable scale setup can be sourced which Ingrid is looking into). The body length, girth and weight measurements will be incredibly helpful both in helping to confirm an age and in ongoing monitoring of nutritional status.

For fluids and feedings tomorrow the plan is to give 700 ml formula with 1.5 liters 50% vytrate at 8 AM, 10 AM, and 12 PM. Then for the 2 PM, 4 PM, and 6 PM feeds he can receive 1 liter formula with 2 liters of 50% vytrate. (Total formula volume will be 5 L tomorrow compared to 3.5 liters today, a ~50% increase in volume). I'll email out a feed schedule sheet separately in case it is helpful. 😊 This will increase the total fluid volume he gets during the day by 3 liters but will still be within his recommended fluid needs of 40-80 ml/kg/day. If he is continuing to show signs of discomfort after any of these feedings please get in touch. [REDACTED] will be at work tomorrow at the zoo so can be reached if needed.

For medications, Toa received his last dose of steroid today. There is no need to continue on with steroid treatment at this time. He is still receiving enrofloxacin 5 mg/kg BID which he started Wednesday morning (14/7/21). This is due to last 7 days, finishing after his dose on the evening of 20/7/21.

We are still awaiting results from the veterinary laboratory for samples taken Monday:

- Lactate, blow hole swab culture (fungal and bacterial).

1. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

2. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thank you so much to everyone for all your dedication and care! Looking forward to seeing you and Toa in person again soon!

[REDACTED] **BA DVM**  
Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
E [REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)

---

**From:** [REDACTED]  
**Sent:** Thursday, 15 July 2021 6:32 pm  
**To:** [REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com); [REDACTED]  
[REDACTED]; Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [REDACTED]  
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[REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>

**Subject:** Re: Veterinary update for orca calf 15/07/21

Hi [REDACTED]

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Thank you to the wider team as well for all your hard work with this little calf.

Kindest regards,

---

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**Sent:** Thursday, 15 July 2021 6:01 PM

**To:** [REDACTED]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]

**Cc:** HUHA Helping You Help Animals [REDACTED]; ingrid [REDACTED] <ingrid [REDACTED]>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>

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Kind regards,

**[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

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200 Daniell Street | Newtown | Wellington 6021

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E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) | 

---

**From:** [REDACTED]

**Sent:** 14 July 2021 18:47

**To:** [REDACTED]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz); [REDACTED]

**Cc:** HUHA Helping You Help Animals [REDACTED]; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [REDACTED];  
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[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>

**Subject:** Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

1. Medical findings

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- Repeat blood tests taken today and run in house show no new/additional abnormalities.
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  - Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
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- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition

present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

Fluids:

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

Feeding:

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.

## 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

## 4. Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
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---

**From:** ██████████  
**Sent:** 13 July 2021 15:47  
**To:** ██████████  
██████████ [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz)  
**Cc:** HUHA Helping You Help Animals ██████████ >; [ingrid@██████████](mailto:ingrid@██████████); ██████████  
██████████ [██████████@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>; ██████████ [██████████@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>;  
██████████ [██████████@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>; ██████████ [██████████@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>; ██████████  
██████████ [██████████@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>; ██████████ [██████████@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>  
**Subject:** Veterinary update for orca calf 13/07/21

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet ██████████ from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by ██████████ also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,  
██████████

██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
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Feed Schedule for 17/7/21

8 AM	10 AM	12 PM	2 PM	4 PM	6 PM	Totals
700 ml formula	700 ml formula	700 ml formula	1 liter formula	1 liter formula	1 liter formula	5.1 liters formula
1.5 liters 50% vytrate	1.5 liters 50% vytrate	1.5 liters 50% vytrate	1.2 liters 50% vytrate	1.2 liters 50% vytrate	1.2 liters 50% vytrate	8.1 liters 50% vytrate
2.2 liter total volume	2.2 liter total volume	2.2 liter total volume	2.2 liter total volume	2.2 liter total volume	2.2 liter total volume	13.2 liter total daily volume

If continued cramping/discomfort seen after any of these feeds please notify Wellington Zoo Vet Team. If regurgitation ever seen, stop tubing and notify vet team.



[Redacted]

**From:** HUHA Helping You Help Animals <[Redacted]>  
**Sent:** Friday, 16 July 2021 4:30 pm  
**To:** [Redacted]  
**Cc:** [Redacted]; Ian Angus; [Redacted]  
**Subject:** Re: Veterinary update for orca calf 15/07/21  
**Attachments:** 20210716\_150054.jpg; 20210716\_150029.jpg

Urinalysis of sample taken 12.30pm 16/7/21

SG 1.010  
PH 5  
Rest of dipstick NAD

On Fri, 16 Jul 2021, 4:12 pm [Redacted] wrote:

Hi [Redacted]

Thank you so much for that information and the quick implementation of the water change system – amazing work from everyone to get that up and running so quickly! We appreciate it is not an easy system to have to get in place.

I have passed the measurements onto the overseas team to get their feed back on an age estimate.

All the best,

[Redacted]

---

**From:** HUHA Helping You Help Animals [Redacted]  
**Sent:** Friday, 16 July 2021 3:50 PM  
**To:** [Redacted]  
**Cc:** [Redacted] <[\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>; [Redacted] <[Ian.Angus@doc.govt.nz](mailto:Ian.Angus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [Redacted] <[\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>; [Redacted] <[\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>; [Redacted] <[\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>; [Redacted] <[\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>  
**Subject:** Re: Veterinary update for orca calf 15/07/21

Lovely to Meet you all today.

Just an update on the water quality and turnover plan. FENZ have been tasked with implimenting this under Ingrid's supervision. We will collect hose schedule data on our trailer wall.

We are applying three different hose types/strengths each from a different direction. They will be turned on and flow intermittently every hour. The reason for varying hose strength and size as well as the intermittent turn on and off is to use them as an enrichment tool as well as a way to turn over water improving quality. There are overflow holes in place.

Total length 2.12

Girth in front fin 1.42

Girth behind fin 1.17

More info to follow as as we receive it.

Cheers

[Redacted]

HUHA

On Thu, 15 Jul 2021, 6:32 pm [Redacted] wrote:

Hi [Redacted]

Thank you again for another comprehensive update! Sounds like all is stable which is great news.

Thank you to the wider team as well for all your hard work with this little calf.

Kindest regards,

**From:** [REDACTED] <[REDACTED]@wellingtonzoo.com>

**Sent:** Thursday, 15 July 2021 6:01 PM

**To:** [REDACTED]

[REDACTED] Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]

**Cc:** HUHA Helping You Help Animals [REDACTED];

ingrid [REDACTED];

<ingrid [REDACTED]>

[REDACTED] <[REDACTED]@wellingtonzoo.com>;

[REDACTED] <[REDACTED]@wellingtonzoo.com>;

[REDACTED] <[REDACTED]@wellingtonzoo.com>;

[REDACTED] <[REDACTED]@wellingtonzoo.com>;

[REDACTED] <[REDACTED]@wellingtonzoo.com>;

[REDACTED] <[REDACTED]@wellingtonzoo.com>;

[REDACTED] <[REDACTED]@wellingtonzoo.com>

**Subject:** Veterinary update for orca calf 15/07/21

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!

#### 1. Current medical findings

Lab tests:

- We have a few results back from the lab:
  - Complete blood count and blood parasite check – normal (but see below)
  - Fibrinogen levels (one way of testing for inflammation) – normal
  - Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - Total blood iron levels – normal
  - The lab's interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we'll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Lactate, blow hole swab culture (fungal and bacterial).

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.
  - Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!)

Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).
- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

#### Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

#### Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

#### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

#### 4. Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress


Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

Ph [Redacted]  
E [Redacted]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |  

---

**From:** [Redacted]

**Sent:** 14 July 2021 18:47

**To:** [Redacted]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz); [Redacted]

**Cc:** HUHA Helping You Help Animals >; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [Redacted];  
[Redacted] >; [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>;  
[Redacted] >; [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>;  
[Redacted] >; [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [Redacted] >;  
[Redacted] >; [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>

**Subject:** Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

1. Medical findings

Lab tests:

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also will several deep lacerations near his tail fluke laterally to his spine.
- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

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- This is being recorded by whale rescue volunteers (thank you!).
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- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

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few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

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Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,





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Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
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**From:** ██████████  
**Sent:** 13 July 2021 15:47  
**To:** ██████████; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz)  
**Cc:** HUHA Helping You Help Animals ██████████; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); ██████████  
██████████@wellingtonzoo.com>; ██████████@wellingtonzoo.com>;  
██████████@wellingtonzoo.com>; ██████████@wellingtonzoo.com>; ██████████  
██████████@wellingtonzoo.com>; ██████████@wellingtonzoo.com>  
**Subject:** Veterinary update for orca calf 13/07/21

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Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,

██████████

**[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
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[Redacted]

**From:** [Redacted]@wellingtonzoo.com>  
**Sent:** Saturday, 17 July 2021 4:35 pm  
**To:** [Redacted]  
**Cc:** [Redacted]; Ian Angus; [Redacted]  
**Subject:** RE: Veterinary update for orca calf 15/07/21  
**Attachments:** Toa Feed Schedule 18.7.21.docx

Hey all, quick update from me today.

- Toa is going really well according to personnel on site – accepting feeds well, and no gastrointestinal comfort seen
- There is possibly a sewerage pipe burst somewhere near the bay, so concerns re: water quality. HUHA vet [Redacted] is organising water testing.
- [Redacted] got a urine sample and USG this morning of 1.017
- [Redacted] mentioned possibly some oedema around caudal oropharynx/throat area (possibly from repeat tubing?) so would like to keep bottle feeding as a back up option in case tubing needs to be abandoned. Toa is currently showing no signs of discomfort or distress during tubing, tolerates it very well. We can check this when we are next on site as well, but in the meantime if HUHA vets can keep a close eye on that please 😊
- We are going to continue upping the ratio of formula to vytrate, so please see the attached feeding schedule for 18/07/21 – there is no hard copy of this, I'm sorry. Had not gotten it printed off before the food was collected this afternoon. At this rate he should be on 100% formula from Monday afternoon, and we can look at making the formula richer or increasing volume if we need to increase caloric intake.
- We will organise a day early next week to revisit Toa to take a repeat blood sample
- I am going to be off for the next two days, but [Redacted] is here tomorrow and [Redacted] will both be here on Monday

Thanks again (and again and again) for everyone's hard work and dedication especially in the horrible conditions today.

[Me tiaki, kia ora!](#)

[Redacted] **BVSc (Hons)**  
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200 Daniell Street | Newtown | Wellington 6021  
Ph [Redacted]  
E [Redacted]@wellingtonzoo.com | W www.wellingtonzoo.com



**From:** [Redacted]@wellingtonzoo.com>  
**Sent:** 16 July 2021 17:02  
**To:** [Redacted]@wellingtonzoo.com>; [Redacted]

Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>;

Cc: HUHA Helping You Help Animals <ingrid@wellingtonzoo.com>;  
<@wellingtonzoo.com>; <@wellingtonzoo.com>;  
<@wellingtonzoo.com>; <@wellingtonzoo.com>

Subject: RE: Veterinary update for orca calf 15/07/21

Hello again, slight update to tomorrow's feed schedule (see attached).

**BA DVM**

Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
E <@wellingtonzoo.com>

---

From: <>  
Sent: Friday, 16 July 2021 4:07 pm  
To: <@wellingtonzoo.com>; <>  
<>; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>;  
<>  
Cc: HUHA Helping You Help Animals <ingrid@wellingtonzoo.com>;  
<@wellingtonzoo.com>; <@wellingtonzoo.com>;  
<@wellingtonzoo.com>; <@wellingtonzoo.com>

Subject: RE: Veterinary update for orca calf 15/07/21

Hello again to everyone!

Thank you all for your amazing continued care of the little calf! I'm just continuing on with a further update on how Toa is doing following the discussion from earlier this afternoon. I'll try to only include new information in this update. Please add anyone I may have forgotten to include!

Due to the change in weather, Toa was moved into a temporary pool yesterday around 5 PM. The move went smoothly and took 20-30 minutes. There have not been any changes noted in his behaviour since changing to the pool and his medical treatments and tubings are taking place at the same intervals. At the moment there is no filtration system in place so, as an alternative, the pool is being continuously filled with sea water via a pump and draining out excess water through holes in the side. The plan is to only keep Toa in the pool until it is safe enough to return him to the sea pen.

As we have increased the concentration of formula being fed, it was observed that Toa is beginning to show a few signs of abdominal discomfort immediately after feeds. He will cramp up and sink to the bottom of the pool briefly. This began last night and happened again this afternoon. In order to hopefully combat this we have come up with the solution of feeding him more frequently throughout the day (every 2 hours instead of every 4) so that he is getting smaller volumes of formula at each feed (but will still receive the same total daily volume). We will still try to increase his volume of formula fed by 50% each day in order to start increasing his caloric intake. It has been difficult to assess the frequency and consistency of his faecal output due to the murkiness/turbulence of water from weather. With increased

In terms of ongoing monitoring, we will continue to do what <> has already discussed (semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour) but may also consider adding in blow hole chuff cultures at least once but could repeat if any indication (we need to source the appropriate petri dish to collect these and confirm with Gribbles how it will need to be submitted), urine samples from first thing in morning prior to tubing to check UA and USG (this could be less frequent, maybe every 3 days or so), and body length and girth measurements (and possibly weights! if a suitable scale setup can be sourced

which Ingrid is looking into). The body length, girth and weight measurements will be incredibly helpful both in helping to confirm an age and in ongoing monitoring of nutritional status.

For fluids and feedings tomorrow the plan is to give 700 ml formula with 1.5 liters 50% vytrate at 8 AM, 10 AM, and 12 PM. Then for the 2 PM, 4 PM, and 6 PM feeds he can receive 1 liter formula with 2 liters of 50% vytrate. (Total formula volume will be 5 L tomorrow compared to 3.5 liters today, a ~50% increase in volume). I'll email out a feed schedule sheet separately in case it is helpful. 😊 This will increase the total fluid volume he gets during the day by 3 liters but will still be within his recommended fluid needs of 40-80 ml/kg/day. If he is continuing to show signs of discomfort after any of these feedings please get in touch. [redacted] will be at work tomorrow at the zoo so can be reached if needed.

For medications, Toa received his last dose of steroid today. There is no need to continue on with steroid treatment at this time. He is still receiving enrofloxacin 5 mg/kg BID which he started Wednesday morning (14/7/21). This is due to last 7 days, finishing after his dose on the evening of 20/7/21.

We are still awaiting results from the veterinary laboratory for samples taken Monday:

- o Lactate, blow hole swab culture (fungal and bacterial).

1. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

2. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thank you so much to everyone for all your dedication and care! Looking forward to seeing you and Toa in person again soon!

[redacted] **BA DVM**  
Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
E [redacted] [@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)

---

**From:** [redacted]  
**Sent:** Thursday, 15 July 2021 6:32 pm  
**To:** [redacted] [@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com); [redacted] Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [redacted]  
**Cc:** HUHA Helping You Help Animals [redacted] >; [ingrid \[redacted\]](mailto:ingrid@[redacted]); [redacted] >; [redacted] [@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] [@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] [@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] [@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] [@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] [@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] [@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>  
**Subject:** Re: Veterinary update for orca calf 15/07/21

Hi [redacted],

Thank you again for another comprehensive update! Sounds like all is stable which is great news.

Thank you to the wider team as well for all your hard work with this little calf.

Kindest regards,

From: [REDACTED] <[REDACTED]@wellingtonzoo.com>

Sent: Thursday, 15 July 2021 6:01 PM

To: [REDACTED]  
<[REDACTED]> Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]

Cc: HUHA Helping You Help Animals [REDACTED] >; ingrid [REDACTED] <ingrid [REDACTED]>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]

update for orca calf 15/07/21

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!

1. Current medical findings

Lab tests:

- We have a few results back from the lab:
  - Complete blood count and blood parasite check – normal (but see below)
  - Fibrinogen levels (one way of testing for inflammation) – normal
  - Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - Total blood iron levels – normal
  - The lab's interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we'll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Lactate, blow hole swab culture (fungal and bacterial).

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.
  - Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!)

#### Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).
- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

#### Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

#### Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.
3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

#### 4. Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.


Kind regards,

██████████ BVS, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

Ph ██████████

E ██████████@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) 

---

From: ██████████

Sent: 14 July 2021 18:47

To: ██████████; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz);

Cc: HUHA Helping You Help Animals; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [@wellingtonzoo.com](mailto:@wellingtonzoo.com)

Subject: Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

1. Medical findings

Lab tests:

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also will several deep lacerations near his tail fluke laterally to his spine.
- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).



## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

Fluids:

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

Feeding:

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.

## 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

## 4. Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

██████████

██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

PH

E ██████████@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com)  

From: [REDACTED]

Sent: 13 July 2021 15:47

To: [REDACTED]

[REDACTED]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz)

Cc: HUHA Helping You Help Animals [REDACTED]; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [REDACTED]

[REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>;

[REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>;

[REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>;

[REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>;

[REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>;

[REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>

Subject: Veterinary update for orca calf 13/07/21

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet [REDACTED] from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by [REDACTED] also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,

[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

Ph [REDACTED]

E [REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com) | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |  

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Feed Schedule for 18/7/21

8 AM	10 AM	12 PM	2 PM	4 PM	6 PM	Totals
1L formula	1L formula	1L formula	1.5 L formula	1.5 L formula	1.5 L formula	7.5 liters formula
1.2 L 50% vytrate	1.2 L 50% vytrate	1.2 L 50% vytrate	700ml 50% vytrate	700ml 50% vytrate	700ml 50% vytrate	5.7 liters 50% vytrate
2.2 liter total volume	2.2 liter total volume	2.2 liter total volume	2.2 liter total volume	2.2 liter total volume	2.2 liter total volume	13.2 liter total daily volume

If continued cramping/discomfort seen after any of these feeds please notify Wellington Zoo Vet Team. If regurgitation ever seen, stop tubing and notify vet team.

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Sunday, 18 July 2021 11:18 am  
**To:** Ian Angus  
**Cc:** [REDACTED]  
**Subject:** RE: Killer whale calf sample

Sorry Ian, I was on a day off, but I believe this sample has been collected for you by the HUHA team :)

[REDACTED] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph [REDACTED]  
E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |  

---

**From:** Ian Angus <iangus@doc.govt.nz>  
**Sent:** 16 July 2021 08:15  
**To:** [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]  
**Subject:** FW: Killer whale calf sample

Hi [REDACTED]  
If time permits are you or a Welli vet able to get this sample? We are seeking iwi approval today.  
Ian

---

**From:** [REDACTED]@auckland.ac.nz>  
**Sent:** Wednesday, 14 July 2021 6:22 am  
**To:** Ian Angus <iangus@doc.govt.nz>  
**Cc:** Dave Lundquist <[REDACTED]>  
**Subject:** Re: Killer whale calf sample

Just pop the tissue from Toa into a small vial 2 ml is fine with ethanol.

It gets sent to me  
[REDACTED]  
School of Biological Sciences  
University of Auckland  
Thomas Building  
3A Symonds St  
Auckland Central 1010

Ph [REDACTED]

Please tell Ngati Toa that that the sample will be held in the archive but won't be used immediately, it will be valuable later when we have sufficient samples to understand the relatedness of the killer whales of Aotearoa.

Sometimes people think we're going to work on them straight away but that's not usually the case.

Good luck today!



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Caution - This message and accompanying data may contain information that is confidential or subject to legal privilege. If you are not the intended recipient you are notified that any use, dissemination, distribution or copying of this message or data is prohibited. If you received this email in error, please notify us immediately and erase all copies of the message and attachments. We apologise for the inconvenience. Thank you.

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Sunday, 18 July 2021 4:12 pm  
**To:** [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** RE: ORCA GOBIERNO NUEVA ZELANDA

Thanks [REDACTED]

I think I've found a good balance for tomorrow's food plan, which kind of fits with what both places say (with a slight lean towards SeaWorld's recommendations).

They both recommend adding simethicone, so will look into getting some tomorrow – looks like you can get it from a pharmacy.

Thanks so much!  
Kind regards,  
[REDACTED]

[REDACTED] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph [REDACTED]  
E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) | 

---

**From:** [REDACTED]  
**Sent:** 18 July 2021 16:04  
**To:** [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** Re: ORCA GOBIERNO NUEVA ZELANDA

Hi [REDACTED],

Sounds like a very wise plan to me and I am certainly very comfortable with that which is why I just sent on to you 3. Just thought it was good info to be aware of and supports the smaller feeds more often which is where we were already headed.

I have just said thank you very much to the LP vet and that we will be in touch if needed.

Thanks again for all your work!

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Sunday, 18 July 2021 3:50 PM  
**To:** [REDACTED]

Cc: [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
Subject: RE: ORCA GOBIERNO NUEVA ZELANDA

Thanks [REDACTED]

Unfortunately now we're heading into the realms where advice starts to conflict! SeaWorld is recommending no feeds overnight to allow the animal to rest and a maximum volume of 3L per feed, and Loro Parque is recommending much smaller feeds and through the night.

I'm tempted to go with SeaWorld's advice for now, as taking someone else's advice will make it harder to come back to SeaWorld to then ask for follow up advice, and they've been so consistent and fast and helpful with their replies that I'm hesitant to change. But will look perhaps at combining the two views where possible, and bear in mind Loro Parque's warnings as well.

Hopefully that suits you too?  
Give us a shout if you have any comments or questions!  
Kind regards,  
[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph [REDACTED]  
E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |

---

**From:** [REDACTED]  
**Sent:** 18 July 2021 14:47  
**To:** [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** Fw: ORCA GOBIERNO NUEVA ZELANDA

Hi team,

Also see email below from Loro Parque vet who has also reached out. She is also echoing the need to keep feed volumes low. Not sure how this compares to the original advice from Sea World.

Don't want to cloud the picture but if anything here is useful or you want to be in touch directly then no problem!

[REDACTED]

---

**From:** [REDACTED]  
**Sent:** Sunday, 18 July 2021 9:50 AM  
**To:** [REDACTED]  
**Cc:** [REDACTED]@loroparque-fundacion.org>; [REDACTED]@loroparque.com>; [REDACTED]  
**Subject:** Re: ORCA GOBIERNO NUEVA ZELANDA

Hi [REDACTED]

Thank you again! Apologies there are a few different avenues that are being used to garner advice so I think you have been copied in in a few places because of that.

Thank you for the formula and the feeding schedule advice. Early on the calf was getting larger volumes but of predominantly electrolytes in an attempt to rehydrate him. Now the formula strength has increased the volumes have decreased though I will review the schedule in light of your advice!

A further question about the husbandry of your calves if I may... Did they stay with the rest of the group through the handrearing process or were they kept alone? What was the level of human attention in those early months? Currently the calf here has people with him 24/7 and we are looking to understand the necessity of this.

Thank you again for reaching out and for your detailed response yesterday. Much appreciated!

---

**From:** [REDACTED]  
**Sent:** Saturday, 17 July 2021 11:00 PM  
**To:** [REDACTED]  
**Cc:** [REDACTED] <[\[REDACTED\]@loroparque-fundacion.org](mailto:[REDACTED]@loroparque-fundacion.org)>; [REDACTED] <[\[REDACTED\]@loroparque.com](mailto:[REDACTED]@loroparque.com)>; [REDACTED]  
**Subject:** Re: ORCA GOBIERNO NUEVA ZELANDA

Hello all

I have been copied to a few mails exchanges and thought I would just add herewith our most recent formula (with which we raised two killer whale calves - that are still with us) but mainly the timing of administration. The biggest issue we found out (and the reason for failure before) is the high volume administered in a short time.

It will have to be fed 24/24 to start with until it can stabilize.

If you cannot have access to zoologica milk powder (but often to be found in zoological institutions), I have also used human milk powder - without lactose - with success.

With a size of 2,15 m - your calf will probably be about 2 to 2,5 months old (the size of our male calf at that age).

For our calves at that age, we really found out that 9L per day is a great maximum (when going higher they started developing medical problems (delay in digestion and inflammation of the digestive system), and these problems can also only be identified if you can take blood regularly and especially perform ultrasounds of the digestive system (together with being able to recognize and assess their digestive organs). They will NOT show these digestive problems behaviourally until they are pretty far. Problem is to reach the necessary calories, as mum's milk is way more caloric than what we can offer them. And the mistake then is going up with the formula.

We would start around the clock - every 2 hours - with a low volume of intubation/bottle- and then we'd raise the volume slowly up to 1000 - 1300 ml (over weeks) max per intubation/bottle and start having longer times at night without feeding.

Up to an age of 9-10 months, 12 L would be the great maximum - but generally we had to go back down to less because of changes identified in the blood and by ultrasound - all related to food.

The other major issue we have found over time is starting to feed fish too early - which I absolutely not recommend (not before 6 months of age, and still, in small quantities).



These are in the big lines the lessons we learned by raising 3 calves, 2 having been successful, and having learned the mistakes from the other one.

What is also very helpful is to add tensio-actives (simethicone) with every formula administration (certainly if by bottle), because they will swallow large quantities of air. Their abdomen is not "distendable" like in other species, and this high quantity of air in their guts can make them very uncomfortable.

Please let me know if I can help you in any other way.

Greetings

On 17 Jul 2021, at 12:19, ██████████ wrote:

Hi ██████████

Thank you very much for the reply! I believe Ian and Ingrid have been busy on-site so probably aren't keeping up with email.

Thank you for the offer of advice on formula and hand rearing. We are also in consultation with a team of Sea World and Vancouver Aquarium vets who have experience in hand rearing. They have provided us with their formula which is what we have adapted based on what is available in NZ for now.

Medically he appears stable at this stage - bloods have been collected twice and nothing alarming. Regular monitoring of resp rate, ins and outs, movement etc are ongoing.

I would also be interested in your team's thoughts on the age of this individual. He is 2.15m long, does not have fully erupted teeth and has the faint remnants of foetal folds still visible.

There are no facilities in NZ that house captive cetaceans and as such we are trying to determine his suitability for release to the wild.

Thank you again for reaching out - have discovered the cetacean community really is fantastic in a situation like this. Such wealth of knowledge and generosity in sharing that knowledge.

Kindest Regards,

[REDACTED]

---

From: [REDACTED] <[\[REDACTED\]@loroparque-fundacion.org](mailto:[REDACTED]@loroparque-fundacion.org)>

Sent: Friday, 16 July 2021 10:52 PM

To: [REDACTED]

Cc: [REDACTED]

[REDACTED] <[\[REDACTED\]@loroparque.com](mailto:[REDACTED]@loroparque.com)>

Subject: Re: ORCA GOBIERNO NUEVA ZELANDA

Dear [REDACTED]

I am [REDACTED] Loro Parque Foundation, and I was trying to contact both Dr. Visser and Ian Angus to offer our help and share our experience in hand rearing orca calves from birth. I have copied [REDACTED], our consultant veterinarian and [REDACTED], one of our vets specialized in cetaceans. They can share their experience and diagnostic skills with you, as well as the critical parameters to hand rear an orca calf.

We are happy to help in any way you need to keep Toa health and safe so it can be reunited with the family pod as soon as possible.

Best regards,

[REDACTED]

[REDACTED], PhD.  
Director

Loro Parque Fundación

[REDACTED]

[REDACTED]

---

**De:** Formulario Contacto Loro Parque

**Enviado:** viernes, 16 de julio de 2021 5:25:23 (UTC) Hora del meridiano de Greenwich: Dublín, Edimburgo, Lisboa, Londres

**Para:** media

**Asunto:** Nueva consulta desde [loroparque.com](http://loroparque.com) | Prensa | [REDACTED]

Nombre: [REDACTED]

Email: [REDACTED] <[\[REDACTED\]@doc.govt.nz](mailto:[REDACTED]@doc.govt.nz)>

Teléfono: [REDACTED]

Mensaje: Kia Ora,

My names is [REDACTED] and I am a veterinarian with the Department of Conservation in New Zealand. I have been involved in the response to the stranded orca calf and saw that you were trying to reach out to offer help.

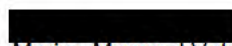
If someone was able to email on the above email address I would be interested in making contact.

Kindest Regards,



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---

  
Marine Mammal Veterinary Services  
Daverlostraat 186  
8310 Assebroek  
Belgium

  
[www.lacavemms.com](http://www.lacavemms.com)

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[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Monday, 19 July 2021 6:12 pm  
**To:** [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** Re: Orca calf

Good idea—can do that! Let us know if you think of anything else we should specifically check for.

---

**From:** [REDACTED]  
**Date:** Monday, 19 July 2021 at 6:02 PM  
**To:** [REDACTED]@wellingtonzoo.com>, [REDACTED]  
[REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Orca calf

Oooh and great news on lots of serum! Might be worth running both to look at trends!

---

**From:** [REDACTED]  
**Sent:** Monday, 19 July 2021 6:01 PM  
**To:** [REDACTED]@wellingtonzoo.com>, [REDACTED]  
[REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Orca calf

Hi [REDACTED]

See attached! Was a little tricky working out exactly what was done when from the ZIMS report so please change it around if I got anything wrong!

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Monday, 19 July 2021 5:58 PM  
**To:** [REDACTED]>, [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>  
**Subject:** Re: Orca calf

Hello!

Thank you so much for sending those through—I haven't seen that VIN article yet but will have a look (sounds a bit frightening!)

I should hopefully be able to get enough serum tomorrow (and we have heaps from last time that we were planning to bank) and will run another CBC.

Have you by any chance made a spread sheet with the blood results yet? [REDACTED] was hoping we could send it to him and I didn't want to reinvent the wheel if not necessary 😊

Thanks so much for your help! Will let you know how he is tomorrow!

From: [Redacted]  
Date: Monday, 19 July 2021 at 5:52 PM  
To: [Redacted] <[\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>  
Cc: [Redacted] <[\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>, [Redacted] <[\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>  
Subject: Orca calf

Hi team,

Hope today has gone well. You may have already seen this report but it made for interesting reading if you haven't already read it (and sadly a very sudden ending.. but good to know just how quick they can crash...)  
<https://www.vin.com/apputil/content/defaultadv1.aspx?pId=11257&catId=32239&id=3863999>. Also here is a urinalysis summary for captives <https://www.vin.com/apputil/content/defaultadv1.aspx?id=3864796&pid=11257&>

Thanks [Redacted] for sending the ZIMS report – am I right that he has only had one haematology so far? Assuming you will be looking to repeat that tomorrow? I was also wondering about a Serum Protein Electrophoresis if you could get enough blood volume (0.3ml serum to gribbles).

So much cool info out there on these guys... To be fair lots of the papers are written by the people we are directly in contact with which is insanely cool!!!

[Redacted]  
[Redacted]  
Veterinary Advisor Kākāpō - *Kaitohutohu Rata Kararahe Kākāpō*

Department of Conservation - *Te Papa Atawhai*  
Postal address: Department of Conservation, PO Box 743, Invercargill 9840, New Zealand  
Physical address: Department of Conservation, Level 7, 33 Don Street, Invercargill 9480, New Zealand

<http://kakaporecovery.org.nz/>



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**From:** [REDACTED]@wellingtonzoo.com>

**Sent:** Monday, 19 July 2021 5:33 pm

**To:** HUHA Helping You Help Animals

**Cc:** [REDACTED]; Ian Angus; [REDACTED]; Kirstie Knowles; [REDACTED]; Ingrid [REDACTED]; [REDACTED]

**Subject:** RE: Veterinary update for orca calf 18/07/21

Hi everyone,

A shorter veterinary update on Toa from me today :)

As usual, Team HUHA and Whale Rescue please feel free to add to these updates!

#### 1) Current medical findings

##### Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Can take that from you tomorrow when we pop by to send it on to the lab.
- A urine sample was collected and tested today:
  - o USG today was 1.018, and there was trace protein and no glucose on the urine dipstick. These findings are of no concern and we'll continue regular urine monitoring to look for any trends.

##### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

#### 2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

##### Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - o His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - o His daily caloric requirements are 120-125kcal/kg/d.

- As of tomorrow he can receive 100% formula (no additional vytrate). According to his requirements of 120-125kcal/kg/d, an estimated weight of 200kg and an estimated caloric content of the food of 1450kcal/L, he requires 16L of formula per day to meet his requirements. This could be divided into several feeds such as 10 x 1.6L feeds or 8 x 2L feeds over the day tomorrow – would that suit how he’s currently feeding?
  - o If he receives this volume, this should also meet his fluid requirements for the day.

A few quick questions please, as I didn’t manage to get anyone on the phone today:

- How was his respiration/defaecation/urination today?
- How much volume did you get into him today formula-wise and vytrate-wise? Was this mostly by bottle or did you tube feed him again today?
- Did you see any signs of post-feed discomfort today?
- Did you see any other signs of gut upset? ie: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.
- We’ve started him on the oral de-gas medication (simethicone) today (19/07/21) that has been recommended by a few vets that have been involved in hand rearing of cetaceans to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We’re still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we’re already doing.

A few of us from the zoo will pop by tomorrow to:

- Take some repeat bloods.
- Catch up with you about some of the physical exam findings, check in with how feeding is going, check in on a couple of monitoring parameters etc. If you’d like us to bring/check anything specific let me know!
- Bring gear/recipes/instructions to hand over the formula prep.

3) Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.


4) Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don’t hesitate to get in touch.

Kind regards,



 BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

---

**From:** HUHA Helping You Help Animals [REDACTED]  
**Sent:** 18 July 2021 19:14  
**To:** [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>;  
[REDACTED] Ian Angus <iangus@doc.govt.nz>; Marine  
<marine@doc.govt.nz>; [REDACTED]  
[REDACTED]; Kirstie Knowles <kknowles@doc.govt.nz>; [REDACTED]>;  
ingrid [REDACTED]@wellingtonzoo.com>  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>

**Subject:** Re: Veterinary update for orca calf 18/07/21

Hi All.

Thanks [REDACTED]

Just to confirm that the Ingrid had the pool switched back to sea water thisafternoon.

Cheers  
[REDACTED]

On Sun, 18 Jul 2021, 5:55 pm [REDACTED]@wellingtonzoo.com> wrote:

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversations or if you otherwise have anything to add!

Firstly thank you so much to everyone who worked so hard in such awful weather in the last couple of days, I thought of you often and I hope you managed to stay warm and dry in between caring for Toa.

1. Current medical findings

Lab tests:

- The lab has unfortunately said that it can't run lactate on the type of sample that we've given them, but we can run it on the next sample we take using a patient-side machine that we can bring with us on the next blood sampling.
- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.



- The team on-site have collected a faecal sample – thank you! Will chat tomorrow about how we get that where it needs to be for analysis.
- A urine sample was collected and tested today:
  - USG today was 1.028, and there was +1 protein and +1 glucose on the urine dipstick. In some animals those dipstick findings can be abnormal, but we'll wait to see if they persist (in some species they can be normal, or at least explained by physiology rather than disease).

#### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage. No significant abnormalities/changes of defaecation have been noted with introducing or increasing the diet.
- He has been observed to urinate in the last 24 hours.

#### Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Ultimately we would like him on just formula (no supplementary fluid), as this contains enough fluid to also meet his fluid requirements, but we've been advised to build up to that slowly, which is why his diet is changing a little every day at the moment.
- Today the feeding plan was 1L formula + 1.2L 50% vytrate for the first three feeds (2.2L total) and then 1.5L formula + 0.7L 50% vytrate for the second three feeds (2.2L total). (Total of 7.5L formula and 5.7L 50% vytrate for today).
  - HUHA team if you could fill us in on how you went with this that would be lovely :)

- **Tomorrow's feeding plan:**
  - **1.1L formula + 0.4L 50% vytrate per feed x 8 feeds at 2 hourly intervals**

**(total of 8.8L formula and 3.2L 50% vytrate).**
- We've had to make a few changes to his feed schedule to get to the feeding plan for tomorrow:
  - He has been showing signs of discomfort after tube feeding – sinking to the bottom of the pool and hunching slightly.
    - This may be due to discomfort due to the volume fed - hence smaller meals tomorrow – fed more frequently so that we still try to meet his requirements.
    - Or it may be due to discomfort from the tubing. The cetacean vets that we've been taking advice from say that bottle feeding him would be a good alternative. They say it may contribute to habituation, but that so does being near to humans and being handled for tubings/treatments etc, so they are not concerned about the bottle feeding on its own per se.
    - A bottle set up has been trialled today with moderate success. The signs of discomfort that were seen post-tubing have not been seen after bottle feeding.
- A few pointers from the cetacean vets:
  - Please make sure he's not gulping air while feeding – this can cause colic and discomfort.
    - They've recommended a de-gas medication be added to the feeds, I will source this asap and let you know when it's ready.
  - Please make sure he's not gulping water while feeding – too much sea water ingestion can affect his electrolyte levels and make him sick.
  - We/you can consider supplement feeding him with tube feeding if some of his bottle feeds are less productive than others.
  - They prefer him to have a break from feeding overnight to allow him to rest, so they do not advise feeding constantly over a 24 hour period at this stage.
- An important piece of information that I received today is that orca abdomens do not expand very easily compared to other mammals. As a result, a build up of anything in the abdomen increases the pressure in the abdomen rather than causing abdominal distension. So a build up of gas can very quickly become uncomfortable, as can ingesting volumes that are too large – so perhaps this is the reason we're seeing some discomfort after tubing.
- Please continue to monitor him for signs of gut upsets: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Today it was noted that some of the volunteers were encouraging him to suck on their thumbs as they thought this might help with feeding. Thank you Whale Rescue and HUHA for realising this was happening and for advising them to stop :)

Due to the suspected/confirmed (?) sewage spill at Plimmerton due to the horrible weather this weekend the team recently changed his pool from salt water to chlorinated water. Please could we change this to fresh water or back to sea water if the Plimmerton sea water is okay again? It was a good idea to change from sea water when the sewage problem was reported, but fresh water is much better for him than chlorinated water, which could negatively affect his skin and eyes.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.


4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



 BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** 17 July 2021 16:35  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]  
Ian Angus <iangus@doc.govt.nz>; Marine  
<marine@doc.govt.nz>; [REDACTED]  
[REDACTED]  
**Cc:** HUHA Helping You Help Animals [REDACTED]>; ingrid [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>;  
<[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
<[REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hey all, quick update from me today.

- Toa is going really well according to personnel on site – accepting feeds well, and no gastrointestinal comfort seen
- There is possibly a sewerage pipe burst somewhere near the bay, so concerns re: water quality. HUHA vet [REDACTED] is organising water testing.
- [REDACTED] got a urine sample and USG this morning of 1.017
- [REDACTED] mentioned possibly some oedema around caudal oropharynx/throat area (possibly from repeat tubing?) so would like to keep bottle feeding as a back up option in case tubing needs to be abandoned. Toa is currently showing no signs of discomfort or distress during tubing, tolerates it very well. We can check this when we are next on site as well, but in the meantime if HUHA vets can keep a close eye on that please 😊
- We are going to continue upping the ratio of formula to vytrate, so please see the attached feeding schedule for 18/07/21 – there is no hard copy of this, I'm sorry. Had not gotten it printed off before the food was collected this afternoon. At this rate he should be on 100% formula from Monday afternoon, and we can look at making the formula richer or increasing volume if we need to increase caloric intake.
- We will organise a day early next week to revisit Toa to take a repeat blood sample
- I am going to be off for the next two days, but [REDACTED] is here tomorrow and [REDACTED] will both be here on Monday

Thanks again (and again and again) for everyone's hard work and dedication especially in the horrible conditions today.

[Me tiaki, kia ora!](#)

[REDACTED] BSc (Hons)  
Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph + [REDACTED]  
E [REDACTED]@wellingtonzoo.com | W www.wellingtonzoo.com | [ ] [ ]



---

**From:** [REDACTED]@wellingtonzoo.com  
**Sent:** 16 July 2021 17:02  
**To:** [REDACTED]@wellingtonzoo.com; [REDACTED]  
[REDACTED]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]  
>  
**Cc:** HUHA Helping You Help Animals <[REDACTED]>; Ingrid <[REDACTED]>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again, slight update to tomorrow's feed schedule (see attached).

[REDACTED] BA DVM  
Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
E [REDACTED]@wellingtonzoo.com

---

**From:** [REDACTED]  
**Sent:** Friday, 16 July 2021 4:07 pm  
**To:** [REDACTED]@wellingtonzoo.com; [REDACTED]  
[REDACTED]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]  
<[REDACTED]>  
**Cc:** HUHA Helping You Help Animals <[REDACTED]>; Ingrid <[REDACTED]>; [REDACTED]

<[REDACTED]@wellingtonzoo.com>; [REDACTED]wellingtonzoo.com>;  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
<[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>

**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again to everyone!

Thank you all for your amazing continued care of the little calf! I'm just continuing on with a further update on how Toa is doing following the discussion from earlier this afternoon. I'll try to only include new information in this update. Please add anyone I may have forgotten to include!

Due to the change in weather, Toa was moved into a temporary pool yesterday around 5 PM. The move went smoothly and took 20-30 minutes. There have not been any changes noted in his behaviour since changing to the pool and his medical treatments and tubings are taking place at the same intervals. At the moment there is no filtration system in place so, as an alternative, the pool is being continuously filled with sea water via a pump and draining out excess water through holes in the side. The plan is to only keep Toa in the pool until it is safe enough to return him to the sea pen.

As we have increased the concentration of formula being fed, it was observed that Toa is beginning to show a few signs of abdominal discomfort immediately after feeds. He will cramp up and sink to the bottom of the pool briefly. This began last night and happened again this afternoon. In order to hopefully combat this we have come up with the solution of feeding him more frequently throughout the day (every 2 hours instead of every 4) so that he is getting smaller volumes of formula at each feed (but will still receive the same total daily volume). We will still try to increase his volume of formula fed by 50% each day in order to start increasing his caloric intake. It has been difficult to assess the frequency and consistency of his faecal output due to the murkiness/turbulence of water from weather. With increased

In terms of ongoing monitoring, we will continue to do what [REDACTED] has already discussed (semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour) but may also consider adding in blow hole chuff cultures at least once but could repeat if any indication (we need to source the appropriate petri dish to collect these and confirm with Gribbles how it will need to be submitted), urine samples from first thing in morning prior to tubing to check UA and USG (this could be less frequent, maybe every 3 days or so), and body length and girth measurements (and possibly weights! if a suitable scale setup can be sourced which Ingrid is looking into). The body length, girth and weight measurements will be incredibly helpful both in helping to confirm an age and in ongoing monitoring of nutritional status.

For fluids and feedings tomorrow the plan is to give 700 ml formula with 1.5 liters 50% vytrate at 8 AM, 10 AM, and 12 PM. Then for the 2 PM, 4 PM, and 6 PM feeds he can receive 1 liter formula with 2 liters of 50% vytrate. (Total formula volume will be 5 L tomorrow compared to 3.5 liters today, a ~50% increase in volume). I'll email out a feed schedule sheet separately in case it is helpful. 😊 This will increase the total fluid volume he gets during the day by 3 liters but will still be within his recommended fluid needs of 40-80 ml/kg/day. If he is continuing to show signs of discomfort after any of these feedings please get in touch. [REDACTED] will be at work tomorrow at the zoo so can be reached if needed.

For medications, Toa received his last dose of steroid today. There is no need to continue on with steroid treatment at this time. He is still receiving enrofloxacin 5 mg/kg BID which he started Wednesday morning (14/7/21). This is due to last 7 days, finishing after his dose on the evening of 20/7/21.

We are still awaiting results from the veterinary laboratory for samples taken Monday:

- o Lactate, blow hole swab culture (fungal and bacterial).

1. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

2. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thank you so much to everyone for all your dedication and care! Looking forward to seeing you and Toa in person again soon!

**BA DVM**

Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

E [@wellingtonzoo.com](mailto: @wellingtonzoo.com)

---

**From:** [@doc.govt.nz](mailto: @doc.govt.nz)

**Sent:** Thursday, 15 July 2021 6:32 pm

**To:** [@wellingtonzoo.com](mailto: @wellingtonzoo.com);

; Ian Angus <[iangus@doc.govt.nz](mailto: iangus@doc.govt.nz)>; Marine

<[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [redacted]  
[redacted]  
Cc: HUHA Helping You Help Animals <[redacted]>; [ingrid \[redacted\]](mailto:ingrid@[redacted]); [redacted]  
[redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>;  
<[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted]  
[redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted]  
[redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>>

**Subject:** Re: Veterinary update for orca calf 15/07/21

Hi [redacted]

Thank you again for another comprehensive update! Sounds like all is stable which is great news.

Thank you to the wider team as well for all your hard work with this little calf.

Kindest regards,

[redacted]

---

**From:** [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>  
**Sent:** Thursday, 15 July 2021 6:01 PM  
**To:** [redacted]; Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [redacted]  
[redacted]  
**Cc:** HUHA Helping You Help Animals [redacted]; [ingrid \[redacted\]](mailto:ingrid@[redacted]) <[ingrid \[redacted\]](mailto:ingrid@[redacted])>; [redacted]  
[redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted]  
[redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted]  
<[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>>  
**Subject:** Veterinary update for orca calf 15/07/21

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!



## 1. Current medical findings

### Lab tests:

- We have a few results back from the lab:
  - Complete blood count and blood parasite check – normal (but see below)
  - Fibrinogen levels (one way of testing for inflammation) – normal
  - Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - Total blood iron levels – normal
  - The lab's interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we'll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Lactate, blow hole swab culture (fungal and bacterial).

### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

- Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!)

#### Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).
- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

#### Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

#### Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

#### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph [Redacted]  
E [Redacted]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |

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From: [Redacted]  
Sent: 14 July 2021 18:47  
To: [Redacted]

[Redacted]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz);

<

Cc: HUHA Helping You Help Animals [redacted]; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [redacted]  
[redacted] [<@wellingtonzoo.com>](mailto:@wellingtonzoo.com); [redacted] [<@wellingtonzoo.com>](mailto:@wellingtonzoo.com);  
[redacted] [<@wellingtonzoo.com>](mailto:@wellingtonzoo.com); [redacted] [<@wellingtonzoo.com>](mailto:@wellingtonzoo.com);  
[redacted] [<@wellingtonzoo.com>](mailto:@wellingtonzoo.com); [redacted] [<@wellingtonzoo.com>](mailto:@wellingtonzoo.com)

**Subject:** Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

1. Medical findings

Lab tests:

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also will several deep lacerations near his tail fluke laterally to his spine.
- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

Fluids:

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

Feeding:

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.

## 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

## 4. Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

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E [Redacted]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |  

---

**From:** [Redacted]

**Sent:** 13 July 2021 15:47

**To:** [Redacted]

[Redacted]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz)

**Cc:** HUHA Helping You Help Animals [Redacted]; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [Redacted]

[Redacted]@wellingtonzoo.com; [Redacted]@wellingtonzoo.com>;

[Redacted]@wellingtonzoo.com>;

[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>

**Subject:** Veterinary update for orca calf 13/07/21

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet [REDACTED] from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by [REDACTED] also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,

[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
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[REDACTED]

**From:** Elizabeth Heeg  
**Sent:** Wednesday, 21 July 2021 8:14 am  
**To:** Kirsty Prior; Dave Smith; Kirstie Knowles; Bronwyn Saunders  
**Cc:** [REDACTED] Jack Mace; Ian Angus; [REDACTED]  
**Subject:** Fwd: Veterinary update for orca calf 20/07/21

Thanks Kirstie, improved comms sounds a good idea as does daily vet meeting

Sent from Workspace ONE Boxer

On 21/07/2021 07:03, Kirstie Knowles <kknowles@doc.govt.nz> wrote:  
Morning all,  
See below vet report in last night.

Key messages:

- Some of the injuries sustained on stranding are healing well, others are being monitored.
- We are a little concerned about his right eye, which is more closed than the left and has mild swelling.
- He has been struggling on and off with discomfort in his gut, likely associated with us trying to get his feeding right.
- Good that he's now starting to do poos.
- He is on antibiotics and medication to help with the gut pains.

Still sounds like the vet is struggling to get the info she needs so today could look to improve comms?

Kirstie Knowles  
Marine Ecosystems Manager  
Te Papa Atawhai - DOC

Note: I support flexible working and may be sending this out of usual office hours. I do not expect an out of hours response.

----- Forwarded message -----

From: [REDACTED]@wellingtonzoo.com>  
Date: 20/07/2021 7:16 pm  
Subject: Veterinary update for orca calf 20/07/21  
To: HUHA Helping You Help Animals [REDACTED]  
Cc: [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>, Ian Angus <iangus@doc.govt.nz>, Marine <marine@doc.govt.nz>, Kirstie Knowles <kknowles@doc.govt.nz>, [REDACTED], [REDACTED], ingrid [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>

Hi everyone,

A veterinary update on Toa from today. Please add anything I may have missed.

1. Current medical findings



#### Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected several faecal samples and these have been submitted for testing for parasitology, gram stain, salmonella culture and occult blood. We will let you know what these results show when we get them.
- A urine sample was collected and tested today:
  - USG today was 1.016 – despite some feeding difficulties in the last 24 hours, it looks like he is not currently dehydrated. We'll continue regular urine monitoring to look for any trends.
- One of our techs performed some water testing today. I will get the full numbers from her for this tomorrow, but I can give you interim findings in the meantime:
  - The chlorine level in the water is negligible. I think there was a misunderstanding here on my part I'm sorry, when I was told that he was in "chlorinated water", I thought you meant "swimming pool level chlorination", which would have been concerning. The level of chlorine in town supply water is much lower and should be fine in the interim if sea water is not available. Thank you for clarifying this today.
- We were not able to get much blood at all today, despite a few attempts. A drop of blood has been made into a blood smear to repeat an estimated white cell count, if the lab deems the size of this sample suitable.
  - We will return on Thursday to try to take some more blood for routine monitoring of his general condition.

#### Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc) but we have taken some photos today to allow us to monitor them over time.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. It is possible that this started around the time of his move to the pool, as his eyes appeared normal before then. One of the cetacean vets we have been talking with thinks this is of minimal concern, but an ophthalmologist that has been contacted would like us to double check a couple of things to make sure it is not of concern. The swelling has reduced somewhat in the last couple of days. He would not let us examine the eye itself today, he held his eyelids tightly shut when we tried to have a look. We'll get in touch with some veterinary ophthalmologists in the lower north island and see what their availability is for a second opinion, and in the meantime we will keep monitoring for improvement of the swelling.
  - Some clear mucous from the eye will be sent to the lab for cytology and culture (although worth noting that normal eye secretions from this species are clear and mucousy).
- There is a small blister on the skin near his blowhole, approximately 1cm in diameter. It contains apparently clear fluid and otherwise there is no inflammation surrounding it. It is the only such lesion that we could see on his skin today. As a result, we are not immediately concerned by this lesion but will continue to keep an eye on it with photos and observations.

#### 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.

- Yesterday (19/07/21) he received 10x feeds of 800-1000ml (with feed consisting of a ratio of 1L formula to 0.4L 50% vytrate).
- His feeding schedule was delayed by a few things during the day yesterday, such that his last feed was given at 1am this morning. After this feed (and to a lesser degree after the 8pm feed) he showed signs of discomfort – rolling along his long axis, and sinking to the bottom of the pool. Over a period of time he passed 3 faecals (his first faecals for the preceding 24 hour period), after which his signs significantly reduced. By this morning's first feed he was behaviourally normal again. I think this is likely an indication that he was in discomfort from too much pressure in his belly from having recently fed and having not defaecated for a while. However another possible reason could be gut upset from diet increases, or a gut disease such as parasitism. As a result our plan today was:
  - Give just 50% vytrate for the first few feeds.
  - Introduce food again at 50:50 formula to 50% vytrate after the first few feeds and monitor (this is a step back on our diet increases, with a plan to increase again in future when his gut settles so that we can aim to meet his caloric requirements).
  - Send faeces for parasitology and a few other tests.
  - **Another thought please** is could we please try to keep 2 hours between feeds? I think his last feed before 1am was at midnight – perhaps this is an indication that a 1 hour feeding interval may be a bit much for him.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 21/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or we could cause quite significant gut upsets.

#### Additional medications:

- Today was his last day of enrofloxacin (antibiotic) injections.
- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

#### Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

#### Formula prep has been handed over to the team on-site at Plimmerton Boat Club today:

- This was done in the hope that this will save all our teams time with regards to organising couriers to and from the zoo to pick up the diet. Let us know if it's not saving you time or if it is causing any other difficulties, we are very happy to take this role on for you again.
- Please also let us know well in advance if you need any of the ingredients topped up or replaced – some of these items will take us a few days to order in.

I have been asked for advice on how to safely increase the salinity for the pool that he is in. Please can you remind me of the dimensions and volume of the pool? With the current estimated whole pool turnover of every four hours, this is going to take a lot of salt. And with the tendency of large volumes of salt to sit on the bottom of pools and dissolve slowly, it is going to take some care to make sure that we don't raise the salinity too high. It may be quite difficult to get the balance right and will take careful monitoring. Will get in touch tomorrow with a plan.

I have received measurements of "107, 135, 134" today – can someone please let me know which of these are length/girth measurements etc?

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

Ph [REDACTED]

E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) | 

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**From:** [REDACTED]  
**Sent:** 19 July 2021 17:33  
**To:** HUHA Helping You Help Animals [REDACTED]  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED] Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]; Kirstie Knowles <kknowles@doc.govt.nz>; [REDACTED] ingric [REDACTED]; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]as@wellingtonzoo.com>  
**Subject:** RE: Veterinary update for orca calf 18/07/21

Hi everyone,

A shorter veterinary update on Toa from me today :)

As usual, Team HUHA and Whale Rescue please feel free to add to these updates!

1. Current medical findings

Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Can take that from you tomorrow when we pop by to send it on to the lab.
- A urine sample was collected and tested today:
  - USG today was 1.018, and there was trace protein and no glucose on the urine dipstick. These findings are of no concern and we'll continue regular urine monitoring to look for any trends.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- As of tomorrow he can receive 100% formula (no additional vytrate). According to his requirements of 120-125kcal/kg/d, an estimated weight of 200kg and an estimated caloric content of the food of 1450kcal/L, he requires 16L of formula per day to meet his requirements. This could be divided into several feeds such as 10 x 1.6L feeds or 8 x 2L feeds over the day tomorrow – would that suit how he's currently feeding?
  - If he receives this volume, this should also meet his fluid requirements for the day.

A few quick questions please, as I didn't manage to get anyone on the phone today:

- How was his respiration/defaecation/urination today?
- How much volume did you get into him today formula-wise and vytrate-wise? Was this mostly by bottle or did you tube feed him again today?
- Did you see any signs of post-feed discomfort today?
- Did you see any other signs of gut upset? ie: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.
- We've started him on the oral de-gas medication (simethicone) today (19/07/21) that has been recommended by a few vets that have been involved in hand rearing of cetaceans to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

A few of us from the zoo will pop by tomorrow to:

- Take some repeat bloods.
- Catch up with you about some of the physical exam findings, check in with how feeding is going, check in on a couple of monitoring parameters etc. If you'd like us to bring/check anything specific let me know!
- Bring gear/recipes/instructions to hand over the formula prep.

## 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

## 4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph ██████████  
E ██████████@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) | 

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From: HUHA Helping You Help Animals ██████████  
Sent: 18 July 2021 19:14  
To: ██████████@wellingtonzoo.com>  
Cc: ██████████@wellingtonzoo.com>; ██████████@wellingtonzoo.com>;  
██████████ Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine  
<[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>;  
██████████; Kirstie Knowles <[kknowles@doc.govt.nz](mailto:kknowles@doc.govt.nz)>;  
[ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com)>; ██████████@wellingtonzoo.com>;  
██████████@wellingtonzoo.com>; ██████████@wellingtonzoo.com>;  
██████████@wellingtonzoo.com>; ██████████@wellingtonzoo.com>

Subject: Re: Veterinary update for orca calf 18/07/21

Hi All.

Thanks ██████████.

Just to confirm that the Ingrid had the pool switched back to sea water thisafternoon.

Cheers  
██████████

On Sun, 18 Jul 2021, 5:55 pm ██████████@wellingtonzoo.com> wrote:

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversations or if you otherwise have anything to add!

Firstly thank you so much to everyone who worked so hard in such awful weather in the last couple of days, I thought of you often and I hope you managed to stay warm and dry in between caring for Toa.

1. Current medical findings

Lab tests:

- The lab has unfortunately said that it can't run lactate on the type of sample that we've given them, but we can run it on the next sample we take using a patient-side machine that we can bring with us on the next blood sampling.

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Will chat tomorrow about how we get that where it needs to be for analysis.
- A urine sample was collected and tested today:
  - USG today was 1.028, and there was +1 protein and +1 glucose on the urine dipstick. In some animals those dipstick findings can be abnormal, but we'll wait to see if they persist (in some species they can be normal, or at least explained by physiology rather than disease).

#### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

#### 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage. No significant abnormalities/changes of defaecation have been noted with introducing or increasing the diet.
- He has been observed to urinate in the last 24 hours.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Ultimately we would like him on just formula (no supplementary fluid), as this contains enough fluid to also meet his fluid requirements, but we've been advised to build up to that slowly, which is why his diet is changing a little every day at the moment.
- Today the feeding plan was 1L formula + 1.2L 50% vytrate for the first three feeds (2.2L total) and then 1.5L formula + 0.7L 50% vytrate for the second three feeds (2.2L total). (Total of 7.5L formula and 5.7L 50% vytrate for today).
  - HUHA team if you could fill us in on how you went with this that would be lovely :)

- **Tomorrow's feeding plan:**
  - **1.1L formula + 0.4L 50% vytrate per feed x 8 feeds at 2 hourly intervals**

**(total of 8.8L formula and 3.2L 50% vytrate).**

- We've had to make a few changes to his feed schedule to get to the feeding plan for tomorrow:

- He has been showing signs of discomfort after tube feeding – sinking to the bottom of the pool and hunching slightly.
  - This may be due to discomfort due to the volume fed - hence smaller meals tomorrow – fed more frequently so that we still try to meet his requirements.
  - Or it may be due to discomfort from the tubing. The cetacean vets that we've been taking advice from say that bottle feeding him would be a good alternative. They say it may contribute to habituation, but that so does being near to humans and being handled for tubings/treatments etc, so they are not concerned about the bottle feeding on its own per-se.
  - A bottle set up has been trialled today with moderate success. The signs of discomfort that were seen post-tubing have not been seen after bottle feeding.
- A few pointers from the cetacean vets:
  - Please make sure he's not gulping air while feeding – this can cause colic and discomfort.
    - They've recommended a de-gas medication be added to the feeds, I will source this asap and let you know when it's ready.
  - Please make sure he's not gulping water while feeding – too much sea water ingestion can affect his electrolyte levels and make him sick.
  - We/you can consider supplement feeding him with tube feeding if some of his bottle feeds are less productive than others.
  - They prefer him to have a break from feeding overnight to allow him to rest, so they do not advise feeding constantly over a 24 hour period at this stage.
- An important piece of information that I received today is that orca abdomens do not expand very easily compared to other mammals. As a result, a build up of anything in the abdomen increases the pressure in the abdomen rather than causing abdominal distension. So a build up of gas can very quickly become uncomfortable, as can ingesting volumes that are too large – so perhaps this is the reason we're seeing some discomfort after tubing.
- Please continue to monitor him for signs of gut upsets: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Today it was noted that some of the volunteers were encouraging him to suck on their thumbs as they thought this might help with feeding. Thank you Whale Rescue and HUHA for realising this was happening and for advising them to stop :)

Due to the suspected/confirmed (?) sewage spill at Plimmerton due to the horrible weather this weekend the team recently changed his pool from salt water to chlorinated water. Please could we change this to fresh water or back to sea water if the Plimmerton sea water is okay again? It was a good idea to change from sea water when the sewage problem was reported, but fresh water is much better for him than chlorinated water, which could negatively affect his skin and eyes.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

#### 4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[REDACTED]

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**Sent:** 17 July 2021 16:35

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<[REDACTED]@wellingtonzoo.com>

**Subject:** RE: Veterinary update for orca calf 15/07/21

Hey all, quick update from me today.

- Toa is going really well according to personnel on site – accepting feeds well, and no gastrointestinal comfort seen
- There is possibly a sewerage pipe burst somewhere near the bay, so concerns re: water quality. HUHA vet [REDACTED] is organising water testing.
- [REDACTED] got a urine sample and USG this morning of 1.017
- [REDACTED] mentioned possibly some oedema around caudal oropharynx/throat area (possibly from repeat tubing?) so would like to keep bottle feeding as a back up option in case tubing needs to be abandoned. Toa is currently showing no signs of discomfort or distress during tubing, tolerates it very well. We can check this when we are next on site as well, but in the meantime if HUHA vets can keep a close eye on that please 😊
- We are going to continue upping the ratio of formula to vytrate, so please see the attached feeding schedule for 18/07/21 – there is no hard copy of this, I'm sorry. Had not gotten it printed off before the food was collected this afternoon. At this rate he should be on 100% formula from Monday afternoon, and we can look at making the formula richer or increasing volume if we need to increase caloric intake.
- We will organise a day early next week to revisit Toa to take a repeat blood sample
- I am going to be off for the next two days, but [REDACTED] is here tomorrow and [REDACTED] will both be here on Monday



Thanks again (and again and again) for everyone's hard work and dedication especially in the horrible conditions today.

[Me tiaki, kia ora!](#)

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**From:** **[REDACTED]** <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>  
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**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again, slight update to tomorrow's feed schedule (see attached).

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**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again to everyone!

Thank you all for your amazing continued care of the little calf! I'm just continuing on with a further update on how Toa is doing following the discussion from earlier this afternoon. I'll try to only include new information in this update. Please add anyone I may have forgotten to include!

Due to the change in weather, Toa was moved into a temporary pool yesterday around 5 PM. The move went smoothly and took 20-30 minutes. There have not been any changes noted in his behaviour since changing to the pool and his medical treatments and tubings are taking place at the same intervals. At the moment there is no filtration system in place so, as an alternative, the pool is being continuously filled with sea water via a pump and draining out excess water through holes in the side. The plan is to only keep Toa in the pool until it is safe enough to return him to the sea pen.

As we have increased the concentration of formula being fed, it was observed that Toa is beginning to show a few signs of abdominal discomfort immediately after feeds. He will cramp up and sink to the bottom of the pool briefly. This began last night and happened again this afternoon. In order to hopefully combat this we have come up with the solution of feeding him more frequently throughout the day (every 2 hours instead of every 4) so that he is getting smaller volumes of formula at each feed (but will still receive the same total daily volume). We will still try to increase his volume of formula fed by 50% each day in order to start increasing his caloric intake. It has been difficult to assess the frequency and consistency of his faecal output due to the murkiness/turbulence of water from weather. With increased

In terms of ongoing monitoring, we will continue to do what [REDACTED] has already discussed (semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour) but may also consider adding in blow hole chuff cultures at least once but could repeat if any indication (we need to source the appropriate petri dish to collect these and confirm with Gribbles how it will need to be submitted), urine samples from first thing in morning prior to tubing to check UA and USG (this could be less frequent, maybe every 3 days or so), and body length and girth measurements (and possibly weights! if a suitable scale setup can be sourced which Ingrid is looking into). The body length, girth and weight measurements will be incredibly helpful both in helping to confirm an age and in ongoing monitoring of nutritional status.

For fluids and feedings tomorrow the plan is to give 700 ml formula with 1.5 liters 50% vytrate at 8 AM, 10 AM, and 12 PM. Then for the 2 PM, 4 PM, and 6 PM feeds he can receive 1 liter formula with 2 liters of 50% vytrate. (Total formula volume will be 5 L tomorrow compared to 3.5 liters today, a ~50% increase in volume). I'll email out a feed schedule sheet separately in case it is helpful. 😊 This will increase the total fluid volume he gets during the day by 3 liters but will still be within his recommended fluid needs of 40-80 ml/kg/day. If he is continuing to show signs of discomfort after any of these feedings please get in touch. [REDACTED] will be at work tomorrow at the zoo so can be reached if needed.

For medications, Toa received his last dose of steroid today. There is no need to continue on with steroid treatment at this time. He is still receiving enrofloxacin 5 mg/kg BID which he started Wednesday morning (14/7/21). This is due to last 7 days, finishing after his dose on the evening of 20/7/21.

We are still awaiting results from the veterinary laboratory for samples taken Monday:

- o Lactate, blow hole swab culture (fungal and bacterial).

1. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

2. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thank you so much to everyone for all your dedication and care! Looking forward to seeing you and Toa in person again soon!

**BA DVM**

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**Sent:** Thursday, 15 July 2021 6:32 pm

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**Subject:** Re: Veterinary update for orca calf 15/07/21

Hi [REDACTED]

Thank you again for another comprehensive update! Sounds like all is stable which is great news.

Thank you to the wider team as well for all your hard work with this little calf.

Kindest regards,

From: [redacted] <[redacted]@wellingtonzoo.com>

Sent: Thursday, 15 July 2021 6:01 PM

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Subject: Veterinary update for orca calf 15/07/21

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!

1. Current medical findings

Lab tests:

- We have a few results back from the lab:
  - Complete blood count and blood parasite check – normal (but see below)
  - Fibrinogen levels (one way of testing for inflammation) – normal
  - Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - Total blood iron levels – normal
  - The lab's interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we'll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Lactate, blow hole swab culture (fungal and bacterial).

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition

present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.
  - Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!)

Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).
- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



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**Subject:** Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

1. Medical findings

Lab tests:

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also will several deep lacerations near his tail fluke laterally to his spine.
- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to

be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

Fluids:

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

Feeding:

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.



3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

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**From:** [Redacted]  
**Sent:** 13 July 2021 15:47  
**To:** [Redacted]

[redacted]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz)  
Cc: HUHA Helping You Help Animals [redacted]; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [redacted]  
[redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>;  
[redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [redacted]  
[redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>

Subject: Veterinary update for orca calf 13/07/21

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet [redacted] from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by [redacted] also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,

[redacted]

[redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
[redacted] | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
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[REDACTED]

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Wednesday, 21 July 2021 5:12 pm  
**To:** NZRadVet; [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** RE: Orca calf - routine abdominal ultrasound  
**Attachments:** 9 Gross and Microscopic Anatomy of Marine Mammals.pdf; 26 Ultrasonography of Marine Mammals.pdf

Hi [REDACTED],

Thanks so much for your response (and potential willingness to help!).

I've attached the information I have on ultrasounding cetaceans from the CRC Manual of Marine Mammal Medicine. I've also attached the chapter on anatomy. Hopefully these are helpful if we do go forward with the ultrasound. The calf is quite tolerant so I think it would be doable to set up a table pool side and ultrasound him that way (although would need something to stand on as well because the sides of the pool are quite high).

[REDACTED] [BA DVM](#)  
Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
E [REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)

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**From:** NZRadVet [REDACTED]  
**Sent:** Wednesday, 21 July 2021 4:09 pm  
**To:** [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
**Subject:** RE: Orca calf - routine abdominal ultrasound

H [REDACTED] & others

Interesting. In short very happy to help out in any way I can.

There are a number of things to consider here

- Not at least we would have to have some idea exactly what we need to be assessing as the window of opportunity sounds as though it would be short. In other words its not just a matter of scanning around the abdomen to see what we see but doing a tailored scan e.g. is there obvious abnormal fluid, etc, etc. This would ideally be based on advice from those others who have experience in this area and would be able to suggest what the important areas are that need to be checked.
- I would need to check out normal anatomy and location of organs in this species – likely very available on the net and other resources.
- I may have to source additional probes which would allow more depth than what I routinely use in small animals – though if I recall you may have such a probe with your M9?
- Would this be a scan from the side of the pool with the orca at the side or in the pool itself. Getting wet doesn't worry me but obviously need to look after the equipment.
- Availability pretty good for this – I would move other stuff around to fit in (including weekends), but I am in Auckland teaching an ultrasound course from the 29<sup>th</sup>-31<sup>st</sup> July (Thursday – Saturday evening) which I can't change.

My first thoughts 😊

Best wishes

██████████  
██████████ BSc DipECVDI FANZCVS MRCVS  
Registered NZ & European Veterinary Imaging Specialist  
Adjunct Associate Professor Massey University  
██████████

[www.nzradvet.co.nz](http://www.nzradvet.co.nz)

radvet<sup>nz</sup>

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**From:** ██████████ [@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>

**Sent:** Wednesday, 21 July 2021 11:57 AM

**To:** NZRadVet ██████████

**Cc:** ██████████ [@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>; ██████████ [@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>; ██████████

██████████ [@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com)>; ██████████

**Subject:** Orca calf - routine abdominal ultrasound

Hi ██████████,

You may be aware that there is an orphaned orca calf currently housed at Plimmerton Boat Club and being cared for by a team of DOC staff, local vets/animal care staff/volunteers, Whale Rescue and ourselves. Our role in this response is to provide advice on health and welfare from a wildlife/zoo vet perspective and visit the site a few times a week to help advise and provide some clinical assistance. As you can imagine, there are a large number of people involved in the response and planning for multiple scenarios is occurring simultaneously.

We are currently in the short term phase of the response, where the plan is to return the calf to its pod. Our vet role in this phase is to advise as best as possible on the current health status of the calf and to advise on how to keep him stable and healthy in the current set up. We are receiving a lot of advice and support from cetacean vets overseas, which has been immensely helpful.

One thing that has popped up a couple of times in recommendations is to perform an abdominal ultrasound as part of the overall health assessment. For completion's sake (not for any urgent medical reason), we're interested in seeing if this is an option (and logistically possible), around all the other moving parts such as pod location, possible release and other contingency planning. I was wondering please if you would be interested in performing such an ultrasound on this patient, and if so what your availability is for the next week or two?

The calf appears generally healthy, although with the transition from oral fluids onto formula feeding there have been some short and temporary bouts of signs of abdominal pain, which have resolved with changes in feeding techniques and/or the passing of faeces. These signs have not been seen yesterday or today.

It is hard to remove him from the water, so scanning would have to be in a pool set up (is this possible?). He can be encouraged to roll onto his back for short periods (although has to hold his breath while on his back, so this is generally in 1-2 minute windows) and can be brought very close to the edge of the pool. He is generally handleable and amenable to non-invasive medical procedures, although does tend to lose patience/interest after a while. We've estimated him at 200kg and he is ~2m long.

Your thoughts much appreciated!

Kind regards,  
██████████

**██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

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# II

## Anatomy and Physiology of Marine Mammals

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# 9

## Gross and Microscopic Anatomy

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Sentiel A. Rommel and Linda J. Lowenstine

### Introduction

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The California sea lion (*Zalophus californianus*) (Figure 1), Florida manatee (*Trichechus manatus latirostris*) (Figure 2), harbor seal (*Phoca vitulina*) (Figure 3), and bottlenose dolphin (*Tursiops truncatus*) (Figure 4) are used in this chapter to illustrate gross anatomy. These species were selected because of their availability and the knowledge base associated with them.\* Gross anatomy of the sea otter (*Enhydra lutra*) is presented in Chapter 44 covering medical aspects of that species. Illustrations of the (A) external features, (B) superficial skeletal muscles, (C) relatively superficial viscera with skeletal landmarks, (D) circulation, body cavities, and some deeper viscera, and (E) skeleton are presented as five separate “layers” on the same page for each of the four species. These illustrations, based on dissections by one of the authors (S.A.R.), are of intact carcasses and thus help show the relative positions of organs in the live animals. The major lymph nodes are illustrated, but to simplify the illustrations, most are not labeled. The drawings represent size, shape, and position of organs in a healthy animal; the skeleton is accurately placed within the soft tissues and body outline. The scale of the drawings is the same for each species so that vertical lines can be used to compare features on all five; a photocopy onto a transparency would allow the reader to compare layers directly. Names of structures are labeled with three-letter abbreviations.\*\* A brief figure legend helps the reader apply basic veterinary anatomical knowledge to the marine mammals illustrated. The style found in *Miller’s Anatomy of the Dog* (Evans, 1993) is followed as much as possible. Most technical terms follow the *Illustrated Veterinary Anatomical Nomenclature* by Schaller (1992).

Recent comparative work on anatomy of marine mammals is found in Pabst et al. (1999), Rommel and Reynolds (2000; in press), and Reynolds et al. (in press). Older but valuable anatomical works include Murie (1872; 1874), Schulte (1916), Howell (1930), Fraser (1952), Slijper (1962), Green (1972), St. Pierre (1974), Bonde et al. (1983), King (1983), and Herbert (1987).

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\*A set of illustrations of a mysticete would be valuable, but as space is limited and they are less likely to be under veterinary care, we chose an odontocete; the skeletal anatomy of the right whale (*Eubalaena glacialis*) is compared with that of other marine mammals in Rommel and Reynolds (in press).

\*\*Abbreviations in the text use capital letters to refer to the label on the structure. The first letter refers to the layer (A being external features at the top and E the skeleton) followed by a hyphen and then the abbreviation of the structure. For example, D-HAR refers to the heart on layer D.

**FIGURE 1** Left lateral illustrations of a healthy California sea lion (*Zalophus californianus*). Based on dissections by S.A.R., with details and nomenclatures from the literature: Murie, 1874; Howell, 1930; English, 1976a. Thanks to Rebecca Duerr for many helpful suggestions. (© Copyright S. A. Rommel. Used with permission of the illustrator.)

**(Layer A) External features.** The following abbreviations are used as labels: ANG = angle of mouth; ANS = anus; AXL = axilla, flipperpit; CAL = calcaneus, palpable bony feature; EAR = external auditory opening, ear; EYE = eye; INS = cranial insertion of the extremity; flipper, fin, and/or fluke; NAR = naris; OLC = olecranon, palpable bony feature; PAT = patella, palpable bony feature; PEC = pectoral limb, fore flipper; PEL = pelvic limb, hind flipper; PIN = pinna, external ear (as opposed to external ear opening); SCA = dorsal border of the scapula, palpable (sometimes grossly visible) bony feature; TAI = tail; UMB = umbilicus; UNG = unguis, finger and toe nails; U/G = urogenital opening; VIB = vibrissae.

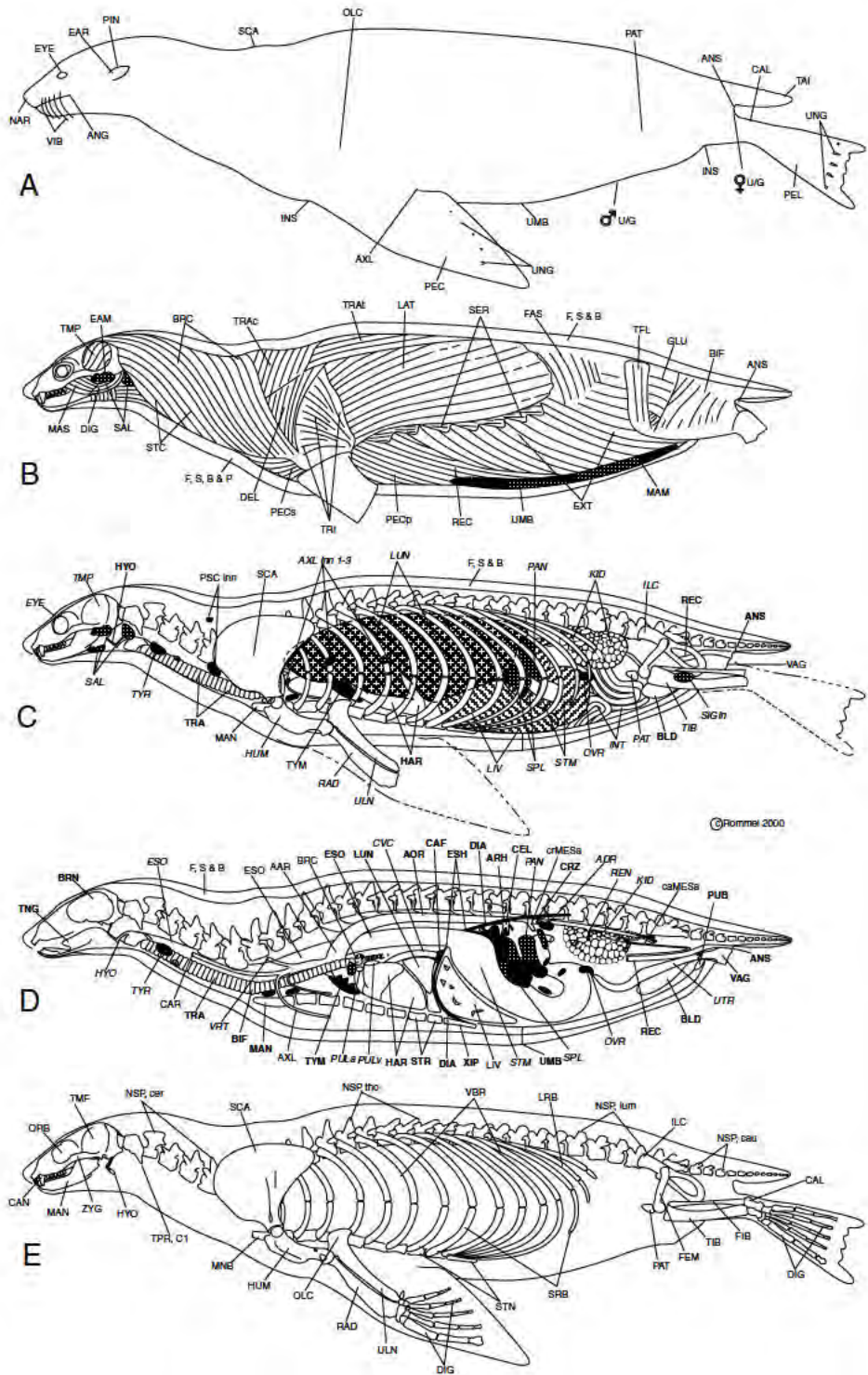
**(Layer B) The superficial skeletal muscles.** The layer of skeletal muscles just deep to the blubber and panniculus muscles. The following abbreviations are used as labels: ANS = anus; BIF = femoral biceps; BRC = brachiocephalic; DEL = deltoid; DIG = digastric; EAM = external auditory meatus; EXT = external oblique; FAS = fascia; F,S,B&P = fur, skin, blubber, and panniculus muscle (where present) cut along midline; GLU = gluteals; LAT = latissimus dorsi; MAM = mammary gland; MAS = masseter; PECp = deep (profound) pectoral; PECs = superficial pectoral; REC = rectus abdominis; SAL = salivary gland; SER = serratus; nipple; STC = sternocephalic; TFL = tensor fascia lata; TMP = temporalis; TRAc = trapezius, cervical portion; TRAt = trapezius, thoracic portion; TRI = triceps brachii; UMB = umbilicus.

**(Layer C) The superficial internal structures with "anatomical landmarks."** This perspective focuses on relatively superficial internal structures; the other important bony or soft "landmarks" are not necessarily visible from a left lateral view, but they are useful for orientation. The relative size of the lung represents partial inflation—full inflation would extend the lung margins to the distal tips of ribs. The female is illustrated because there is greater variation in uterine anatomy than in testicular and penile anatomy; note, however, that only the sea lion (of the illustrated species) is scrotal (actually the sea lion testes migrate into the scrotum in response to environmental temperature). The following abbreviations are used as labels (structures in midline are in **type**, those off-midline are in *italics*): ANS = anus; AXL *lnn* = axillary lymph nodes; BLD = urinary bladder; F,S&B = fur, skin, blubber (cut at midline); HAR = heart; HYO = hyoid apparatus; INT = intestines; ILC = iliac crest; KID = left kidney; LIV = liver; LUN = lung (note that the lung extends under the scapula); MAN = manubrium of the sternum; OVR = left ovary; PAN = pancreas; PAT = patella; PSC *ln* = prescapular lymph nodes; RAD = radius; REC = rectum; SAL = salivary glands; SCA = scapula; SIG *ln* = superficial inguinal lymph node; SPL = spleen; STM = stomach; TIB = tibia; TMP = temporalis; TRA = trachea; TYR = thyroid gland; TYM = thymus gland; ULN = ulna; VAG = vagina.

**(Layer D) A view slightly to the left of the midsagittal plane illustrating the circulation, body cavities, and selected organs.** Note that the diaphragm separates the heart and lungs from the liver and other abdominal organs. The following abbreviations are used as labels (structures on the midline are in **normal type**, those off-midline are in *italics*): AAR = aortic arch; ADR = adrenal gland; ANS = anus; AOR = aorta; ARH = aortic hiatus; AXL = axillary artery; BIF = tracheobronchial bifurcation; BLD = urinary bladder; BRC = bronchus; BRN = brain; CAF = caval foramen; CAR = carotid artery; caMESa = caudal mesenteric artery; CEL = celiac artery; CRZ = crus of the diaphragm; crMESa = cranial mesenteric artery; CVC = vena cava, between diaphragm and heart; DIA = diaphragm, cut at midline, extends from crura dorsally to sternum ventrally; ESO = esophagus (to the left of the midline cranially, on the midline caudally); ESH = esophageal hiatus; F,S&B = fur, skin, blubber (cut at midline); HAR = heart; HYO = hyoid bones; KID = right kidney; LIV = liver, cut at midline; LUN = right lung between heart and diaphragm; MAN = manubrium of sternum; OVR = left ovary; PAN = pancreas; PUB = pubic symphysis; PULa = pulmonary artery, cut at hilus of lung; PULv = pulmonary vein, cut at hilus of lung; REC = rectum; REN = renal artery; SPL = spleen; STM = stomach; STR = sternum, sternabrae; TNG = tongue; TRA = trachea; TYM = thymus gland; TYR = thyroid gland; UMB = umbilicus; UTR = uterus; VAG = vagina; VRT = vertebral artery; XIP = xyphoid process of the sternum.

**(Layer E) The skeleton.** Regions of the vertebral column (cervical, thoracic, lumbar, sacral, and caudal) are abbreviated (in lower case) as **cer**, **tho**, **lum**, **sac**, and **cau**, respectively, and are used as modifiers after an abbreviation in caps and a comma. If a specific vertebra is labeled, it will be represented by a capitalized first letter (for caudal, Ca will be used) and the vertebral number, i.e., first cervical = C1. The following abbreviations are used as labels: CAL = calcaneus; CAN = canine tooth (not present in cetaceans or manatees); DIG = digits; FEM = femur; FIB = fibula; HUM = humerus; HYO = hyoid bones; ILC = iliac crest of the pelvis; LRB = last, or caudalmost, rib; MAN = mandible; MNB = manubrium, the cranialmost bony part of the sternum; NSP = neural spine (spinous process), e.g., thoracic neural spines = NSP, **tho**; OLC = olecranon; ORB = orbit; PAT = patella; RAD = radius; SCA = scapula; STN = sternum, composed of individual sternabrae; SRB = sternal ribs, costal cartilages; TIB = tibia; TMF = temporal fossa; TPR = transverse process, e.g., TPR, C1 = transverse process of the first cervical vertebra; ULN = ulna; VBR = vertebral ribs; ZYG = zygomatic arch.





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**FIGURE 2** Left lateral illustrations of a healthy Florida manatee (*Trichechus manatus latirostris*). Based on dissections by S.A.R., with details and nomenclatures from the literature: Murie, 1872; Domning, 1977; 1978; Rommel and Reynolds, 2000. Thanks to D. Domning for suggestions on the muscle illustration. (© S. A. Rommel. Used with permission of the illustrator.)

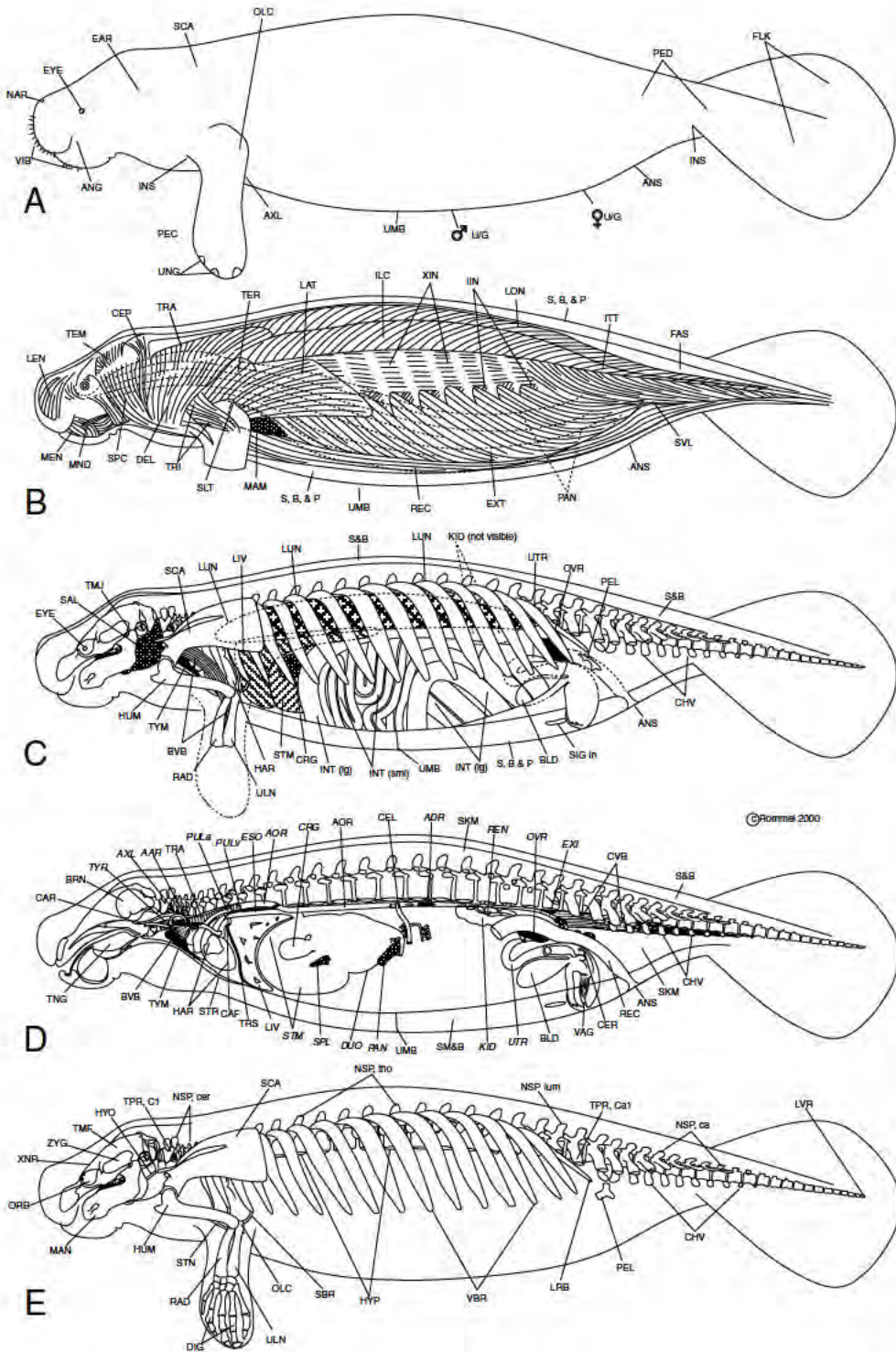
**(Layer A) External features.** The following abbreviations are used as labels: ANG = angle of mouth; ANS = anus; AXL = axilla; EAR = external auditory opening, ear; EYE = eye; FLK = fluke entire caudal extremity in manatees; flukes = entire caudal extremity in dugongs; INS = cranial insertion of the extremity, flipper and/or fluke; NAR = naris; OLC = olecranon, palpable bony feature; PEC = pectoral limb, flipper; PED = peduncle, base of tail, between anus and fluke; SCA = dorsal border of the scapula, palpable bony feature in emaciated individuals; UMB = umbilicus; UNG = unguis, fingernails; U/G = urogenital opening; VIB = vibrissae.

**(Layer B) The superficial skeletal muscles.** The layer of skeletal muscles just deep to the blubber and panniculus muscles. The following abbreviations are used as labels: ANS = anus; CEP = cephalohumeralis; DEL = deltoid; EXT = external oblique; FAS = fascia; S,B&P = skin, blubber, and panniculus muscle (where present) cut along midline; IIN = internal intercostals; ILC = iliocostalis; ITT = intertransversarius; LAT = latissimus dorsi; LEN = levator nasolabialis; LON = longissimus; MAM = mammary gland, in axillary region, thus partly hidden under the flipper; MEN = mentalis; MND = mandibularis; PAN = panniculus, illustrated using dotted lines, is a robust and dominant superficial muscle; a layer of blubber is found on both the medial and lateral aspects of this muscle; REC = rectus abdominis; SLT = mammary slit, nipple; SPC = sphincter colli; SVL = sarcoccygeus ventralis lateralis; TER = teres major; TMP = temporalis; TRA = trapezius; TRI = triceps brachii; UMB = umbilicus, XIN = external intercostals.

**(Layer C) The superficial internal structures with "anatomical landmarks."** This perspective focuses on relatively superficial internal structures. Skeletal elements are included for reference, but not all are labeled. The left kidney (not visible from this vantage in the manatee) is illustrated. The relative size of the lung represents partial inflation. The following abbreviations are used as labels: ANS = anus; BLD = urinary bladder (dotted, not really visible in this view); BVB = brachial vascular bundle; CHV = chevrons, chevron bones; EYE = the eye (note how small it is); HAR = heart; HUM = humerus; INT = intestines; note the large diameter of the large intestines; KID = left kidney, not visible from this vantage in the manatee; LIV = liver; LUN = lung (note lung extends under scapula, and over heart); OVR = left ovary; PEL = pelvic vestige; RAD = radius; SAL = salivary gland; S&B = skin and blubber; SCA = scapula; SIG In = superficial inguinal lymph node; S,B&P = skin, blubber, and panniculus muscle, cut at midline; STM = stomach; TMJ = temporomandibular joint; TYM = thymus gland; ULN = ulna; UMB = umbilical scar; UTR = uterine horn; VAG = vagina.

**(Layer D) A view slightly to the left of the midsagittal plane illustrates the circulation, body cavities, and selected organs.** Note that the diaphragm of the manatee is unique and that the distribution of organs and the separation of thoracic structures from abdominal structures requires special consideration. The following abbreviations are used as labels (structures on the midline are in **normal** type, those off-midline are in **italics**): AAR = aortic arch; ADR = left adrenal gland; ANS = anus; AOR = aorta; AXL = axillary artery; BLD = urinary bladder; BRN = brain; BVB = brachial vascular bundle (cut); CAF = caval foramen; CAR = carotid artery; CDG = cardiac gland; CEL = celiac artery; CER = cervix; CHV = chevron bones; CRG = cardiac gland; CVB = caudal vascular bundle; DUO = duodenum; ESO = esophagus (to the left of the midline cranially, on the midline caudally); EXI = external iliac artery; HAR = heart; KID = right kidney; LIV = liver, cut at midline; OVR = right ovary; PAN = pancreas; PULa = pulmonary artery, cut at hilus of lung; PULv = pulmonary vein, cut at hilus of lung; REC = rectum; REN = renal artery; S&B = skin and blubber; SKM = skeletal muscle; SM&B = skin, muscle, and blubber (cut at midline); SPL = spleen; STM = stomach; STR = sternum; TNG = tongue; TRA = trachea; TRS = transverse septum; TYM = thymus gland; TYR = thyroid gland; UMB = umbilical scar; UTR = uterus; VAG = vagina.

**(Layer E) The skeleton.** Regions of the vertebral column (cervical, thoracic, lumbar, sacral, and caudal), are abbreviated (in lowercase) as **cer**, **tho**, **lum**, **sac**, and **cau**, respectively, and are used as modifiers after an abbreviation in caps and a comma. If a specific vertebra is labeled, it will be represented by a capitalized first letter (for caudal, Ca will be used) and the vertebral number, i.e., first cervical = C1. The following abbreviations are used as labels: CHV = chevrons, chevron bones; DIG = digits, columns of finger bones; HUM = humerus; HYO = hyoid apparatus; HYP = hypapophysis, ventral midline vertebral process; LRB = last, or caudalmost, rib; LVR = last, or caudalmost, vertebra; MAN = mandible; NSP = neural spine (spinous process), e.g., thoracic neural spines = NSP, **tho**; OLC = olecranon; ORB = orbit; PEL = pelvic bone; RAD = radius; SCA = scapula; STN = sternum, if sternabrae are commonly fused; SBR = sternal ribs, costal cartilages; TMF = temporal fossa; TPR = transverse process, C1; ULN = ulna; VBR = vertebral ribs; XNR = external (bony) nares; XIP = xyphoid process, cartilaginous caudal extension of the sternum; ZYG = zygomatic process of the squamosal.



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**FIGURE 3** Left lateral illustrations of a healthy harbor seal (*Phoca vitulina*). Based on dissections by S.A.R., with details and nomenclatures from the literature: Howell, 1930; Huber, 1934; Bryden, 1971; Tedman and Bryden, 1981; Rommel et al., 1998; Pabst et al., 1999. (© Copyright S. A. Rommel. Used with permission of the illustrator.)

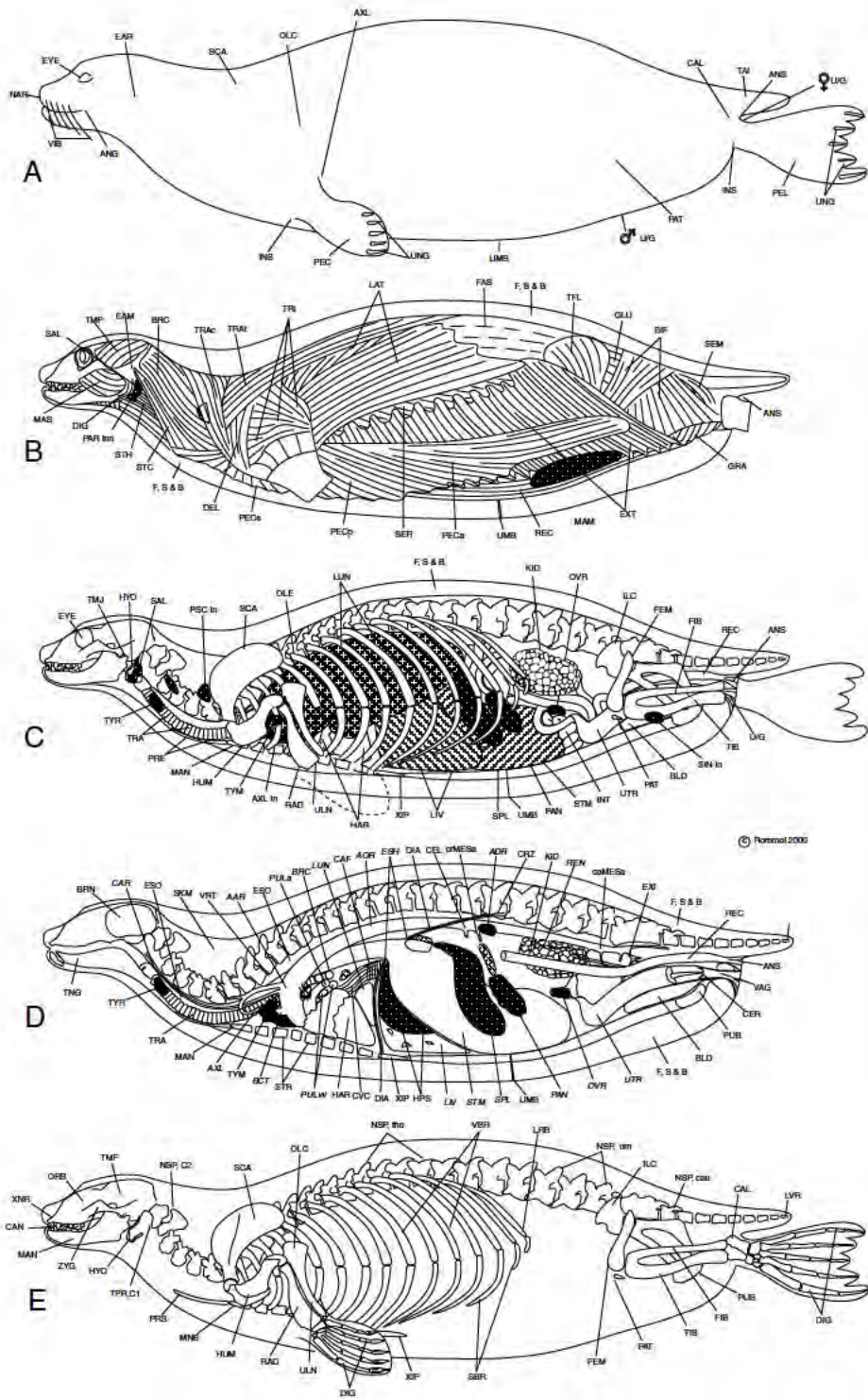
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**(Layer B) The superficial skeletal muscles.** The layer of skeletal muscles just deep to the blubber and panniculus muscles. The following abbreviations are used as labels: ANS = anus; BIF = femoral biceps; BRC = brachiocephalic; DEL = deltoid; DIG = digastric; EAM = external auditory meatus; EXT = external oblique; FAS = fascia; FS&B = fur, skin, blubber, and panniculus muscle (where present) cut along midline; GLU = gluteals; GRA = gracilis; LAT = latissimus dorsi; MAM = mammary gland; MAS = masseter; PAR In = parotid lymph nodes (In for a single lymph node); PECa = ascending pectoral, extends over the patella and part of hind limb; PECs = superficial, pectoral; PECp = deep (profound) pectoral; REC = rectus abdominis; SAL = salivary gland; SEM = semitendinosus; SER = serratus; STC = sternocephalic; STH = sternohyoid; TFL = tensor fascia lata; TMP = temporalis; TRAc = trapezius, cervical portion; TRAt = trapezius, thoracic portion; TRI = triceps brachii; UMB = umbilicus.

**(Layer C) The superficial internal structures with "anatomical landmarks."** A view focused on relatively superficial internal structures visible from that perspective; the other important bony or soft "landmarks" are not necessarily visible from a left lateral view, but they are useful for orientation. The relative size of the lung represents partial inflation—full inflation would extend margins to distal tips of ribs. The following abbreviations are used as labels: ANS = anus; AXL = axillary lymph node; BLD = urinary bladder; EYE = eye; FEM = femur; FIB = fibula; HAR = heart; HUM = humerus; HYO = hyoid apparatus; INT = intestines; ILC = iliac crest; KID = left kidney; LIV = liver; LUN = lung; MAN = manubrium of the sternum; OLE = olecranon; OVR = left ovary; PAN = pancreas; PAT = patella; PRE = presternum, cranial sternal cartilage; PSC In = prescapular lymph node; RAD = radius; REC = rectum; SAL = salivary glands; SIG In = superficial inguinal lymph node; SCA = scapula; SPL = spleen; STM = stomach; TMJ = temporomandibular joint; TIB = tibia; TRA = trachea; TYR = thyroid gland; TYM = thymus gland; ULN = ulna; UMB = umbilical scar; UTR = left uterine horn; VAG = vagina; XIP = xiphoid.

**(Layer D) A view slightly to the left of the midsagittal plane illustrates the circulation, body cavities, and selected organs.** Note that the diaphragm separates the heart and lungs from the liver and other abdominal organs. The following abbreviations are used as labels (structures on the midline are in normal type, those off-midline are in italics): AAR = aortic arch; ADR = left adrenal gland; ANS = anus; AOR = aorta; AXL = axillary artery; BCT = left brachiocephalic trunk; BRC = left bronchus as it enters the lung; BLD = urinary bladder; BRN = brain; CAF = caval foramen, with caval sphincter; CAR = carotid artery; CEL = celiac artery; CER = cervix; CVC = caudal vena cava; CRZ = left crus of the diaphragm; DIA = diaphragm, cut at midline, extends from crura dorsally to sternum ventrally; ESO = esophagus (to the left of the midline cranially, on the midline caudally); ESH = esophageal hiatus; EXI = external iliac artery; FS&B = fur, skin, and blubber, plus panniculus where appropriate, cut on midline; HAR = heart; HPS = hepatic sinus within liver; KID = right kidney; LIV = liver, cut at midline; LUN = lung, right lung between heart and diaphragm; MAN = manubrium of sternum; caMESA = caudal mesenteric artery; crMESA = cranial mesenteric artery; OVR = ovary; PAN = pancreas; PUB = pubic symphysis; PULa = pulmonary artery, cut at hilus of lung; PULvv = pulmonary veins, cut at hilus of lung; REC = rectum; REN = renal artery; SKM = skeletal muscle; SPL = spleen; STM = stomach; STR = sternum made up of individual sternabrae; TNG = tongue; TRA = trachea; TYM = thymus gland; TYR = thyroid gland; UMB = umbilicus; UTR = uterus; VAG = vagina; XIP = xiphoid process of the sternum.

**(Layer E) The skeleton.** Regions of the vertebral column (cervical, thoracic, lumbar, sacral, and caudal) are abbreviated (in lower case) as *cer*, *tho*, *lum*, *sac*, and *cau*, respectively, and are used as modifiers after an abbreviation in caps and a comma. If a specific vertebra is labeled, it will be represented by a capitalized first letter (for caudal, Ca will be used) and the vertebral number, i.e., first cervical = C1. The following abbreviations are used as labels: CAL = calcaneus; CAN = canine tooth; DIG = digits; FEM = femur; FIB = fibula; HUM = humerus; HYO = hyoid bones; ILC = iliac crest of the pelvis; LRB = last, or caudalmost, rib; LVR = last, or caudalmost, vertebra; MAN = mandible; MNB = manubrium, the cranialmost bony part of the sternum; NSP = neural spine (spinous process), e.g., thoracic neural spines = NSP, *tho*; OLC = olecranon; ORB = orbit; PAT = patella; PRS = presternum, cartilaginous extension of the sternum, particularly elongate in seals; PUB = pubic symphysis; RAD = radius; SCA = scapula; SBR = sternal ribs, costal cartilages; TIB = tibia; TMF = temporal fossa; TPR = transverse process, e.g., TPR, C1 = transverse process of the first cervical vertebra; ULN = ulna; VBR = vertebral ribs; XNR = external (bony) nares, nasal aperture of the skull; XIP = xiphoid process, cartilaginous caudal extension of the sternum; ZYG = zygomatic arch.



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**FIGURE 4** Left lateral illustrations of a healthy bottlenose dolphin (*Tursiops truncatus*). Based on dissections by S.A.R. with details and nomenclatures from the literature: Howell, 1930; Huber, 1934; Fraser, 1952; Slijper, 1962; Mead, 1975; Strickler, 1978; Klima et al., 1980; Pabst, 1990; Rommel et al., 1998; Pabst et al., 1999. Thanks to T. Yamada for suggestions on the muscle illustration. (© S. A. Rommel. Used with permission of the illustrator.)

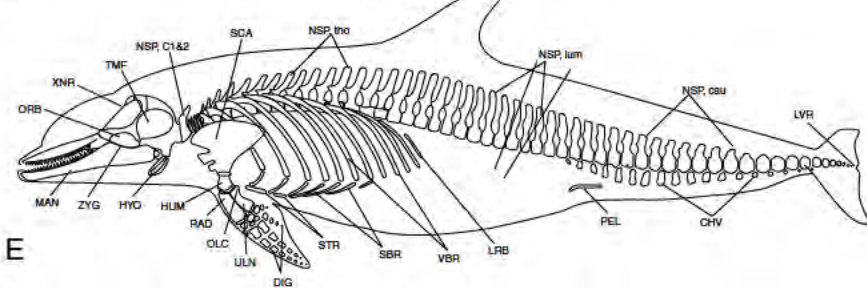
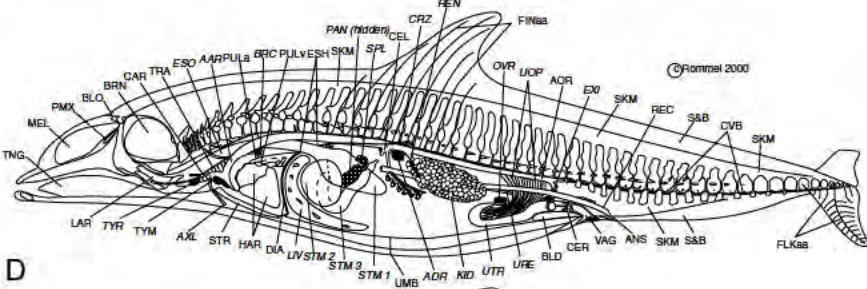
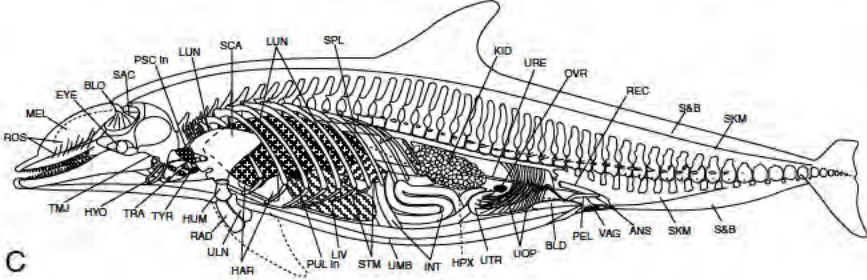
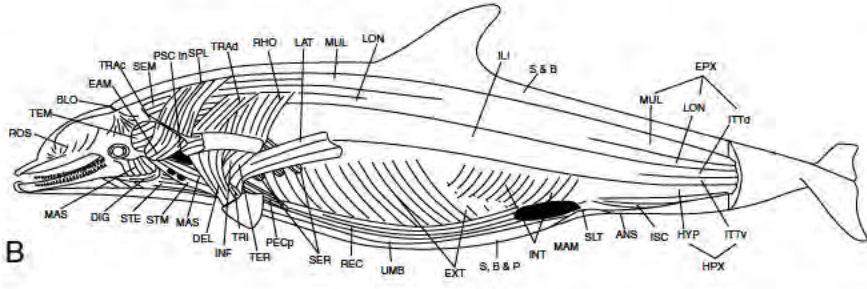
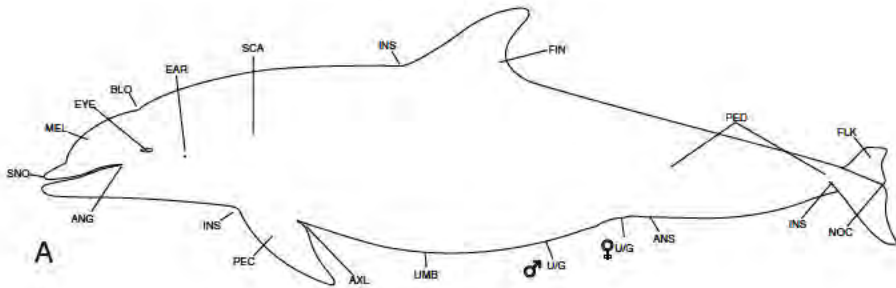
**(Layer A) External features.** The following abbreviations are used as labels: ANG = angle of mouth; ANS = anus; AXL = axilla; BLO = blowhole, external naris in dolphin; EAR = external auditory opening, ear; EYE = eye; FIN = dorsal fin; FLK = flukes (entire caudal extremity in cetaceans); INS = cranial insertion of the extremity; flipper, fin, and/or fluke; NOC = fluke notch in dugongs and in most cetaceans; PEC = pectoral limb, flipper; PED = peduncle, base of tail, between anus and flukes; MEL = melon; SCA = dorsal border of the scapula, palpable bony feature in emaciated dolphins; SNO = snout, cranial tip of upper jaw; UMB = umbilicus; U/G = urogenital opening.

**(Layer B) The superficial skeletal muscles.** The layer of skeletal muscles just deep to the blubber and panniculus muscles. Note that the large muscles ventral to the dorsal fin are surrounded by a tough connective tissue sheath (Pabst, 1990). The following abbreviations are used as labels: ANS = anus; BLO = blowhole; DEL = deltoid; DIG = digastric; EAM = external auditory meatus; EPX = epaxial muscles, upstroke muscles; EXT = external oblique; HYP = hypaxialis; HPX = hypaxial muscles, downstroke muscles; ILI = iliocostalis; INT = internal oblique; ISC = oschium; ITTd = intertransversarius caudae dorsalis; ITTv = intertransversarius caudae ventralis; LAT = latissimus dorsi; LEV = levator ani; LON = longissimus; MAM = mammary gland; MAS = masseter; MUL = multifidus; PECp = deep (profound) pectoral; PSC In = prescapular lymph node; REC = rectus abdominis; RHO = rhomboid; ROS = rostral muscles; S,B,&P = skin, blubber, and panniculus muscle (where present) cut along midline; SER = serratus; SLT = mammary slit, nipple; SPL = splenius; STE = sternohyoid; STM = sternomastoid; TER = teres major; TMP = temporalis; TRAd = trapezius dorsalis; TRAc = trapezius cranialis; TRI = triceps brachii; UMB = umbilicus.

**(Layer C) The superficial internal structures with "anatomical landmarks."** The relative size of the lung represents partial inflation—full inflation would extend margins to distal tips of ribs. The following abbreviations are used as labels: ANS = anus; BLD = urinary bladder; BLO = blowhole; EYE = eye; HAR = heart; HPX = hypaxial muscles; HUM = humerus; HYO = hyoid apparatus; INT = intestines; KID = left kidney; LIV = liver; LUN = lung (note that it extends beneath the scapula); MEL = melon; OVR = left ovary; PEL = pelvic vestige; PSC In = prescapular lymph node; PUL In = pulmonary lymph node, unique to cetaceans; RAD = radius; REC = rectum; ROS = rostral muscles, to manipulate the melon; SAC = lateral diverticulae, air sacs in dolphin; S&B = skin and blubber; SCA = scapula; SKM = skeletal muscle; SPL = spleen; STM = stomachs; TMJ = temporomandibular joint; TRA = trachea; TYR = thyroid gland; ULN = ulna; UMB = umbilical scar; UOP = uterovarian plexus; URE = ureter; UTR = uterine horn; VAG = vagina.

**(Layer D) A view slightly to the left of the midsagittal plane illustrates the circulation, body cavities, and selected organs.** Note that the diaphragm separates the heart and lungs from the liver and other abdominal organs. The following abbreviations are used as labels (structures on the midline are in normal type, those off-midline are in italics): AAR = aortic arch; ADR = left adrenal gland; ANS = anus; AOR = aorta; AXL = axillary artery; BLD = urinary bladder; BLO = blowhole; BRC = bronchus; BRN = brain; CAR = carotid artery; CEL = celiac artery; CER = cervix; CRZ = left crus of the diaphragm; CVB = caudal vascular bundle; DIA = diaphragm, cut at midline, extends from crura dorsally to sternum ventrally; ESO = esophagus (to the left of the midline cranially, on the midline caudally); ESH = esophageal hiatus; EXI = external iliac artery; FINaa = arteries arrayed along the midline of the dorsal fin; FLKaa = arterial plexus on dorsal and ventral aspects of each fluke; HAR = heart; KID = right kidney; LAR = larynx or goosbeak; LIV = liver, cut at midline; MEL = melon; OVR = right ovary; PAN = pancreas (hidden behind first stomach); PMX = premaxillary sac; PULa = pulmonary artery, cut at hilus of lung; PULv = pulmonary vein, cut at hilus of lung; REC = rectum; REN = renal artery; S&B = skin and blubber, panniculus where appropriate cut at midline; SKM = skeletal muscle; SPL = spleen; STM1 = forestomach; STM2 = main stomach; STM3 = pyloric stomach; STR = sternum, sternabrae; TNG = tongue; TRA = trachea; TYM = thymus gland; TYR = thyroid gland; UMB = umbilicus; UOP = right uterovarian vascular plexus in dolphin; URE = right ureter; UTR = uterus; VAG = vagina.

**(Layer E) The skeleton.** Regions of the vertebral column (cervical, thoracic, lumbar, sacral, and caudal), are abbreviated (in lower case) as *cer*, *tho*, *lum*, *sac*, and *cau*, respectively, and are used as modifiers after an abbreviation in caps and a comma. If a specific vertebra is labeled, it will be represented by a capitalized first letter (for caudal, Ca will be used) and the vertebral number, i.e., first cervical = C1. The following abbreviations are used as labels: CHV = chevrons, chevron bones; DIG = digits; HUM = humerus; HYO = hyoid apparatus; LRB = last, or caudalmost, rib; LVR = last, or caudalmost, vertebra; MAN = mandible; NSP = neural spine; e.g., thoracic neural spines = NSP, *tho*; OLC = olecranon; ORB = orbit; PEL = pelvic vestige; RAD = radius; SCA = scapula; STR = sternum; SBR = sternal ribs, costal ribs; TMF = temporal fossa; ULN = ulna; VBR = vertebral ribs; XNR = external (bony) nares, nasal aperture of the skull; ZYG = zygomatic arch.



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Included is a section on microanatomy to introduce the microanatomical peculiarities of marine mammals to pathologists and thus aid them in performing routine histopathological examination of marine mammal tissues. The microscopic appearance of organs and tissues is presented following the gross anatomical descriptions. This information has been gathered from the examination of tissues submitted to the University of California Veterinary Medical Teaching Hospital Pathology Service over the last 20 years. These tissues were acquired from stranded marine mammals, such as California sea lions, harbor seals, northern elephant seals (*Mirounga angustirostris*), southern sea otters (*Enhydra lutris nereis*), and a few small odontocetes and gray whales (*Eschrichtius robustus*). Anatomical observations from the literature are also included and referenced. Previous reviews of microanatomy include Simpson and Gardner (1972), Britt and Howard (1983), and Lowenstine and Osborne (1990).

Histological recognition of organs and tissues from marine mammals poses little problem for individuals acquainted with the microanatomy of terrestrial mammals. The patterns of degenerative, inflammatory, and proliferative changes observed in marine mammal tissues are also similar to those observed in domestic mammalian species. Knowledge of specific microanatomy is necessary, however, for subtle changes to be recognized.

## External Features

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Consider the morphological features of the selected marine mammals. Streamlining and thermoregulation have caused changes in the appearance of marine mammals; these adaptations include the modification of appendages and other extremities for swimming, an increase in blubber for insulation, the development of axial locomotion, and the development of ascrotal testes (Pabst et al., 1999).

### Sea Lions

The otariids (fur seals and sea lions), represented by the California sea lion, are also called eared seals because they have distinct pinnae (A-PIN) associated with their external ear openings (A-EAR). Like other pinnipeds, sea lions have robust vibrissae (A-VIB) on their snouts. Fur and/or blubber help streamline and insulate their bodies. Otariids (and walrus) can assume distinctly different postures on land by rotating their pelvis to position their pelvic (or hind) flippers (A-PEL) under their bodies. Note the presence of nails (unguis; A-UNG) on the extremities. Eared seals propel themselves with their pectoral (or fore) flippers (A-PEC) when swimming. The adult males of the sexually dimorphic California sea lion (and most other otariids) are much larger than the females. The teeth of sea lions are often stained dark brown or black in the absence of significant dental calculus. As in other carnivora, the nasal turbinates are well developed (Mills and Christmas, 1990).

### Manatees

The sirenians are represented by the Florida manatee. They lack hind limbs and have a dorsoventrally flattened fluke (A-FLK; note that it is *flukes* in cetaceans and dugongs and *fluke* in manatees). There is no dorsal fin, and the pectoral limbs or flippers are much more mobile than those of cetaceans—it is common to see manatees with their flippers folded across their chests or manipulating food into the mouth. The skin is rough and relatively thick and massive when compared with that of terrestrial mammals of the same body size. The skin is denser than water and contributes significantly to negative buoyancy (Nill et al., 2000). The vibrissae are robust but short (from wear), and the body hairs are fine but sparse, and give a nude



appearance to the skin of the manatee. Although body hairs are sparse, they are uniquely innervated and might provide vibrational and other tactile sensations (Reep et al., 1999). The eyes (A-EYE) of manatees are small and, unlike the eyes of other mammals, close using a sphincter rather than distinct upper and lower eyelids.

## Seals

The phocids, or earless seals (also called hair seals), are represented by the harbor seal. They have vibrissae similar to those of a dog. Their nares (A-NAR) are located at the dorsal aspects of their snouts. Phocid eyes are typically large (C-EYE) when compared with those of other marine mammals. Note that the appearance of phocids is generally the same, whether they are in the water or on land. Phocids commonly tuck their heads back against the thoraxes, making the neck look shorter than it really is, and they locomote in the water by lateral undulation of their pelvic flippers (A-PEL). Their flippers have long curved nails (A-UNG). Some phocids have multiple cusps on the caudal teeth, which in some species are quite complex and ornate.

## Dolphins

The odontocetes are represented by the bottlenose dolphin. The cetaceans are characterized by the absence of pelvic limbs but are graced with large caudal structures called flukes (A-FLK). The melon (A-MEL) is a rostral fat pad that, together with elongated premaxillae and maxillae, gives the dolphin its “bottlenose.” The external nares are joined as a single respiratory opening at the blowhole (A-BLO), located at or near the apex of the skull. The externally smooth skin of dolphins has a thickened dermis, referred to as blubber. Some cetaceans also have dorsal fins (A-FIN), which are midline, nonmuscular, fleshy structures that may help stabilize them hydrodynamically. The keel of the peduncle (A-PED) provides streamlining and acts as a mechanical spring (Pabst et al., 1999). Cetaceans also have a pair of pectoral flippers that help them steer. Dolphins have facial hairs *in utero* but lose them at or near the time of birth (Brecht et al. 1997). Drawings contrasting features of the head and teeth of a representative porpoise and a representative dolphin appear in Reynolds et al. (1999). The unusual head of the sperm whale (*Physeter macrocephalus*) is described in detail by Cranford (1999). Dolphins have conical, pointed (when young and unworn) teeth. In contrast to dolphins, porpoises have flattened spade-shaped teeth and the lower, cranial margin of the melon extends all the way to the margin of the upper jaw or beak—there is no “bottle-shaped nose.” As dolphins age, their teeth wear down, as they are abraded by ingested material and each other; the name *truncatus* is derived from the truncated appearance of the teeth in the original specimen. The tongues of the bottlenose dolphin and some other odontocetes have elaborate cranial and lateral marginal papillae, which are important for nursing (Donaldson, 1977).

## Microanatomy of the Integument

The cetacean integument differs significantly from that of terrestrial mammals in that there are no hair follicles (save for a few on the snouts of some species) and no sebaceous or apocrine glands (Greenwood et al., 1974; Ling, 1974). The thick epidermis is nonkeratinizing, lacks a granular layer, and is composed primarily of stratum spinosum (stratum intermedium) with deep rete pegs. The basal layer has continuous mitoses. Continuous desquamation caused by water friction may account for the absence of a keratinized stratum corneum and the continuous cell replication in the basal layer. The papillary dermis is extremely well vascularized (Elsner et al., 1974). The reticular dermis grades into the fat-filled panniculus adiposus, creating a fatty

layer referred to as the blubber layer. The blubber contains many collagen (fibrous) bundles and elastic fibers, and adipocytes are interspersed so that blubber thickness may not diminish significantly during catabolism of fat. The blubber layer is connected to the underlying musculature by loose connective tissue (subcutis).

Pinnipeds, sea otters, and sirenians are haired (although hair density varies enormously from sea otters to walruses and sirenians), and therefore their skin is more similar to domestic mammals than is cetacean skin. The epidermis of these species is partially or entirely keratinizing. The stratum corneum is thickest on weight-bearing surfaces, such as the relatively glabrous ventral surfaces of fore and hind flippers, where the entire epidermis is quite thick. A stratum granulosum is present in phocids. Compound hair follicles consisting of a single guard hair follicle and several intermediate and underfur follicles are common, especially in fur seals and sea otters. Elephant seals, monk seals, and walruses, which lack underfur, all have simple hair follicles consisting of a single guard hair. Like terrestrial mammals, hair follicles of sea otters and pinnipeds are associated with well-developed sebaceous and apocrine (sweat) glands. Apocrine sweat glands are relatively large in the otariid seals, whereas the sebaceous glands are more prominent in the phocids. In densely haired regions of fur seals, the sweat glands enter the hair follicle above (distal) the sebaceous gland duct, but in sparsely haired species (such as the harp seal) and in sparsely haired areas of densely haired species, the pattern is reversed (Ling, 1974). Concentrations of glands vary with location on the animal, and patterns of gland distribution have not been fully described for all species. In some pinniped species, apocrine gland secretion may be more evolved for scent and olfactory communication than for thermoregulation (Greenwood et al., 1974). Hair follicles in all species are said to lack arrector pili muscles and have a fairly fixed angle relative to the skin surface. Vibrissae may be selectively heated by changes in blood flow (Mauck et al., 2000).

The blubber layer is relatively thin in fur seals and sea otters; in these species, the pelage is presumed to provide primary insulation. The connective tissue in the pinniped dermis contains many elastic fibers. The reticular layer is thicker than the papillary layer. The lower portions of hair follicles extend into the deep reticular dermis and are often surrounded by adipose tissue in those species with a thick blubber layer.

An interesting physiological phenomenon involving the marine mammal integument is the catastrophic cyclic molting that occurs in some phocids (Ling, 1974). Domestic mammals also tend to shed hair cyclically, but the stratum corneum is desquamated continuously, accompanied by continuous proliferation of the basal cell layer. In some phocids, basilar mitosis is seasonal, and the lipid-rich stratum corneum is parakeratotic and persists as a protective, presumably waterproof, sheet from one molt to the next. Prior to molt, a granular cell layer develops, and during molt, the surface epithelium is shed in great sheets along with the hair. In harp seals, this process is manifest grossly as small circular lesions that open and become confluent, leading to a drying-out and sloughing of the entire epidermal surface. Catastrophic molt has been best described histologically in the southern elephant seal (*M. leonina*) and is also evident in the northern elephant seal. Cyclic shedding or molt has also been seen in otariids but occurs more slowly, with shedding of the hair over several weeks or months.

Mammary glands (B-MAM) are ventral, medial, and relatively caudal in most marine mammals, but they are axillary in sirenians. Cetaceans and some phocids have a single pair of nipples (B-SLT), but otariids and polar bears have two pairs of nipples. In cetaceans, the nipples are within mammary slits located lateral to the urogenital opening (note that some male cetaceans have distinct mammary slits). Detailed anatomy of the phocid mammary gland is described by Bryden and Tedman (1974) and Tedman and Bryden (1981).

## The Superficial Skeletal Muscles

The skeletal muscles that are encountered when the skin, blubber,\* and panniculus muscles are removed are illustrated in layer B of each figure. Note that the panniculus (B-PAN) is represented as dotted lines in the manatee because it is such a robust muscle, bordered on its lateral and medial aspects by “blubber.” The skeletal muscle of most marine mammals is very dark red, almost black, because of the relatively high myoglobin concentration.

The design of the musculoskeletal system profoundly influences any mammal’s power output because it affects both thrust and propulsive efficiency (Pabst et al., 1999). Thrust forces depend on muscle morphology and the mechanical design of the skeletal system. The propulsive efficiency of the animal depends on the size, shape, position, and behavior of the appendage(s) used to produce thrust. Terrestrial mammals usually use their appendicular musculoskeletal system to swim using the proverbial dog paddle—alternate strokes of the forelimbs (and sometimes hind limbs). Pinnipeds use their more-derived appendicular musculoskeletal systems to swim. Unlike the other marine mammals, the fully aquatic sirenians and cetaceans swim using only their vertebral or axial musculoskeletal systems.

Thus, in mammals that use their appendicular musculoskeletal systems to swim, two morphological “solutions” to increase thrust production are observed (Pabst et al., 1999). Proximal locomotor muscles tend to have large cross-sectional areas and so would have the potential to generate large in-forces. Proximal limb bones (i.e., humerus and femur) tend to be shorter than more distal bones (i.e., radius, ulna, tibia, and fibula), which increases the mechanical advantage of the lever system. The short proximal limb bones have an added hydromechanical benefit. These bones tend to be partially or completely enveloped in the body, which helps reduce drag on the appendage and increased body streamlining (Tarasoff, 1972; English, 1977; King, 1983).

Contrast the distribution of muscle mass in the four species. Note that adaptations to each locomotory specialization have enlarged or reduced the corresponding muscles found in terrestrial mammals. Contrast the massiveness of the pectoral muscles (B-PEC) of the sea lion with those in the seal. The triceps (B-TRI) and deltoids (B-DEL) are also enlarged in both pinnipeds to increase thrust, and the olecranon (C,E-OLC) of both the seal and sea lion are enlarged to increase the mechanical advantage of these muscles. Note that the harbor seal has a unique component of the pectoral—an ascending pectoral muscle (B-PECa)—that extends over the humerus (also described for another phocid, the southern elephant seal; see Bryden, 1971). A dramatic change in thickness of the abdominal wall muscles (B-INT, EXT) occurs in young seals as they make the transition from a more terrestrial to a more aquatic lifestyle.

Cetaceans and sirenians use their axial musculoskeletal systems to swim. Epaxial muscles (B-EPX) bend the vertebral column dorsally in upstroke; hypaxial muscles (B-HPX) and abdominal muscles bend the vertebral column ventrally in downstroke. Because there is no “recovery” phase, efficiency is increased. These muscles generate thrust forces that are delivered to the fluid medium via their flukes (Domning, 1977; 1978; Strickler, 1980; Pabst, 1990).

The elongated neural spines (E-NSP) and transverse processes (E-TPR) of cetaceans also increase the mechanical advantage of the axial-muscle lever system, relative to that system in terrestrial mammals. By inserting far from the point of rotation, the lever arm-in is increased and, thus, force output is increased. A novel interaction between the tendons of the epaxial muscles and a connective tissue sheath that envelops those muscles also increases the work output of the axial musculoskeletal system in cetaceans (Pabst, 1993; Pabst et al., 1999). The

\*The term *blubber* is used differently in different species. In sea lions, seals, and manatees, it is subcutaneous fat in one or two layers, and resembles that found in terrestrial mammals. Blubber in cetaceans is fat—“inflated” dermis (Pabst et al., 1999).

sirenian axial skeleton does not display elongated processes, which would increase the lever arm-in for dorsoventral flexion. Instead, the lumbar and cranialmost caudal vertebrae have elongated transverse processes (Domning, 1977; 1978).

## The Diaphragm as a Separator of the Body Cavities

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The orientation of the diaphragm (C,D-DIA) in most marine mammals is very similar to the orientation of the diaphragm in the dog. Visualizing size, shape, and extent of the diaphragm will help one visualize the dynamics of respiration and diving. The diaphragm lies in a transverse plane and provides a musculotendinous sheet to separate the major organs of the digestive, excretory, and reproductive systems (all typically caudal to the diaphragm) from the heart with its major vessels; the lungs (C-LUN) and associated vessels and airways; the thyroid (C,D-THY), thymus (C,D-TYM), and a variety of lymph nodes, all located cranial to the diaphragm. The diaphragm is generally confluent with the transverse septum, so it attaches medially at its ventral extremity to the sternum.

Although the diaphragm acts as a separator between the heart and lungs and the other organs of the body, the diaphragm is traversed by nerves and other structures, such as the aorta (D-AOR) (crossing in a dorsal and central position), the vena cava (D-CVC) (crossing more ventrally than the aorta, and often slightly left of the midline, although appearing to approximate the center of the liver), and the esophagus (D-EOS) (crossing slightly right of the midline, at roughly a midhorizontal level). This transverse orientation exists in most marine mammals, although the orientation of the diaphragm may be slightly diagonal, with the ventral portion more cranial than the dorsal portion.

The West Indian manatee's diaphragm differs from this general pattern of orientation and attachment. The manatee diaphragm and the transverse septum (D-TRS) are separate, with the latter occupying approximately the "typical" position of the diaphragm, and the diaphragm itself occupying a horizontal plane extending virtually the entire length of the body cavity. This apparently unique orientation presumably relates to buoyancy control (Rommel and Reynolds, 2000). There are two separate hemidiaphragms in the manatee. The central tendons firmly attach to hypapophyses (E-HYP) on the ventral aspects of the thoracic vertebrae, thereby producing the two pleural cavities.

## Gross Anatomy of Structures Cranial to the Diaphragm

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### Heart and Pericardium

The pericardium is a fluid-filled sac surrounding the heart; in manatees, it often contains more fluid than is found in the typical mammal or in other marine mammals. The heart occupies a ventral position in the thorax (immediately dorsal to the sternum; D-STR). The heart lies immediately cranial to the central portion of the diaphragm (D-DIA; or the transverse septum in the manatee, D-TRS). In some species, the lungs (D-LUN) may embrace the caudal aspect of the heart, separating the caudal aspect of the heart from the diaphragm. As in all other mammals, marine mammal hearts have four chambers, separate routes for pulmonary and systemic circulation, and the usual arrangements of great vessels (venae cavae, D-CVC; aorta, D-AOR; coronary arteries; pulmonary arteries, PULaa; pulmonary veins, PULvv). Many marine mammal hearts are flattened from front to back (ventral to dorsal), are relatively squat from top to bottom, and have a rounded apex, giving them a shape quite different from the hearts of most terrestrial mammals (Drabek, 1975). Most pinnipeds and some cetaceans also have a distinctive dilatation of the aortic arch (Drabek, 1977). Cardiac fat occurs, but is rapidly lost in debilitated animals.

## Pleura and Lungs

The pleural cavities and lungs (C-LUN) are generally found dorsal and lateral to the heart; in the manatee, the lungs are unusual in that they extend virtually the length of the body cavity and remain dorsal to the heart (Rommel and Reynolds, 2000). Lungs of some marine mammals (cetaceans and sirenians) are unlobed. The cranial ventral portion of the left lung in the bottlenose dolphin and other small odontocetes is very thin, almost veil-like, where it overlies the heart. Lobation in the pinnipeds is generally similar to that in the dog, that is, two lobes on the left (the cranial lobe has cranial and caudal parts) and three (including the accessory lobe) on the right. Reduction of lobation occurs in some phocids (Boyd, 1975; King, 1983). The terminal airways in all marine mammals are reinforced with either cartilage or muscle (Pabst et al., 1999). Apical (tracheal) bronchi are present in dolphins. In otariids, it is important to note that the bifurcation (D-BIF) of the trachea into the main-stem bronchi takes place at the thoracic inlet, not at the pulmonary hilus as is the case in phocids and cetaceans (McGrath et al., 1981; Nakakuki, 1993a,b; Wessels and Chase, 1998). The lungs of cetaceans are grossly smooth, but those of many pinnipeds are divided into distinct lobules in the ventral fields. Interestingly, sea otter lungs have distinct interlobular septa. The size of marine mammal lungs depends upon each species' diving proficiency. Marine mammals that make deep and prolonged dives (e.g., elephant seals) tend to have smaller lungs than expected (based on allometric relationships), whereas shallow divers (e.g., sea otters) tend to have larger than expected lungs (Pabst et al., 1999).

## Mediastinum

The mediastinum is an artifact of the downward expansion of the lungs on either side of the heart in the typical mammal (Romer and Parsons, 1977); thus, the traditional definition of the mammalian mediastinum does not apply to manatees. The positions of the aortic hiatus, caval foramen (D-CAF), and esophageal hiatus (D-ESH) are unusual because of the configuration of the diaphragm. The manatee mediastinum (see manatee, layer D) is the midline region dorsal to where the pericardium attaches to the heart and ventral to the diaphragm, cranial to the transverse septum up to approximately the level of the first cervical vertebra. This is essentially what constitutes the cranial mediastinum of other mammals. The thyroid, thymus, tracheobronchial lymph nodes, and the tracheobronchial bifurcation are in the region defined as mediastinal in the manatee (Rommel and Reynolds, 2000). The mediastinum is thin and generally complete in the pinnipeds.

## Thymus

The thymus (C,D-TYM), which typically is relatively larger in young than in old individuals of any species, is found on the cranial aspect of the pericardium (sometimes extending caudally to embrace almost the entire heart) and may extend into the neck in otariids, the bottlenose dolphin (Cowan and Smith, 1999), and some other species.

## Thyroids

The thyroid glands (C,D-TYR) of the bottlenose dolphin and the manatee are located in the cranial part of the mediastinum along either side of the distal part of the trachea (C,D-TRA), prior to its bifurcation (D-BIF) into the bronchi. The paired, large, oval, dark-brown thyroid glands of pinnipeds, however, lie along the trachea just caudal to the larynx outside of the thoracic inlet (similar to the position in dogs).

## Parathyroids

The parathyroid glands have been described in small cetaceans, and their location relative to the thyroid gland varies among species examined to date (Hayakawa et al., 1998). In Risso's dolphins (*Grampus griseus*) they are dorsal to the thyroids or embedded within them, whereas in bottlenose dolphins they are on the surface of the thyroids and in the connective tissue surrounding the dorsal side of the thyroids. Little is known about the parathyroids of pinnipeds and sirenians.

## Larynx

The cetacean respiratory system has undergone several modifications that are associated with the production of sound. Immediately ventral and lateral to the blowhole (B,C,D-BLO) are small sacs or lateral diverticulae (C-SAC). Medial to the diverticulae are the paired internal nares that extend on the cranial aspect of the braincase (D-BRN). The larynx (C-LAR), a spout-shaped structure referred to as the goosebeak, is composed of an elongated epiglottis and corniculate cartilage (Reidenberg and Laitman, 1987). The goosebeak extends through a small opening in the esophagus (supported laterally by an enlarged thyroid cartilage) into the relatively vertical narial passage; food can pass to either side of the goosebeak. Cetaceans have a robust hyoid apparatus (C,E-HYO) to support movements of the larynx. A palatopharyngeal sphincter muscle can keep the goosebeak firmly sealed (Pabst et al., 1999). For a detailed description of sound-producing anatomy, see Cranford et al. (1996).

## Caval Sphincter

One additional structure that is associated with the circulatory system, located on the cranial aspect of the diaphragm in seals and sea lions, is a feature atypical in mammals. This is the muscular caval sphincter (D-CAS), which can regulate the flow of oxygenated\* blood in the large venous hepatic sinus (D-HPS) to the heart during dives (Elsner, 1969).

## Microscopic Anatomy of Structures Cranial to the Diaphragm

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### Respiratory System

In cetaceans and otariids, cartilage extends around small bronchioles to the periphery of the lungs. In most phocids, cartilage is present around bronchi and bronchioles (Tarasoff and Kooyman, 1973; Boshier, 1974; Boyd, 1975). Bronchial glands are especially numerous in larger-caliber bronchi and bronchioles of phocids. The configuration of terminal airways branching into alveoli varies among marine mammals, but, in general, respiratory ducts with small alveolar sacs make up the functional parenchyma. Myoelastic sphincters are present in the terminal bronchioles, presumably as an adaptation to diving (Boshier, 1974; Wessels and Chase, 1998). The number of alveolar duct units per lobule varies with species. The interalveolar septa have double rows of capillaries in most cetaceans and some otariids (e.g., in Steller but not California sea lions) but a single row of capillaries in phocids.

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\* In diving mammals with abundant arteriovenous anastomoses (shunts between arteries and veins before capillary beds), one can find high blood pressure and highly oxygenated blood in veins. One such venous reservoir of oxygenated venous blood is the hepatic sinus of seals (King, 1983).

## Thymus

The thymus of marine mammals is composed of lobules, each with a distinct lymphocyte-rich cortex and a less cellular medulla. In many stranded immature marine mammals, there is profound thymic atrophy, with lymphoid depletion, and mineralization and keratinization of Hassell's corpuscles.

## Thyroids

The thyroids of neonatal California sea lions, harbor seals, and elephant seals have plump cuboidal epithelium and little colloid (Little, 1991; Schumacher et al., 1993). In adults of the former two species, the epithelium also remains cuboidal, and the follicles remain fairly uniform in size. The thyroids of cetaceans are often distinctly lobulated, and the follicles of both young and adults are often small and lined with cuboidal epithelium similar to that of pinnipeds (Harrison, 1969b).

## Parathyroids

The parathyroids of Risso's dolphins are divided into lobules by connective tissue, and have parenchymal cells consisting of chief cells with intracellular lipid droplets (Hayakawa et al., 1998).

## Gross Anatomy of Structures Caudal to the Diaphragm

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Easy-to-find landmarks caudal to the diaphragm include a massive liver (C,D-LIV) and the various components of the gastrointestinal (GI) tract. The gonads and most other parts of the reproductive tracts are found only after the removal of the GI tract, except in a pregnant uterus.

### Liver

Typically, the liver is located immediately caudal to the diaphragm. It is a large, brownish, multi-lobed organ that tends to have most of its volume or mass positioned to the left of the body midline. Marine mammal livers are generally not too different from those of other mammals, although the manatee liver is a little more to the right and dorsal than are the livers of most other mammals. The number of lobes and the fissures in the lobes may vary, particularly in the sea lion's liver, in which deep fissures give the lobes a deeply scalloped appearance. Bile may be stored in a gall bladder (often greenish in color) located ventrally, between lobes of the liver, although some mammals (e.g., cetaceans, horses, and rats) lack a gall bladder. Bile enters the duodenum (D-DUO) to facilitate chemical digestion of fats.

### Digestive System

Most of the volume of the cavity caudal to the diaphragm (the abdominal cavity) is occupied by the various components of the GI tract: the stomach, the small intestine (C-INTsm; duodenum, jejunum, ileum), and the large intestine (C-INTlg; cecum, colon, and rectum; C,D-REC). A strong sphincter marks the distal end of the stomach (the pylorus) before it connects with the small intestine (duodenal ampulla in cetaceans and sirenians). The separation between jejunum and ileum of the small intestine is difficult to distinguish grossly, although the two sections differ microscopically.

The junction of the small and large intestines may be marked by the presence of a midgut cecum (homologous to the human appendix). The cecum is absent in most toothed whales, but present in some baleen whales (not the bowhead whale), vestigial but present in pinnipeds, and

absent in sea otters. In manatees, the cecum is large, globular, and has two blind pouches called cecal horns. The large intestine, as its name implies, has a larger diameter than the small intestine in some marine mammals. In the sea lion, seal, and dolphin there is little difference in gross appearance between the small and large intestines. The cecum of sea lions and seals is about a meter from the anus, whereas the small intestines are about 20 times as long; in adult manatees, both the large and small intestines may approach or even exceed 20 m (Reynolds and Rommel, 1996). The proportions and functions of these components reflect feeding habits and trophic levels of the different marine mammals.

Accessory organs of digestion include the salivary glands (C-SAL; absent in cetaceans, present in pinnipeds, very large in the manatee), pancreas (D-PAN), and liver. The pancreas is sometimes a little difficult to locate, because it can be a rather diffuse organ and decomposes rapidly; however, a clue to its location is its proximity to the initial part of the duodenum into which pancreatic enzymes flow (Erasmus and Van Aswegen, 1997). Another organ that is structurally, but not functionally, associated with the GI tract is the spleen (D-SPL), which is suspended by a ligament, generally from the greater curvature of the stomach in simple-stomached species, or from the first stomach in cetaceans). It is usually on the right side, but may have its greatest extent along the left side of the body. The spleen is usually a single organ, but in some species (mainly cetaceans), accessory spleens (occasionally referred to as hemal lymph nodes) may accompany it. It varies considerably in size among species; in manatees and cetaceans it is relatively small, but the spleen is relatively massive in some deep-diving pinnipeds (Zapol et al., 1979; Ponganis et al., 1992), where it acts to store red blood cells temporarily.

The length and mass of the GI tract may be very impressive and create three-dimensional relationships that can be complex. Tough connective tissue sheets called mesenteries suspend the organs from the dorsal part of the abdominal cavity, and shorter connective tissue bands (ligaments\*) hold organs close to one another in predictable arrangements (e.g., the spleen is almost always found along the greater curvature of the stomach and is connected to the stomach by the gastrosplenic ligament). Numerous lymph nodes and fat are also suspended in the mesenteries.

The GI tracts of pinnipeds and other marine mammal carnivores follow the general patterns outlined above, although the intestines can be very long in some species (Schumacher et al., 1995; Stewardson et al., 1999). Cetaceans, however, have some unique specializations (Gaskin, 1978). In these animals, there are three or more compartments to the stomach, depending on the species. Functionally, the multiple compartments of cetacean stomachs correspond well to regions of the single stomach of most other mammals. Most cetaceans have three compartments; the first, called the forestomach (D-STM1; essentially an enlargement of the esophagus), is muscular and very distensible; it acts much like a bird crop (i.e., as a receiving chamber). The second (D-STM2), or glandular compartment, is the primary site of chemical breakdown among the stomach compartments; it contains the same types of enzymes and hydrochloric acid that characterize the "typical" mammalian stomach. Finally, the "U-shaped" third compartment, or pyloric stomach (D-STM3), ends in a strong sphincteric muscle that regulates flow of digesta into the duodenum of the small intestine. The initial part of the cetacean duodenum is expanded into a small saclike ampulla (occasionally mistaken for a fourth stomach).

\*Ligament has several meanings in anatomy: a musculoskeletal element (e.g., the anterior cruciate ligament), a vestige of a fetal artery or vein (e.g., the round ligament of the bladder), the margin of a fold in a mesentery (e.g., broad ligament), and a serosal fold between organs (e.g., the gastrosplenic ligament). *Note:* In human terminology *anterior* and *posterior* are used; in comparative and veterinary terminology *cranial* and *caudal* are used when relating to the head and tail, respectively.



Among the marine mammals, sirenians have the most remarkable development of the GI tract. Sirenians are herbivores and hindgut digesters (similar to horses and elephants), so the large intestine (specifically the colon) is extremely enlarged, enabling it to act as a fermentation vat (see Marsh et al., 1977; Reynolds and Rommel, 1996). The sirenian stomach is single chambered and has a prominent accessory secretory gland (the cardiac gland) extending prominently from the greater curvature. The duodenum is capacious and has two obvious diverticulae projecting from it. The GI tract of the manatee, with its contents, can account for more than 20% of an individual's weight.

## Urinary Tract

The kidneys (C,D-KID) typically lie against the musculature of the back (B-HPX, hypaxial muscles), at or near the dorsal midline attachment of the diaphragm (crus, D-CRZ). In the manatee, the unusual placement of the diaphragm means that the kidneys lie against the diaphragm, not against hypaxial muscles. In many marine mammals, the kidneys are specialized as reniculate (multilobed) kidneys, where each lobe (renule) has all the components of a metanephric kidney. The reason that marine mammals possess reniculate kidneys is uncertain, but the fact that some large terrestrial mammals also possess reniculate kidneys has led to speculation that they are an adaptation associated simply with large body size (Vardy and Bryden, 1981), rather than for a marine lifestyle. Large body size may be important as the proximal convoluted tubules cannot be overlengthy and still conduct urine (Maluf and Gassmann, 1998).

The kidneys are drained by separate ureters (D-URE), which carry urine to a medially and relatively ventrally positioned urinary bladder (C,D-BLD). The urinary bladder lies on the floor of the caudal abdominal cavity and, when distended, may extend as far forward as the umbilicus (A,B,C,D-UMB) in some species. The pelvic landmarks are less prominent in the fully aquatic mammals. In the manatee the bladder can be obscured by abdominal fat. Note that the renal arteries (D-REN) of cetaceans enter the cranial pole of the organ, and the ureters exit near the caudal pole, whereas in other marine mammals they enter and exit the hilus (typical of most mammals). Additionally, in manatees, there are accessory arteries on the surface of the kidney (Maluf, 1989).

## Genital Tract

Pabst et al. (1999) noted that the reproductive organs tend to reflect phylogeny more than adaptations to a particular niche. If one were to examine the ventral aspect prior to removal of the skin and other layers, one would discover that, especially in the sirenians and some cetaceans, positions of male and female genital openings are obviously different, permitting easy determination of sex without dissection. In all cases, the female urogenital opening (A-U/G) is relatively caudal, compared with the opening for the penis in males. One way to approach dissection of the reproductive tracts is to follow structures into the abdomen from the external openings.

The position and general form of the female reproductive tracts are similar to those of terrestrial mammals (Boyd et al., 1999). The vagina (C,D-VAG) opens cranial to the anus (A,B,C,D-ANS) and leads to the uterus (C,D-UTR), which is bicornuate in marine mammal species. The body of the uterus is found on the midline and is located dorsal to the urinary bladder (the ventral aspect of the uterus rests against the bladder). The uterine horns (cornua) extend from the uterine body toward the lateral aspects of the abdominal cavity. Implantation of the fertilized egg and subsequent placental development take place in the walls of the uterine horns, usually in the ipsilateral horn to ovulation (see Chapter 11, Reproduction). Dimensions of uterine horns vary with reproductive history and age. Often the fetus may expand the pregnant horn to occupy a substantial portion of the abdominal cavity. The horns terminate

distally in an abrupt reduction in diameter and extend as uterine tubes (fallopian tubes) to paired ovaries (C,D-OVR). The uterus and ovaries are suspended from the dorsal abdominal wall by the broad ligaments. Uterine scars and ovarian structures may provide information about the reproductive history of the individual (Boyd et al., 1999; see Chapter 11, Reproduction).

The ovaries of mature females may have one or more white or yellow-brown scars, called corpora albicantia and corpora lutea, respectively (see Chapter 11, Reproduction). Although ovaries are usually small solid organs, in sirenians they are relatively diffuse, with many follicles and more than one corpus albicans.

The male reproductive tracts of marine mammals have the same fundamental components as those of "typical" mammals, but positional relationships may be significantly different. These differences are due to the testicond (ascrotal) position of the testes in many species (sea lion testes become scrotal when temperatures are elevated). The testes of some marine mammals are intra-abdominal\* (DeSmet, 1977), whereas in phocids they are in the inguinal canal, covered by the oblique muscles and blubber (see Figure 2-20 in Pabst et al., 1999). The position of marine mammal testes creates certain thermal problems because spermatozoa do not survive well at body (core) temperatures; in some species, these problems are solved by circulatory adaptations mentioned below. The penis of marine mammals is retractable, and it normally lies within the body wall. General structure of the penis relates to phylogeny (Pabst et al., 1999). In cetaceans, it is fibroelastic type with a sigmoid flexure that is lost during erection, as seen in ruminants. Pinnipeds, sea otters and polar bears have a baculum within the penis, as do domestic dogs; in manatees it is muscular (see Chapter 11, Reproduction, and see [Sexual Dimorphisms](#), below).

## Adrenal Glands

In marine mammals, adrenal glands (D-ADR) lie cranial to the kidneys and caudal to the diaphragm, as in terrestrial mammals. Adrenal glands can be confused with lymph nodes, but if one slices the organ in half, an adrenal gland is easy to distinguish grossly by its distinct cortex and medulla. In contrast, lymph nodes are more uniform in appearance.

## Microscopic Anatomy of Structures Caudal to the Diaphragm

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### Liver

The histology of the liver of pinnipeds is quite similar to that of terrestrial mammals. In cetaceans, however, portal triads may have very thick-walled vessels (Hilton and Gaskin, 1978). Smooth muscle may also be found around some central veins (throttling veins) (Arey, 1941). Stainable iron (hemosiderosis) is common in neonatal harbor and northern elephant seals and in older otariids in captivity. Ito cells may be quite prominent in marine mammals, compatible with the presence of high vitamin A levels found in these livers (Rhodahl and Moore, 1943).

### Digestive System

The oropharynx of pinnipeds and odontocetes, and the caudal part of the odontocete tongue, are richly endowed with minor mucous glands, which enter out onto the mucosal surface via ducts that are visible grossly as small pits. Microscopically, the nonglandular and glandular stomachs resemble the analogous structures in terrestrial mammals. Parietal cells are exception-

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\* The position of the testes in sea otters is scrotal, and the testes of polar bears are seasonally scrotal (Reynolds et al., in press).

ally prominent in odontocetes. In sirenians, the cardiac gland is a submucosal mass that protrudes cranially from the greater curvature of the stomach; it has a complicated folded lumen lined by mucous surface cells overlying long gastric glands lined with mucous and parietal cells. The glands of the main sac are lined by mucous cells and a lesser number of parietal cells (Marsh et al., 1977; Reynolds and Rommel, 1996). Histologically, the intestines of marine mammals are also similar to those of domestic mammals with the following exceptions (Schumacher et al., 1995). The villi are said to be absent in the proximal duodenum in some cetaceans, and Brunner's glands are variably present. Plicae rather than villi are often present, creating chevron shapes on cross sections of cetacean intestine. The light and electron microscopic appearance of the small intestine of small odontocetes has been described in detail (Harrison et al., 1977). Gut-associated lymphoid aggregates are present throughout the intestines and may be diffuse or nodular. They are especially numerous in the distal colon of odontocetes and baleen whales, where they form the anal tonsil (Cowan and Brownell, 1974; Romano et al., 1993).

### Urinary Tract

Each reniculus has a histologically distinct cortex and medulla. Since cortex completely surrounds the medulla in the reniculi, ascending inflammation in one reniculus may spill over into the interstitium of an adjacent reniculus, giving the pattern of interstitial (hematogenous) nephritis. Thus, it is important to sample several reniculi from each kidney to assess pathological processes. In cetaceans there is normally a fibromuscular band at the corticomedullary junctions surrounding the medullary pyramid. Glomeruli of all species examined are of remarkably similar size (about one half the width of a 40× high dry field).

### Genital Tract

The morphology of the reproductive tract of the female varies with the stages of estrus and gestation (see Chapter 11, Reproduction). A description of cyclic changes in some of the cetaceans is given in Harrison (1969a) and in some sirenians in Boyd et al. (1999). Morphological changes of the genital mucosa associated with the estrous cycle have not been studied in detail in marine mammals, other than the harbor seal (Bigg and Fisher, 1974). In this species (described here to illustrate the variation in appearance through the estrous cycle), during follicular development then regression, the uterine mucosa increases in height and pseudostratification and then decreases to simple cuboidal. Uterine gland epithelium increases in height and secretory activity, and glands become increasingly coiled. Vaginal epithelium "destratifies" to become a "transitional-type" epithelium only a few cells thick, with vaginal pits (glands) lined by columnar epithelium with apical secretory product (goblet cell-like). The endometrial luminal and glandular epithelium of the nongravid horn is secretory and declines to cuboidal by parturition. During this luteal phase, there are subnuclear lipid vacuoles in the glandular epithelium. The vaginal epithelium is transitional during early placentation, but increases in secretory activity to become lined with tall columnar mucous cells with fingerlike projections of the lamina propria replacing the mucosal pits. During lactation, the morphology of both uterine and vaginal epithelium changes again. In the first part of lactation, the surface and glandular uterine epithelium is cuboidal, then undergoes hypertrophy and hyperplasia during the latter half of lactation. Luminal epithelium is occasionally pseudostratified, and the uterine stroma of both horns is edematous. The patchy hyperplasia and pseudostratification might be mistaken for dysplasia. Vaginal epithelium is almost transitional during the first part of lactation but proliferates to stratified squamous nonkeratinizing cells covered by sloughing mucous cells by the end of lactation.

The endometrium of the gray seal prior to implantation is described by Boshier (1979; 1981).

The placenta of pinnipeds is zonary, endotheliochorial, similar to that of domestic carnivores. In late gestation, it is often deep orange because of the marginal hematoma from which the fetus gains its iron stores *in utero*. After parturition and involution, old implantation sites may be visible grossly as dark areas in the mucosa, which are represented histologically by stromal hemosiderosis and arterial hyalinization. The placenta of cetaceans is diffuse epitheliochorial. The structure of the phocid corpus luteum is described by Sinha et al. (1972; 1977a).

The prostate is the only accessory sex gland in pinnipeds and cetaceans (Harrison, 1969a). It is tubuloalveolar and has cuboidal to low-columnar to pseudostratified lining cells with basilar nuclei and pale apical cytoplasm. The fine structure of phocid testes and seminiferous tubules are described by Leatherland and Ronald (1979) and Sinha et al. (1977b), respectively.

## Adrenals

Pinniped adrenals may have an undulating or pseudolobulated cortex. In cetaceans, however, pseudolobulation is extensive and is created by connective tissue septae extending from the capsule. Large nerves, ganglia, and many blood vessels are associated with the hilus and capsular surface of pinniped adrenals.

## Lymphoid and Hematopoietic Systems

The capsules and trabeculae of pinniped lymph nodes are quite thick, and there is often abundant hilar and medullary connective tissue as well (Welsch, 1997). The degree of fibrosis seems to increase with age, and may be a function of chronic drainage reactions. Pinniped lymph nodes are organized like those of canids, having a peripheral subcapsular sinus, cortical follicular and interfollicular (paracortical) regions, and medullary cords and sinuses. Although some authors report that marine mammal lymphoid tissue is usually quiescent and lacks follicular development, secondary follicles are common in both peripheral and visceral lymph nodes of stranded pinnipeds, probably due to the common presence of skin wounds and visceral parasitism. In many stranded pinnipeds, the lymph nodes are sparsely but diffusely populated by lymphocytes, and the ghosts of germinal centers can be seen. Since this morphology is most common when the interval from death to post-mortem is prolonged, it has been interpreted to be a "washing out" of lymphocytes due to autolysis.

The lymph nodes of some cetaceans are often deeply infolded or fused so that they appear to be organized similarly to the nodes of suids, whose follicular cortex is buried deep within the node and sinusoids and cords are located more toward the periphery. The correlation of anatomical location with nodal morphology has not been made for all species. The visceral nodes of the bottlenose dolphin have extensive smooth muscle in the capsule and trabeculae and have incomplete marginal sinuses (Cowan and Smith, 1999). The lymph nodes of the beluga are described by Romano et al. (1993).

The elongated spleen of pinnipeds has a thick fibromuscular capsule and trabeculae with a sinusoidal pattern similar to that of canids. Periarteriolar reticular sheaths are more prominent in phocids than in otariids. The spherical spleen of cetaceans also has a thick capsule, which is fibrous externally and muscular internally, with the muscle cells extending into the thick trabeculae (Cowan and Smith, 1999). Extramedullary hematopoiesis is common in the spleens of pinniped and sea otter pups, but it seems to be uncommon in cetaceans.

## Nervous System

A detailed description of marine mammal neuroanatomy is beyond the scope of this chapter; for a comparison of some marine mammal brains (D-BRN), see Pabst et al. (1999). Suffice it

to say that the brains of cetaceans and pinnipeds are large and well developed and have complex gyri in the cerebral and cerebellar cortices that are relatively larger than similarly sized brains of terrestrial mammals (Flanigan, 1972). The cetacean cerebrum is globoid and the rostral lobes extend ventrally. Like higher primates, cetaceans have well-developed temporal lobes (ventrolateral aspects of the cortices) that make brain removal a challenge. The pinniped brain is similar in orientation to the canine brain except for the larger cerebellum.

In pinnipeds, the pineal gland is very large (up to 1.5 cm in diameter), especially in neonates (Bryden et al., 1986) and the size varies seasonally (see Chapter 10, Endocrinology). The pineal gland is located on the dorsal aspect of the diencephalon between the thalami and may be attached to the falx cerebri when the calvarium is removed at necropsy. There are no published descriptions of the pineal in cetaceans, and whether or not it exists is unclear.

The pituitary gland is relatively large in both cetaceans and pinnipeds (Harrison, 1969b; Leatherland and Roland, 1976; 1978; Griffiths and Bryden, 1986). It is located within a shallow sella tunica in cetaceans and is surrounded by reams of blood vessels making it difficult to remove on necropsy. In pinnipeds, it is often sheared off during removal of the brain, so care should be taken to cut the lip of bone partially covering it to remove it intact.

The spinal cord of phocids is relatively shorter than that of otariids; only the cauda equina occupies the lumbar and sacral canal. The cauda equina of the harbor seal pup is similar to that of the dog, but as they grow older, the cord changes significantly. The cauda equina starts in the lumbocaudal region in manatees. The region surrounding the cord—the vertebral canal—is significantly enlarged in seals, cetaceans, and sirenians. The neural canal is filled mostly with vascular tissue in seals and cetaceans and mostly with venous and fatty tissue in manatees. Manatee brains have pronounced lissencephaly and large lateral ventricles (Reep et al., 1989).

## Circulatory Structures

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In general, blood vessels are named for the regions they feed or drain. Thus, the fully aquatic marine mammals (cetaceans and sirenians) lack femoral arteries, which supply the pelvic appendage. However, most organs in marine mammals are similar to those of terrestrial mammals, so their central blood supplies are also similar.

The aorta (D-AOR) leaves the heart (D-HAR) as the ascending aorta, then forms the aortic arch (D-AAR) and roughly follows the vertebral column dorsal to the diaphragm as the thoracic aorta, which gives off segmental intercostal arteries and, in the case of cetaceans and manatees, feeds to the thoracic retia. Some of the segmental arteries of the dolphin anastomose at the base of the dorsal fin to form the single arteries that are arranged along the centerline of the dorsal fin (D-DFNaa). The aorta continues into the abdomen as the abdominal aorta, which gives off several paired (e.g., renal, gonadal) and unpaired (e.g., celiac, mesenteric) arteries. The caudal aorta follows the ventral aspect of the vertebrae in the tail; in the permanently aquatic marine mammals the caudal vessels are large when compared with the vessels in species with small tails. In the dolphin, the caudal arteries branch into dorsal and ventral superficial arrays of arteries (D-FLKaa; Elsner et al., 1974). In the permanently aquatic marine mammals, there are robust ventral chevron bones that form a canal in which the caudal aorta, its branches, and some veins (the caudal vascular bundle, D-CVB) are protected. This site is convenient in some species for venipuncture; however, note that it is an arteriovenous plexus, so samples collected may be mixed arterial and venous blood.

Some of the diving mammals (e.g., seals, cetaceans, and sirenians) have few or no valves in their veins (Rommel et al., 1995); this adaptation simplifies blood collection because the blood can drain toward the site from both directions, although blood collection is complicated by the arteriovenous plexuses described above. Other exceptions to the general pattern of mammalian

circulation are associated with thermoregulation and diving. Countercurrent heat exchangers abound, and extensive arteriovenous anastomoses exist to permit two general objectives to be fulfilled: (1) regulating loss of heat to the external environment while keeping core temperatures high, and (2) permitting cool blood to reach specific organs (e.g., testes and epididymides, ovaries and uteri) that cannot sustain exposure to high body temperatures (see reviews by Rommel et al., 1998; Pabst et al., 1999).

Mammals have three options for blood supply to the brain: the internal carotid, the external carotid, and the vertebral arteries. Some species use only one and others two, but the manatees use all three pathways. Cetaceans have a unique blood supply to the brain (D-BRN); the blood to the brain first enters the thoracic retia, a plexus of convoluted arteries in the dorsal thorax. Blood leaves the thoracic retia and enters the spinal retia, where it surrounds the spinal cord and enters the foramen magnum (McFarland et al., 1979). There are two working hypotheses for this convoluted path to the brain: (1) the elasticity of the retial system allows mechanical damping of the blood pulse pressure wave (McFarland et al., 1979; Shadwick and Gosline, 1994), and (2) the juxtaposition of the thoracic retia to the dorsal aspect of the lungs may provide thermal control of blood entering the spinal retia (Rommel et al., 1993b). Combined with cooled blood in the epidural veins, the spinal retia may provide some temperature control of the central nervous system (Rommel et al., 1993b).

Carotid bodies, important in regulation of blood flow, have been documented in the harbor seal (Clarke et al., 1986).

## The Potential for Thermal Insult to Reproductive Organs

Mammals maintain high and, in most species, relatively uniform core temperatures. Because they live in water, which conducts heat 25 times faster than air at the same temperature, many marine mammals have elevated metabolic rates and/or adaptations to reduce heat loss to the environment (Kooyman et al., 1981; Costa and Williams, 1999). Aquatic mammals with low metabolic rates must live in warm water or possess even more elaborate heat-conserving structures. Most mammalian tissues tolerate limited fluctuations in temperature, and some tissues, such as muscle, perform better at somewhat higher temperatures. However, reproductive tissues are particularly susceptible to thermal insult, and various mechanisms have evolved to protect them (VanDemark and Free, 1970; Blumberg and Moltz, 1988).

In terrestrial mammals, production and storage of viable sperm requires a relatively narrow range of temperatures. Temperatures between 35 and 38°C can effectively block spermatogenesis (Cowles, 1958; 1965). Abdominal temperatures can detrimentally affect long-term storage of spermatozoa in the epididymides in many species (Bedford, 1977). In many mammals, the scrotum provides a cooler environment by allowing the sperm-producing tissues to be positioned outside the abdominal cavity, away from relatively high core temperatures. Additionally, in scrotal mammals, the pampiniform plexus can, via countercurrent heat exchange, reduce the temperature of arterial blood from the core to the testes and help keep testicular temperature below that of the core (Evans, 1993). The skin of the scrotum is well vascularized, has an abundance of sweat glands, and is highly innervated with temperature receptors. Muscles in the scrotal wall involuntarily contract and relax in response to cold and hot temperatures, respectively. The exposed scrotum provides a thermal window through which heat may be transferred to the environment, thereby regulating the temperature of sperm-producing tissues.

Interestingly, the morphological adaptations for streamlining observed in some marine mammals create potentially threatening thermal conditions for the reproductive systems of diving mammals. The primary locomotory muscles of terrestrial mammals are appendicular,

so much of the locomotory heat energy of the muscle is transferred to the environment rather than directed into the body cavities; this is not the case for ascrotal marine mammals, whose primary locomotory muscles surround the abdominal and pelvic cavities.

A factor that may increase core temperature of marine mammals is change in blood flow patterns during diving. Marine mammals can dramatically redistribute their cardiac output during dives, resulting in severely reduced blood flow to some body tissues, such as muscles and viscera (Elsner and Gooden, 1983; Kooyman, 1985). In terrestrial mammals, redistributions of cardiac output in response to physiological conditions such as exercise, feeding, thermoregulation, and pregnancy are relatively well known (Elsner, 1969; Baker and Chapman, 1977; Baker, 1982; Blumberg and Moltz, 1988). For example, in humans, large increases in muscle temperature (as high as  $1^{\circ}\text{C}/\text{min}$ ) have been measured during the ischemia at the onset of exercise (Saltin et al., 1968). Surprisingly, the magnitude of routine cardiovascular adjustments undergone by marine mammals during prolonged dives (Elsner, 1999) is approached in terrestrial mammals only during pathological conditions such as hyperthermia and hypovolemic shock. The axial locomotion of pinnipeds, cetaceans, and manatees requires a relatively large thermogenic muscle mass around the vertebral column and abdominal organs. Blubber insulates these thermogenic muscles, suggesting the potential for elevated temperatures at the reproductive systems, particularly during the ischemia of prolonged dives. The temporary absence of cooling blood through locomotory muscles increases the probability of severe thermal consequences for the diving mammal. Abdominal, or partly descended, testes (cryptorchidism) result in sterility in many domestic mammals and humans. Ascrotal testes are typical for many marine mammals, such as phocid seals, dolphins, and manatees. There are vascular adaptations that prevent deep-body hyperthermic insult in cetaceans and phocids (Rommel et al., 1998). In dolphins, cooled venous blood is delivered to an inguinal counter-current heat exchanger to cool the testes and epididymides indirectly, whereas, in phocid seals, cooled venous blood is delivered to an inguinal venous plexus to cool the testes and epididymides directly. Similar structures prevent reproductive hyperthermic insult in females (Rommel et al., 1995).

One additional vascular adaptation that may have significant influence on diving is the presence of cooled blood in the large vascular structures within the vertebral canal, adjacent to the spinal cord. The large epidural veins (dolphins, seals, and manatees) and spinal retia (dolphins) may influence spinal cord temperature and, thus, influence dive capabilities, by modifying regional metabolic rates (Rommel et al., 1993b). The central nervous system is temperature sensitive, and lowering cord temperature influences global metabolic responses.

## Skeleton

Knowledge of the skeleton offers landmarks for soft tissue collection and provides an estimate of body size from partial remains (Rommel and Reynolds, in press). Traditionally, the postcranial skeleton is subdivided into axial components (the vertebral column, ribs, and sternabrae, which are "on" the midline) and appendicular components (the forelimbs, hind limbs, and pelvic girdle, which are "off" the midline). The scapulae and humeri of the forelimbs are indirectly attached to the body, essentially by tensile elements (muscles and tendons); in contrast, the hind limbs are attached via a pelvis directly to the vertebral column and thus are able to transmit both tension and compression to the body.

The skeleton supports and protects soft tissues, controls modes of locomotion, and determines overall body size and shape; the marrow of some bones may generate the precursors of certain blood cells. While the animal is alive, bones are continuously remodeled in response to biochemical and biomechanical demands and, thus, offer information that can help

biologists interpret events in the life history of the animal after its death. Skeletal elements contribute to fat (particularly in the cetaceans) and calcium (particularly in the sirenians) storage and thus influence buoyancy.

The sea lion propels itself through the water by its forelimbs, and its skeletal components are relatively massive in that region. On land, its forelimbs can act as fulcrums for shifting the center of mass by changing the shape of its neck and the trunk (for more, see English, 1976a,b; 1977). The permanently aquatic species locomote with a dorsoventral motion of the trunk and elongated tail. This dorsoventral motion of the axial skeleton is characteristic of almost all mammalian locomotion. In contrast, the seal uses lateral undulations of its trunk and hind flippers when swimming (like a fish), yet it may locomote on land with dorsoventral undulations, like its terrestrial ancestors.

Relative motion between vertebrae is controlled, in part, by the size and shape of the intervertebral disks. The intervertebral disks resist the compression that skeletal muscles exert and tend to force vertebrae together. Intervertebral disks are composite structures, with a fibrous outer ring, the annulus fibrosus, and a semiliquid inner mass, the nucleus pulposus. The outermost fibers of the annulus are continuous with the fibers of the periosteum. The flexibility of the vertebral column depends, in part, on the thickness of the disks. Intervertebral disks are a substantial proportion (10 to 30%) of the length of the postcranial vertebral column. The intervertebral disks provide flexibility but are not "responsible" for the general curvature of the spine—the nonparallel vertebral body faces provide the spinal curvature.

For convenience, the vertebral column is separated into five regions, each of which is defined by what is or is not attached to the vertebrae. These regions are cervical, thoracic, lumbar, sacral, and caudal. In some species, the distinctions between vertebrae from each region are unambiguous. However, in some other species the distinctions between adjacent regions are less obvious. This is particularly true in the permanently aquatic species, where there is little or no direct connection between the pelvic vestiges and the vertebral column.

The vertebral formula varies within, as well as among, species. The number of vertebrae, excluding the caudal vertebrae, is surprisingly close to 30 in most mammals (Flower, 1885). Most mammals have seven cervical, or neck, vertebrae (sirenians and two-toed sloth have six and the three-toed sloth has nine), whereas the number of thoracic and lumbar vertebrae varies between species. The number of sacral vertebrae is commonly two to five, but there are exceptions. The number of caudal vertebrae varies widely—long tails usually have numerous caudal vertebrae.

The cervical vertebrae are located cranial to the rib-bearing vertebrae of the thorax. Some cervical vertebrae have movable lateral processes known as cervical ribs, none of which makes contact with the sternum. Typically, the permanently aquatic marine mammals have short necks, even if they have seven cervical vertebrae. However, the external appearance of a short neck in seals is misleading. Close comparison of the seal and sea lion skeletons reveals that they have quite similar neck lengths, although the distribution of body mass is different. Seals often hold their heads close to the thorax, which causes a deep "S" curve in the neck. This provides the seals with a "slingshot potential" for grasping prey (or careless handlers). The shapes of the seal neck vertebrae are complex to allow this curve. Serial fusion (ankylosis) of two or more cervical vertebrae is common in the cetaceans, although in some cetaceans (e.g., the narwhal, beluga, and river dolphins), all the cervical vertebrae are unfused and provide considerable neck mobility.

The rib-bearing vertebrae are the thoracic vertebrae, and the thoracic region is defined by the presence of movable ribs. The authors distinguish between vertebral ribs (E-VBR), which are associated with the vertebrae, and "sternal ribs" (E-SBR), which are associated with the sternum. This distinction is made because some odontocetes, unlike most other mammals,



have bony rather than cartilaginous sternal ribs (bony “sternal ribs” are also found in the armadillo). “Costal cartilages” is an acceptable alternative term for sternal ribs if the sternal ribs are never ossified (calcification with old age does not count).

Some thoracic vertebrae have ventral vertebral projections called hypapophyses (see the manatee, E-HYP)—not to be confused with chevron bones, which are intervertebral and not part of the caudal vertebrae. In the manatee, the diaphragm is firmly attached along the midline of the central tendon to hypapophyses. Hypapophyses also occur in some cetaceans (e.g., the pygmy and dwarf sperm whales, *Kogia*) in the caudal thorax and cranial lumbar regions. It is assumed that these hypapophyses increase the mechanical advantage of the hypaxial muscles much as do the chevrons (Rommel, 1990).

The neural spines (E-NSP) of thoracic vertebrae of many mammals are often longer than those in any other region of the body. Long neural spines provide mechanical advantage to neck muscles that support a head cantilevered in front of the body. Terrestrial species with large heads tend to have long neural spines, but in aquatic mammals the buoyancy of water negates this reason for long neural spines.

## Ribs

Embryologically, ribs and transverse processes develop from the same precursors. Thus, some aspects of ribs are similar to those of transverse processes (E-TPR). It is the formation of a movable joint that distinguishes a rib from a transverse process. An unfinished joint may be indicative of developmental age. In some species (i.e., the manatee) there may be a movable “rib” (pleurapophysis) on one side and an attached “transverse process” on the other side of the same (typically the last thoracic) vertebra (Rommel and Reynolds, 2000).

Ribs may attach to their respective vertebrae at one or more locations (e.g., centrum, transverse process). Typically, the cranialmost ribs have two distinct regions of articulation (capitulum and tuberculum) with juxtaposed vertebrae and are referred to as double headed. The caudalmost ribs have single attachments and are referred to as single headed. In most mammals, the single-headed ribs have lost their tubercula and are attached to their vertebrae at the capitulum on the centrum. In contrast, the single-headed ribs of cetaceans lose their capitula and are attached to their respective vertebrae by their tubercula on the transverse processes (Rommel, 1990). The last ribs (E-LRB) often “float” free from attachment at one or both ends; these ribs tend to be significantly smaller than the ones cranial to them, and they are often lost in preparation of the skeleton.

The ribs of some marine mammals are more flexible than those of their terrestrial counterparts; this flexibility is an adaptation to facilitate diving. Ribs are illustrated in layer E in the correct posture for a healthy animal. Note that all illustrated species but the manatees have oblique angles between the rib shaft and the long axis of the body. As the hydraulic pressures increase with depth, the ribs rotate to avoid bending with changes in thoracic cavity volume.

## Sternum

The sternum (D,E-STR) is formed from bilaterally paired, serial elements called sternabrae. The paired elements fuse on the midline, occasionally imperfectly, leaving foramina in the sternum. The cranialmost sternal ribs (E-SRB, also called costal cartilages) extend from the vertebral ribs to articulate firmly with the sternum at the junctions between sternabrae. The first sternal rib articulates with the manubrium (C,D-MAN) cranial to the first intersternabral joint. The manubrium may have an elongate cartilaginous extension (e.g., in seals), and the first sternal rib is often different from the more caudal sternal ribs (typically larger and more robust). In some mysticetes, only the manubrium is formed, and only the first rib has a bony attachment to it. The subsequent ribs articulate with a massive cartilaginous structure that extends from the caudal

aspect of the manubrium (which may be referred to as a pseudosternum). The xiphoid process (E-XIP, last sternabra) is also different; it too may articulate with more than one (often many) sternal rib(s) and have a large cartilaginous extension.

### Postthoracic Vertebrae

Some authors avoid the difficulties of defining the lumbar, sacral, and caudal regions in the permanently aquatic species by lumping them into one category—the postthoracic vertebrae; by “lumping,” these authors avoid some interesting comparisons. Generally, the lumbar vertebrae are trunk vertebrae that do not bear ribs, and the number of lumbar vertebrae is closely linked to the number of thoracic vertebrae, but not always. Note that the caudal vertebrae of cetaceans start with the start of the chevron bones, and extend to the tip of the tail (fluke notch, A-NOC), whereas manatee vertebrae stop 3 to 9% of the total body length (as much as 17 cm in a large specimen) from the fluke tip (E-LVR).

### Sacral Vertebrae

There are at least two commonly accepted definitions for sacral vertebrae: (1) serial fusion of postlumbar vertebrae, only some of which may attach to the pelvis (the human os sacrum), and (2) only those that attach to the ilium, whether or not they are serially fused. Both definitions have merit. Within species, the number of serially ankylosed vertebrae may vary, particularly with age. Additional landmarks are the exit of spinal nerves from the neural canal and the foramina for segmental blood vessels. In species with a bony attachment between the vertebral column and the pelvis, the definition of sacral is easy. However, in the cetaceans and some sirenians (dugongs have a ligamentous attachment between the vertebral column and the pelvic vestiges), there are no sacral vertebrae by definition.

### Chevron Bones

The chevron bones are ventral intervertebral ossifications in the caudal region. By definition, each is associated with the vertebra cranial to it (note that there is some controversy over which is the first caudal vertebra; see Rommel, 1990). Chevron bone pairs are juxtaposed (in manatees) or fused (in dolphins, but not always) at their ventral apexes and articulate dorsally with the vertebral column to form a triangular channel. Within the channel (hemal canal) are found the blood vessels to and from the tail. In some species, the ventral aspects of each chevron bone fuse and may continue as a robust ventral protection that can function to increase the mechanical advantage of the hypaxial muscles to ventroflex the tail. In some individuals, the first two or three chevrons may remain open ventrally but fuse serially on either side.

### Pectoral Limb Complex

The forelimb skeleton includes the scapula, humerus, radius and ulna, and manus. The scapula is attached to the axial skeleton only by muscles. There is no functional clavicle in marine mammals (Strickler, 1978; Klima et al., 1980). The scapula consists of an essentially flat (slightly concave medially) blade with an elongate scapular spine extending laterally from it. The distal tip of the spine, if present, is the acromion. The scapular spine is roughly in the center of the scapular blade in most mammals. However, in cetaceans, the scapular spine is close to the cranial margin of the scapular blade, and both the acromion and coracoid extend beyond the leading edge of the blade.

The humerus (E-HUM) has a ball-and-socket articulation in the glenoid fossa of the scapula—this is a very flexible joint. The humerus articulates distally with the radius (E-RAD) and ulna (E-ULN); this is also a flexible joint in most other mammals, but it is constrained in cetaceans. The olecranon is a proximal extension of the ulna that increases the mechanical advantage of the

triceps muscles that extend the forelimb. In species like the sea lion, the olecranon is robust; however, in the cetacea, it is relatively small. The radius and ulna of manatees fuse at both ends as the animal ages. This fusion prevents axial twists that pronate and supinate the manus. The radius and ulna of cetaceans are also constrained but not typically fused.

The distal radius and ulna articulate with the proximal aspect of the manus. The manus includes the carpals, metacarpals, and phalanges (English, 1976). There are five “columns” of phalanges, each of which is called a digit. The digits are numbered starting from the cranial aspect (the thumb, which is digit one, associated with the radius).

In many of the marine mammals, the “long” bones of the pectoral limb (humerus, radius, and ulna) are relatively short, and the phalanges are elongated. Cetaceans are unique among mammals in that they have more than the maximum number of phalanges found in all other mammals; this condition is known as hyperphalangy (Howell, 1930). The number varies within each species—the bottlenose dolphin has a maximum number of nine digits.

### Pelvic Limb Complex

The typical mammalian pelvis is made of bilaterally paired bones: ilium, ischium, pubis, and acetabular bone (the paired *ossa coxarum*), one to three caudal vertebrae, and the sacrum. Each of the halves of the pelvis attaches (via the ilium) to one or more sacral vertebrae. The crest of the ilium (C,E-ILC) is a prominent landmark that flares forward and outward beyond the region of attachment between the sacrum and the ilium. The *ossa coxarum* join ventrally along the midline at the pelvic symphysis, which incorporates the pubic bone cranially and the ischiatic bone caudally. In the permanently aquatic marine mammals, there is but a vestige of a pelvis (E-PEL) to which portions of the rectus abdominis muscles (B-REC) may attach. Additionally, the crura of the penis may be supported by these vestiges (Fagone et al., 2000). In some of the large whales, there is occasionally a vestige of a hind limb articulating with the pelvic vestige.

The hind limb, if present, articulates with the vertebral column via a ball-and-socket joint at the hip. The proximal limb bone is the femur (C,E-FEM). The socket of the pelvis, the acetabulum, receives the head of the femur. Distally, the femur articulates with the tibia and the fibula (as the stifle joint). The tibia and fibula distally articulate with the pes, or foot. The pes is composed of the tarsals proximally, the metatarsals, and the phalanges distally. Note that the digits of the sea lion terminate a significant distance from the tips of the flipper.

### Sexual Dimorphisms

In many mammals, the adult males are larger than the adult females. In marine mammals, this size difference is at its extreme in otariids, elephant seals, and the sperm whales. In contrast, the adult females of the baleen whales and some other species are larger than the adult males. In the permanently aquatic marine mammals, there may be sexual dimorphisms in the pelvic vestiges (Fagone et al., 2000). The penises of mammals are supported by crura consisting of a tough outer component (*tunica albuginea*) and the cavernous erectile central component (*corpus cavernosum*), which attach to the ischiatic bones of the pelvis. The muscles that engorge the penis with blood are also attached to the pelvis. Presumably, the mechanical forces associated with these muscles influence pelvic vestige size and shape, particularly in manatees.

Males in some groups of mammals, particularly the carnivores, have a bone within the penis (the baculum) that helps support the penis. Growth rate of the os penis differs from that of the appendicular skeleton in some species (Miller et al., 1998).

## Bone Marrow

Bone marrow of cetaceans is vertebral as well as costal. Because the marrow cavity of the bones of marine mammals generally retains abundant trabecular bone throughout life, it is best to examine the marrow histologically via impression smears of cut surface or in decalcified sections. Most manatee bones are amedullary (Fawcett, 1942), so usable marrow impression smears are restricted to vertebrae.

## Acknowledgments

The authors thank Meghan Bolen, Judy Leiby, James Quinn, John Reynolds, Lisa Johnson, and Terry Spraker for reviewing the manuscript, Dan Cowan for information on parathyroids, and Frances Gulland and Rebecca Duerr at The Marine Mammal Center for helpful discussions. Anatomical illustrations were created with FastCAD (Evolution Computing, Tempe, AZ).

## References

- Arey, L.B., 1941, Throttling veins in the livers of certain mammals, *Anat. Rec.*, 81: 21–33.
- Baker, J.R., 1989, Pollution-associated uterine lesions in grey seals from the Liverpool Bay area of the Irish Sea, *Vet. Rec.*, 125: 303.
- Baker, M.A., 1982, Brain cooling in endotherms in heat and exercise, *Annu. Rev. Physiol.*, 44: 85–96.
- Baker, M.A., and Chapman, L.W., 1977, Rapid cooling in exercising dogs, *Science*, 195: 781–783.
- Bedford, J.M., 1977, Evolution of the scrotum: The epididymis as the prime mover? in *Reproduction and Evolution, Proceedings of the Fourth Symposium on Comparative Biology and Reproduction*, Calaby, J.H., and Tyndale-Biscoe, C.H. (Eds.), Australian Academy of Sciences, Canberra City, 171–182.
- Bigg, M.A., and Fisher, H.D., 1974, The reproductive cycle of the female harbour seal off southeastern Vancouver Island, in *Functional Anatomy of Marine Mammals*, Vol. 2, Harrison, R.J. (Ed.), Academic Press, London, 329–347.
- Blumberg, M.S., and Moltz, H., 1988, How the nose cools the brain during copulation in the male rat, *Physiol. Behav.*, 43: 173–176.
- Bonde, R.K., O'Shea, T.J., and Beck, C.A., 1983, Manual of procedures for the salvage and necropsy of carcasses of the West Indian manatee (*Trichechus manatus*), U.S. Department of the Interior, National Biological Survey, available from National Technical Information Service, Springfield, VA.
- Boshier, D.P., 1974, Proceedings: Structural features in the lung of the Weddell seal, *Leptonychotes weddellii*, which facilitate deep diving: a light and electron microscope study, *J. Anat.*, 118: 400.
- Boshier, D.P., 1979, Electron microscopic studies on the endometrium of the grey seal (*Halichoerus grypus*) during its preparation for nidation, *J. Anat.*, 128: 721–735.
- Boshier, D.P., 1981, Structural changes in the corpus luteum and endometrium of seals before implantation, *J. Reprod. Fert., Suppl.*, 29: 143–149.
- Boyd, R.B., 1975, A gross and microscopic study of the respiratory anatomy of the Antarctic Weddell seal, *Leptonychotes weddellii*, *J. Morphol.*, 147: 309–336.
- Boyd, I.L., Lockyer, C., and Marsh, H.D., 1999, Reproduction in marine mammals, in *Biology of Marine Mammals*, Reynolds, J.E., and Rommel, S.A. (Eds.), Smithsonian Institution Press, Washington, D.C., 218–286.
- Brecht, M., Preilowski, B., and Merzenich, M.M., 1997, Functional architecture of the mystacial vibrissae, *Behav. Brain Res.*, 84: 81–97.
- Britt, J.O., and Howard, E.B., 1983, Anatomic variants of marine mammals, in *Pathobiology of Marine Mammal Disease*, Vol. 1, Howard, E.B. (Ed.), CRC Press, Boca Raton, FL, 8–46.
- Brown, W.R., Geraci, J.R., Hicks, D.B., St. Aubin, D.J., and Schroeder, J.P., 1983, Epidermal proliferation in the bottlenose dolphin (*Tursiops truncatus*), *Can. J. Zool.*, 61: 1587–1590.

- Bryden, M.M., 1971, Myology of the southern elephant seal *Mirounga leonina* (L.), Antarctic Pinnipedia, American Geophysical Union, *Antarct. Res. Ser.*, 18: 109–140.
- Bryden, M.M., and Tedman, R., 1974, Proceedings: The mammary gland of the elephant seal, *Mirounga leonina*, *J. Anat.*, 118, 399–400.
- Bryden, M.M., Griffiths, D.J., Kennaway, D.J., and Ledingham, J., 1986, The pineal gland is very large and active in newborn Antarctic seals, *Experientia*, 42: 564–566.
- Clarke, J.A., de Burgh Daly, M., and Elsner, R., 1986, The carotid body of the harbour seal (*Phoca vitulina richardsi*), *Anat. Embryol.*, 174: 391–400.
- Costa, D.P., and Williams, T.M., 1999, Marine Mammal Energetics, in *Biology of Marine Mammals*, Reynolds, J.E., and Rommel, S.A. (Eds.), Smithsonian Institution Press, Washington, D.C., 176–217.
- Cowan, D.F., and Brownell, R.L., 1974, Gut-associated lymphoepithelial organ (“anal tonsil”) in the gray whale, in *Functional Anatomy of Marine Mammals*, Vol. 2, Harrison, R.J. (Ed.), Academic Press, London, 321–327.
- Cowan, D.F., and Smith, T.L., 1999, Morphology of the lymphoid organs of the bottlenose dolphin, *Tursiops truncatus*, *J. Anat.*, 194: 505–517.
- Cowles, R.B., 1958, The evolutionary significance of the scrotum, *Evolution*, 12: 417–418.
- Cowles, R.B., 1965, Hyperthermia, aspermia, mutation rates, and evolution, *Q. Rev. Biol.*, 40: 341–367.
- Cranford, T.W., 1999, The sperm whale’s nose: Sexual selection on a grand scale? *Mar. Mammal Sci.*, 15: 1133–1157.
- Cranford, T.W., Amundin, M., and Norris, K.W., 1996, Functional morphological and homology in the odontocete nasal complex: Implications for sound generation, *J. Morphol.*, 228: 223–285.
- DeSmet, W.M.A., 1977, The position of the testes in cetaceans, in *Functional Anatomy of Marine Mammals*, Vol. 3, Harrison, R.J. (Ed.), Academic Press, London, 361–386.
- Domning, D.P., 1977, Observations on the myology of *Dugong dugon* (Muller), *Smithsonian Contrib. Zool.*, 226.
- Domning, D.P., 1978, The myology of the Amazonian manatee, *Trichechus inunguis* (Natterer) (Mammalia: Sirenia), *Acta Amazonica*, 8(2), Supl. 1: 1–81.
- Donaldson, B.J., 1977, The tongue of the bottlenose dolphin (*Tursiops truncatus*), in *Functional Anatomy of Marine Mammals*, Vol. 3, Harrison, R.J. (Ed.), Academic Press, London, 175–197.
- Drabek, C.M., 1975, Some anatomical aspects of the cardiovascular system of Antarctic seals and their possible functional significance in diving, *J. Morphol.*, 145: 85–105.
- Elsner, R., 1969, Cardiovascular adaptations to diving, in *The Biology of Marine Mammals*, Anderson, H.I. (Ed.), Academic Press, London, 117–145.
- Elsner, R.W., 1999, Living in water: solutions to physiological problems, in *Biology of Marine Mammals*, Reynolds, J.E., and Rommel, S.A. (Eds.), Smithsonian Institution Press, Washington, D.C., 73–116.
- Elsner, R., and Gooden, B., 1983, Diving and asphyxia: a comparative study of animals and man, *Physiological Society Monographs*, Cambridge University Press, 40: 1–175.
- Elsner, R., Pirie, J., Kenney, D.D., and Schemmer, S., 1974, Functional circulatory anatomy of cetacean appendages, in *Functional Anatomy of Marine Mammals*, Vol. 2, Harrison, R.J. (Ed.), Academic Press, London, 143–159.
- English, A.W., 1976a, Functional anatomy of the hands of fur seals and sea lions, *Am. J. Anat.*, 147: 1–18.
- English, A.W., 1976b, Limb movements and locomotor function in the California sea lion (*Zalophus californianus*), *J. Zool.*, 178: 341–364.
- English, A.W., 1977, Structural correlates of forelimb function in fur seals and seal lions, *J. Morphol.*, 151: 325–352.
- Erasmus, C.P., and Van Aswegen, G., 1997, The endocrine pancreas of the Cape fur seal, *Arctocephalus pusillus* (Schreber, 1776): An immunocytochemical study, *Onderstepoort J. Vet. Res.*, 64: 239–242.
- Evans, H.E., 1993, *Miller’s Anatomy of the Dog*, 3rd ed., W.B. Saunders, Philadelphia, 550 pp.
- Fagone, D.M., Rommel, S.A., and Bolen, M.E., 2000, Sexual dimorphism in vestigial pelvic bones of the Florida manatee, *Fla. Sci.*, 63: 177–181.

- Fawcett, D.W., 1942, The amedullary bones of the Florida manatee (*Trichechus latirostris*), *Am. J. Anat.*, 71: 271–309.
- Flanigan, N.J., 1972, The central nervous system, in *Mammals of the Sea, Biology and Medicine*, Ridgway, S.H. (Ed.), Charles C Thomas, Springfield, IL, 215–246.
- Flower, W.H., 1885, *An Introduction to the Osteology of the Mammalia*, 3rd ed., Macmillan, London (reprinted by A. Asher & Co., Amsterdam, 1966), 258 pp.
- Fraser, F.C., 1952, *Handbook of R.H. Burne's Cetacean Dissections*, Trustees of the British Museum, London, 210 pp.
- Gaskin, D.E., 1978, Form and function of the digestive tract and associated organs in cetacea, with a consideration of metabolic rates and specific energy budgets, *Oceanogr. Mar. Biol. Annu. Rev.*, 16: 313–345.
- Green, R.F., 1972, Observations on the anatomy of some cetaceans and pinnipeds, in *Mammals of the Sea, Biology and Medicine*, Ridgway, S.H. (Ed.), Charles C Thomas, Springfield, IL, 247–297.
- Greenwood, A.G., Harrison, R.J., and Whitting, H.W., 1974, Functional and pathological aspects of the skin of marine mammals, in *Functional Anatomy of Marine Mammals*, Vol. 2, Harrison, R.J. (Ed.), Academic Press, London, 73–110.
- Griffiths, D.J., and Bryden, M.M., 1986, Adenohypophysis of the elephant seal (*Mirounga leonina*): Morphology and seasonal histological changes, *Am. J. Anat.*, 176: 483–495.
- Harrison, J.F., Johnson, F.R., and Young, B.A., 1977, The small intestine of dolphins (*Tursiops*, *Delphinus*, *Stenella*), in *Functional Anatomy of Marine Mammals*, Vol. 3, Harrison, R.J. (Ed.), Academic Press, London, 297–331.
- Harrison, R.J., 1969a, Reproduction and reproductive organs, in *The Biology of Marine Mammals*, Andersen, H.T. (Ed.), Academic Press, New York, 253–348.
- Harrison, R.J., 1969b, Endocrine organs: Hypophysis, thyroid and adrenal, in *The Biology of Marine Mammals*, Andersen, H.T. (Ed.), Academic Press, New York, 349–390.
- Harrison, R.J., Brownell, R.L., Jr., and Boice, R.G., 1972, Reproduction and gonadal appearances in some odontocetes, in *Functional Anatomy of Marine Mammals*, Vol. 1, Harrison, R.J. (Ed.), Academic Press, London, 362–429.
- Hayakawa, D., Chen, H., Emura, S., Tamada, A., Yamahira, T., Terasawa, K., Isono, H., and Shoumura, S., 1998, The parathyroid glands of two species of dolphin—Risso's dolphin, *Grampus griseus*, and bottlenose dolphin, *Tursiops truncatus*, *Gen. Comp. Endocrinol.*, 110: 58–66.
- Herbert, D., 1987, The Topographic Anatomy of the Sea Otter *Enhydra lutris*, M.S. thesis, Johns Hopkins University, Baltimore, MD, 42 pp.
- Hilton, J.W., and Gaskin, D.E., 1978, Comparative volumes and vascular microanatomy of the intra-hepatic venous system of the harbour porpoise, *Phocoena phocoena* (L.), *Can. J. Zool.*, 56: 2292–2298.
- Howell, A.B., 1930, *Aquatic Mammals: Their Adaptations to Life in the Water*, Charles C Thomas, Springfield, IL, 338 pp.
- Huber, E., 1934, Anatomical notes on Pinnipedia and Cetacea, in *Marine Mammals*, Packard, E.L., Kellogg, R., and Huber, E. (Eds.), Carnegie Institute of Washington, *Contrib. Paleontol.*, 447: 105–136.
- King, J.E., 1983, *Seals of the World*, 2nd ed., Comstock, Ithaca, NY, 240 pp.
- Klima, M., Oeleschlager, H.A., and Wunsch, D., 1980, Morphology of the pectoral girdle in the Amazon dolphin *Inia geoffrensis* with special reference to the shoulder joint and movements of the flippers, *Sonderdruck Z. Säugetierk.*, 45: 288–309.
- Kooyman, G.L., 1985, Physiology without constraint in diving mammals, *Mar. Mammal Sci.*, 1: 166–178.
- Kooyman, G.L., Castellini, M.A., and Davis, R.W., 1981, Physiology of diving in marine mammals, *Annu. Rev. Physiol.*, 43: 343–356.
- Leatherland, J.F., and Roland, K., 1976, Structure of the adenohypophysis in juvenile harp seal, *Pagophilus groenlandicus*, *Cell Tissue Res.*, 173: 367–382.
- Leatherland, J.F., and Ronald, K., 1978, Structure of the adenohypophysis in parturient female and neonate harp seals, *Pagophilus groenlandicus*, *Cell Tissue Res.*, 192: 341–357.

- Leatherland, J.F., and Ronald, K., 1979, Structure of the testis in neonate and adult harp seals, *Pagophilus groenlandicus*, *Cell Tissue Res.*, 201: 45–49.
- Ling, J.K., 1974, The integument of marine mammals, in *Functional Anatomy of Marine Mammals*, Vol. 2, Harrison, R.J. (Ed.), Academic Press, London, 1–44.
- Little, G.J., 1991, Thyroid morphology and function and its role in thermoregulation in the newborn southern elephant seal (*Mirounga leonina*) at Macquarie Island, *J. Anat.*, 176: 55–69.
- Lowenstine, L.J., and Osborne, K.G., 1990, Practical marine mammal microanatomy for pathologists, in *Handbook of Marine Mammal Medicine: Health, Disease, and Rehabilitation*, Dierauf, L.A. (Ed.), CRC Press, Boca Raton, FL, 287–290.
- Maluf, N.S.R., 1989, Renal anatomy of the manatee, *Trichechus manatus*, Linnaeus, *Am. J. Anat.*, 184: 269–286.
- Maluf, N.S.R., and Gassmann, J.J., 1998, Kidneys of the killer whale and significance of reniculism, *Anat. Rec.*, 250: 34–44.
- Marsh, H., Heinsohn, G.E., and Spain, A.V., 1977, The stomach and duodenal diverticulae of the dugong (*Dugong dugon*), in *Functional Anatomy of Marine Mammals*, Vol. 3, Harrison, R.J. (Ed.), Academic Press, London, 271–295.
- Mauck, B., Eysel, U., and Dehnhardt, G., 2000, Selective heating of vibrissal follicles in seals (*Phoca vitulina*) and dolphins (*Sotalia fluviatilis guianensis*), *J. Exp. Biol.*, 203(14): 2125–2131.
- McFarland, W.L., Jacobs, M.S., and Morgane, P.J., 1979, Blood supply to the brain of the dolphin, *Tursiops truncatus*, with comparative observations on special aspects of the cerebrovascular supply of other vertebrates, *Neurosci. Biobehav. Rev.* (Suppl. 1), 3L: 1–93.
- McGrath, C.J., Feeney, D., Crimi, A.J., and Ruff, J., 1981, Upper airway of the California sea lion: An anesthetist's perspective, *Vet. Med. Small Anim. Clin.*, 76: 548–549.
- Mead, J.G., 1975, Anatomy of the external nasal passages and facial complex in the Delphinidae (Mammalia: Cetacea), *Smithsonian Contrib. Zool.*, 207: 1–72.
- Miller, E.H., Stewart, A.R.J., and Stenson, G.B., 1998, Bacular and testicular growth, allometry, and variation in the harp seal (*Pagophilus groenlandicus*), *J. Mammal.*, 79: 502–513.
- Mills, R.P., and Christmas, H.E., 1990, Applied comparative anatomy of the nasal turbinates, *Clin. Otolaryngol.*, 15: 553–558.
- Morgane, P.J., and Jacobs, M.S., 1972, Comparative anatomy of the cetacean nervous system, in *Functional Anatomy of Marine Mammals*, Vol. 1, Harrison, F.J. (Ed.), Academic Press, London, 117–244.
- Murie, J., 1872, On the form and structure of the manatee, *Trans. Zool. Soc. London*, 8: 127–202.
- Murie, J., 1874, Researches upon the anatomy of the Pinnipedia, Part 3, Descriptive anatomy of the sealion (*Otaria jubata*), *Trans. Zool. Soc. London*, 8: 501–582.
- Nakakuki, S., 1993a, The bronchial tree, lobular division and blood vessels of the harbor seal (*Phoca vitulina*) lung, *Kaibogaku Zasshi*, 68: 497–503.
- Nakakuki, S., 1993b, The bronchial tree and lobular division of the lung of the California sea lion (*Zalophus californianus*), *J. Vet. Med. Sci.*, 55: 669–671.
- Nill, E.K., Rommel, S.A., Pabst, D.A., and McLellan, W.A., 2000, Does the thick skin of the Florida manatee (*Trichechus manatus latirostris*) provide ballast? *Am. Zool.*, 39: 114A.
- Pabst, D.A., 1990, Axial muscles and connective tissues of the bottlenose dolphin, in *The Bottlenose Dolphin*, Leatherwood, S., and Reeves, R.R. (Eds.), Academic Press, San Diego, CA, 51–67.
- Pabst, D.A., 1993, Intramuscular morphology and tendon geometry of the epaxial swimming muscles of dolphins, *J. Zool.*, 230: 159–176.
- Pabst, D.A., Rommel, S.A., McLellan, W.A., Williams, T.M., and Rowles, T.K., 1994, Temperature regulation of the dolphin testis, *J. Morphol.*, 220: 397.
- Pabst, D.A., Rommel, S.A., McLellan, W.A., Williams, T.M., and Rowles, T.K., 1995, Thermoregulation of the intra-abdominal testes of the bottlenose dolphin (*Tursiops truncatus*) during exercise, *J. Exp. Biol.*, 198: 221–226.

- Pabst, D.A., Rommel, S.A., and McLellan, W.A., 1999, The functional morphology of marine mammals, in *Biology of Marine Mammals*, Reynolds, J.E., and Rommel, S.A. (Eds.), Smithsonian Institution Press, Washington, D.C., 15–72.
- Ponganis, P.J., Kooyman, G.L., Sartoris, D., and Jobsis, P., 1992, Pinniped splenic volumes, *Am. J. Physiol.*, 262: R322–325.
- Reep, R.L., Stoll, M.S., and Marshall, C.D., 1999, Do sirenians have a mammalian version of the lateral line? Postcranial tactile hairs in Florida manatees, *Soc. Neurosci., Abstr.*, 25: 102.
- Reep, R.L., Johnson, J.I., Switzer, and R.C., Welker, W.I., 1989, Manatee cerebral cortex: Cytoarchitecture of the frontal region in *Trichechus manatus latirostris*, *Brain Behav. Evol.*, 34: 365–386.
- Reidenberg, J.S., and Laitman, J.T., 1987, Position of the larynx in Odontoceti (toothed whales), *Anat. Rec.*, 218: 98–106.
- Reynolds, J.E., III, and Rommel, S.A., 1996, Structure and function of the gastrointestinal tract of the Florida manatee, *Trichechus manatus latirostris*, *Anat. Rec.*, 245: 539–558.
- Reynolds, J.E., III, O'Dell, D.K., and Rommel, S.A., 1999, Marine mammals of the world, in *Biology of Marine Mammals*, Reynolds, J.E., and Rommel, S.A. (Eds.), Smithsonian Institution Press, Washington, D.C., 1–14.
- Reynolds, J.E., III, Rommel, S.A., and Bolen, M.E., in press, Gross visceral morphology of marine mammals, in *Encyclopedia of Marine Mammals*, Perrin, W.F., Wursig, B., and Thewissen, H.G.M. (Eds.), Academic Press, New York.
- Rhodahl, K., and Moore, T., 1943, Vitamin A content and toxicity of bear and seal liver, *Biochem. J.*, 37: 166–168.
- Riedman, M., 1990, *The Pinnipeds: Seals, Sea Lions and Walruses*, University of California Press, Berkeley, 439 pp.
- Romano, T.A., Felten, S.Y., Olschowka, J.A., and Felten, D.L., 1993, A microscopic investigation of the lymphoid organs of the beluga whale, *Delphinapterus leucas*, *J. Morphol.*, 215: 261–287.
- Romer, A.S., and Parsons, T.S., 1977, *The Vertebrate Body*, 5th ed., W.B. Saunders, Philadelphia, 624 pp.
- Rommel, S.A., 1990, The osteology of the bottlenose dolphin, in *The Bottlenose Dolphin*, Leatherwood, S., and Reeves, R.R. (Eds.), Academic Press, New York, 29–49.
- Rommel, S.A., and Reynolds, J.E., III, 2000, Diaphragm structure and function in the Florida manatee (*Trichechus manatus latirostris*), *Anat. Rec.*, 259: 41–51.
- Rommel, S.A. and Reynolds, J.E., III, in press, Postcranial skeletal morphology of marine mammals, in *Encyclopedia of Marine Mammals*, Perrin, W.F., Wursig, B., and Thewissen, H.G.M. (Eds.), Academic Press, New York.
- Rommel, S.A., Pabst, D.A., McLellan, W.A., Mead, J.G., and Potter, C.W., 1992, Anatomical evidence for a countercurrent heat exchanger associated with dolphin testes, *Anat. Rec.*, 232: 150–156.
- Rommel, S.A., Pabst, D.A., and McLellan, W.A., 1993a, Functional morphology of the vascular plexus associated with the cetacean uterus, *Anat. Rec.*, 237: 538–546.
- Rommel, S.A., Pabst, D., McLellan, W., Early, G., and Matassa, K., 1993b, Cooled abdominal and epidural blood in dolphins and seals: Two previously undescribed thermoregulatory sites, *Abstr., Tenth Biennial Conference on the Biology of Marine Mammals*, Nov., Galveston, TX.
- Rommel, S.A., Pabst, D.A., McLellan, W.A., Williams, T.M., and Friedel, W.A., 1994, Temperature regulation of the testes of the bottlenose dolphin (*Tursiops truncatus*): Evidence from colonic temperatures, *J. Comp. Physiol. B*, 164: 130–134.
- Rommel, S.A., Early, G.A., Matassa, K.A., Pabst, D.A., and McLellan, W.A., 1995, Venous structures associated with thermoregulation of phocid seal reproductive organs, *Anat. Rec.*, 243: 390–402.
- Rommel, S.A., Pabst, D.A., and McLellan, W.A., 1998, Reproductive thermoregulation in marine mammals, *Am. Sci.*, 86: 440–448.
- Rommel, S., Pabst, D., and McLellan, W., in press, Skull morphology of marine mammals, in *Encyclopedia of Marine Mammals*, Perrin, W.F., Wursig, B., and Thewissen, H.G.M. (Eds.), Academic Press, New York.



- St. Pierre, H., 1974, The topographical splanchnology and the superficial vascular system of the harp seal *Pagophilus groenlandicus* (Erleben 1777), in *Functional Anatomy of Marine Mammals*, Vol. 2, Harrison, R.J. (Ed.), Academic Press, London, 161–195.
- Saltin, B., Gagge, A.P., and Stolwijk, J.A.J., 1968, Muscle temperature during submaximal exercise in man, *J. Appl. Physiol.*, 65: 460–468.
- Schaller, O., 1992, *Illustrated Veterinary Anatomical Nomenclature*, Ferdinand Enke Verlag, Stuttgart, 560 pp.
- Schulte, H. von W., 1916, Anatomy of a fetus of *Balaenoptera borealis*, *Mem. Am. Mus. Nat. Hist.*, 1(VI): 389–502 + plates XLIII–XLII.
- Schumacher, U., Zahler, S., Horny, H.P., Heidemann, G., Skirnisson, K., and Welsch, U., 1993, Histological investigations on the thyroid glands of marine mammals (*Phoca vitulina*, *Phocoena phocoena*) and the possible implications of marine pollution, *J. Wildl. Dis.*, 29: 103–108.
- Schumacher, U., Klein, P., Plotz, J., and Welsch, U., 1995, Histological, histochemical, and ultrastructural investigations on the gastrointestinal system of Antarctic seals: Weddell seal (*Leptonychotes weddellii*) and crabeater seal (*Lobodon carcinophagus*), *J. Morphol.*, 225: 229–249.
- Shadwick, R.E., and Gosline, J.M., 1994, Arterial mechanics in the fin whale suggest a unique hemodynamic design, *Am. J. Physiol.*, 267(36): R805–R818.
- Simpson, J.G., and Gardner, M.B., 1972, Comparative microanatomy of selected marine mammals, in *Mammals of the Sea, Biology and Medicine*, Ridgway, S.H. (Ed.), Charles C Thomas, Springfield, IL, 298–418.
- Sinha, A.A., and Erickson, A.W., 1972, Ultrastructure of the corpus luteum of Antarctic seals during pregnancy, *Z. Zellforsch. Mikrosk. Anat.*, 133: 13–20.
- Sinha, A.A., Erickson, A.W., and Seal, U.S., 1977a, Fine structure of Leydig cells in crabeater, leopard and Ross seals, *J. Reprod. Fertil.*, 49: 51–54.
- Sinha, A.A., Erickson, A.W., and Seal, U.S., 1977b, Fine structure of seminiferous tubules in Antarctic seals, *Cell Tissue Res.*, 178: 183–188.
- Slijper, E.J., 1962, *Whales*, Hutchinson, London, 511 pp.
- Stewardson, C.L., Hemsley, S., Meyer, M.A., Canfield, P.J., and MacDonald, J.H., 1999, Gross and microscopic visceral anatomy of the male Cape fur seal, *Arctocephalus pusillus pusillus* (Pinnipedia: Otariidae), with reference to organ size and growth, *J. Anat.*, 195: 235–255.
- Strickler, T.L., 1978, Myology of the shoulder of *Pontoporia blainvillei*, including a review of the literature on shoulder morphology in the cetacea, *Am. J. Anat.*, 152: 419–431.
- Strickler, T.L., 1980, The axial musculature of *Pontoporia blainvillei*, with comments on the organization of this system and its effect on fluke-stroke dynamics, *Am. J. Anat.*, 157: 49–59.
- Tarasoff, F.J., 1972, Comparative aspects of the hindlimbs of the river otter, sea otter and seal, in *Functional Anatomy of Marine Mammals*, Vol. 1, Harrison, R.J. (Ed.), Academic Press, London, 333–359.
- Tarasoff, F.J., and Kooyman, G.L., 1973, Observations on the anatomy of the respiratory system of the river otter, sea otter, and harp seal, II, The trachea and bronchial tree, *Can. J. Zool.*, 51: 171–177.
- Tedman, R.A., and Bryden, M.M., 1981, The mammary gland of the Weddell seal, *Leptonychotes weddellii* (Pinnipedia), I. Gross and microscopic anatomy, *Anat. Rec.*, 199: 519–529.
- VanDemark, N.L., and Free, M.J., 1970, Temperature effects, in *The Testis*, Vol. 3, Johnson, A.D., Gomes, W.R., and VanDemark, N.L. (Eds.), Academic Press, New York, 233–312.
- Vardy, P.H., and Bryden, M.M., 1981, The kidney of *Leptonychotes weddellii* (Pinnipedia: Phocidae) with some observations on the kidneys of two other southern phocid seals, *J. Morphol.*, 167: 13–34.
- Welsch, U., Schwertfirm, S., Skirnisson, K., and Schumacher, U., 1997, Histological, histochemical, and fine structural observations on the lymph node of the common seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*), *Anat. Rec.*, 247: 225–242.
- Wessels, J.C., and Chase, C.C., 1998, Light and electron microscopical observations on the terminal airways and alveoli of the lung of the South African (Cape) fur seal *Arctocephalus pusillus*, *Onderstepoort J. Vet. Res.*, 65: 253–262.

Zapol, W.M., Liggins, G.C., Schneider, R.C., Qvist, J., Snider, M.T., Creasy, R.K., and Hochachka, P.W., 1979, Regional blood flow during simulated diving in the conscious Weddell seal, *J. Appl. Physiol.*, 47: 986–973.

# 26

## Ultrasonography

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Fiona Brook, William Van Bonn, and Eric Jensen

### Introduction

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The advantages and clinical applications of diagnostic ultrasound in the field of veterinary medicine are now well established, and this technique plays a valuable role in the care of marine mammals. However, few clinicians appear to have utilized the diagnostic capabilities of B-mode sonography, and even fewer have reported their experiences, so that there is little available reference material.

Every potential practitioner should study the basic physics of ultrasound, since this is essential to understanding how ultrasound interacts with different tissues and interfaces, how the image is formed, and how to recognize image artifacts; there are several good, simple reference texts available (Hykes et al., 1992; Sanders, 1998). The purpose of this chapter is to provide hands-on sonographic information and practical marine mammal guidelines. Equipment selection, scanning techniques, common errors and limitations, and normal sonographic anatomy are described, along with illustrations of lesions identified in marine mammals using ultrasound. Much of the sonographic information gathered to date has been in dolphins and the information in this chapter is no exception; more work on other marine mammals is needed.

### Indications

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Sonography is a valuable adjunct to information provided from physical examination, radiology, and endoscopy. It is indicated any time that more information about internal structure is desirable. This technique has proved more valuable than plain radiographs in marine mammal species. The inclusion of sonography in routine health surveys should be considered in a comprehensive preventive medicine program.

As a diagnostic technique, sonography is simple, safe (AIUM, 1988), and cost-effective, and its noninvasiveness and ease of adaptability to any working environment make it an ideal addition to the diagnostic armamentarium of the marine mammal clinician. Ultrasound can provide a vast amount of morphological information, because it is able to differentiate soft tissue structures, accurately assess morphology and morphometry, and locate and characterize many conditions that alter echopatterns, shape, and position. Animals can be trained to cooperate for examination, chemical restraint is not required, and examinations can be repeated as often as necessary without risk, enabling monitoring of disease and the course of therapy.

Pulmonary disease is prevalent in both wild and captive marine mammals worldwide (Brown et al., 1960; Duignan et al., 1992; Reeves et al., 1994), and is considered by many to be the

most common cause of death in dolphins (see Chapter 40, Cetaceans). The high incidence of such disease is probably due to the specific adaptations in the anatomical structure of the cetacean respiratory apparatus (Wislocki, 1929), plus the lack of a cough reflex, preventing emission of exudates and particulates. If available, sonography should be part of the first line of investigation of suspected pulmonary disorders or thoracic trauma in marine mammals. Chest sonography is also indicated following trauma; pleural effusion, chylothorax, hemothorax, and/or rib fractures are all diagnosable using sonography.

## Limitations

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Ultrasound examinations of marine mammals are often performed outdoors, in direct sunlight, and it may be difficult to see the image adequately. This can be overcome by using (1) a dark-colored blanket, somewhat like an old-fashioned photographer's hood, to shield the monitor or (2) a heads-up video display, which allows remote viewing of the screen.

A sick animal may not be cooperative and this may necessitate removal of the dolphin from the water in order to conduct an adequate examination. When this is necessary, or if animals are accustomed to such handling, an appropriately prepared deck area should be available at, or near, the side of the enclosure and the dolphin placed on a wet foam mattress. In the authors' experience, this has had no serious adverse effect on any dolphin. However, it should be noted that sick animals, especially those with respiratory disease and significant lung disease, may experience significant ventilation/perfusion ( $\dot{V}/\dot{Q}$ ) inequalities out of water, and thus caution should be taken in working with dolphins so affected. When necessary, these effects can be minimized by scanning the animal in sternal recumbency.

The sheer size of some marine mammals may prohibit useful ultrasonographic examination of some structures. The relatively thick integument and blubber layers in animals such as the walrus are very difficult to penetrate without serious loss of resolution and image detail. Having said that, it is always worth a try!

## Technique

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### Equipment and Preparation

Any standard diagnostic ultrasound unit with a "scroll" or "zoom" capability, allowing visualization of deeper structures, can be used to examine marine mammals. Transducer selection depends on the size of the patient and the area of interest. A 3.5-MHz linear/curvilinear array transducer provides a wider field size, suitable for examination of larger animals and deeper structures. A 3.5-MHz linear array, with a 10-cm footprint is best for larger animals, or to visualize large or deep organs and advancing pregnancies. A 5-MHz curvilinear array is suitable for smaller animals and superficial structures. For eye examinations, a 10-MHz transducer is ideal, although a reasonable examination can be conducted using 7.5 MHz. It may be necessary to use up to 2.5 MHz for examination of deep structures in very large animals, such as big killer whales (*Orcinus orca*), but it must be noted that image detail and, therefore, diagnostic accuracy will be sacrificed. Sector probes are not as suitable, as the field of view close to the transducer is limited, the lateral resolution is poorer, and edge artifacts are more pronounced. The noise and vibrations of mechanical sector transducers also may disturb some animals. Modern curved array probes provide adequate access, even when acoustic windows are small.

Gone are the days of having to worry about fixed focal zones and changing transducers in the middle of an examination. All modern transducers have dynamic focusing, which means the depth of the focal zone is constantly changed along the beam axis, effectively extending the

focal zone along the entire depth of the image. Many machines also have manual focusing options, which allow for fine tuning of layers of the image at particular depths. An effort should be made to ensure consistent use of power, or “gain,” levels, both for comparison between animals and within individuals. It can be all too easy to mislead oneself into thinking a structure is “brighter” or “darker” than it was before, if care and attention are not paid to this. This must also, obviously, be considered in light of the animal’s weight—significant weight gain or loss will affect the acoustic power of the ultrasound beam, and thereby the brightness of the image.

All modern transducers are waterproofed, but may be further protected by covering them with a sheath or plastic bag containing some acoustic gel, and sealed with waterproof tape around the cable. If animals are trained for enclosure-side examination, the area being examined is often at or above the surface and no covering is needed. Coupling gel may be needed when examining pinnipeds. However, because of the nature of the dolphin’s skin, there is no surface air layer to act as a barrier to the ultrasound beam, and gel is not required.

Animal training for medical procedures, including ultrasound scanning, is now an integral part of husbandry and management of marine mammals in many facilities. With training, these animals quickly accommodate and cooperate in examinations. Pinnipeds can be trained to station erect, or to lie down and roll into a supine or semisupine position for examination. Both positions are necessary—the erect for examination of the chest, upper abdomen, head, and neck, and the supine for examination of the lower abdomen and pregnancy. They may also be scanned while lying in a tub of water, which can eliminate the need for coupling gel.

## Image Orientation

Consistent orientation and labeling of images is essential for systematic interpretation of scans and for image transfer between clinicians. Consistent positioning of animals aids this and also reinforces the animal’s training. There are two main methods of orienting ultrasound images. The first is most commonly used by sonographers and some veterinarians. The top of the image represents the skin surface on which the transducer is placed. For sagittal, parasagittal, and/or coronal (also termed *dorsal*) scans, the animal will be in sternal, dorsal, or lateral recumbency, with the head to the left, or in front, of the operator, or erect. The cranial aspect of the image is to the left of the monitor, and the caudal aspect is to the right. For transverse views, when the animal is in dorsal recumbency, the animal’s head should be to the left of the operator. The left side of the abdomen should be on the right of the image/monitor and right side on the left (i.e., the image is oriented to the viewer in the same way as the animal’s anatomy while scanning). For transverse views through the side of the abdomen (e.g., when scanning the kidney, ovary, and testis), the animal is in lateral recumbency, with the head to the operator’s left, or erect, for the left side and the head to the operator’s right for the right side. The side being examined is at the top of the image/monitor, the dorsum is on the right, and the ventrum on the left.

The second method is the one that has been most commonly used by veterinarians, particularly for small-animal studies, and standardizes transducer placement to produce sonograms with the following orientations: for scans parallel to the long axis of the body (sagittal, parasagittal, coronal /dorsal, oblique), the head of the animal is at the right of the sonogram; for scans perpendicular to the long axis of the animal (transverse, oblique), the dorsal aspect of the animal is to the right on the sonogram.

The authors believe the method used is a matter of personal preference, and that operators should choose the one they are most comfortable or familiar with—but they emphasize the need for consistency and accurate labeling. Standardization of image labeling and orientation reduces confusion when interpreting sonograms, allows for consistency between studies, and facilitates ease of transducer placement with animals routinely positioned in or out of the water.

## Clinical Applications

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### Thoracic Imaging

Sonography of the chest can be difficult because of the air-filled lungs, but is a valuable method of detection and characterization of changes in the pleura, pleural cavity, and pulmonary parenchyma. Pleural effusion, pneumonia, lung abscessation, and thoracic lymphadenopathy are all detectable on sonography. Ultrasound-guided thoracentesis can facilitate collection of aspirates for culture or cytology, providing valuable information for specific therapy, while also providing relief of physical signs in the animal with large pleural effusions, respiratory distress, tachycardia, and altered buoyancy (Rhinehart et al., 1995).

Little is known of cardiac disorders in marine mammals and, to the authors' knowledge, there has been only one report of congenital, structural anomalies in a dolphin fetus (Gray and Conklin, 1974). Congestive heart failure and amyloidosis have been reported in dolphins and seals (Miller and Ridgway, 1963; Reeves et al., 1994; Cowan, 1995) (see Chapter 23, Noninfectious Diseases). Parasitosis is another concern, and cardiac nematode infestation has been reported (Brown et al., 1960) and depicted using ultrasound in harbor seals (*Phoca vitulina*) (Stone, 1990).

### Heart and Mediastinum

Echocardiography is commonly used in veterinary care of many species (Nyland and Mattoon, 1995), but is not as easily applied in marine mammals, particularly cetaceans. Although an experienced echographer could probably detect gross abnormalities using standard techniques, further data collection is necessary to document normal cardiac parameters for meaningful echocardiography in all marine mammal species.

B-mode echocardiography provides a two-dimensional (2D) image, which allows comprehensive evaluation of the anatomy, spatial relationships, and motion of cardiac structures. M-mode echocardiography is an older technique that uses a much narrower ultrasound beam to detect only axial motion in a very small section of the heart. A B-mode transducer is used to produce a 2D image, which is used to guide and orient the M-mode examination. Axial measurements of the dynamics of different structures can be made. The advantage of M-mode is that it has a much faster sampling rate than B-mode, which is limited by lower frame rates and poorer image resolution. M-mode recordings are much closer to "real time" and so are better able to detect rapid movement and subtle changes, which may be missed on B-mode alone. Meaningful M-mode examinations require standardization of techniques, as well as knowledge and understanding of beam paths and normal and pathological cardiac anatomy. M-mode echocardiography is currently being used by one of the authors (E.J.) to monitor and establish norms for fetal heart rates in hopes of using this as a tool to monitor overall fetal health and fetal stress.

Often the entire cardiac surface area in the dolphin is surrounded by lung tissue. The large sternum obstructs access from the ventral midline and the heart is therefore not accessible. In some animals, the lungs are not so intrusive and a low parasternal approach may allow access to the heart. This is best done with a dolphin remaining in the water in dorsal recumbency. This position may help to remove the lungs from more of the cardiac surface and increase available window size. Trans-sternal echocardiography is possible in the very young calf. Transesophageal echocardiography is possible in larger animals, with the endoscopic transducer inserted, through a mouth guard, in the same way as a standard endoscope or gastric tube.

Doppler echocardiography uses changes in frequency of a sound beam, which is reflected from moving cellular elements in blood, to depict and assess various blood flow parameters. There are several Doppler techniques, including color flow imaging, in common clinical use



FIGURE 1 Left coronal/dorsal view of the aortic arch in a dolphin (head to the left; left side up).

for human cardiac evaluation. Doppler echocardiography provides further information on hemodynamics, including direction and characterization of flow patterns. Again, applications in marine mammals have not been explored.

Similar to the heart, the mediastinum is not easily visualized in dolphins; nevertheless, visualization should be attempted if clinically indicated. An enlarged thymus or mediastinal lymphadenopathy may be seen, and benign mediastinal tumors, lymphangiomyomatosis, cystic transformation, and malignant lymphomas have been reported in cetaceans (Cockrill, 1960; Rawson et al., 1992; Cowan, 1994; Bossart et al., 1997). The aortic arch and associated vessels of the smaller dolphin species can sometimes be demonstrated by placing the transducer immediately above the sternum, in the transverse plane, and angling the beam approximately 30 to 45° caudally, or by scanning in the coronal/dorsal plane, just above the pectoral flipper (Figure 1). This view is also useful for evaluating possible aortic arch nodes, which are associated with the thyroid and thymus. Pinnipeds are easier subjects for echocardiography. Whether trained or restrained, surrounding lung, as in dolphins, does not obstruct access to the heart. Intercostal spaces are large and an oblique parasternal approach from either side allows good visualization of the entire heart. Again, gross abnormalities may be detected, but normal parameters are, as yet, unknown. More work needs to be done in this area.

## Lungs

The anatomy and surface landmarks of the lungs are described in Chapter 9. A full survey of both lungs should be carried out, with particular attention paid to the ventrolateral bases, as these are most dependent and commonly involved in cases of pulmonary infection. With the dolphin in lateral recumbency, the transducer is placed in the transverse plane and perpendicular to the subject, below the pectoral flipper. It is then moved caudally toward the base of the lung, along the pectoral line. Moving in parallel sweeps, the examination continues until the entire lung has been assessed in a grid-type pattern. The procedure is repeated with the transducer in a sagittal/parasagittal plane, aiming toward the midline, and then repeated again for the contralateral lung.

The surface of the parietal pleura can be examined through the intercostal spaces and lies just deep to a thin, echolucent muscle layer beneath the ribs. Many dolphins show evidence of apparent pleural irregularity with multiple associated, highly echogenic “streaks” on the image. These are “comet-tail” artifacts, a type of reverberation artifact produced at an air interface and a phenomenon

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FIGURE 2 Sagittal scan showing longitudinal section through mid-abdomen of a young *T. t. aduncas*. Highly echogenic “comet-tail” artifacts are seen at air/bowel wall interfaces.

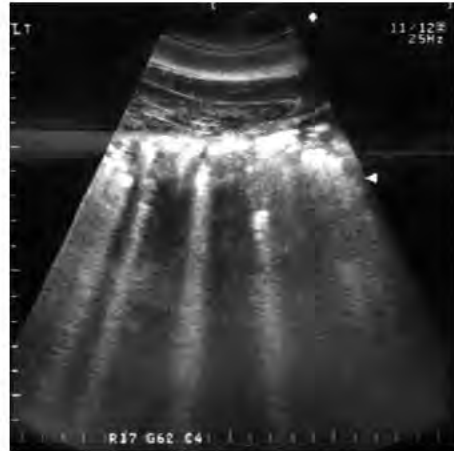


FIGURE 3 Sagittal, midline scan of caudal thorax showing suspected hemothorax following trauma in a false killer whale (*Pseudorca crassidens*).

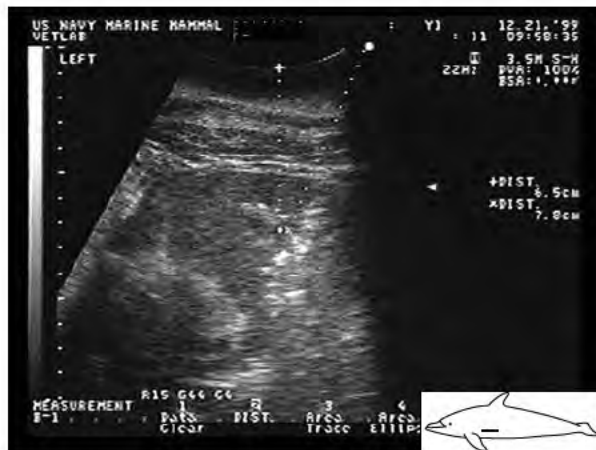
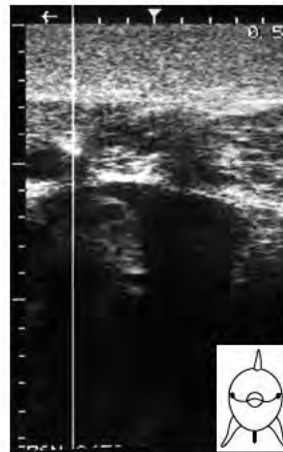


FIGURE 4 Left coronal/dorsal view of the left lung base in a bottlenose dolphin (*T. truncatus*), demonstrating extensive consolidation. Lack of aeration in the affected area allows penetration of the ultrasound beam. Cursor marks show guide for needle placement and required depth for UGFNAB. (Image credit: U.S. Navy.)



well recognized in sonography (Laing, 1983; Thickman et al., 1983). This appearance has been observed in animals with no subsequent evidence of pleural abnormality at necropsy and is not indicative of pathology, but may be age associated. Other interfaces that commonly produce this type of artifact are the diaphragm-lung and bowel wall-bowel gas (Figure 2). Normal, air-filled lung presents the typical reverberation artifact of an air-to-tissue/fluid interface.

Pulmonary infiltrate may be diagnosed by absence of the normal reverberation pattern and penetration of the ultrasound beam to reveal the presence of fluid within the thorax (Figure 3), pulmonary lesions (most commonly abscesses), or consolidation (Figure 4). The appearance of echolucent, edematous, or consolidated lung tissue surrounding air-filled bronchioles is pathognomic of pneumonia. Smaller, more discrete, echolucent or heterogenous lesions (Figure 5) are more likely to be sites of focal abscessation, which are commonly reported in both pinnipeds and cetaceans. Care must always be taken to image any suspected abnormality in at least two planes, to ensure a focal lesion is indeed present.

The sonographic appearances of abscesses are variable and these may be difficult to identify, particularly if they are isoechoic to surrounding tissue, or echogenic because of the presence of gas or chronic changes, such as encapsulation or mineralization. Borders may be irregular and poorly demarcated, and the appearance of contents may be misleading. Where there is

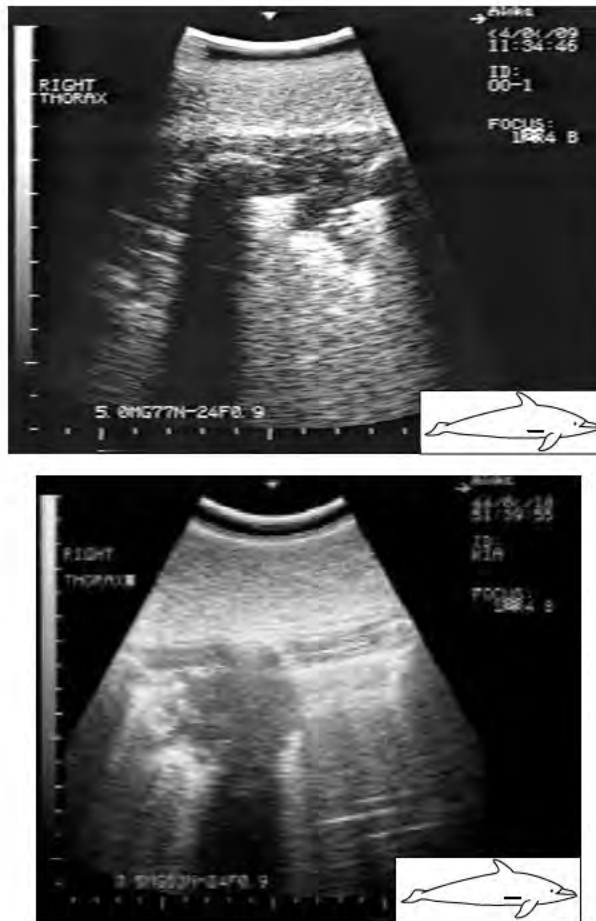


FIGURE 5 Right coronal/dorsal views of the pleural surface showing (top) small granulomata in a killer whale calf and (bottom) subpleural abscess in a bottlenose dolphin (*T. truncatus*). (Image credits: T. Robeck.)

doubt, chest radiography should also be performed for further information. Again, it is important to scan and repeat-scan systematically, and to ensure the position of any lesion is accurately determined and recorded for follow-up examination to be most useful.

In Figure 3, there are multiple rib fractures and a probable hemothorax in a young, male false killer whale (*Pseudorca crassidens*) attacked by an adult female killer whale. At least one fracture was confirmed radiographically, but it was not possible to obtain adequate radiographs of all sites in this large animal. Removal of a large animal with suspected rib fractures from the weight-bearing environment of the water to a hard poolside surface may, indeed, be contraindicated, because of the risk of lung puncture by a displaced fracture or fracture fragments. Routine sonography of this animal, under trained behavior, allowed monitoring of the fluid collection, callous formation, and the degree of fracture healing, and assisted in determination of when to allow the animal to return to performance training.

Ultrasound-guided fine-needle aspiration biopsy (UGFNAB) of pulmonary lesions can provide valuable information on cause and for determining appropriate therapy. UGFNAB has been performed successfully in dolphins (see Figure 4), including repeat procedures on the same animal at intervals of several weeks, without complications (Van Bonn, pers. obs.). The region of interest is visualized, and the skin aseptically prepared as for surgery. Sterile lubricating gel is used if coupling is necessary. Needle placement is guided by the sonogram to avoid vital structures and vasculature. A regional "wash" is also rewarding. Introduce 10 to 15 ml of sterile saline via the needle and apply suction immediately to recover as much diagnostic material as possible. Cytology, microbiology, and virology of the aspirated material is extremely valuable in the diagnosis of several respiratory diseases (see Chapter 20, Cytology).

Always remember that lesions deep to normal lung and not extending to the pleura will not be able to be visualized. Sonography, therefore, may identify the presence of pulmonary disease, but cannot exclude it, and may not demonstrate the full extent of the affected area. Chest radiography should always be performed, if clinically indicated and feasible.

### Thoracic Lymph Nodes

A dolphin has numerous lymph nodes within the thorax, which often enlarge markedly in the presence of pulmonary infection, presenting an amorphous, echolucent "mass" on sonography (Figure 6, left), which may be difficult to differentiate from an area of consolidation.

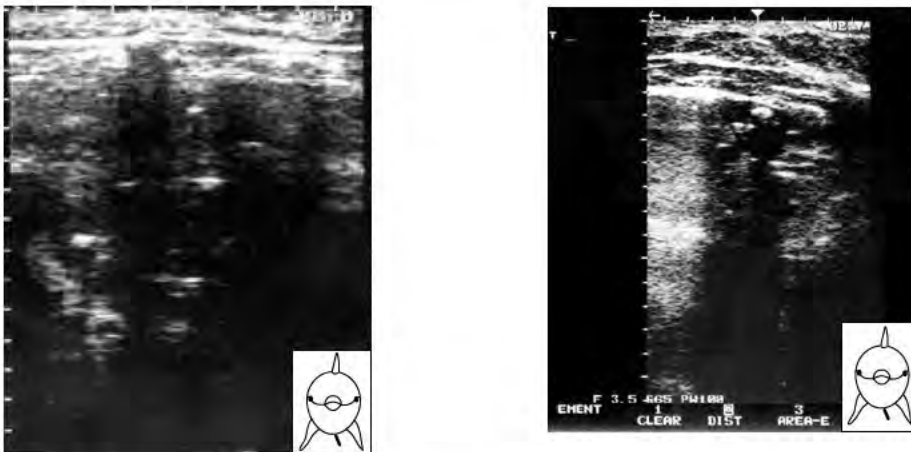


FIGURE 6 Parasagittal views of diaphragmatic lymph nodes in a bottlenose dolphin (*T. t. aduncas*), showing (left) acute lymphadenopathy and (right) chronic appearance with mineralized foci.

These may also contain mineralized foci, particularly if chronically affected (Figure 6, right). Thoracic lymphadenopathy is most commonly seen in the caudoventral aspect of the thorax, just above the diaphragm and ventral to the heart (diaphragmatic nodes), and in the apical region, where the prescapular (or superficial cervical) nodes are situated. Chest radiography in these large animals may be difficult, and radiographs are often of poor quality, although the newer technology of computed radiography (CR) holds much promise (see Chapter 25, Radiography). Pulmonary changes may also be subtle and not clearly demonstrated on radiographs. Therefore, the visualization of affected lymph nodes is very important and may be the only detectable sign of chest infection on imaging. UGFNAB of prescapular nodes has been performed without complications by one of the authors (W.V.B.). Although not as yet reported in the literature, UGFNAB of intrathoracic lymph nodes may also be a valuable diagnostic procedure in cases of suspected thoracic disease with demonstrated lymphadenopathy.

### Abdominal Imaging

In the dolphin, scanning of the upper abdomen is relatively easy. However, the more acute rounding of the caudoventral abdomen and the dense musculature make a midline approach difficult, particularly in the lower abdomen. Scanning in the parasagittal and transverse planes, through the lateral abdominal wall, provides the best contact and access to the entire abdomen. For standardization, the abdomen can be divided into three sections: (1) cranial, containing the liver, biliary system, spleen, pancreas, forestomach, second (or fundic) stomach, duodenal ampulla, and the pylorus; (2) middle, containing the kidneys, small bowel, and gravid uterus; and (3) caudal, containing small bowel, rectum, urinary bladder, and reproductive organs.

Animals vary in body size and shape; similarly, the size and "normal" echopatterns of each individual's organs vary. Thus, a baseline record of each individual in the normal state should be obtained. Abdominal scanning in the smaller seals, particularly in trained animals, is not difficult, although a thorough examination can take time, since the animal will need to be repositioned several times to allow access to the whole abdomen. Ultrasound may not always be possible in larger animals, such as big males, or walruses, due to their size and thick blubber layers.

The liver, biliary system, spleen, and urinary and reproductive tracts can be separately identified and assessed for normal size and echopatterns. The gastrointestinal (GI) tract can also be visualized, and the motility of the bowel and appearance of bowel contents can prove to be clinically significant. Unless grossly affected, the normal pancreas is very difficult to visualize adequately.

### Liver and Biliary System

Liver disorders are relatively common in wild and captive marine mammals, particularly parasitosis, hepatic lipidosis, hepatitis, and diffuse and focal cirrhosis (Cockrill, 1960; Brown et al., 1960; Baker, 1992). The large dolphin liver is molded to the inferior surface of the diaphragm, extends across the entire upper abdomen, and is larger on the right side. The liver is examined by placing the dolphin left side up initially, with the transducer perpendicular and placed longitudinally and parallel to the pectoral flipper, along the pectoral plane. Scan from the diaphragm to the caudal hepatic margin. Sequential sagittal/parasagittal and transverse scans of the whole liver are then carried out. The procedure is repeated with the dolphin right side up. Baseline records should include the distance of the caudal extent of the liver above (U.L. +  $x$  cm) or below (U.L. -  $x$  cm) the umbilicus, in the midline. This is done with the animal in the supine position. The caudal margin of the liver usually lies rostral the umbilicus in a dolphin; however, in a large animal, the normal liver may extend several centimeters caudal

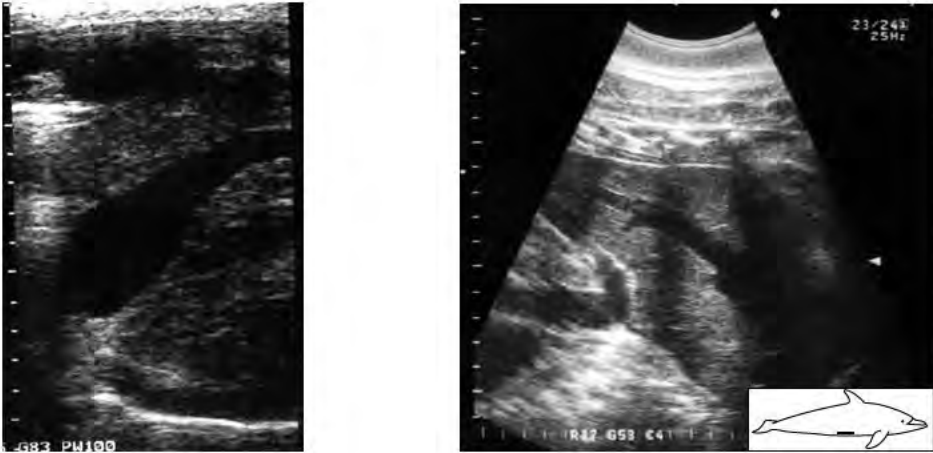


FIGURE 7 (Left) Transverse oblique scan showing a normal gallbladder and right lobe of liver in California sea lion (*Z. californianus*) and (right) right coronal/dorsal section of normal liver in a bottlenose dolphin (*T. truncatus*).

the umbilicus. Measurements will, of course, vary with degree of inspiration, or flexion/extension of the body. Care should be taken to ensure the dolphin inhales in the same way before rotating and is as relaxed as possible, to maximize repeatability of measurements. Although not strictly accurate, this technique does provide a useful indicator of significant increase or decrease in liver size, and is a useful part of routine examination and records. In pinnipeds, the entire liver can be examined in the supine position, although it will probably be necessary to reposition the animal to assess the whole liver adequately. The upper liver can be examined with the animal erect, but the caudal margin extends very low in the abdomen and is not adequately visualized in this position. The gallbladder is relatively large and easy to evaluate.

The outline of the liver is smooth with a sharp caudal edge. The normal echotexture is similar to that seen in most liver tissue, presenting a homogenous, finely speckled pattern of midlevel intensity (Figure 7), frequently interrupted by hepatic and portal vascular branches. The large hepatic veins in dolphins and venous sinuses in pinnipeds are easily visualized, coursing toward the vena cava. Thicker, echogenic borders identify the portal veins, due to surrounding Glisson's capsule. Nowadays, with higher-resolution equipment, intravascular flow within the normal hepatic and portal veins is frequently observed, and must not be interpreted as pathological. The flow is imaged as moving echoes within the lumen of the vessel, and is in phase with the cardiac cycle. Flow may be seen to be bidirectional or even turbulent, especially at the low end of the cardiac cycle. The signal is similar to that seen due to rouleaux formation in humans and is thought to be a result of low flow velocities in the central veins of diving mammals. This phenomenon is currently being investigated by one of the authors (W.V.B.).

Ideally, if the biliary system is to be evaluated, subjects should not be fed for about 6 hours prior to examination, to allow maximal accumulation of bile and full distension of the biliary tree. The pinniped gallbladder is large and easily seen when distended. Dolphins do not have a gallbladder, but the distal bile ducts are relatively large and similar in size, position, and echopattern to the portal veins, so care must be taken to differentiate these. Bile ducts tend to run deep to the portal veins and are larger in diameter at the porta hepatis, but taper quickly within the liver (Figure 8) and are not normally seen within the peripheral parenchyma. Disease of the biliary system is apparently rare in marine mammals. A "starry-sky" pattern of the liver, with transitory dilatation of the central bile ducts, has been seen in a proven case of fluke infestation (Figure 9). On one occasion, mobile, echogenic foci were seen within the lumen of the ducts of this animal. These disappeared following treatment and the ducts regressed to normal size.

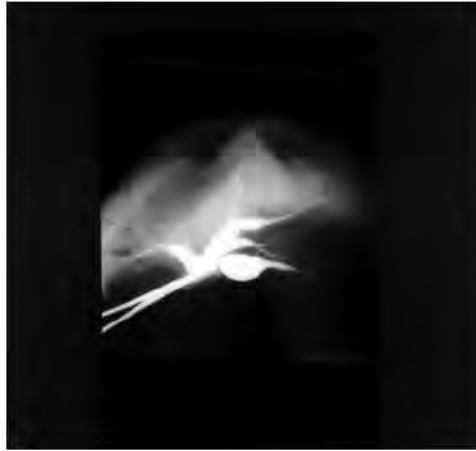


FIGURE 8 Radiograph of an excised bottlenose dolphin (*T. truncatus*) liver. The bile duct has been cannulated and injected with contrast medium to delineate the biliary tree.

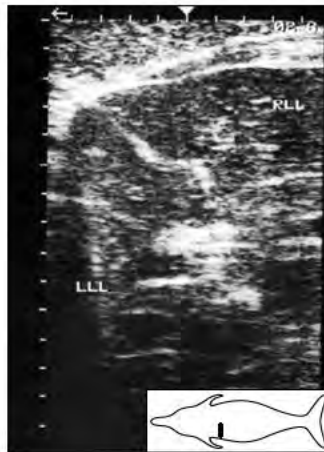


FIGURE 9 Transverse section of liver showing abnormal sonographic appearance of intrahepatic bile ducts in a case of fluke infestation in a young, male bottlenose dolphin (*T. t. aduncas*).

Changes in size, shape, and echogenicity of the liver may indicate diffuse lesions. Blunting of the caudal margin and “bulging” of the liver between the ribs has been seen in acute hepatitis. Diffuse increases in parenchymal echogenicity have been observed with subsequent biochemical indicators of hepatopathy (see Chapter 19, Clinical Pathology). If liver disease is suspected, an attempt should be made to examine the area around the porta hepatis and the para-aortic regions, for lymphadenopathy (Figure 10).

A general increase in liver echogenicity is common in pregnant dolphins, as increased fat deposition occurs (Figure 11, left). It is advisable to monitor the degree of “fatty liver” in pregnancy, particularly in females with a history of liver dysfunction, since this has been known to preempt hepatic failure due to excessive steatosis in one bottlenose dolphin (*Tursiops truncatus aduncas*) with a prior history of acute hepatitis (Brook, pers. obs.). Cirrhotic changes, with lobular fibrosis and decreased size, may be observed in dolphins with a history of hepatitis (Figure 11, right). If this is suspected, the animal should be monitored for disease progression, even if liver function appears clinically normal. Discrete hepatic lesions are relatively rare in

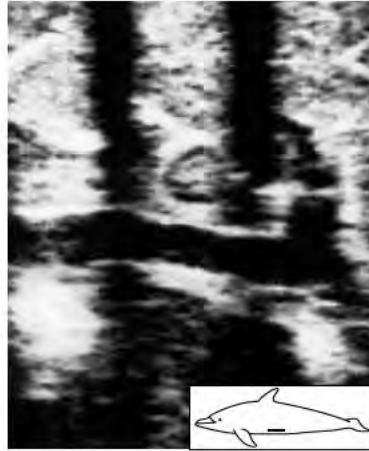


FIGURE 10 Longitudinal section of normal portal vein and periportal lymph nodes in a bottlenose dolphin (*T. truncatus*).

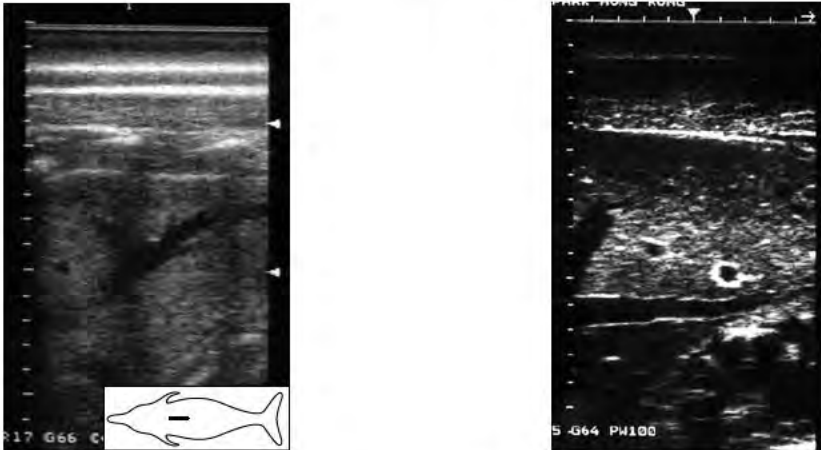


FIGURE 11 (Left) Fatty liver in a pregnant bottlenose dolphin (*T. t. aduncas*). (Right) Cirrhotic changes in the liver of an adult, male bottlenose dolphin (*T. t. aduncas*) with a history of repeated episodes of hepatopathy. The parenchymal echopattern is hyperechoic and coarsened, and intralobular fibrosis can be seen at the boundary between the liver parenchyma and the large intrahepatic vessels.

marine mammals, although granulomas, fibromas, lipomas, and hemangiomas have been reported (Cockrill, 1960; see Chapter 23, Noninfectious Diseases).

## Spleen

The spleen in a bottlenose dolphin is relatively small and rounded, or slightly ovoid, lying just to the left of the midline, medial and deep to the forestomach, and often behind the second stomach (fundic chamber) and duodenum (Figure 12).

It is ideal to restrict food for 6 hours prior to sonographic examination, to facilitate visualization of the spleen without the food-filled stomachs and duodenum getting in the way. Because of the dolphin spleen's variable position and the gut that surrounds it, sonographic identification may be difficult. The spleen is most often seen using a parasagittal approach through the ventral abdomen from the right side, using the liver as an acoustic window. As it is small, the normal spleen can be visualized in its entirety and presents a very even, speckled

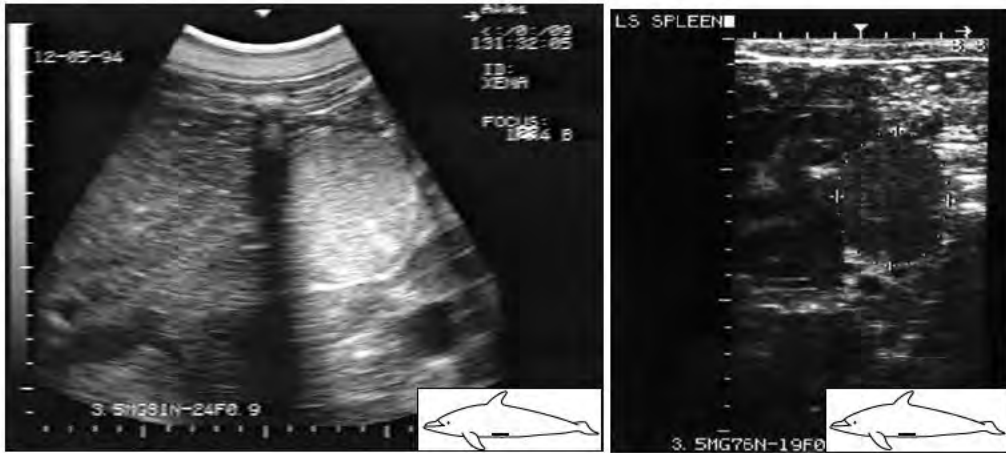


FIGURE 12 Left coronal/dorsal views of (left) a hyperechoic spleen in a stranded bottlenose dolphin (*T. truncatus*). (Image courtesy of T. R. Robeck.) (Right) A normal bottlenose dolphin (*T. t. aduncas*) spleen. (The stranded animal was diagnosed with pneumonia, and it is possible that the spleen was affected, but this was not determined.)

echo pattern, usually isoechoic or slightly more echogenic than the normal liver. Reported normal sizes are variable within the same species (Figure 12)—3.5 to 6.0 cm in *T. t. aduncas*; 6.0 to 8.0 cm in *T. t. truncatus* (Stone, 1990)—and normal baselines should be documented for each individual when possible. Because of the mobility of the spleen, it is difficult to access the largest diameter reliably, and this may account for some variability of sizes noted. Splenic size appears to increase only slightly, or remain unchanged, in cases of systemic infection in dolphins. The size appears to be most dramatically affected in cases of septicemia, where splenic congestion usually presents as increased echolucency of the parenchyma. If hemorrhagic, the sonographic appearance of the spleen may vary from diffusely echolucent to diffuse or focal areas of increased echogenicity.

In seals, the sonographic appearance of the spleen is similar to that of the dog, although it is more difficult to access, because of the elongated rib cage of the pinniped. It is also obscured by the stomach and the small and large bowel. It may be accessed through scanning in a subcostal oblique plane, allowing the transducer to be guided by the left costal margin, or by transverse or coronal scans from the left side, through the intercostal spaces. The subject should be in an erect position, if possible. A curvilinear array is the best choice of transducer for examination of the spleen in pinnipeds, as it allows a reasonable contact area but with the flexibility needed to angle up and between ribs.

### Pancreas

It is difficult to visualize the margins of the normal marine mammal pancreas, because of its elongated and irregular shape, lack of definitive border, and its position, closely affixed to the duodenum, often behind the second stomach and the bowel. The gland is finely lobulated, with no capsule to provide differentiation or delineation on sonography. Sections of the normal pancreas may sometimes be identified when surrounded by fluid-filled bowel loops. Pancreatic pathology in dolphins is most commonly confirmed in cases of septicemia (Brown et al., 1960).

### Gastrointestinal Tract

Gastrointestinal disorders are common in marine mammals, especially dolphins. With relatively less intestinal gas than most species, sonography can provide useful information about much

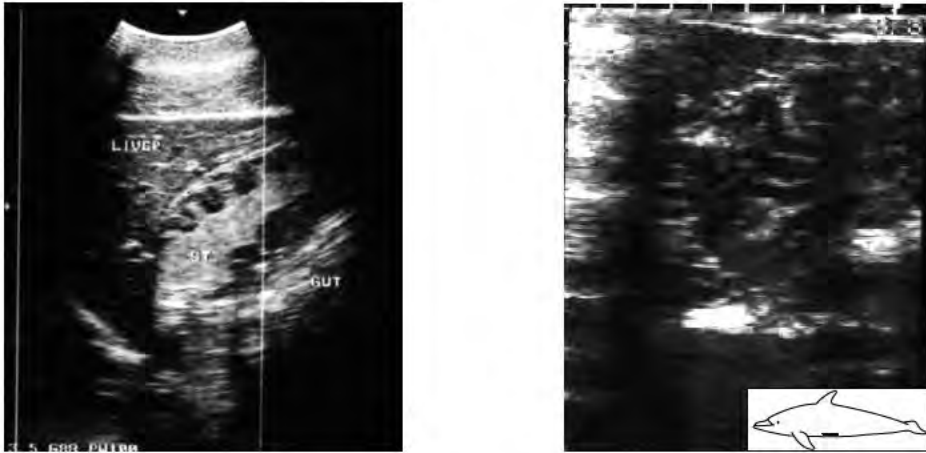


FIGURE 13 Sonographic appearance of (left) a normal, empty fundic stomach and (right) thickened rugal folds in an endoscopically confirmed gastritis in *Tursiops*.

of the GI tract. The appearance and thickness of the gut lumen and wall can be assessed in cases of suspected gastroenteritis or obstruction, peristalsis can be observed in real time, and hyper- or hypomotility identified. GI masses can also be identified and peritoneal effusions detected and evaluated.

Ultrasound does not provide much useful information about the main stomach; that is, forestomach. The proximal wall may be imaged for gross pathology. However, there is insufficient information about normal appearance and mural thickness at present for this to be very useful. The stomach is rarely empty and is also hugely distensible, making measurement unreliable. The stomach usually contains free gas, which, even in small amounts, will rise to the transducer side, scattering the ultrasound beam and preventing imaging of the lumen. Sternal recumbency may be useful for examination of the forestomach. Gas rises dorsally, so scanning in the coronal/dorsal plane, ventral to the gas, can improve visualization. The fluid in the forestomach can provide a good acoustic window to the deeper anatomy of the cranial abdomen. Administration of water via stomach tube prior to the examination may also be useful. Besides distending the GI tract and stimulating motility and gastric contraction, it allows visualization of the pylorus and duodenum, and the fluid-filled gut highlights adjacent anatomy (spleen, pancreas). Gastroscopy, however, remains the method of examination of choice for the stomach (see Chapter 27, Endoscopy).

In dolphins, the second, or fundic, stomach contains very little free gas and can be seen quite well. It is easily identifiable by its position, thick wall, and distinctive rugae (Figure 13). A marked increase in rugal thickness may indicate gastritis or parasitosis (Woodard et al., 1969) in an animal in which normal appearances are known, although normal ranges have yet to be published. The transition of hyperechoic gastric contents through the second stomach is easy to monitor and may be useful to identify functional abnormalities or mass lesions.

The pylorus is obvious on ultrasound, and can be seen extending laterally from the fundic stomach, then reflecting at the medial border of the right liver, to run caudomedially for a short distance within the cranial abdomen. The size, motility, and transition of contents through the pyloric chamber may provide useful information. In one case of clinically suspected obstruction, marked and prolonged distension of the pyloric chamber, with hypermotility and increasing hyperechogenicity of contents, possibly due to microbubble formation, has been seen (Figure 14). A partial obstruction was suspected. After a period



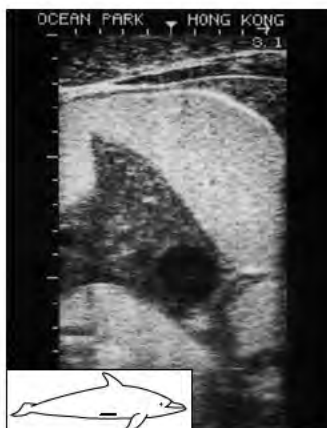


FIGURE 14 Distended, possibly partially obstructed pylorus/duodenum in an adult male bottlenose dolphin (*T. t. aduncas*). Hyperechogenicity of contents is probably due to microbubble formation.

of some weeks, this suddenly resolved and a few days later the dolphin passed several large, hard objects in its feces. These were composed of impacted sand, which was later discovered to be entering the enclosure through a faulty filter. This dolphin had regularly been observed hovering around the affected inlet.

The sonographic appearance of inflammatory GI disorders varies depending on the pathology involved, the site and extent of involvement, and associated complications, such as peritonitis. The relatively fluid caudal bowel contents of marine mammals provide a useful “contrast medium” when examining the GI tract. Gas content in caudal bowel is normally low when compared with that of other species, and changes in mural thickness are more easily seen. Similarly, dense fecal matter seen in other species does not obscure the rectum. Unlike in humans and small animals, it is not easy sonographically to differentiate bowel wall layers in marine mammals, even with the improved resolution of modern equipment. Normal mural thickness values have not been determined, but any pathological increase is usually obvious to the experienced eye (Figure 15). Similarly, hypermotility can be seen and monitored. Acute hypomotility appears to be less common, but in the authors’ experience has been iatrogenically induced by overzealous oral fluid administration and is easily recognizable. Luminal patterns seen depend on contents, although it is rare to see empty bowel segments, particularly in dolphins. The normal appearance in the caudal bowel is that of relatively hypoechoic fluid contents.

The presence of large amounts of gas within the bowel lumen or hyperechogenicity of feces may be indicative of disease, but can also be seen when diet is varied, in some cases of stress, or in clinically normal animals. The large pararectal lymph nodes may also be examined (Figure 16). Mesenteric nodes are more difficult to evaluate, possibly because they are invested by smooth muscle, which likely increases their echogenicity, making it almost impossible to differentiate nodes from surrounding tissue. Further research is required to determine the role of ultrasound in assessment of the GI tract in marine mammals.

Ultrasound is the least invasive and most accurate method for detecting the presence of ascites in marine mammals (Figure 17). Evaluation of the fluid for particulates, and assessing whether the small bowel is seen to float freely or appear matted and adhered may give further information. Ultrasound can identify a suitable location for paracentesis and guide safe needle placement. The development of ascites in dolphins is generally not a good prognostic indicator.

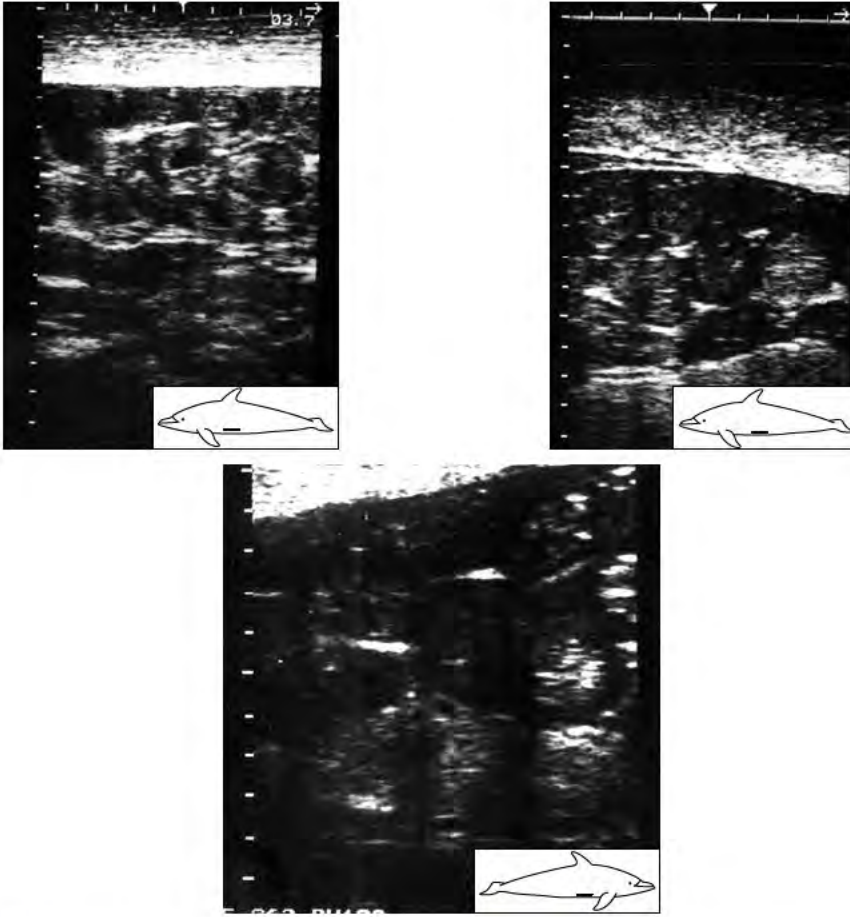


FIGURE 15 Progressive enteritis in the same animal shown in Figure 14. (Top left) Normal appearance of small bowel; images (top right) and (bottom) show increasing bowel wall thickness and hypoechoogenicity (note same scale).

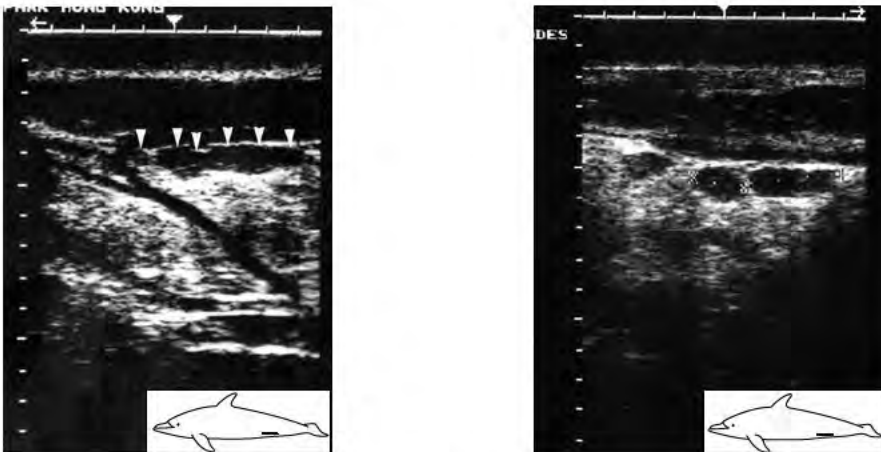


FIGURE 16 Mildly enlarged, hypochoic pararectal lymph nodes in two dolphins with clinical signs of enteritis.

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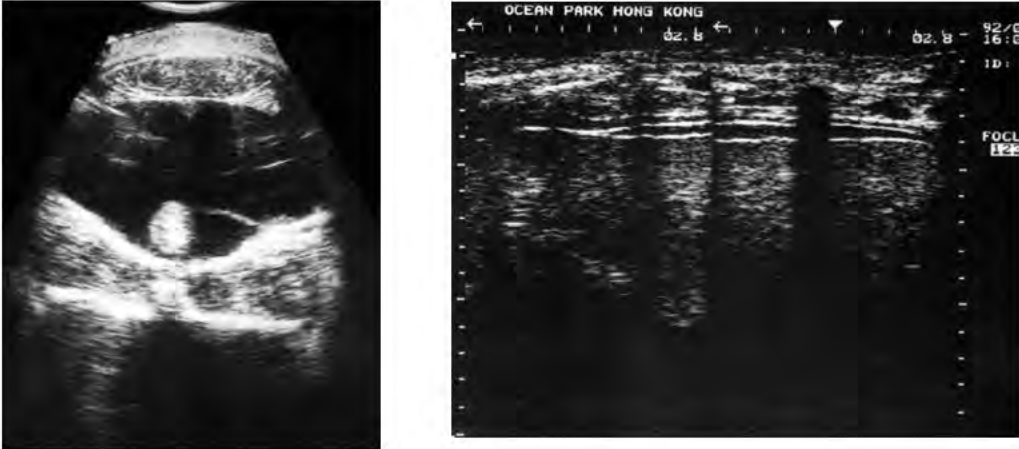


FIGURE 17 (Left) Gross ascites in a bottlenose dolphin (*T. t. aduncas*) calf in hepatic failure following severe weaning difficulties, and (right) mild ascites seen in a pregnant female dolphin with excessive hepatic steatosis and progressively abnormal liver function tests/liver parameters.

### Urinary Tract

Focal lesions, such as cysts, abscesses, adenomas, mineral deposits, and frank calculi, have been reported in kidneys (Brown et al., 1960; Miller and Ridgway, 1963; Migaki et al., 1978; Howard et al., 1983), but diffuse glomerular disease appears to be rare. Massive interstitial corticomedullary amyloidosis has also been noted (Cowan, 1995). Both dolphin and pinniped kidneys can be examined using ultrasound. In both, the kidneys are large, with renal lengths loosely correlated with body length.

The dolphin kidneys are easy to find, located caudal to the dorsal fin, and lying with their medial aspects closely aligned to either side of the midline, tucked up between the large hypaxial muscles. They are located by scanning along the pectoral line, with the transducer in the transverse position and moving either caudally from the dorsal fin or cranially from the cranial end of the genital slit. Kidneys are multilobulated. The individual renules can be seen, each with its own collecting system and a hyperechoic boundary, the overall appearance resembling that of a bag of marbles (Figure 18). The multiple interfaces presented by these anatomical

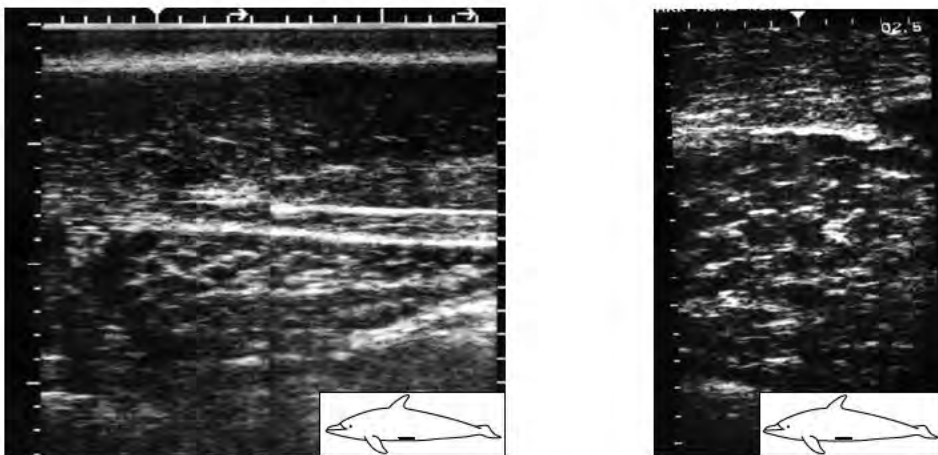


FIGURE 18 Sonographic appearance of bottlenose dolphin kidneys in (left) a 7-year-old male and (right) a 27-year-old male.

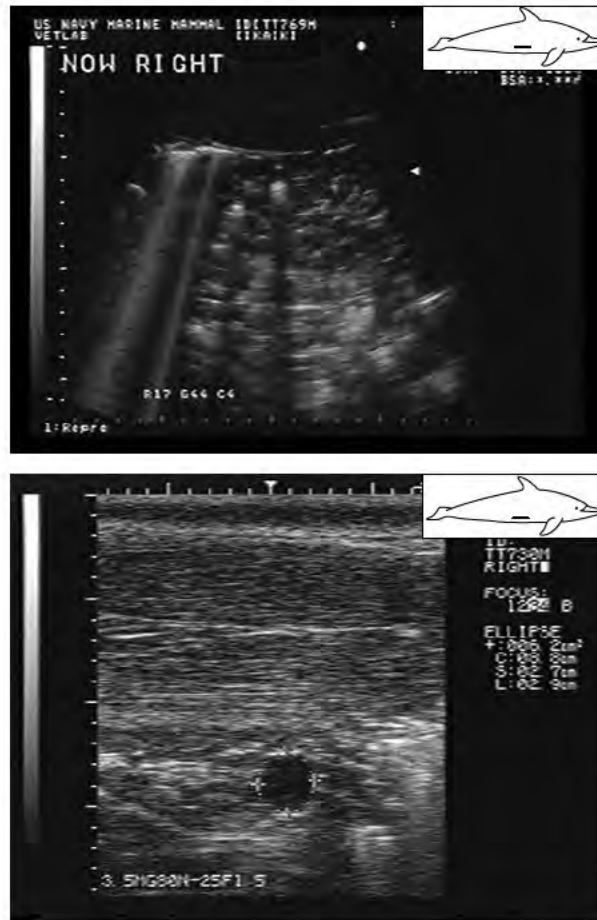


FIGURE 19 (Top) Two small renal calculi are seen in a male bottlenose dolphin (note the acoustic shadows behind each of the foci), and (bottom) a simple renal cyst is shown in the right kidney of another male. (Image credits: U.S. Navy.)

structures produce high-amplitude echoes, which appear to become more pronounced with age (Figure 18, right), and may even produce acoustic shadowing and mimic small calculi or mineral deposits. Scanning in more than one plane should eliminate shadowing if mineralization is not present (Figure 19, top).

Pinniped kidneys are more similar in appearance to those of the pig or bear, and are anatomically located in much the same place as in the dog. Because of its more caudal position, the left kidney is easier to see; overlying bowel often obscures the right, which also lies higher under the rib cage and may be inaccessible. With the animal in lateral or dorsal recumbency, the transducer is placed on the ventral abdomen, at the lower costal margin and in the sagittal or coronal/dorsal plane. Firm pressure is usually required to displace overlying bowel loops and visualize kidneys adequately. Once the kidney is located, full sagittal and transverse scans are performed. Sometimes a ventrally located spleen may provide a useful acoustic window for examination of the left kidney in seals. Large amounts of perirenal fat may also help to differentiate kidneys.

Relative echogenicity of the kidneys to other reference organs has not been established for these species. The medullae cannot be reliably differentiated in dolphins and, because of the size of the average patient and the anatomy of the dolphin kidney, subtle changes in parenchymal appearance

and echogenicity are unlikely to be detected in marine mammals with currently available equipment. Apart from identification of focal lesions, the value of ultrasound in the evaluation of renal disease in marine mammals is not yet clear. UGFNABs of kidneys have been successfully performed by two of the authors (W.V.B., E.J.).

The normal ureters are not seen in these large animals. However, the oval, urine-filled bladder is easy to examine (see Figure 21, right). The bladder wall can be assessed for thickness and any lesions. Wall thickness should be  $\leq 3$  mm in bottlenose dolphins (*T. t. aduncas*) when fully distended, but normal measurements have not been documented in other species. The bladder lumen should be anechoic, although, rarely, crystalline debris may be seen circulating in the urine. Bladder calculi have been reported in marine mammals and should present as mobile foci with highly echogenic, curved surfaces and marked distal acoustic shadowing.

### Reproductive Tract

As for many species, much of the available literature about reproductive tracts relates to the use of ultrasound during pregnancy (Leopold, 1977; Stone et al., 1984; Williamson et al., 1990; Taverne, 1991; Young and Grantmyre, 1992; Barr et al., 1994; Brook et al., 1994; Brook, 1994; Jensen, 1999; Stone et al., 1999; Van Bonn, 1999). Sonographic appearances of the reproductive tract in the male (Brook et al., 1991; 1996; Brook, 1997; 1999) and female (Brook et al., 1992; 1994; 1996; 1999; Robeck et al., 1998) bottlenose dolphin have also been documented.

#### Males

Ultrasound can be used to examine the intra-abdominal testes, epididymes, vasa deferentia, penis, bulbourethral and bulbocavernosol muscles in dolphins, and the scrotum and its contents in the California sea lion (*Zalophus californianus*). Phocids have a scrotal structure, but inguinal testes, which are not accessible for transcutaneous examination.

Dolphin testes are situated in the caudal abdomen, approximately midway between the midline and the ventral edge of the hypaxial muscles. They are easily located and assessed using ultrasound. The testes are elliptical and elongated, with a well-defined border (Figure 20, left). In cross section the testes are rounded (Figure 20, right). Testicular length increases dramatically during the

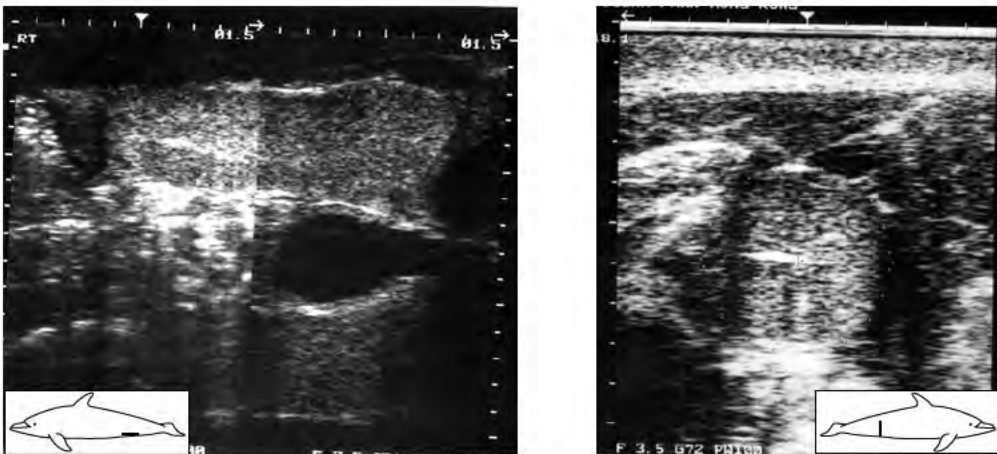


FIGURE 20 (Left) Coronal/dorsal scan showing longitudinal section, and (right) transverse scan showing transverse section of mature dolphin testes. Note small parenchymal cysts in the right image; these are common and usually resolve spontaneously.

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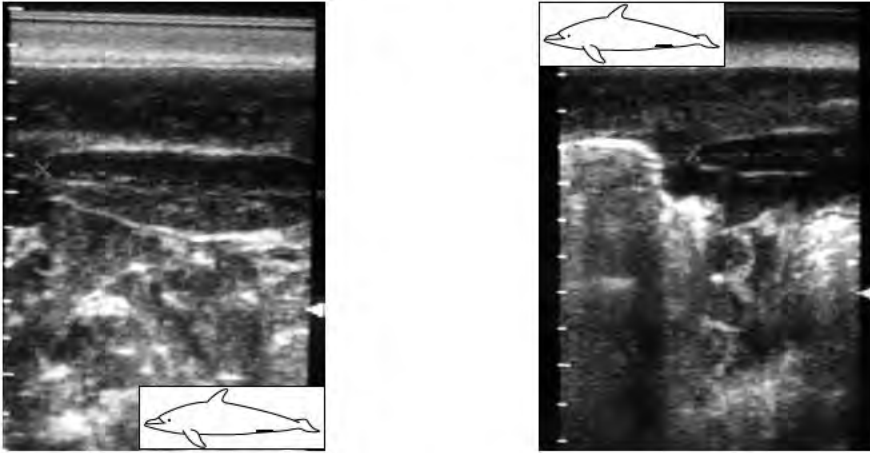


FIGURE 21 Coronal/dorsal scans showing longitudinal section of the testes in (left) a subadult and (right) a juvenile bottlenose dolphin. The partially filled, oval urinary bladder is seen in the midline in the right image.

process of sexual maturation and does not appear to regress in those species without a clearly defined seasonal breeding pattern, such as the bottlenose dolphin, false killer whale (*Pseudorca crassidens*), and killer whale (*Orcinus orca*).

Three distinct sonographic patterns can be seen in dolphin testes, and these can be used to estimate reproductive status (Brook, 1997; Brook et al., 2000). Mature testes are homogeneous and moderately to highly echogenic. This is the characteristic appearance of mature testes seen in many species of mammal. A lobular pattern may be visible in the parenchyma of older animals (Figure 20, left).

The sonographic appearance of the testicular parenchyma in subadults is less well defined (Figure 21, left). The parenchymal echopattern is homogenous, but less echogenic than in mature animals. Immature testes are relatively small, and the testicular parenchyma is hypoechoic and poorly differentiated (Figure 21, right). The epididymis is clearly visualized, from the triangular head at the cranial end to the dilated and convoluted distal end, where it is not possible to distinguish where the epididymis joins the vas deferens. In mature males, rounded protrusions of convoluted tubules may be seen adjacent to the epididymis. The reported incidence of pathology of the dolphin reproductive tract is low, with orchitis apparently the most common disorder. Changes in size, shape, and/or sonographic appearance of the testicular parenchyma should be detectable if orchitis is clinically suspected. This usually presents focal areas of decreased echogenicity. Small, simple cysts, probably due to obstruction of tubules, may occasionally be seen within the testes (Figure 20, right); these usually resolve spontaneously.

Sonographic examination of the male reproductive tract in pinnipeds is more of a challenge and usually requires sedation. Scrotal swelling is not uncommon in pinnipeds and ultrasound is very useful to identify scrotal edema (Figure 22), or hydrocele, or to detect testicular lesions.

### Females

The ovaries in cetaceans are relatively superficial, tucked high in the dorsolateral aspect of the abdomen, to lie in the angle formed by the hypaxialis lumborum (hlm) and rectus abdominus (ram) muscles, against the wall of the abdominal cavity, at a variable distance from the genital slit. There is a palpable depression in the flank where these muscles meet, which can also provide a guide to transducer placement. The transducer is held in the transverse position and placed at the junction of the hlm and ram, at the midpoint of the genital slit, then moved cranially until the transverse axis of the ovary is identified (Figure 23, left). The transducer can



FIGURE 22 Sagittal scan through the distended scrotum of a fur seal (*Callorhinus ursinus*) showing massive edema.

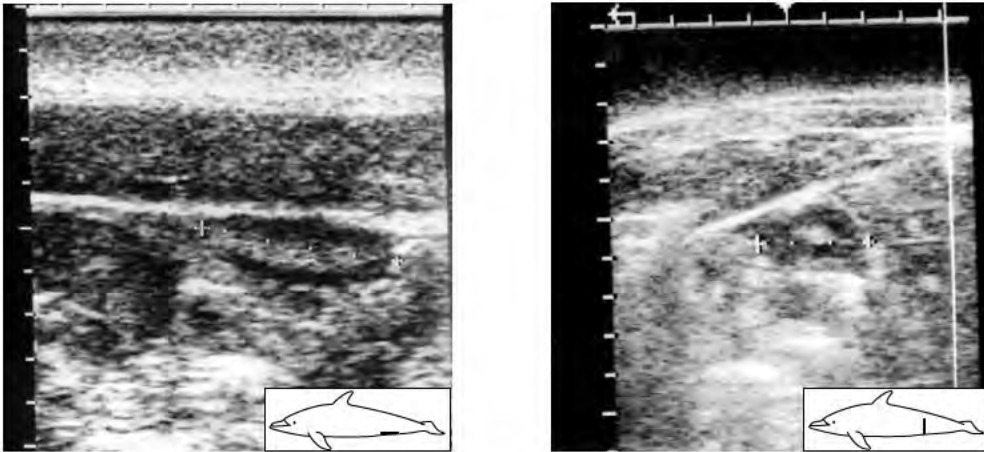


FIGURE 23 (Left) LS and (right) transverse section images of the ovary in a bottlenose dolphin. Note smaller follicle in the right image.

then be rotated 90° to visualize the long axis of the ovary (Figure 23, right). It may be necessary to angle the transducer slightly dorsally. The position of the ovary varies quite widely, and they may be seen anywhere from the caudal pole of the ipsilateral kidney down to the level of the uterine body. This variation in position is particularly seen in females that have given birth, and is likely due to loss of integrity of suspensory structures.

It is possible routinely to identify and assess the ovaries of all species of cetaceans studied, including harbor porpoises (*Phocoena phocoena*), bottlenose dolphins, white-sided dolphins (*Lagenorhynchus obliquidens*), belugas (*Delphinapterus leucas*), false killer whales, and killer whales (Figure 24). To the authors' knowledge, there is no report of the sonographic appearance of the ovaries in any pinniped.

Sonography can be more difficult in larger, older, or fatter females, or when ovaries are inactive due to lactation or prolonged periods of anestrus, yet visualization can usually be achieved with perseverance. The ovarian cortex in older females is generally more echogenic than in younger animals, and the outline is more irregular. In the long axis, a double, echogenic "tram line" appearance, representing the reflections of the mesovarium in the

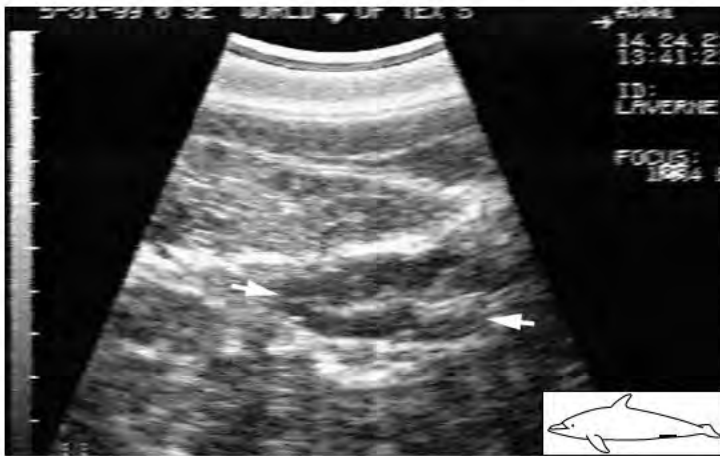


FIGURE 24 LS images of the ovary in (top) a killer whale and (bottom) a white-sided dolphin. (Image credits: T. Robeck.)

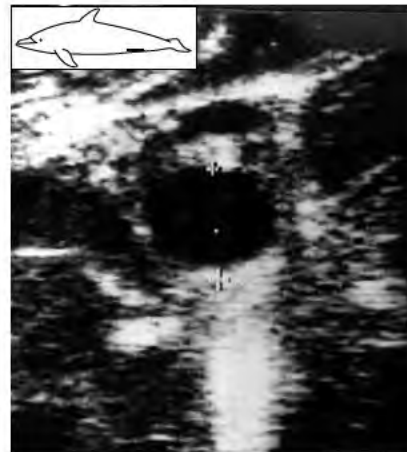
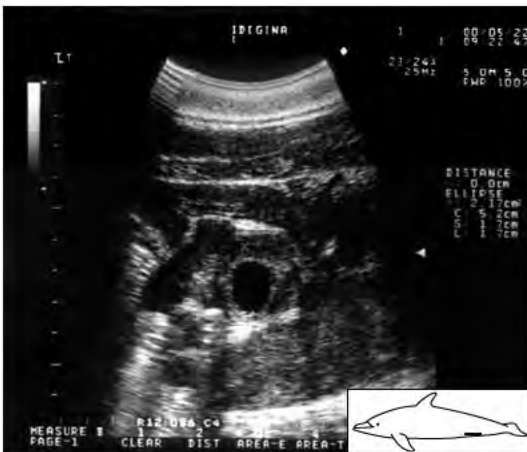


FIGURE 25 Sonographic appearance of follicles in bottlenose dolphins. Note thickened, hyperechoic wall in the left image. This developed into an anovulatory follicular cyst of 5.0-cm diameter before spontaneous resolution. Multiple follicular development seen in the right image is common, especially in older females.

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hilum, is a useful marker for identifying the ovary (see Figures 23 and 24). Small, echolucent areas seen within the hilum of some ovaries may represent blood or lymphatic vessels. Free fluid occasionally seen within the hilum represents normal peritoneal fluid. Small, quiescent, antral follicles as large as 4 mm in diameter are occasionally seen, whether a dolphin is exhibiting ovarian activity or not. Developing follicles are always prominent and easily identifiable by ultrasonography, even in older and larger dolphins, when it is sometimes difficult to distinguish the ovary clearly. A developing follicle presents the classic, rounded, cystic appearance seen in most mammals (Figure 25).

The corpus luteum (CL) can also be seen and monitored. The usual appearance of a CL in a nonconceptive cycle is a rounded, solid mass with unclear margins at the site of the ruptured follicle, which may appear isoechoic or slightly more echogenic than the ovarian parenchyma. Rarely, a nonconceptive CL may appear hypoechoic. Hypoechoic CLs can be distinguished from follicles by their larger size, thicker walls, and lack of distal acoustic enhancement. CLs of pregnancy in bottlenose dolphins tend to be larger than those of nonconceptive cycles, and appear hypoechoic, organized, and more regular in outline. This appearance is a useful sign for diagnosis of early pregnancy before the conceptus is visualized. Occasionally, and particularly if associated with pregnancy, the CL may cavitate (Figure 26).

The use of ultrasound to monitor the ovarian cycle in dolphins has added much to knowledge of reproductive physiology in some species and has allowed the application of controlled, selective breeding programs and artificial insemination (see Chapter 11, Reproduction).

Pathology of the ovaries, including ovarian carcinoma, mucinous cystadenoma, and granulosa cell tumors, has been reported in cetaceans (Cockrill, 1960), and ovarian cysts (Munson et al., 1998; Robeck et al., 2000) are not unusual. Fibromyoma appears to be the most commonly identified uterine abnormality (Cockrill, 1960).

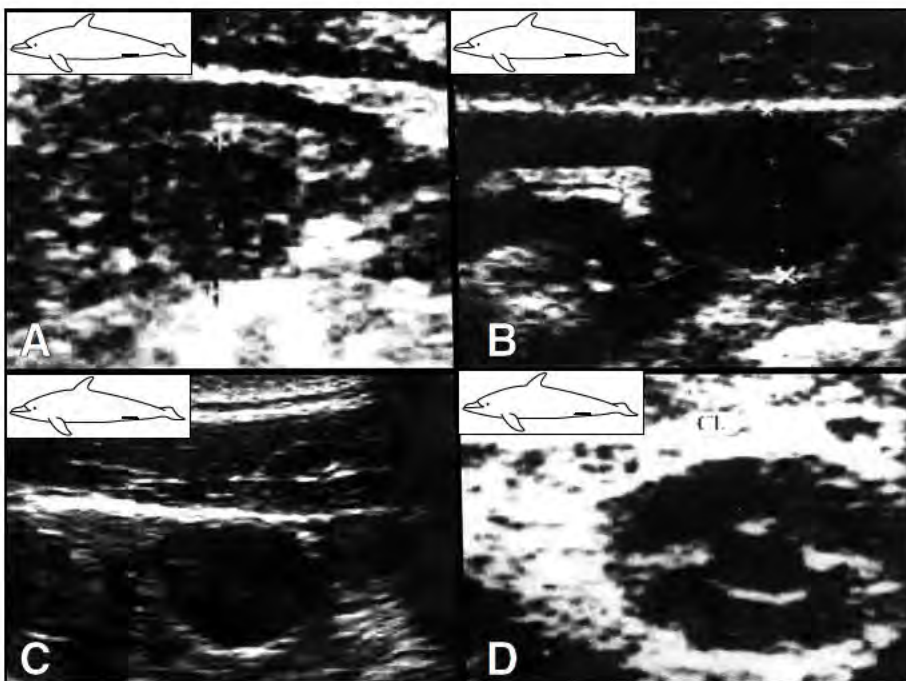


FIGURE 26 Sonographic appearances of CLs in bottlenose dolphins (*T. t. aduncas*): (A) CL of a nonconceptive cycle; (B) persistent, “cystic” CL (note lack of acoustic enhancement behind); (C) CL of early pregnancy (2 to 3 weeks gestation); (D) cavitated CL in later pregnancy (26 weeks).

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To examine the uterus, the transducer is placed in the longitudinal plane, just above the genital slit and moved dorsally until the cervix can be visualized lying just dorsal to the urinary bladder. The transducer is then moved cranially, with short dorsoventral sweeps to examine the uterine body and ipsilateral horn. Again, the procedure is repeated for the other side. The uterine cervix can be seen to angle dorsally, immediately behind and/or to one side of the urinary bladder. There may be mucus present in the cervical canal, which may delineate the internal architecture and allow visualization of the pseudocervix and spermothechal recess.

The uterus is bicornuate and relatively large and the uterine horns curve backward along their length, toward the ovaries. The uterus is usually surrounded by gut, and therefore not always easy to examine. The normal uterus is soft and very malleable, with a thin, poorly demarcated myometrium. It presents as an amorphous, soft tissue "mass" on ultrasonography. Sections of the endometrium may also be seen. Further study is required to be able to characterize the ultrasonographic appearance of the endometrium in all species and to compare changes during periods of ovarian activity. Sonography of the pregnant uterus is described in Chapter 11 (Reproduction).

## Eyes

B-mode ultrasonographic examination of the eye has been performed in veterinary medicine for more than two decades, and there are numerous references about sonographic ophthalmic techniques and appearances of intraocular and retrobulbar pathology in the literature (Johnston and Feeney, 1980; Dziezyc et al., 1987; Fielding, 1987; Nyland and Mattoon, 1995). This technique can also be used for examination of marine mammals (Cartee et al., 1995) using a standard ultrasound unit, in conjunction with a 7.5- to 10-MHz transducer. A 5-MHz transducer may be needed for the orbit. Scanning is performed through the eyelid, using an acoustic coupling gel. Both pinnipeds and dolphins can be examined without anesthesia if trained to station for examination. In the authors' experience, direct contact with the corneal surface of the eye, as carried out for small animals, is not as acceptable to marine mammals. Indications for eye sonography include trauma, photophobia, retraction of the globe, complete or partial closure, or any ocular opacity.

A transonic standoff pad is useful for examination of the cornea, anterior chamber, or eyelids, and improves visualization of the lens, as it decreases reverberation artifacts in the near field. Full sagittal and transverse scans of both eyes for comparison need to be carried out. The transducer is placed on the optic axis and then "swept" in an arc across the whole globe. There are no established normal axial measurements for these species. Retinal detachments (Figure 27), intraocular hemorrhage, subluxation of the lens, and lacrimal gland hyperplasia (Figure 28) have been demonstrated using this technique in marine mammals.

## Musculoskeletal System

Ultrasonography is an ideal method for diagnosing and monitoring muscular injury, and can also be used to evaluate superficial skeletal structures. This can be very useful when radiography is not available or even, in some cases, to add further information when non-specific radiological abnormalities are found. Muscle pathology, particularly abscess formation, is common in cetaceans (Brown et al., 1960; Cockrill, 1960) and may have serious consequences. Abscesses, granulomas, osteolytic lesions (Figure 29) and fractures have all been diagnosed in dolphins using sonography.

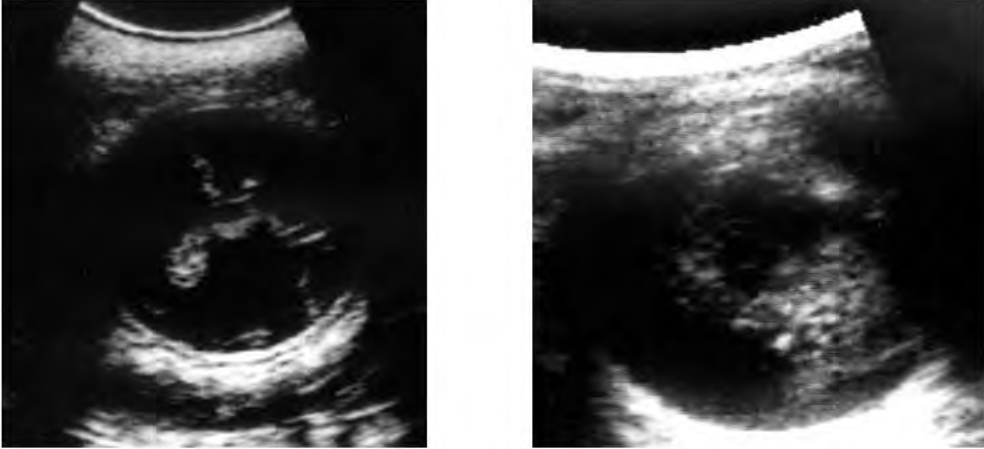


FIGURE 27 Retinal detachments shown in a (left) California sea lion (*Z. californianus*) and (right) bottlenose dolphin (*T. truncatus*).



FIGURE 28 Sonographic images of (top) collapsed globe with subluxation of the lens, retinal detachment, and hemorrhage and (bottom) lacrimal gland hyperplasia in an elderly male *T. t. aduncas*.

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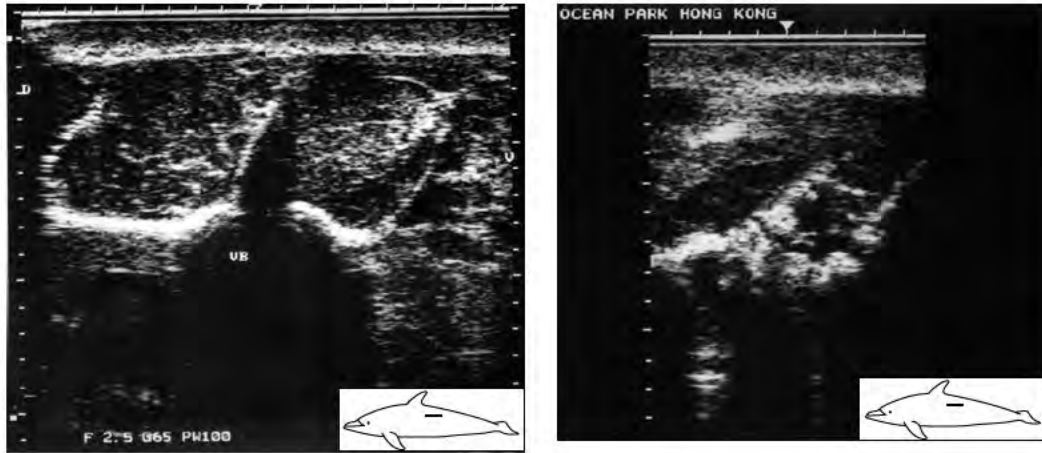


FIGURE 29 Sonographic appearance of (left) normal vertebral body and spinous process and (right) severe spondylitis and degeneration resulting from *Staphylococcus aureus* infection.

### Body Condition

Sonography is an excellent means of measuring and tracking blubber and subcutaneous adipose tissue thickness. It is important that the site of determination be standardized between examinations in a given individual, and between individuals, if inferences are to be drawn about differences. The blubber and subcutaneous fat layers tend to be thickest in the cervical region of cetaceans, and if one site is to be chosen, this may be the most valuable. However, this site is also very dynamic, and correlations with factors such as caloric intake, age, gender, season, and water temperature have not been completely tested to date, but hold promise as excellent indicators of body condition change.

### Conclusion

The use of ultrasonography in the care and management of marine mammals has increased during the last decade. Many now recognize it as being safe, noninvasive, cost-effective, and very valuable as a means of diagnosis and monitoring of many conditions in these large animals, often when other types of imaging are impossible or unavailable. Modern units are relatively inexpensive and image quality has improved dramatically. What is needed now is for more marine mammal clinicians to practice utilizing this technology and for those who already have to better share their experiences and the information they are gathering, so that others can utilize that experience to the benefit of the animals in their care.

### Acknowledgments

The authors thank all of the colleagues who work and have worked with them, facilitating their role as “imagers,” and Reimi Kinoshita and Natalie Rourke for reviewing this chapter.

### References

AIUM (American Institute of Ultrasound in Medicine), 1988, Bioeffects considerations for the safety of diagnostic ultrasound, *J. Ultrasound Med.*, 7: 51–53.

- Baker, J.R., 1992, Causes of mortality and parasites and incidental lesions in dolphins and whales from British waters, *Vet. Rec.*, 130: 569–572.
- Barr, L.L., Gillespie, D., Campbell, M.K., and Babcock, D., 1994, Prenatal sonography: A useful adjunct in the management of the gravid captive walrus (*Odobenus rosmarus divergens*), *J. Ultrasound Med.*, 13: 485–486.
- Bossart, G.D., Ewing, R., Herron, A.J., Cray, C., Mase, B., Decker, S.J., Alexander, J.W. and Altman, N.H., 1997, Immunoblastic malignant lymphoma in dolphins: Histologic, ultrastructural and immunohistochemical features, *J. Vet. Diagn. Invest.*, 9: 454–459.
- Brook, F.M., 1994, Ultrasound diagnosis of anencephaly in a bottlenose dolphin, *J. Zoo Wildl. Med.*, 25: 569–573.
- Brook, F.M., 1997, The Use of Diagnostic Ultrasound in Assessment of the Reproductive Status of the Bottlenose Dolphin, *Tursiops aduncas*, in Captivity and Applications in Management of a Controlled Breeding Programme, Ph.D. thesis, The Hong Kong Polytechnic University, Kowloon, Hong Kong, 339 pp.
- Brook, F.M., 1999, Sonographic ovarian and testicular evaluation in bottlenose dolphins, *Tursiops truncatus aduncas*, in *Proceedings of Bottlenose Dolphin Reproductive Workshop*, 207–222.
- Brook, F.M., Chow, D.C.M.A., and Schroeder, J.P., 1991, Ultrasound imaging of the reproductive tract of the male bottlenose dolphin, *Br. J. Radiol.*, 763: 645.
- Brook, F.M., Chow, D.C.M.A., and Schroeder, J.P., 1992, Ultrasound imaging of the reproductive tract of the female bottlenose dolphin, *Tursiops aduncas*, *Br. J. Radiol.*, 775: 628.
- Brook, F.M., Kinoshita, R., Chan, S.Y., and Hui, S.W., 1994, Sonographic assessment and monitoring of the reproductive status of the bottlenose dolphin, *Tursiops aduncas*, in captivity, Abstr., *Proceedings of the 4th Annual Conference on Southeast Asian Zoology*, 179.
- Brook, F.M., Kinoshita, R., Chan, S.Y., and Hui, S.W., 1996, Applications of sonography in controlled breeding of captive bottlenose dolphins at Ocean Park, Hong Kong, *Proceedings of the 6th Annual Conference on Southeast Asian Zoology*, 48.
- Brook, F.M., Kinoshita, R., Brown, B., and Metreweli, C., in press, Sonographic anatomy of the testes and epididymis of the bottlenose dolphin, *Tursiops truncatus aduncas*, *J. Reprod. Fertil.*
- Brown, D.H., McIntyre, R.W., Delli Quadri, C.A., and Schroeder, R.J., 1960, Health problems of captive dolphins and seals, *J. Am. Vet. Med. Assoc.*, 137: 534–538.
- Cartee, R.E., Brosemer, K., and Ridgway, S.H., 1995, The eye of the bottlenose dolphin (*Tursiops truncatus*) evaluated by B mode ultrasonography, *J. Zoo Wildl. Med.*, 26: 414–421.
- Cockrill, W.R., 1960, Pathology of the cetacea. Part 1, *Br. Vet. J.*, 116: 133–144.
- Cowan, D.F., 1994, Involution and cystic transformation of the thymus in the bottlenose dolphin, *Tursiops truncatus*, *Vet. Pathol.*, 31: 648–653.
- Cowan, D.F., 1995, Amyloidosis in the bottlenose dolphin, *Tursiops truncatus*, *Vet. Pathol.*, 32: 311–314.
- Duignan, P.J., Geraci, J.R., Raga, J.A., and Calzada, N., 1992, Pathology of morbillivirus infection in striped dolphins (*Stenella coeruleoalba*) from Valencia and Murcia, Spain, *Can. J. Vet. Res.*, 56: 242–248.
- Dziezyc, J., Hager, D.A., and Millichamp, N.J., 1987, Two-dimensional real-time ocular ultrasonography in the diagnosis of ocular lesions in dogs, *J. Am. Anim. Hosp. Assoc.*, 23: 501–508.
- Fielding, J.A., 1987, Ultrasound imaging of the eye through the closed lid using a non-dedicated scanner, *Clin. Radiol.*, 38: 131–135.
- Gray, K.N., and Conklin, R.H., 1974, Multiple births and cardiac anomalies in the bottlenosed dolphin, *J. Wildl. Dis.*, 10: 155–157.
- Howard, E.B., Britt, J.O., and Simpson, J.P., 1983, Neoplasms in marine mammals, in *Pathology of Marine Mammal Diseases*, Vol. 2, Howard, E.B. (Ed.), CRC Press, Boca Raton, FL, 95–162.
- Hykes, D.L., Hedrick, W.R., and Starchman, D.E., 1992, *Ultrasound Physics and Instrumentation*, Mosby Year Book, St. Louis, MO, 295 pp.
- Jensen, E., 1999, Early embryonic loss, in *Proceedings Bottlenose Dolphin Reproductive Workshop*, 273–278.

- Johnston, G.R., and Feeney, D.A., 1980, Radiology in ophthalmic diagnosis, *Vet. Clin. North Am. Small Anim. Pract.*, 10: 317–337.
- Laing, F.C., 1983, Commonly encountered artifacts in clinical ultrasound, *Semin. Ultrasound*, 4: 27–43.
- Leopold, G.R., 1977, Role of diagnostic ultrasound in evaluating pregnancy in *Tursiops truncatus*, in Breeding Dolphins; Present Status, Suggestions for the Future, Ridgway, S.H., and Benirschke, K. (Eds.), MMC report 76/07, 217–219.
- Migaki, C., Woodward, J.C., and Goldston, R.T., 1978, Renal adenoma in an Atlantic bottlenose dolphin (*Tursiops truncatus*), *Am. J. Vet. Res.*, 39: 1920–1921.
- Miller, R.M., and Ridgway, S.H., 1963, Clinical experiences with dolphins and whales, *Small Anim. Clin.*, 3: 189–193.
- Munson, L., Calzada, N., Kennedy, S., and Sorensen, T.B., 1998, Luteinized ovarian cysts in Mediterranean striped dolphins, *J. Wildl. Dis.*, 34: 656–660.
- Nyland, T.G., and Mattoon, J.S., 1995, *Veterinary Diagnostic Ultrasound*, W.B. Saunders, Philadelphia, 357 pp.
- Rawson, A.J., Patton, G.W., and Brooks, J.S., 1992, Lymphangiomyomatosis in the Atlantic bottlenose dolphin (*Tursiops truncatus*), *J. Wildl. Dis.*, 28: 323–325.
- Reeves, R.R., DeMaster, D.P., Hill, C.L., and Leatherwood, S., 1994, Survivorship of odontocete cetaceans at Ocean Park, Hong Kong, 1974–1994, *Asian Mar. Biol.*, 11: 107–124.
- Rhinehart, H., Townsend, F., Gorzelany, J., and Broecker, S., 1995, Ultrasound-aided thoracocentesis of a bottlenose dolphin, unreferenced paper.
- Robeck, T.R., McBain, J.F., Mathey, S., and Kraemer, D.C., 1998, Ultrasonographic evaluation of the effects of exogenous gonadotropins on follicular recruitment and ovulation induction in the Atlantic bottlenose dolphin (*Tursiops truncatus*), *J. Zoo Wildl. Med.*, 29: 6–13.
- Robeck, T.R., Jensen, E., Brook, F., Rourke, N., Rayner, C., and Kinoshita, R., 2000, Preliminary investigations into ovulation manipulation techniques in delphinids, in *Proceedings of Joint Meeting of the American Association of Zoo Veterinarians and the International Association for Aquatic Animal Medicine*, New Orleans, LA, 222–225.
- Sanders, R.C., 1998, *Clinical Sonography. A Practical Guide*, 3rd ed., Lippincott, Philadelphia, 613 pp.
- Stone, L.R., 1990, Diagnostic ultrasound in marine mammals, in *Handbook of Marine Mammal Medicine: Health, Disease and Rehabilitation*, Dierauf, L. (Ed.), CRC Press, Boca Raton, FL, 235–264.
- Stone, L.R., Phillips, B., and Sweeney, J.C., 1984, Diagnostic ultrasound of the bottlenose dolphin, *Abstr., Annual Proceedings of the American Association of Zoo Veterinarians*, 94.
- Stone, L.R., Johnson, R.L., Sweeney, J.C., and Lewis, M.L., 1999, Fetal ultrasonography in dolphins with emphasis on gestational aging, in *Zoo and Wild Animal Medicine. Current Therapy 4*, Fowler, M.E., and Miller, R.E. (Eds.), W.B. Saunders, Philadelphia, 501–506.
- Taverne, M.A.M., 1991, Applications of two-dimensional ultrasound in animal reproduction, *Wien. Tierärztl. Monatsschr.*, 78: 341–345.
- Thickman, D.I., Ziskin, M.C., Jacobs Goldenberg, N., and Linder, B.E., 1983, Clinical manifestations of the comet tail artifact, *J. Ultrasound Med.*, 2: 225–230.
- Van Bonn, W., 1999, Infectious diseases and late term abortions, in *Proceedings Bottlenose Dolphin Reproductive Workshop*, 279–288.
- Williamson, P., Gales, N.J., and Lister, S., 1990, Use of real-time B-mode ultrasound for pregnancy diagnosis and measurement of fetal growth rate in captive bottlenose dolphins (*Tursiops truncatus*), *J. Reprod. Fertil.*, 88: 543–548.
- Wislocki, G.B., 1929, On the structure of the lungs of the porpoise (*Tursiops truncatus*), *Am. J. Anat.*, 44: 47–72.
- Woodard, J.C., Zam, S.G., Caldwell, D.K., and Caldwell, M.C., 1969, Some parasitic diseases of dolphins, *Pathol. Vet. (Swiss)*, 6: 257–272.
- Young, J.S., and Grantmyre, E.B., 1992, Real-time ultrasound for pregnancy diagnosis in the harbour seal (*Phoca vitulina concolor*), *Vet. Rec.*, 130: 328–333.

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Sweet thank you! Yeah I just hope [REDACTED] machine is able to be used in a pool ;)

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**Sent:** 21 July 2021 12:01  
**To:** [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Orca calf updates

Ah you are amazing, thank you! 😊

Re the question to [REDACTED] about ultrasound – these guys are regularly scanned in the water overseas and works REALLY well! We can definitely put him in touch with the overseas teams to check their set ups but all appears to look normal from the many images I have seen. Animals are usually positioned on their sides or in a little animal like this would just reach under the water which makes for AWESOME contact and should result in pretty decent images.

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Wednesday, 21 July 2021 11:58 AM  
**To:** [REDACTED]  
**Subject:** RE: Orca calf updates

Thanks [REDACTED] Call me anytime if you need an urgent update. Have had a chat with [REDACTED] this morning and am basically planning on doing just/mostly orca work today (clinic permitting).

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
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---

**From:** [REDACTED]  
**Sent:** 21 July 2021 11:52

To: [REDACTED]@wellingtonzoo.com>  
Subject: RE: Orca calf updates

Morena! (just)

I think that sounds like exactly what she is after! Seems that have a 5PM round-table now to talk through logistics for the coming day (I presume). Will confirm today and go from there!

[REDACTED]

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From: [REDACTED]@wellingtonzoo.com>  
Sent: Wednesday, 21 July 2021 11:05 AM  
To: [REDACTED]  
Subject: RE: Orca calf updates

Sounds good!

Totally understand she has important reporting lines and that this information is essential for the planning team. Perhaps we could organise to get the information to her by 5pm with regards to: "releasable vs not releasable in the next 24 hours" and "any major developments", and follow up with the finer planning details at the email update later?

See you at 2pm!

:)

[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
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200 Daniell Street | Newtown | Wellington 6021  
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---

From: [REDACTED] >  
Sent: 20 July 2021 22:22  
To: [REDACTED]@wellingtonzoo.com>  
Subject: Re: Orca calf updates

Hello 😊

Ah great news!

I am going to have a chat with Kirstie tomorrow lunchtime. It was all a bit of a rushed phonecall tonight that she sprung that deadline on me so will have a chat and see what she NEEDS vs what she might like to have and see if we can come up with a happy medium if needed

Thank you again for all your work on his!

[REDACTED]



**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Tuesday, 20 July 2021 7:18 PM  
**To:** [REDACTED]>  
**Subject:** RE: Orca calf updates

Hullo hullo,

It looks like a vesicle to me, but no others anywhere and doesn't appear inflamed/infected, so I'm not immediately concerned. I think monitor for now.

Thanks for letting me know about Kirstie's daily deadline. Not sure how to best go about that, as sometimes it takes me as late as this in the evening to get time to sit down and really put together everything that has happened during the day and all the results that have come through into the inbox. Happy to take calls if you think that's best (I don't know much about your internal comms system), but also mindful that that is doubling up on information and comms a little bit. Does her data have to be super up to date, or can she work with the previous evening's report in the interim if I/we haven't got a report through by 5pm?

Thanks so much!

[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
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E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |

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**From:** [REDACTED]>  
**Sent:** 20 July 2021 17:19  
**To:** [REDACTED]@wellingtonzoo.com>  
**Subject:** Orca calf updates

Hi [REDACTED],

Sorry one more question – the “ulcer” by the blow hole... any thoughts on that?

I just had a chat to Kirstie and she has to update her boss at 5pm daily – so a slight change to the updates request. If it were possible to have vet updates by 5 that would be amazing (but I said I didn't want to put that pressure on you) suggested instead how about you and I (or your nominated other Welly Zoo vet contact) have a quick chat each afternoon (might have a think of some key questions to cover each day? Health concerns list, any new health concerns and a yay/nay release in next 24 hrs?) and I can fire the vet thoughts in brief up the chain before 5.

Let me know what you think!

😊 [REDACTED]

[REDACTED]  
Veterinary Advisor Kākāpō - *Kaitohutohu Rata Kararahe Kākāpō*

Department of Conservation - *Te Papa Atawhai*

Postal address: Department of Conservation, PO Box 743, Invercargill 9840, New Zealand

Physical address: Department of Conservation, Level 7, 33 Don Street, Invercargill 9480, New Zealand

<http://kakaforecovery.org.nz/>

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Wednesday, 21 July 2021 11:14 am  
**To:** [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** RE: Orca calf

Thanks [REDACTED], this is super useful.

The ~ daily urine tests are occasionally showing trace protein and low pH (~5), and seeing these reference ranges it looks like that's normal for the species. Reassuring news.

We've sent a slide of for a basic WCC today, and the team on-site are going to reattempt blood today – will let you know how they get on. Otherwise will probably re-attempt bloods ourselves tomorrow.

Kind regards,  
[REDACTED]

[REDACTED] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
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**From:** [REDACTED]  
**Sent:** 19 July 2021 17:52  
**To:** [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** Orca calf

Hi team,

Hope today has gone well. You may have already seen this report but it made for interesting reading if you haven't already read it (and sadly a very sudden ending.. but good to know just how quick they can crash...)  
<https://www.vin.com/apputil/content/defaultadv1.aspx?pId=11257&catId=32239&id=3863999>. Also here is a urinalysis summary for captives <https://www.vin.com/apputil/content/defaultadv1.aspx?id=3864796&pid=11257&>

Thanks [REDACTED] for sending the ZIMS report – am I right that he has only had one haematology so far? Assuming you will be looking to repeat that tomorrow? I was also wondering about a Serum Protein Electrophoresis if you could get enough blood volume (0.3ml serum to gribbles).

So much cool info out there on these guys... To be fair lots of the papers are written by the people we are directly in contact with which is insanely cool!!!

[REDACTED]

[REDACTED]  
*Veterinary Advisor Kākāpō - Kaitohutohu Rata Kararahe Kākāpō*

[REDACTED]

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**From:** [REDACTED]  
**Sent:** Wednesday, 21 July 2021 6:08 pm  
**To:** Kirstie Knowles; Elizabeth Heeg; Bronwyn Saunders; Sarah Owen; Kirsty Prior; Jack Mace  
**Cc:** Ian Angus  
**Subject:** RE: Veterinary update for orca calf 21/07/21

**Follow Up Flag:** Follow up  
**Flag Status:** Completed

Hi Kirstie,

Just to clarify he is not back in the sea pen they have just switched the water back over to sea water as opposed to the town supply that has been used since concerns of a sewage leak into the harbour.

---

**From:** Kirstie Knowles <kknowles@doc.govt.nz>  
**Sent:** Wednesday, 21 July 2021 6:07 PM  
**To:** Elizabeth Heeg <eheeg@doc.govt.nz>; Bronwyn Saunders <bsaunders@doc.govt.nz>; Sarah Owen <sarahowen@doc.govt.nz>; Kirsty Prior <kprior@doc.govt.nz>; Jack Mace <jmace@doc.govt.nz>  
**Cc:** Ian Angus <iangus@doc.govt.nz>; [REDACTED]  
**Subject:** Fwd: Veterinary update for orca calf 21/07/21

Today's vet update below.  
Didn't realise he was back in the sea pen.

Summary from [REDACTED] (DOC Vet):  
All stable, OK to release in next 24 hrs should opportunity arise assuming all goes well overnight. No major health concerns, no more Colic. Investigating NZ vet specialist help to look at eye and maybe abdominal ultrasound. Not due to major concerns but good to do if ongoing.

Kirstie Knowles  
Marine Ecosystems Manager  
Te Papa Atawhai - DOC

Note: I support flexible working and may be sending this out of usual office hours. I do not expect an out of hours response.

----- Forwarded message -----  
**From:** [REDACTED] <[REDACTED]@wellingtonzoo.com>  
**Date:** 21/07/2021 5:52 pm  
**Subject:** Veterinary update for orca calf 21/07/21  
**To:** HUHA Helping You Help Animals [REDACTED]  
<[REDACTED]@wellingtonzoo.com>, [REDACTED] <[REDACTED]@wellingtonzoo.com>, [REDACTED]  
<[REDACTED]@wellingtonzoo.com>, Ian Angus <iangus@doc.govt.nz>, Marine  
<marine@doc.govt.nz>, [REDACTED]  
<[REDACTED]@wellingtonzoo.com>, Kirstie Knowles <kknowles@doc.govt.nz>, [REDACTED]  
<[REDACTED]@wellingtonzoo.com>, ingrid [REDACTED], Daniel Warsaw [REDACTED] <[REDACTED]@wellingtonzoo.com>, [REDACTED]  
<[REDACTED]@wellingtonzoo.com>, [REDACTED] <[REDACTED]@wellingtonzoo.com>, Shanna Rose

[REDACTED]@wellingtonzoo.com> [REDACTED]@wellingtonzoo.com>

Cc:

Hi everyone,

A veterinary update on Toa from today.

## 1. Current medical findings

Lab tests:

- A blowhole culture taken 12/07/21 grew a light growth of E.coli and no fungi. This is of no clinical concern given the light growth and no signs of respiratory disease. It is likely that we'll repeat blowhole cultures throughout his time in care to monitor for trends.
- We are awaiting faecal results from samples submitted to the lab today: for parasitology, gram stain, salmonella culture and occult blood.
- A urine sample was collected and tested today:
  - USG today was 1.014. Some reference ranges for urine testing have been circulated amongst the vet teams (thanks Lydia!) which indicate that our urine testing results so far are normal for this species.
- Blood was taken today by the HUHA team (thank you!):
  - In house biochem: Generally of no concern. His blood urea nitrogen (BUN) has increased slightly above normal, but this is likely to do with having recently eaten a protein rich meal (= formula). This analyte also increases with kidney disease/dehydration, but all our other blood and urine tests indicate that he is well hydrated and his kidneys are functioning normally. There are some other minor deviations from normal which are of no clinical significance at this stage but which we will monitor the trends of over time.
  - CBC: will be sent to the lab tomorrow
  - Serum electrophoresis: will be sent to the lab tomorrow
  - Cholesterol/triglycerides: will be sent to the lab tomorrow
  - Some historical blood has been stored in our -80°C freezer.
- We are awaiting cytology and culture on eye discharge submitted to the lab today.

Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc). These are being monitored.
  - A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reduced in severity today. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- Girth measurement update:
  - On 16/07/21: length 2.12m, girth in front of dorsal fin 1.42m, girth behind dorsal fin 1.17m
  - On 20/07/21: girth at widest point in front of dorsal fin 1.42m, girth at widest point behind dorsal fin 1.17m, girth at pectoral fin insert 1.34m
  - Girth measurements have some limitations in their use to assess body condition, but these results indicate no immediate significant weight loss. We will continue to monitor this over time to assess his response to feeding and the success of feeding.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (regular today) and urination (observed today).

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Today the plan is to feed him 10x feeds of 50:50 formula to 50% vytrate at 1.5 hour-intervals. No colic or other signs of gut disease have been observed since overnight on Monday night/very early Tuesday morning.
  - This is a step back on our diet increases, with a plan to slowly increase again in future when his gut settles so that we can aim to meet his caloric requirements.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 22/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing/communicating.

He is still in the pool, but as of today (21/07/21) he is back in sea water.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

Ph

E ██████████@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) | 



From: [REDACTED]  
Sent: 20 July 2021 19:15  
To: 'HUHA Helping You Help Animals' [REDACTED]  
Cc: [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; 'Ian Angus' <iangus@doc.govt.nz>; 'Marine' <marine@doc.govt.nz>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; 'Kirstie Knowles' <kknowles@doc.govt.nz>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; 'Ingrid' <ingrid[REDACTED]>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>

Subject: Veterinary update for orca calf 20/07/21

Hi everyone,

A veterinary update on Toa from today. Please add anything I may have missed.

1. Current medical findings

Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected several faecal samples and these have been submitted for testing for parasitology, gram stain, salmonella culture and occult blood. We will let you know what these results show when we get them.
- A urine sample was collected and tested today:
  - USG today was 1.016 – despite some feeding difficulties in the last 24 hours, it looks like he is not currently dehydrated. We'll continue regular urine monitoring to look for any trends.
- One of our techs performed some water testing today. I will get the full numbers from her for this tomorrow, but I can give you interim findings in the meantime:
  - The chlorine level in the water is negligible. I think there was a misunderstanding here on my part I'm sorry, when I was told that he was in "chlorinated water", I thought you meant "swimming pool level chlorination", which would have been concerning. The level of chlorine in town supply water is much lower and should be fine in the interim if sea water is not available. Thank you for clarifying this today.
- We were not able to get much blood at all today, despite a few attempts. A drop of blood has been made into a blood smear to repeat an estimated white cell count, if the lab deems the size of this sample suitable.
  - We will return on Thursday to try to take some more blood for routine monitoring of his general condition.

Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc) but we have taken some photos today to allow us to monitor them over time.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. It is possible that this started around the time of his move to the pool, as his eyes appeared normal before then. One of the cetacean vets we have been talking with thinks this is of minimal concern, but an ophthalmologist that has been contacted would like us to double check a couple of things to make sure it is not of concern. The swelling has reduced somewhat in the last couple of days. He would not let us examine the eye itself today, he held his eyelids tightly shut when we tried to have a look. We'll get in touch with

some veterinary ophthalmologists in the lower north island and see what their availability is for a second opinion, and in the meantime we will keep monitoring for improvement of the swelling.

- Some clear mucous from the eye will be sent to the lab for cytology and culture (although worth noting that normal eye secretions from this species are clear and mucousy).
- There is a small blister on the skin near his blowhole, approximately 1cm in diameter. It contains apparently clear fluid and otherwise there is no inflammation surrounding it. It is the only such lesion that we could see on his skin today. As a result, we are not immediately concerned by this lesion but will continue to keep an eye on it with photos and observations.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Yesterday (19/07/21) he received 10x feeds of 800-1000ml (with feed consisting of a ratio of 1L formula to 0.4L 50% vytrate).
- His feeding schedule was delayed by a few things during the day yesterday, such that his last feed was given at 1am this morning. After this feed (and to a lesser degree after the 8pm feed) he showed signs of discomfort – rolling along his long axis, and sinking to the bottom of the pool. Over a period of time he passed 3 faecals (his first faecals for the preceding 24 hour period), after which his signs significantly reduced. By this morning's first feed he was behaviourally normal again. I think this is likely an indication that he was in discomfort from too much pressure in his belly from having recently fed and having not defaecated for a while. However another possible reason could be gut upset from diet increases, or a gut disease such as parasitism. As a result our plan today was:
  - Give just 50% vytrate for the first few feeds.
  - Introduce food again at 50:50 formula to 50% vytrate after the first few feeds and monitor (this is a step back on our diet increases, with a plan to increase again in future when his gut settles so that we can aim to meet his caloric requirements).
  - Send faeces for parasitology and a few other tests.
  - **Another thought please** is could we please try to keep 2 hours between feeds? I think his last feed before 1am was at midnight – perhaps this is an indication that a 1 hour feeding interval may be a bit much for him.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 21/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or we could cause quite significant gut upsets.

Additional medications:

- Today was his last day of enrofloxacin (antibiotic) injections.
- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

Formula prep has been handed over to the team on-site at Plimmerton Boat Club today:

- This was done in the hope that this will save all our teams time with regards to organising couriers to and from the zoo to pick up the diet. Let us know if it's not saving you time or if it is causing any other difficulties, we are very happy to take this role on for you again.
- Please also let us know well in advance if you need any of the ingredients topped up or replaced – some of these items will take us a few days to order in.

I have been asked for advice on how to safely increase the salinity for the pool that he is in. Please can you remind me of the dimensions and volume of the pool? With the current estimated whole pool turnover of every four hours, this is going to take a lot of salt. And with the tendency of large volumes of salt to sit on the bottom of pools and dissolve slowly, it is going to take some care to make sure that we don't raise the salinity too high. It may be quite difficult to get the balance right and will take careful monitoring. Will get in touch tomorrow with a plan.

I have received measurements of "107, 135, 134" today – can someone please let me know which of these are length/girth measurements etc?

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph [Redacted]  
E [Redacted]@wellingtonzoo.com | W www.wellingtonzoo.com

---

From: [Redacted]  
Sent: 19 July 2021 17:33  
To: HUHA Helping You Help Animals <[Redacted]>  
Cc: [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;  
[Redacted]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>;  
[Redacted] Kirstie Knowles <kknowles@doc.govt.nz>; [Redacted]  
ingric [Redacted]@wellingtonzoo.com>; [Redacted]  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>

Subject: RE: Veterinary update for orca calf 18/07/21

Hi everyone,

A shorter veterinary update on Toa from me today :)

As usual, Team HUHA and Whale Rescue please feel free to add to these updates!

1. Current medical findings

Lab tests:



- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Can take that from you tomorrow when we pop by to send it on to the lab.
- A urine sample was collected and tested today:
  - USG today was 1.018, and there was trace protein and no glucose on the urine dipstick. These findings are of no concern and we'll continue regular urine monitoring to look for any trends.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- As of tomorrow he can receive 100% formula (no additional vytrate). According to his requirements of 120-125kcal/kg/d, an estimated weight of 200kg and an estimated caloric content of the food of 1450kcal/L, he requires 16L of formula per day to meet his requirements. This could be divided into several feeds such as 10 x 1.6L feeds or 8 x 2L feeds over the day tomorrow – would that suit how he's currently feeding?
  - If he receives this volume, this should also meet his fluid requirements for the day.

A few quick questions please, as I didn't manage to get anyone on the phone today:

- How was his respiration/defaecation/urination today?
- How much volume did you get into him today formula-wise and vytrate-wise? Was this mostly by bottle or did you tube feed him again today?
- Did you see any signs of post-feed discomfort today?
- Did you see any other signs of gut upset? ie: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.
- We've started him on the oral de-gas medication (simethicone) today (19/07/21) that has been recommended by a few vets that have been involved in hand rearing of cetaceans to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

A few of us from the zoo will pop by tomorrow to:

- Take some repeat bloods.
  - Catch up with you about some of the physical exam findings, check in with how feeding is going, check in on a couple of monitoring parameters etc. If you'd like us to bring/check anything specific let me know!
  - Bring gear/recipes/instructions to hand over the formula prep.
3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
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From: HUHA Helping You Help Animals ██████████  
Sent: 18 July 2021 19:14  
To: ██████████ <██████████@wellingtonzoo.com>  
Cc: ██████████ <██████████@wellingtonzoo.com>; ██████████ <██████████@wellingtonzoo.com>;  
██████████ <ian.angus@doc.govt.nz>; Marine  
<marine@doc.govt.nz>;  
██████████; Kirstie Knowles <kknowles@doc.govt.nz>;  
ingric <██████████@wellingtonzoo.com>; ██████████ <██████████@wellingtonzoo.com>;  
██████████ <██████████@wellingtonzoo.com>; ██████████ <██████████@wellingtonzoo.com>;  
██████████ <██████████@wellingtonzoo.com>; ██████████ <██████████@wellingtonzoo.com>

Hi All.  
Thanks ██████████

Just to confirm that the Ingrid had the pool switched back to sea water thisafternoon.

Cheers  
[REDACTED]

On Sun, 18 Jul 2021, 5:55 pm [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)> wrote:

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversations or if you otherwise have anything to add!

Firstly thank you so much to everyone who worked so hard in such awful weather in the last couple of days, I thought of you often and I hope you managed to stay warm and dry in between caring for Toa.

#### 1. Current medical findings

Lab tests:

- The lab has unfortunately said that it can't run lactate on the type of sample that we've given them, but we can run it on the next sample we take using a patient-side machine that we can bring with us on the next blood sampling.
- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Will chat tomorrow about how we get that where it needs to be for analysis.
- A urine sample was collected and tested today:
  - USG today was 1.028, and there was +1 protein and +1 glucose on the urine dipstick. In some animals those dipstick findings can be abnormal, but we'll wait to see if they persist (in some species they can be normal, or at least explained by physiology rather than disease).

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

#### 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage. No significant abnormalities/changes of defaecation have been noted with introducing or increasing the diet.
- He has been observed to urinate in the last 24 hours.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).

- His daily caloric requirements are 120-125kcal/kg/d.
- Ultimately we would like him on just formula (no supplementary fluid), as this contains enough fluid to also meet his fluid requirements, but we've been advised to build up to that slowly, which is why his diet is changing a little every day at the moment.
- Today the feeding plan was 1L formula + 1.2L 50% vytrate for the first three feeds (2.2L total) and then 1.5L formula + 0.7L 50% vytrate for the second three feeds (2.2L total). (Total of 7.5L formula and 5.7L 50% vytrate for today).
  - HUHA team if you could fill us in on how you went with this that would be lovely :)
  
- **Tomorrow's feeding plan:**
  - **1.1L formula + 0.4L 50% vytrate per feed x 8 feeds at 2 hourly intervals**

**(total of 8.8L formula and 3.2L 50% vytrate).**
  
- We've had to make a few changes to his feed schedule to get to the feeding plan for tomorrow:
  - He has been showing signs of discomfort after tube feeding – sinking to the bottom of the pool and hunching slightly.
    - This may be due to discomfort due to the volume fed - hence smaller meals tomorrow – fed more frequently so that we still try to meet his requirements.
    - Or it may be due to discomfort from the tubing. The cetacean vets that we've been taking advice from say that bottle feeding him would be a good alternative. They say it may contribute to habituation, but that so does being near to humans and being handled for tubings/treatments etc, so they are not concerned about the bottle feeding on its own per se.
    - A bottle set up has been trialled today with moderate success. The signs of discomfort that were seen post-tubing have not been seen after bottle feeding.
- A few pointers from the cetacean vets:
  - Please make sure he's not gulping air while feeding – this can cause colic and discomfort.
    - They've recommended a de-gas medication be added to the feeds, I will source this asap and let you know when it's ready.
  - Please make sure he's not gulping water while feeding – too much sea water ingestion can affect his electrolyte levels and make him sick.
  - We/you can consider supplement feeding him with tube feeding if some of his bottle feeds are less productive than others.
  - They prefer him to have a break from feeding overnight to allow him to rest, so they do not advise feeding constantly over a 24 hour period at this stage.
- An important piece of information that I received today is that orca abdomens do not expand very easily compared to other mammals. As a result, a build up of anything in the abdomen increases the pressure in the abdomen rather than causing abdominal distension. So a build up of gas can very quickly become uncomfortable, as can ingesting volumes that are too large – so perhaps this is the reason we're seeing some discomfort after tubing.
- Please continue to monitor him for signs of gut upsets: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Today it was noted that some of the volunteers were encouraging him to suck on their thumbs as they thought this might help with feeding. Thank you Whale Rescue and HUHA for realising this was happening and for advising them to stop :)

Due to the suspected/confirmed (?) sewage spill at Plimmerton due to the horrible weather this weekend the team recently changed his pool from salt water to chlorinated water. Please could we change this to fresh water or back to sea water if the Plimmerton sea water is okay again? It was a good idea to change from sea water when the sewage problem was reported, but fresh water is much better for him than chlorinated water, which could negatively affect his skin and eyes.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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From: [Redacted]@wellingtonzoo.com>

Sent: 17 July 2021 16:35

To: [Redacted]@wellingtonzoo.com>; [Redacted]

[Redacted]@wellingtonzoo.com>; [Redacted]

Ian Angus <iangus@doc.govt.nz>; Marine

<marine@doc.govt.nz>; [Redacted]

Cc: HUHA Helping You Help Animals [Redacted];

ingrid [Redacted];

[Redacted]@wellingtonzoo.com>;

[Redacted]@wellingtonzoo.com>;

[Redacted]@wellingtonzoo.com>;

[Redacted]@wellingtonzoo.com>; [Redacted]

[redacted]@wellingtonzoo.com>

**Subject:** RE: Veterinary update for orca calf 15/07/21

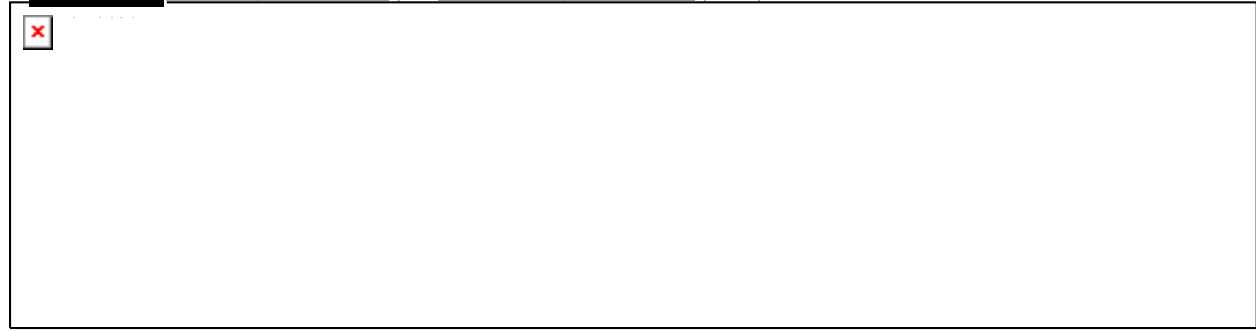
Hey all, quick update from me today.

- Toa is going really well according to personnel on site – accepting feeds well, and no gastrointestinal comfort seen
- There is possibly a sewerage pipe burst somewhere near the bay, so concerns re: water quality. HUHA vet [redacted] is organising water testing.
- [redacted] got a urine sample and USG this morning of 1.017
- [redacted] mentioned possibly some oedema around caudal oropharynx/throat area (possibly from repeat tubing?) so would like to keep bottle feeding as a back up option in case tubing needs to be abandoned. Toa is currently showing no signs of discomfort or distress during tubing, tolerates it very well. We can check this when we are next on site as well, but in the meantime if HUHA vets can keep a close eye on that please 😊
- We are going to continue upping the ratio of formula to vytrate, so please see the attached feeding schedule for 18/07/21 – there is no hard copy of this, I'm sorry. Had not gotten it printed off before the food was collected this afternoon. At this rate he should be on 100% formula from Monday afternoon, and we can look at making the formula richer or increasing volume if we need to increase caloric intake.
- We will organise a day early next week to revisit Toa to take a repeat blood sample
- I am going to be off for the next two days, but [redacted] is here tomorrow and [redacted] will both be here on Monday

Thanks again (and again and again) for everyone's hard work and dedication especially in the horrible conditions today.

[Me tiaki, kia ora!](#)

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**From:** [redacted]@wellingtonzoo.com>

**Sent:** 16 July 2021 17:02

**To:** [redacted]@wellingtonzoo.com>; [redacted]

[redacted] Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [redacted]

**Cc:** HUHA Helping You Help Animals [redacted] [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com)>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>

**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again, slight update to tomorrow's feed schedule (see attached).

BA DVM

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200 Daniell Street | Newtown | Wellington 6021  
E [\[REDACTED\]@wellingtonzoo.com](mailto: [REDACTED]@wellingtonzoo.com)

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**From:** [REDACTED]  
**Sent:** Friday, 16 July 2021 4:07 pm  
**To:** [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED]  
[REDACTED] <[ianangus@doc.govt.nz](mailto:ianangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [REDACTED]  
**Cc:** HUHA Helping You Help Animals <[ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again to everyone!

Thank you all for your amazing continued care of the little calf! I'm just continuing on with a further update on how Toa is doing following the discussion from earlier this afternoon. I'll try to only include new information in this update. Please add anyone I may have forgotten to include!

Due to the change in weather, Toa was moved into a temporary pool yesterday around 5 PM. The move went smoothly and took 20-30 minutes. There have not been any changes noted in his behaviour since changing to the pool and his medical treatments and tubings are taking place at the same intervals. At the moment there is no filtration system in place so, as an alternative, the pool is being continuously filled with sea water via a pump and draining out excess water through holes in the side. The plan is to only keep Toa in the pool until it is safe enough to return him to the sea pen.

As we have increased the concentration of formula being fed, it was observed that Toa is beginning to show a few signs of abdominal discomfort immediately after feeds. He will cramp up and sink to the bottom of the pool briefly. This began last night and happened again this afternoon. In order to hopefully combat this we have come up with the solution of feeding him more frequently throughout the day (every 2 hours instead of every 4) so that he is getting smaller volumes of formula at each feed (but will still receive the same total daily volume). We will still try to increase his volume of formula fed by 50% each day in order to start increasing his caloric intake. It has been difficult to assess the frequency and consistency of his faecal output due to the murkiness/turbulence of water from weather. With increased

In terms of ongoing monitoring, we will continue to do what [REDACTED] has already discussed (semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour) but may also consider adding in blow hole chuff cultures at least once but could repeat if any indication (we need to source the appropriate petri dish to collect these and confirm with Gribbles how it will need to be submitted), urine samples from first thing in morning prior to tubing to check UA and USG (this could be less frequent, maybe every 3 days or so), and body length and girth measurements (and possibly weights! if a suitable scale setup can be sourced

which Ingrid is looking into). The body length, girth and weight measurements will be incredibly helpful both in helping to confirm an age and in ongoing monitoring of nutritional status.

For fluids and feedings tomorrow the plan is to give 700 ml formula with 1.5 liters 50% vytrate at 8 AM, 10 AM, and 12 PM. Then for the 2 PM, 4 PM, and 6 PM feeds he can receive 1 liter formula with 2 liters of 50% vytrate. (Total formula volume will be 5 L tomorrow compared to 3.5 liters today, a ~50% increase in volume). I'll email out a feed schedule sheet separately in case it is helpful. 😊 This will increase the total fluid volume he gets during the day by 3 liters but will still be within his recommended fluid needs of 40-80 ml/kg/day. If he is continuing to show signs of discomfort after any of these feedings please get in touch. [REDACTED] will be at work tomorrow at the zoo so can be reached if needed.

For medications, Toa received his last dose of steroid today. There is no need to continue on with steroid treatment at this time. He is still receiving enrofloxacin 5 mg/kg BID which he started Wednesday morning (14/7/21). This is due to last 7 days, finishing after his dose on the evening of 20/7/21.

We are still awaiting results from the veterinary laboratory for samples taken Monday:

- Lactate, blow hole swab culture (fungal and bacterial).

1. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

2. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thank you so much to everyone for all your dedication and care! Looking forward to seeing you and Toa in person again soon!



E [redacted]@wellingtonzoo.com

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From: [redacted]  
Sent: Thursday, 15 July 2021 6:32 pm  
To: [redacted]@wellingtonzoo.com>; [redacted] Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [redacted]  
Cc: HUHA Helping You Help Animals [redacted] ingrid [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>  
Subject: Re: Veterinary update for orca calf 15/07/21

Hi [redacted]

Thank you again for another comprehensive update! Sounds like all is stable which is great news.

Thank you to the wider team as well for all your hard work with this little calf.

Kindest regards,

[redacted]

---

From: [redacted]@wellingtonzoo.com>  
Sent: Thursday, 15 July 2021 6:01 PM  
To: [redacted]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [redacted]  
Cc: HUHA Helping You Help Animals [redacted]; ingrid [redacted] <ingrid [redacted]>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>  
Subject: Veterinary update for orca calf 15/07/21

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!

1. Current medical findings

Lab tests:

- We have a few results back from the lab:
  - Complete blood count and blood parasite check – normal (but see below)
  - Fibrinogen levels (one way of testing for inflammation) – normal
  - Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - Total blood iron levels – normal
  - The lab’s interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we’ll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Lactate, blow hole swab culture (fungal and bacterial).

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We’ll await further lab results.

The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.
  - Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!).

Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).

- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

#### Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

#### Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

#### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

#### 4. Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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---

**From:** [Redacted]  
**Sent:** 14 July 2021 18:47

**To:** [Redacted]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz); [Redacted]

**Cc:** HUHA Helping You Help Animals >; [ingrid@\[Redacted\].wellingtonzoo.com](mailto:ingrid@[Redacted].wellingtonzoo.com); <[\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>; [\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>; [\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>; [\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>; [\[Redacted\]@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com)>

**Subject:** Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

## 1. Medical findings

### Lab tests:

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also will several deep lacerations near his tail fluke laterally to his spine.
- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

### Fluids:

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

Feeding:

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



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**From:** ██████████  
**Sent:** 13 July 2021 15:47  
**To:** ██████████  
██████████ [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz)  
**Cc:** HUHA Helping You Help Animals ██████████ [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); ██████████ [wellingtonzoo.com](mailto:wellingtonzoo.com);  
██████████ [@wellingtonzoo.com](mailto:wellingtonzoo.com)>; ██████████ [wellingtonzoo.com](mailto:wellingtonzoo.com)>;  
██████████ [@wellingtonzoo.com](mailto:wellingtonzoo.com)>; ██████████ [@wellingtonzoo.com](mailto:wellingtonzoo.com)>; ██████████  
<██████████ [@wellingtonzoo.com](mailto:wellingtonzoo.com)>; ██████████ [@wellingtonzoo.com](mailto:wellingtonzoo.com)>  
**Subject:** Veterinary update for orca calf 13/07/21

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet ██████████ from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by ██████████ also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,



**[REDACTED] BSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph [REDACTED]  
E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |

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[REDACTED]

**From:** Kirsty Prior  
**Sent:** Wednesday, 21 July 2021 9:20 pm  
**To:** Kirstie Knowles; Jack Mace; Sarah Owen; Bronwyn Saunders; Elizabeth Heeg  
**Cc:** Ian Angus; [REDACTED]  
**Subject:** RE: ACTION: Water quality recommendations for orca calf

Roger that Kirstie,

I'll get back to you with water flow levels

- Shade for day
- and noting the low light requirements for night

Cheers,

Kirsty

---

**From:** Kirstie Knowles <kknowles@doc.govt.nz>  
**Sent:** Wednesday, 21 July 2021 6:39 pm  
**To:** Kirsty Prior <kprior@doc.govt.nz>; Jack Mace <jmace@doc.govt.nz>; Sarah Owen <sarahowen@doc.govt.nz>; Bronwyn Saunders <bsaunders@doc.govt.nz>; Elizabeth Heeg <eheeg@doc.govt.nz>  
**Cc:** Ian Angus <iangus@doc.govt.nz>; [REDACTED]  
**Subject:** ACTION: Water quality recommendations for orca calf

Kirsty - please note the requested site actions in here from the chief vet....

Kirstie Knowles  
Marine Ecosystems Manager  
Te Papa Atawhai - DOC

Note: I support flexible working and may be sending this out of usual office hours. I do not expect an out of hours response.

----- Forwarded message -----

**From:** [REDACTED] <[REDACTED]@wellingtonzoo.com>  
**Date:** 21/07/2021 3:59 pm  
**Subject:** Water quality recommendations for orca calf  
**To:** 'HUHA Helping You Help Animals' [REDACTED] <[REDACTED]@wellingtonzoo.com>, [REDACTED] <[REDACTED]@wellingtonzoo.com>, [REDACTED] <[REDACTED]@wellingtonzoo.com>, Ian Angus <iangus@doc.govt.nz>, Marine <marine@doc.govt.nz>, [REDACTED] <[REDACTED]@wellingtonzoo.com>, Kirstie Knowles <kknowles@doc.govt.nz>, [REDACTED] <[REDACTED]@wellingtonzoo.com>, ingrid [REDACTED] <[REDACTED]@wellingtonzoo.com>, [REDACTED] <[REDACTED]@wellingtonzoo.com>, [REDACTED] <[REDACTED]@wellingtonzoo.com>, [REDACTED] <[REDACTED]@wellingtonzoo.com>

**Cc:**  
Hi everyone,

With Toa currently housed in a pool set up, we need to consider and closely monitor water quality to maintain his health and welfare. Poor water quality can adversely affect his health.

Pool water testing results on 20/07/21:

- pH 7.56
- Nitrates 0 ppm
- Nitrites 0 ppm
- Salinity 439ppm
- Carbonate hardness 35.8ppm
- Free chlorine 0.05mg/L
- Total chlorine 0.4mg/L
- Combined chlorine (total chlorine-free chlorine) 0.35mg/L

These results are consistent with town tap water supply and show no water quality issues. This chlorine level is much lower than “swimming pool chlorine levels”, and is probably negligible from a health perspective. Since then he has been switched back onto sea water in the pool.

“Increased skin sloughing has been observed in animals reared in fresh water when moved between sea water and fresh water” according to our marine mammal medicine textbook. Please monitor him for this in general, and bear this in mind for future planning with regards to moving him to/from the sea/pool – ie minimising moves where possible is likely better for his skin health.

My understanding is that the pool water quality is being managed by pumping water into the pool with large hoses, and letting the pool overflow old water as new water is pumped in. The hoses work intermittently (for enrichment/noise purposes?) and I’ve been advised that the current rate of flow should turn over the whole pool volume every four hours. The pool volume has been estimated at 32,000L.

- Can someone please check in with the fire response team to see if this is all correct?

Faeces and urine passed by Toa are organic matter. With time/bacterial action/chemical breakdown, this organic matter will become ammonia. Marine mammals can tolerate higher ammonia levels than fish but if the levels get too high this will be toxic.

- The current rate of overflow/water turnover that you are achieving with the hoses should be good enough to keep levels of ammonia low. But careful monitoring will be important.
- In a closed pool system (ie with pumps/filters rather than our overflow system), it is recommended that daily water quality checks of pH, chlorine levels, NO<sub>3</sub> (nitrate), NO<sub>2</sub> (nitrite), and NH<sub>3</sub> (ammonia) should be conducted and trends should be monitored.
  - In a rapidly overflowing system like ours, water tests 2-3 times a week should probably be sufficient. We can bring water testing gear with us when we visit the site and do this testing. We can start testing more frequently if results indicate this is required.
  - If your team is keen and able to test water more frequently than that, a standard pool testing kit could be purchased from a swimming pool shop – check that it can test for pH, chlorine levels, NO<sub>3</sub> (nitrate), NO<sub>2</sub> (nitrite), and NH<sub>3</sub> (ammonia), follow the kit testing instructions and record the results in a log book – let us know if you have any questions about the results.
- It could be beneficial to monitor coliform bacteria levels in the pool weekly. The levels of these should be no more than 1000 coliform bacteria/100 ml water. Coliform bacteria are found in faeces, so these levels indicate the level of faecal contamination of the pool.
  - We’ll look into where this testing can be performed.
  - This is a good point to remind staff that are in the water about hand hygiene prior to eating and hygiene in general – they are likely exposed to a degree of orca faecal matter when they are in the water.

The pool/pump set up is probably the best pool set up that we can achieve at this site with this size pool. From a purely water quality perspective, better still would be being in the ocean (in the sea pen), as this would allow even faster “water turnover” and more reliable salinity/pH/organic matter levels than the pool. If it is safe to use sea water for the pool (water quality of the harbour permitting) then this would be preferable. Fresh water from the town drinking supply is an okay temporary alternative for short periods.

If fresh water is used to fill the pool, it will take a lot of effort, salt and monitoring to turn this into a salt water pool. If sea water salinity is 30-35 parts per thousand, and the pool is 32,000L then ~100kg of added salt will create sea water level salt concentrations. However, if the water is turning over every 4 hours, then this needs to be added

every 4 hours. Salt in that amount doesn't necessarily dissolve easily or equally through the water column, so if it sits on the bottom of the pool but overflow happens at the top of the water column, then adding 100kg of salt every 4 hours will likely result in slowly increasing salt levels in the pool, which can be toxic.

In summary: I think this should only be attempted if it is possible to carefully test the salt levels in the pool 2-3 times a day – so this would require the purchasing of a salinity meter, and careful monitoring by personnel experienced in testing and managing salinity levels. Lifting that much salt will also have human health and safety implications.

Also important from a husbandry and welfare perspective is provision of shelter from sunlight and keeping a dark area at night. Is it possible to erect some kind of shade shelter over part/all of the pool during the day to provide sun protection please? This will help with maintaining skin and eye health (cetaceans can get sunburnt just like people can). What is the current lighting regime at night? Is it possible to provide darkness for all/part of the night time to facilitate his rest and biological rhythms please?

Let me know if you have any questions or comments!

Kind regards,

[Redacted]

[Redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

Ph

E [Redacted]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |  

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Thursday, 22 July 2021 6:41 pm  
**To:** [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** Quick thoughts on short term medical monitoring plan for Toa

Hi [REDACTED]

We had a few short term plans for Toa's case management, so thought I'd let you know in case you'd like to apply those to your time at the Plimmerton Boat Club for the next few days:

- Bloods 1-2x per week
  - o CBC/fibrinogen/2x in-house biochem panels at TNTK/and a few other bits and pieces – see [REDACTED] emails.
  - o Last done 21/07/21
  - o [REDACTED] and one of the HUHA vets are great at taking blood :)
- Pool water testing
  - o May not be applicable – he may be back in the sea pen!
  - o We were thinking 2-3x per week pool water testing for pH, chlorine levels, salinity, NO<sub>3</sub>, NO<sub>2</sub>, and NH<sub>3</sub>. We have the gear for this if you'd like to borrow.
  - o Also we recommended weekly coliform tests if in pool – [REDACTED] found that Gribbles can run this, so feel free to send a sample to us to pass on for testing.
- Girths/weight as often as possible
  - o Whale Rescue takes these measurements relatively frequently, and I don't often manage to catch them on the phone on a day, but if you're on site you'll be able to get this info much more easily!
- Blowhole culture/cytology
  - o We were thinking of getting these weekly, last done on 12/07/21. May not be super useful clinically immediately, but might be useful to monitor trends over time (ie changing biome) or choose what treatment to use if respiratory signs develop?
- Urine
  - o They were able to collect this almost daily, so we were running USG/dipstick where possible.
- Still working on comms with [REDACTED] – see separate emails.
- Let us know if you're running low on de-gas, any drugs, or any diet ingredients, we can get some more!
- Anything else you need – equipment/personnel/research/comms etc – let us know and we'll see what we can do!

Kind regards,  
[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

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[REDACTED]

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Thursday, 22 July 2021 6:51 pm  
**To:** VOS Reception; [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** RE: Fwd: Orca calf - ophthalmic exam

Thanks so much [REDACTED], really appreciate it. Will see how he goes over the next couple of days, and will be in touch again on Sunday when I'm back at work and when we'll know a bit better how our next week is looking. Since I contacted you he has been moved back into salt water, and of better quality/faster turnover than when he first started showing his clinical signs, and there has been some improvement noted.

There are so many moving parts in his operation that we have quite a short planning window at the moment, but I will reassess Sunday and give you as much notice as we can! Saturday and Sunday our vets can't head out as we have limited staffing – so we won't book you for this weekend. We might take you up on your offer of Thursday – will let you know as soon as possible (I also appreciate that you said "potentially Thursday", not "definitely Thursday", so I realise Thursday is not a given!).

I am not aware of [REDACTED] having had a look yesterday, but will check in on the details about that!

Thanks again so very much!  
Kind regards,  
[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph [REDACTED]  
E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |  

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**From:** VOS Reception [REDACTED]  
**Sent:** 21 July 2021 18:08  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>;  
luddstrom@doc.govt.nz  
**Subject:** Re: Fwd: Orca calf - ophthalmic exam

Hi [REDACTED] and All

Challenging situation for you guys to be involved with. I am happy to assist under the direct request from the zoo vets. Hence I would operate within the same brief as you guys are working under. I would want one of you guys present while I assess. I don't want to be having to figure out whom I am advising regarding this patient.

Huha has contacted [REDACTED] resident, about having a look. She has discussed this with me and I had the understanding that she assessed the calf today. I am not sure whether she has or not.

The most likely cause of this issue is water quality. It is likely that improvement of the water quality (I.e. osmolarity etc..) or return to salt water would be required to resolve this. Also, if you guys can't open the eyes to exam, it is likely that I will have the same difficulty. That being said, I can come and have a look. I'll bring dive gear and a dive torch to see if that is a useful approach.

Availability wise, I am quite booked up during the week. Saturday or Sunday this weekend would be an option, and potentially Thursday next week.

So, let me know your thoughts on all this and what you want me to do.

Cheers

██████████  
On 21/07/2021 4:51 pm, kellam bayley wrote:

----- Forwarded message -----  
From: ██████████@wellingtonzoo.com>  
Date: Wed, Jul 21, 2021 at 12:14 PM  
Subject: Orca calf - ophthalmic exam  
To: ██████████  
Cc: ██████████@wellingtonzoo.com>, ██████████  
██████████@wellingtonzoo.com>, ██████████@wellingtonzoo.com>, ██████████  
██████████>

Hi ██████████

You may be aware that there is an orphaned orca calf currently housed at Plimmerton Boat Club and being cared for by a team of DOC staff, local vets/animal care staff/volunteers, Whale Rescue and ourselves. Our role in this response is to provide advice on health and welfare from a wildlife/zoo vet perspective and visit the site a few times a week to help advise and provide some clinical assistance. As you can imagine, there are a large number of people involved in the response and planning for multiple scenarios is occurring simultaneously.

We are currently in the short term phase of the response, where the plan is to return the calf to its pod. Our vet role in this phase is to advise as best as possible on the current health status of the calf and to advise on how to keep him stable and healthy in the current set up. We are receiving a lot of advice and support from cetacean vets overseas, which has been immensely helpful.

In the last few days it has been noticed that the calf is holding his right eye shut more than the left, and that there is mild swelling of the eyelids of the right eye. The vet on-site and one of our vets have attempted an ophthalmic exam but when this is attempted he holds the eye tightly shut so we can't get a look at anything. It is possible that these clinical signs started when he was moved from the sea pen to his temporary pool set up, when weather conditions deteriorated – so it's possible that this may be a result of a change in water type/quality, or that there was trauma to the eyelids/eye from the stretcher set up used to move him. There are clear mucoid secretions from the eye, which are normal for the species. He has alternated between sea water and town supply fresh

water (with a very low level of chlorine – negligible on water testing) while in the pool, depending on water quality of the harbour (there was a burst sewage pipe in the weather event).

I was wondering if you would be interested in examining the eye please, and if so, what your availability is in the next week or two? There will be a few logistical difficulties around organising this, but hopefully we can work something out! It is hard to remove him from the water, so examination would have to be in the pool – but he can be brought over to the side of the pool for examination. He is generally handleable and amenable to non-invasive medical procedures, although does tend to lose patience/interest after a while. We've estimated him at 200kg and he is ~2m long. I don't know how he will react to handling of the eye area, and sedation is probably not an immediate option, although if you're interested in having a look we can have a chat and make a plan for how best to approach this.

Your thoughts much appreciated!

Kind regards,

██████████

██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

Ph ██████████

E ██████████ [@wellingtonzoo.com](mailto:██████████@wellingtonzoo.com) | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |  |

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██████████ BVSc MVSc MANZCVS CertVOphthal Dip ECVO  
Registered Specialist in Veterinary Ophthalmology

[REDACTED]

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Thursday, 22 July 2021 6:46 pm  
**To:** [REDACTED]; NZRadVet  
**Cc:** [REDACTED]

Thanks so much [REDACTED] really appreciate it. Will see how he goes over the next couple of days, and will be in touch again on Sunday when I'm back at work and when we'll know a bit better how our next week is looking. There are so many moving parts that we have quite a short planning window at the moment, but will reassess Sunday and give you as much notice as we can!

Thanks again so very much!  
Kind regards,  
[REDACTED]

[REDACTED] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph [REDACTED]  
E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) | 

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** 21 July 2021 17:12  
**To:** NZRadVet [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
**Subject:** RE: Orca calf - routine abdominal ultrasound

Hi [REDACTED],

Thanks so much for your response (and potential willingness to help!).

I've attached the information I have on ultrasounding cetaceans from the CRC Manual of Marine Mammal Medicine. I've also attached the chapter on anatomy. Hopefully these are helpful if we do go forward with the ultrasound. The calf is quite tolerant so I think it would be doable to set up a table pool side and ultrasound him that way (although would need something to stand on as well because the sides of the pool are quite high).

[REDACTED] **BA DVM**  
Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
E [REDACTED]@wellingtonzoo.com

---

**From:** NZRadVet [REDACTED]  
**Sent:** Wednesday, 21 July 2021 4:09 pm  
**To:** [REDACTED]@wellingtonzoo.com>  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@doc.govt.nz>  
**Subject:** RE: Orca calf - routine abdominal ultrasound



Hi [REDACTED] & others

Interesting. In short very happy to help out in any way I can.

There are a number of things to consider here

- Not at least we would have to have some idea exactly what we need to be assessing as the window of opportunity sounds as though it would be short. In other words its not just a matter of scanning around the abdomen to see what we see but doing a tailored scan e.g. is there obvious abnormal fluid, etc, etc. This would ideally be based on advice from those others who have experience in this area and would be able to suggest what the important areas are that need to be checked.
- I would need to check out normal anatomy and location of organs in this species – likely very available on the net and other resources.
- I may have to source additional probes which would allow more depth than what I routinely use in small animals – though if I recall you may have such a probe with your M9?
- Would this be a scan from the side of the pool with the orca at the side or in the pool itself. Getting wet doesn't worry me but obviously need to look after the equipment.
- Availability pretty good for this – I would move other stuff around to fit in (including weekends), but I am in Auckland teaching an ultrasound course from the 29<sup>th</sup>-31<sup>st</sup> July (Thursday – Saturday evening) which I can't change.

My first thoughts 😊

Best wishes

[REDACTED]

[REDACTED]

*Registered NZ & European Veterinary Imaging Specialist  
Adjunct Associate Professor Massey University*

[REDACTED]

[www.nzradvet.co.nz](http://www.nzradvet.co.nz)



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**From:** [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>

**Sent:** Wednesday, 21 July 2021 11:57 AM

**To:** NZRadVet [REDACTED] <[REDACTED]>

**Cc:** [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED]

**Subject:** Orca calf - routine abdominal ultrasound

Hi [REDACTED],

You may be aware that there is an orphaned orca calf currently housed at Plimmerton Boat Club and being cared for by a team of DOC staff, local vets/animal care staff/volunteers, Whale Rescue and ourselves. Our role in this response is to provide advice on health and welfare from a wildlife/zoo vet perspective and visit the site a few times a week to help advise and provide some clinical assistance. As you can imagine, there are a large number of people involved in the response and planning for multiple scenarios is occurring simultaneously.

We are currently in the short term phase of the response, where the plan is to return the calf to its pod. Our vet role in this phase is to advise as best as possible on the current health status of the calf and to advise on how to keep him stable and healthy in the current set up. We are receiving a lot of advice and support from cetacean vets overseas, which has been immensely helpful.

One thing that has popped up a couple of times in recommendations is to perform an abdominal ultrasound as part of the overall health assessment. For completion's sake (not for any urgent medical reason), we're interested in seeing if this is an option (and logistically possible), around all the other moving parts such as pod location, possible release and other contingency planning. I was wondering please if you would be interested in performing such an ultrasound on this patient, and if so what your availability is for the next week or two?

The calf appears generally healthy, although with the transition from oral fluids onto formula feeding there have been some short and temporary bouts of signs of abdominal pain, which have resolved with changes in feeding techniques and/or the passing of faeces. These signs have not been seen yesterday or today.

It is hard to remove him from the water, so scanning would have to be in a pool set up (is this possible?). He can be encouraged to roll onto his back for short periods (although has to hold his breath while on his back, so this is generally in 1-2 minute windows) and can be brought very close to the edge of the pool. He is generally handleable and amenable to non-invasive medical procedures, although does tend to lose patience/interest after a while. We've estimated him at 200kg and he is ~2m long.

Your thoughts much appreciated!

Kind regards,

[Redacted]

[Redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

Ph [Redacted]

E [Redacted]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com)  

[REDACTED]

---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Thursday, 22 July 2021 9:40 am  
**To:** Ian Angus; [REDACTED]  
**Subject:** RE: Veterinary update for orca calf 21/07/21

Thanks Ian,

I had a quick chat with [REDACTED] this morning around their feeding concerns and I will contact [REDACTED] (a senior vet at SeaWorld) first of all for some trouble shooting, as he helped us formulate the current diet to start with.

Happy to chat to [REDACTED] as well, and the name [REDACTED] has been mentioned as well this morning. All good contacts I'm sure. Will contact [REDACTED] first as he's more familiar with what we've been doing so far. Would love to be included in any discussions with [REDACTED] and [REDACTED] too please, this will help us help the team on-site better – if we know what is discussed and recommended.

Let me know what you find out, and I'll let you know what [REDACTED] says too.

Kind regards,  
[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
Ph [REDACTED]  
E [REDACTED]@wellingtonzoo.com | W [www.wellingtonzoo.com](http://www.wellingtonzoo.com) |  

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**From:** Ian Angus <iangus@doc.govt.nz>  
**Sent:** 22 July 2021 06:52  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
**Subject:** Veterinary update for orca calf 21/07/21

Thank you folks. Ingrid suggested approaching a [REDACTED] somebody from overseas to further discuss orca supplementary feeding. Ill find my notes for a surname.

[REDACTED] Huha will head away later today for work at Westport. [REDACTED] will I understand takeover as lead vet in her absence.

Great if you two could liaise over the sat tag proposal, as keen to ensure we get this done correctly, and with veterinary support available if needed.

And [REDACTED], should we discuss the best time to sat tag with [REDACTED] If we did get approval and decide to proceed Ingrid and I agreed we might just take some advice to see what might be a good or the best timing option. You and I then need share this with the planning team on site. All of course a contingency.

Sent from Workspace ONE Boxer

On 21/07/2021 5:52 pm, [REDACTED]@wellingtonzoo.com> wrote:  
Hi everyone,

A veterinary update on Toa from today.

## 1. Current medical findings

Lab tests:

- A blowhole culture taken 12/07/21 grew a light growth of E.coli and no fungi. This is of no clinical concern given the light growth and no signs of respiratory disease. It is likely that we'll repeat blowhole cultures throughout his time in care to monitor for trends.
- We are awaiting faecal results from samples submitted to the lab today: for parasitology, gram stain, salmonella culture and occult blood.
- A urine sample was collected and tested today:
  - USG today was 1.014. Some reference ranges for urine testing have been circulated amongst the vet teams (thanks [REDACTED]!) which indicate that our urine testing results so far are normal for this species.
- Blood was taken today by the HUHA team (thank you!):
  - In house biochem: Generally of no concern. His blood urea nitrogen (BUN) has increased slightly above normal, but this is likely to do with having recently eaten a protein rich meal (= formula). This analyte also increases with kidney disease/dehydration, but all our other blood and urine tests indicate that he is well hydrated and his kidneys are functioning normally. There are some other minor deviations from normal which are of no clinical significance at this stage but which we will monitor the trends of over time.
  - CBC: will be sent to the lab tomorrow
  - Serum electrophoresis: will be sent to the lab tomorrow
  - Cholesterol/triglycerides: will be sent to the lab tomorrow
  - Some historical blood has been stored in our -80°C freezer.
- We are awaiting cytology and culture on eye discharge submitted to the lab today.

Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc). These are being monitored.
  - A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reduced in severity today. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- Girth measurement update:
  - On 16/07/21: length 2.12m, girth in front of dorsal fin 1.42m, girth behind dorsal fin 1.17m
  - On 20/07/21: girth at widest point in front of dorsal fin 1.42m, girth at widest point behind dorsal fin 1.17m, girth at pectoral fin insert 1.34m
  - Girth measurements have some limitations in their use to assess body condition, but these results indicate no immediate significant weight loss. We will continue to monitor this over time to assess his response to feeding and the success of feeding.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (regular today) and urination (observed today).

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Today the plan is to feed him 10x feeds of 50:50 formula to 50% vytrate at 1.5 hour-intervals. No colic or other signs of gut disease have been observed since overnight on Monday night/very early Tuesday morning.
  - This is a step back on our diet increases, with a plan to slowly increase again in future when his gut settles so that we can aim to meet his caloric requirements.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 22/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing/communicating.

He is still in the pool, but as of today (21/07/21) he is back in sea water.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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From: [Redacted]

Sent: 20 July 2021 19:15

To: 'HUHA Helping You Help Animals' [Redacted]

Cc: [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;

[REDACTED] 'Ian Angus' <iangus@doc.govt.nz>; 'Marine' <marine@doc.govt.nz>; [REDACTED] Kirstie Knowles' <kknowles@doc.govt.nz>; [REDACTED] >; 'Ingrid' <ingrid@wellingtonzoo.com>; [REDACTED] >; [REDACTED] @wellingtonzoo.com>; [REDACTED] @wellingtonzoo.com>; [REDACTED] @wellingtonzoo.com>; [REDACTED] @wellingtonzoo.com>

**Subject:** Veterinary update for orca calf 20/07/21

Hi everyone,

A veterinary update on Toa from today. Please add anything I may have missed.

#### 1. Current medical findings

##### Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected several faecal samples and these have been submitted for testing for parasitology, gram stain, salmonella culture and occult blood. We will let you know what these results show when we get them.
- A urine sample was collected and tested today:
  - USG today was 1.016 – despite some feeding difficulties in the last 24 hours, it looks like he is not currently dehydrated. We'll continue regular urine monitoring to look for any trends.
- One of our techs performed some water testing today. I will get the full numbers from her for this tomorrow, but I can give you interim findings in the meantime:
  - The chlorine level in the water is negligible. I think there was a misunderstanding here on my part I'm sorry, when I was told that he was in "chlorinated water", I thought you meant "swimming pool level chlorination", which would have been concerning. The level of chlorine in town supply water is much lower and should be fine in the interim if sea water is not available. Thank you for clarifying this today.
- We were not able to get much blood at all today, despite a few attempts. A drop of blood has been made into a blood smear to repeat an estimated white cell count, if the lab deems the size of this sample suitable.
  - We will return on Thursday to try to take some more blood for routine monitoring of his general condition.

##### Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc) but we have taken some photos today to allow us to monitor them over time.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. It is possible that this started around the time of his move to the pool, as his eyes appeared normal before then. One of the cetacean vets we have been talking with thinks this is of minimal concern, but an ophthalmologist that has been contacted would like us to double check a couple of things to make sure it is not of concern. The swelling has reduced somewhat in the last couple of days. He would not let us examine the eye itself today, he held his eyelids tightly shut when we tried to have a look. We'll get in touch with some veterinary ophthalmologists in the lower north island and see what their availability is for a second opinion, and in the meantime we will keep monitoring for improvement of the swelling.
  - Some clear mucous from the eye will be sent to the lab for cytology and culture (although worth noting that normal eye secretions from this species are clear and mucousy).

- There is a small blister on the skin near his blowhole, approximately 1cm in diameter. It contains apparently clear fluid and otherwise there is no inflammation surrounding it. It is the only such lesion that we could see on his skin today. As a result, we are not immediately concerned by this lesion but will continue to keep an eye on it with photos and observations.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Yesterday (19/07/21) he received 10x feeds of 800-1000ml (with feed consisting of a ratio of 1L formula to 0.4L 50% vytrate).
- His feeding schedule was delayed by a few things during the day yesterday, such that his last feed was given at 1am this morning. After this feed (and to a lesser degree after the 8pm feed) he showed signs of discomfort – rolling along his long axis, and sinking to the bottom of the pool. Over a period of time he passed 3 faecals (his first faecals for the preceding 24 hour period), after which his signs significantly reduced. By this morning's first feed he was behaviourally normal again. I think this is likely an indication that he was in discomfort from too much pressure in his belly from having recently fed and having not defaecated for a while. However another possible reason could be gut upset from diet increases, or a gut disease such as parasitism. As a result our plan today was:
  - Give just 50% vytrate for the first few feeds.
  - Introduce food again at 50:50 formula to 50% vytrate after the first few feeds and monitor (this is a step back on our diet increases, with a plan to increase again in future when his gut settles so that we can aim to meet his caloric requirements).
  - Send faeces for parasitology and a few other tests.
  - **Another thought please** is could we please try to keep 2 hours between feeds? I think his last feed before 1am was at midnight – perhaps this is an indication that a 1 hour feeding interval may be a bit much for him.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 21/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or we could cause quite significant gut upsets.

Additional medications:

- Today was his last day of enrofloxacin (antibiotic) injections.
- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

Formula prep has been handed over to the team on-site at Plimmerton Boat Club today:

- This was done in the hope that this will save all our teams time with regards to organising couriers to and from the zoo to pick up the diet. Let us know if it's not saving you time or if it is causing any other difficulties, we are very happy to take this role on for you again.

- Please also let us know well in advance if you need any of the ingredients topped up or replaced – some of these items will take us a few days to order in.

I have been asked for advice on how to safely increase the salinity for the pool that he is in. Please can you remind me of the dimensions and volume of the pool? With the current estimated whole pool turnover of every four hours, this is going to take a lot of salt. And with the tendency of large volumes of salt to sit on the bottom of pools and dissolve slowly, it is going to take some care to make sure that we don't raise the salinity too high. It may be quite difficult to get the balance right and will take careful monitoring. Will get in touch tomorrow with a plan.

I have received measurements of "107, 135, 134" today – can someone please let me know which of these are length/girth measurements etc?

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

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**From:** [Redacted]  
**Sent:** 19 July 2021 17:33  
**To:** HUHA Helping You Help Animals [Redacted]  
**Cc:** [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;  
[Redacted] Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine  
<[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>;  
[Redacted] Kirstie Knowles <[kknowles@doc.govt.nz](mailto:kknowles@doc.govt.nz)>; [Redacted]>;  
[ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com)>; [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>

**Subject:** RE: Veterinary update for orca calf 18/07/21

Hi everyone,

A shorter veterinary update on Toa from me today :)

As usual, Team HUHA and Whale Rescue please feel free to add to these updates!

1. Current medical findings

Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Can take that from you tomorrow when we pop by to send it on to the lab.



- A urine sample was collected and tested today:
  - USG today was 1.018, and there was trace protein and no glucose on the urine dipstick. These findings are of no concern and we'll continue regular urine monitoring to look for any trends.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- As of tomorrow he can receive 100% formula (no additional vytrate). According to his requirements of 120-125kcal/kg/d, an estimated weight of 200kg and an estimated caloric content of the food of 1450kcal/L, he requires 16L of formula per day to meet his requirements. This could be divided into several feeds such as 10 x 1.6L feeds or 8 x 2L feeds over the day tomorrow – would that suit how he's currently feeding?
  - If he receives this volume, this should also meet his fluid requirements for the day.

A few quick questions please, as I didn't manage to get anyone on the phone today:

- How was his respiration/defaecation/urination today?
- How much volume did you get into him today formula-wise and vytrate-wise? Was this mostly by bottle or did you tube feed him again today?
- Did you see any signs of post-feed discomfort today?
- Did you see any other signs of gut upset? ie: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.
- We've started him on the oral de-gas medication (simethicone) today (19/07/21) that has been recommended by a few vets that have been involved in hand rearing of cetaceans to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

A few of us from the zoo will pop by tomorrow to:

- Take some repeat bloods.
  - Catch up with you about some of the physical exam findings, check in with how feeding is going, check in on a couple of monitoring parameters etc. If you'd like us to bring/check anything specific let me know!
  - Bring gear/recipes/instructions to hand over the formula prep.
3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

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---

**From:** HUHA Helping You Help Animals [Redacted]  
**Sent:** 18 July 2021 19:14  
**To:** [Redacted]@wellingtonzoo.com>  
**Cc:** [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;  
<[Redacted]>; Ian Angus <iangus@doc.govt.nz>; Marine  
<marine@doc.govt.nz>; [Redacted]; Kirstie Knowles <kknowles@doc.govt.nz>; [Redacted]  
ingrid [Redacted]; [Redacted]@wellingtonzoo.com>; [Redacted]  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>

**Subject:** Re: Veterinary update for orca calf 18/07/21

Hi All.

Thanks [Redacted]

Just to confirm that the Ingrid had the pool switched back to sea water thisafternoon.

Cheers  
[Redacted]

On Sun, 18 Jul 2021, 5:55 pm [REDACTED]@wellingtonzoo.com> wrote:

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversations or if you otherwise have anything to add!

Firstly thank you so much to everyone who worked so hard in such awful weather in the last couple of days, I thought of you often and I hope you managed to stay warm and dry in between caring for Toa.

## 1. Current medical findings

Lab tests:

- The lab has unfortunately said that it can't run lactate on the type of sample that we've given them, but we can run it on the next sample we take using a patient-side machine that we can bring with us on the next blood sampling.
- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Will chat tomorrow about how we get that where it needs to be for analysis.
- A urine sample was collected and tested today:
  - USG today was 1.028, and there was +1 protein and +1 glucose on the urine dipstick. In some animals those dipstick findings can be abnormal, but we'll wait to see if they persist (in some species they can be normal, or at least explained by physiology rather than disease).

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage. No significant abnormalities/changes of defaecation have been noted with introducing or increasing the diet.
- He has been observed to urinate in the last 24 hours.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Ultimately we would like him on just formula (no supplementary fluid), as this contains enough fluid to also meet his fluid requirements, but we've been advised to build up to that slowly, which is why his diet is changing a little every day at the moment.

- Today the feeding plan was 1L formula + 1.2L 50% vytrate for the first three feeds (2.2L total) and then 1.5L formula + 0.7L 50% vytrate for the second three feeds (2.2L total). (Total of 7.5L formula and 5.7L 50% vytrate for today).
  - HUHA team if you could fill us in on how you went with this that would be lovely :)
  
- **Tomorrow's feeding plan:**
  - **1.1L formula + 0.4L 50% vytrate per feed x 8 feeds at 2 hourly intervals**

**(total of 8.8L formula and 3.2L 50% vytrate).**
  
- We've had to make a few changes to his feed schedule to get to the feeding plan for tomorrow:
  - He has been showing signs of discomfort after tube feeding – sinking to the bottom of the pool and hunching slightly.
    - This may be due to discomfort due to the volume fed - hence smaller meals tomorrow – fed more frequently so that we still try to meet his requirements.
    - Or it may be due to discomfort from the tubing. The cetacean vets that we've been taking advice from say that bottle feeding him would be a good alternative. They say it may contribute to habituation, but that so does being near to humans and being handled for tubings/treatments etc, so they are not concerned about the bottle feeding on its own per se.
    - A bottle set up has been trialled today with moderate success. The signs of discomfort that were seen post-tubing have not been seen after bottle feeding.
- A few pointers from the cetacean vets:
  - Please make sure he's not gulping air while feeding – this can cause colic and discomfort.
    - They've recommended a de-gas medication be added to the feeds, I will source this asap and let you know when it's ready.
  - Please make sure he's not gulping water while feeding – too much sea water ingestion can affect his electrolyte levels and make him sick.
  - We/you can consider supplement feeding him with tube feeding if some of his bottle feeds are less productive than others.
  - They prefer him to have a break from feeding overnight to allow him to rest, so they do not advise feeding constantly over a 24 hour period at this stage.
- An important piece of information that I received today is that orca abdomens do not expand very easily compared to other mammals. As a result, a build up of anything in the abdomen increases the pressure in the abdomen rather than causing abdominal distension. So a build up of gas can very quickly become uncomfortable, as can ingesting volumes that are too large – so perhaps this is the reason we're seeing some discomfort after tubing.
- Please continue to monitor him for signs of gut upsets: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Today it was noted that some of the volunteers were encouraging him to suck on their thumbs as they thought this might help with feeding. Thank you Whale Rescue and HUHA for realising this was happening and for advising them to stop :)

Due to the suspected/confirmed (?) sewage spill at Plimmerton due to the horrible weather this weekend the team recently changed his pool from salt water to chlorinated water. Please could we change this to fresh water or back to sea water if the Plimmerton sea water is okay again? It was a good idea to change from sea water when the sewage problem was reported, but fresh water is much better for him than chlorinated water, which could negatively affect his skin and eyes.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.
3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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**From:** [Redacted]@wellingtonzoo.com>

**Sent:** 17 July 2021 16:35

**To:** [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [Redacted]

**Cc:** HUHA Helping You Help Animals [Redacted]>; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com)>; [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>

**Subject:** RE: Veterinary update for orca calf 15/07/21

Hey all, quick update from me today.

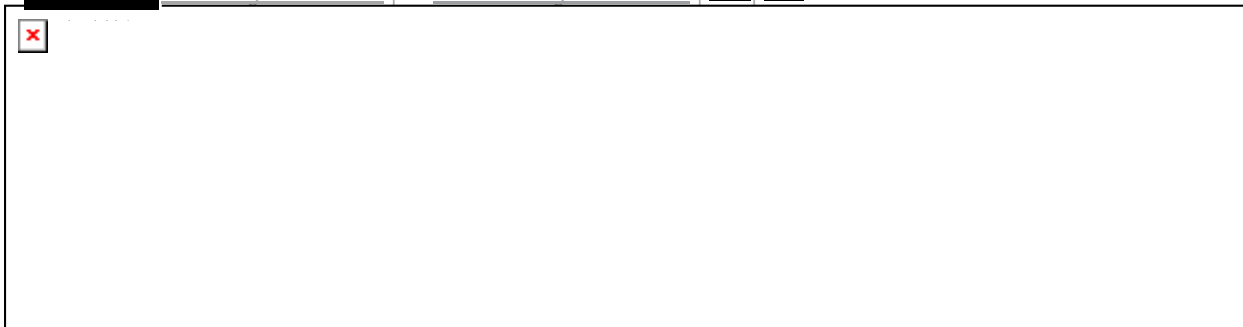
- Toa is going really well according to personnel on site – accepting feeds well, and no gastrointestinal comfort seen

- There is possibly a sewerage pipe burst somewhere near the bay, so concerns re: water quality. HUHA vet [redacted] is organising water testing.
- [redacted] got a urine sample and USG this morning of 1.017
- [redacted] mentioned possibly some oedema around caudal oropharynx/throat area (possibly from repeat tubing?) so would like to keep bottle feeding as a back up option in case tubing needs to be abandoned. Toa is currently showing no signs of discomfort or distress during tubing, tolerates it very well. We can check this when we are next on site as well, but in the meantime if HUHA vets can keep a close eye on that please 😊
- We are going to continue upping the ratio of formula to vytrate, so please see the attached feeding schedule for 18/07/21 – there is no hard copy of this, I'm sorry. Had not gotten it printed off before the food was collected this afternoon. At this rate he should be on 100% formula from Monday afternoon, and we can look at making the formula richer or increasing volume if we need to increase caloric intake.
- We will organise a day early next week to revisit Toa to take a repeat blood sample
- I am going to be off for the next two days, but [redacted] is here tomorrow and [redacted] will both be here on Monday

Thanks again (and again and again) for everyone's hard work and dedication especially in the horrible conditions today.

[Me tiaki, kia ora!](#)

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**From:** [redacted]@wellingtonzoo.com>  
**Sent:** 16 July 2021 17:02  
**To:** [redacted]@wellingtonzoo.com>; [redacted]  
 [redacted]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [redacted]  
**Cc:** HUHA Helping You Help Animals [redacted]; ingrid [redacted]; [redacted]  
 [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again, slight update to tomorrow's feed schedule (see attached).

[redacted] BA DVM  
 Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust  
 200 Daniell Street | Newtown | Wellington 6021  
 E [redacted]@wellingtonzoo.com

**From:** [REDACTED]  
**Sent:** Friday, 16 July 2021 4:07 pm  
**To:** [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED]  
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Ilan Angus <[ilanus@doc.govt.nz](mailto:ilanus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [REDACTED]  
**Cc:** HUHA Helping You Help Animals [REDACTED] >; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com)>; [REDACTED]  
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**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again to everyone!

Thank you all for your amazing continued care of the little calf! I'm just continuing on with a further update on how Toa is doing following the discussion from earlier this afternoon. I'll try to only include new information in this update. Please add anyone I may have forgotten to include!

Due to the change in weather, Toa was moved into a temporary pool yesterday around 5 PM. The move went smoothly and took 20-30 minutes. There have not been any changes noted in his behaviour since changing to the pool and his medical treatments and tubings are taking place at the same intervals. At the moment there is no filtration system in place so, as an alternative, the pool is being continuously filled with sea water via a pump and draining out excess water through holes in the side. The plan is to only keep Toa in the pool until it is safe enough to return him to the sea pen.

As we have increased the concentration of formula being fed, it was observed that Toa is beginning to show a few signs of abdominal discomfort immediately after feeds. He will cramp up and sink to the bottom of the pool briefly. This began last night and happened again this afternoon. In order to hopefully combat this we have come up with the solution of feeding him more frequently throughout the day (every 2 hours instead of every 4) so that he is getting smaller volumes of formula at each feed (but will still receive the same total daily volume). We will still try to increase his volume of formula fed by 50% each day in order to start increasing his caloric intake. It has been difficult to assess the frequency and consistency of his faecal output due to the murkiness/turbulence of water from weather. With increased

In terms of ongoing monitoring, we will continue to do what [REDACTED] has already discussed (semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour) but may also consider adding in blow hole chuff cultures at least once but could repeat if any indication (we need to source the appropriate petri dish to collect these and confirm with Gribbles how it will need to be submitted), urine samples from first thing in morning prior to tubing to check UA and USG (this could be less frequent, maybe every 3 days or so), and body length and girth measurements (and possibly weights! if a suitable scale setup can be sourced which Ingrid is looking into). The body length, girth and weight measurements will be incredibly helpful both in helping to confirm an age and in ongoing monitoring of nutritional status.

For fluids and feedings tomorrow the plan is to give 700 ml formula with 1.5 liters 50% vytrate at 8 AM, 10 AM, and 12 PM. Then for the 2 PM, 4 PM, and 6 PM feeds he can receive 1 liter formula with 2 liters of 50% vytrate. (Total formula volume will be 5 L tomorrow compared to 3.5 liters today, a ~50% increase in volume). I'll email out a feed schedule sheet separately in case it is helpful. 😊 This will increase the total fluid volume he gets during the day by 3 liters but will still be within his recommended fluid needs of 40-80 ml/kg/day. If he is continuing to show signs of discomfort after any of these feedings please get in touch [REDACTED] will be at work tomorrow at the zoo so can be reached if needed.

For medications, Toa received his last dose of steroid today. There is no need to continue on with steroid treatment at this time. He is still receiving enrofloxacin 5 mg/kg BID which he started Wednesday morning (14/7/21). This is due to last 7 days, finishing after his dose on the evening of 20/7/21.

We are still awaiting results from the veterinary laboratory for samples taken Monday:

- Lactate, blow hole swab culture (fungal and bacterial).

1. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

2. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thank you so much to everyone for all your dedication and care! Looking forward to seeing you and Toa in person again soon!

[REDACTED] **BA DVM**

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200 Daniell Street | Newtown | Wellington 6021

E [REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)

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From: [REDACTED] >

Sent: Thursday, 15 July 2021 6:32 pm

To: [REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com); [REDACTED]



[redacted]; Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [redacted]

Cc: HUHA Helping You Help Animals [redacted] [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)

Subject: Re: Veterinary update for orca calf 15/07/21

Hi [redacted]

Thank you again for another comprehensive update! Sounds like all is stable which is great news.

Thank you to the wider team as well for all your hard work with this little calf.

Kindest regards,

[redacted]

---

From: [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)

Sent: Thursday, 15 July 2021 6:01 PM

To: [redacted]; Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [redacted]

Cc: HUHA Helping You Help Animals [redacted] [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com) <[ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com)>; [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com); [redacted] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)

Subject: Veterinary update for orca calf 15/07/21

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!

1. Current medical findings

Lab tests:

- We have a few results back from the lab:
  - Complete blood count and blood parasite check – normal (but see below)
  - Fibrinogen levels (one way of testing for inflammation) – normal
  - Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - Total blood iron levels – normal

- The lab's interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we'll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Lactate, blow hole swab culture (fungal and bacterial).

#### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.
  - Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!)

Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).
- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

#### Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

#### Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

#### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

#### 4. Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

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**From:** [Redacted]  
**Sent:** 14 July 2021 18:47  
**To:** [Redacted]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz); [Redacted]  
**Cc:** HUHA Helping You Help Animals; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [Redacted]  
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**Subject:** Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

1. Medical findings

#### Lab tests:

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

#### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also will several deep lacerations near his tail fluke laterally to his spine.
- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

#### Fluids:

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

#### Feeding:

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for

signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



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Cc: HUHA Helping You Help Animals ██████████; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); ██████████  
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██████████@wellingtonzoo.com>; ██████████@wellingtonzoo.com>  
Subject: Veterinary update for orca calf 13/07/21

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet ██████████ from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by ██████████ also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,

██████████

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[REDACTED]

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Friday, 23 July 2021 1:04 pm  
**To:** [REDACTED]; HUHA Helping You Help  
Animals; HUHA VETS  
**Subject:** FW: Feeding Sheet.xlsx  
**Attachments:** Feeding Sheet.xlsx; Growth rates and handraising beluga calves from poster.docx

Hi all,

Info from Todd that he's said he's happy for me to pass on to the feeding team :)

Hope it helps!  
B

[REDACTED] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
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**From:** [REDACTED]@SeaWorld.com>  
**Sent:** 23 July 2021 11:55  
**To:** [REDACTED]@wellingtonzoo.com>  
**Subject:** Feeding Sheet.xlsx

[REDACTED]

Here's are example feeding tally sheets that we would require our staff to initial with each feed to track feeding totals and amounts. Feel free to use, copy, modify or throw out, if not needed... I've separated out formulas by %, which obviously effects total Kcals. It's easy to see if he misses a feed or is not getting enough calories, that weight will be lost.

Hopefully, we've clarified the formula making and the goal of getting to 100% formula. The Team can start with smaller volumes of feeds to ensure that he is consistently getting them, and then try to increase caloric density by adding some form of fat (cream, oil, or shark/ray liver). As [REDACTED] also pointed out with their calves there appeared to be a volume threshold, however if his body is demanding it, we have also found that volume can be increased incrementally if they are tolerating the formula. A lot of it is based on individual.

Fortunately our killer whale moms have been excellent and we haven't needed to intervene, unlike at Loro Parque. However, we have seen maternal neglect in belugas and that is where most of our experience comes from, so in the example provided (doc) one just needs to scale up for the most part. [REDACTED] at SeaWorld San Antonio did hand-raise killer whale calf orphaned by mom. I've asked him if he still has his presentation about that case... I know [REDACTED] will chime in at some point, because they have needed to intervene with each of their calves.

Regards,  
[REDACTED]

**"Orca " Calf**

Date: \_\_\_\_\_

Birthdate: est. 3/1/2021

Arrival Weight: estimated 200 kg

Today's Weight @ 0600 : 190 kg ( + or - ) 10 kg

Orca calf Kcal requirements = 120-140 Kcals/kg

Kcal Requirements: 22800 kcal

Artificial Formula caloric density : 1.6 kcals/ml

Formula intake goal: 14250 mls

Volume of per feed day: 1583 mls

TIME	FORMULA GOAL	ACTUAL AMOUNT	INITIALS
0530	<u>50% formula</u>	<u>1500</u> mls	
0800	<u>50% formula</u>	<u>1500</u> mls	
1130	<u>50% formula</u>	<u>1500</u> mls	
1400	<u>50% formula</u>	<u>1500</u> mls	
1630	<u>50% formula</u>	<u>1500</u> mls	
1900	<u>50% formula</u>	<u>1500</u> mls	
2130	<u>50% formula</u>	<u>1500</u> mls	
2400	<u>50% formula</u>	<u>1500</u> mls	
0230	<u>50% formula</u>	<u>1500</u> mls	

Total formula for 24 hour period: 13500 mls

Total Kcals for 24 hour period: 10800 kcals

Orca calf Kcal requirements = 120-140 Kcals/kg

If reflux present, try again in 30 minutes

=====

**RX**

Simethicone PO

Simethicone PO

Simethicone PO

Simethicone PO

Simethicone PO

## Growth rates and hand-rearing guidelines of orphaned beluga (*Delphinapterus leucas*) calves

### Abstract

Orphaned marine mammals provide a unique challenge to ensure proper nutrition and behavioral socialization for optimal physical and mental development. Animals are often orphaned secondary to maternal neglect, maternal naiveté, maternal aggression, maternal loss or death, neonatal weakness or illness. In the uncommon event that a neonate marine mammal, such as a beluga (*Delphinapterus leucas*) or Pacific walrus (*Odobenus rosmarus divergens*), is found orphaned within hours to days of birth, the animal must first be examined, stabilized, and treated for any medical conditions, such as dehydration, infection, parasitism, hypoglycemia or hypothermia. Secondly, the orphaned animal should be placed in appropriate species-specific housing for swimming, hauling-out, and maintenance of water quality. Despite the small sample size of orphaned belugas and walrus that have been raised, the weight gain on average for both species is ~ 1 lb or 0.45 kg/day for the first 90 days. These data may provide valuable insights for the caloric and feeding requirements of mom-calf pairs with estimated neonate age. A review of guidelines for artificial formula composition, caloric requirements, animal handling, and behavior training of managed orphan beluga calves and wild orphaned Pacific walrus calves will be presented.

### Beluga whale (*Delphinapterus leucas*)

Beluga are all-white medium-sized toothed whales belonging to the Monodontidae family. They are found in social groups of 10 to hundreds, primarily in the Arctic and Subarctic regions with 15 subpopulations identified (Jefferson, 2012). Beluga are well adapted for cold water with a thick blubber layer for thermal insulation and a prominent melon. They have strong seasonal site fidelity but some populations migrate through circumpolar corridors to share winter ranges. Mating occurs in the spring with gestation lasting 15 – 15.5 months, with birth in late spring to summer the following year (Robeck, 2005). Observation of beluga births in the wild have been rarely reported, however reports of alloparental care from other adults aiding calf to surface or swimming with calf have been witnessed (Leung, 2010). Neonates nurse for 1-3 years based on tooth development and food availability. Allonursing, nursing of offspring of a different female, has been reported in beluga and other cetacean species, so alloparental care may aid neonate survival in wild and managed populations (Leung, 2010). Beluga calves may be orphaned as a result of maternal separation, maternal or conspecific aggression, disorientation, labor complications, disease or environmental causes. Orphaned calves that are separated from dam or nursery group will have decreased survival without managed intervention.

With permission of NMFS, triage of a wild orphaned beluga calf may begin by isolating the calf in a waist-deep pool and supported by staff or buoyancy device, if needed. Measurements of weight, length, and girth should be obtained. A veterinary exam to assess vital parameters and body systems should be conducted. Body condition and hydration are estimated by weight and physical characteristics. Hydration therapy is first initiated to corrected dehydration.

Beluga Hand-rearing Guidelines – with orogastric tube (small canine or foal tube used)

Initial treatment with oral electrolyte solution (Hydralyte® or Pedialyte® solution) – (50 mls)

Colostrum supplementation with formula if milk from dam can be obtained, DI IgG injection 100 mg IM, if not

3 hrs post – admin 50% formula (100 mls)

6 hrs post – admin 50% formula (150 mls)

9 hrs post – admin 75% formula (180 mls)

12 hrs post – admin 75% formula (180-200 mls)

15 hrs post – admin 75% formula (180-200 mls)

2<sup>nd</sup> day

Empiric antibiotic therapy, if needed

Blood analysis – Cell Blood Count (CBC), Serum chemistry panel

Feeding volumes increased (180 to 300+ mls) over successive feedings, formula strength increased (75 – 100%). Bottle feeds with lamb nipple can be instituted once calf is stable.

\*Feeding interval approximately every 2-3 hrs, depending on tolerance of volume given.

Calculating caloric requirements

(example) 45 kg x 100 kcal/day = 4500 kcal/day

cetacean formula ~1.5 – 1.8 kcals/ml = 2500 mls/8x in 24 hrs

= 312 mls/feed (q3hrs)

Gradual addition of fish oil (menhaden oil) can increase caloric density of formula to ~2.0 kcal/ml (beluga milk = ~2.5 kcal/ml)

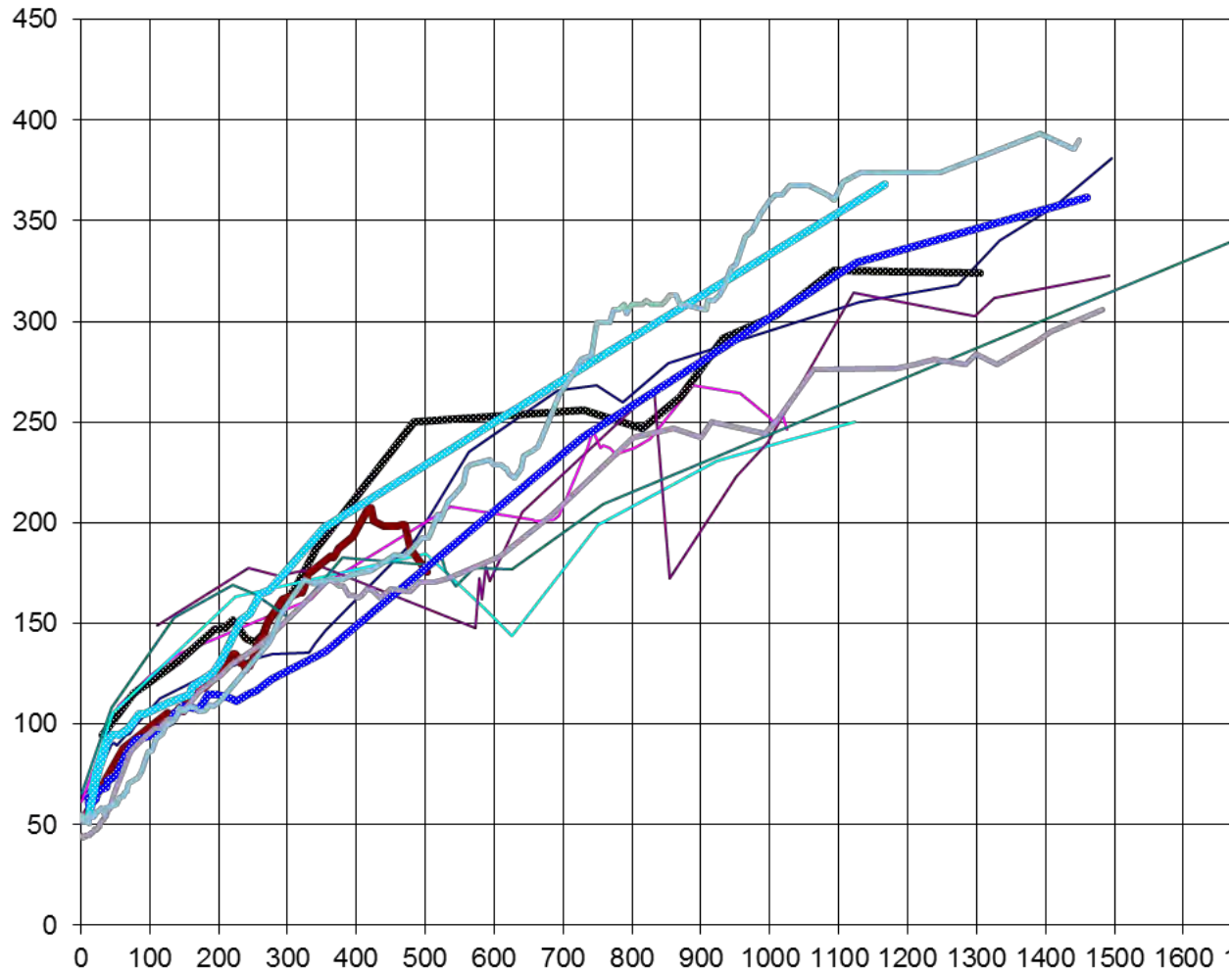
Neonate requirement is low in first few days of life due to nursing learning curve, goal to gradually increase feedings to meet caloric requirement over 2-3 days, depending on how calf processes formula

Cetacean Formula – upon request from author

Fish diet - assisted hand-feeding of fish can begin as early as 12 - 15 weeks of age or 3- 4 months of age

Growth – Range of caloric needs starting with Week 1, 0.1 lb or 0.045 kg/day at 98 kcal/kg for neonate to Weeks 3-6 averaging 0.7 lb or 0.3 kg/day at ~157 kcal/day, averaging ~1 lb or 0.45 kg/day

Weight (kg) vs. age (days) of beluga calves



### Beluga Calf Summary

Avg. birth weight – 55 to 65 kg

Avg. birth length – 140 – 163 cm

Smallest surviving calf – 53.6 kg and 140 cm

Avg. weight gain 0 – 90 days = 0.45 kg/day

Avg. length gain in 200 days = 0.15 - 0.24 cm/day

First solid food consumption from 172 to 328 days



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**From:** Kirstie Knowles  
**Sent:** Friday, 23 July 2021 7:04 am  
**To:** Elizabeth Heeg; Reg Kemper; Jack Mace; Bronwyn Saunders; Sarah Owen; Kirsty Prior  
**Cc:** Ian Angus; [REDACTED]; Kristopher Ramm  
**Subject:** Fwd: Re: Veterinary update for orca calf 22/07/21  
**Attachments:** image006.png; image007.jpg; image008.jpg; image001.png

Vet update from yesterday (Wellington zoo) plus response from onsite HUHA vet nurse.

**SUMMARY**

Condition as previous but now noting the concern re injury from pool.  
No major concerns from Lab results.

Good having [REDACTED] on site, especially to monitor feeding.

Kirstie Knowles  
Marine Ecosystems Manager  
Te Papa Atawhai - DOC

Note: I support flexible working and may be sending this out of usual office hours. I do not expect an out of hours response.

----- Forwarded message -----

From: HUHA Helping You Help Animals [REDACTED]  
Date: 22/07/2021 7:17 pm  
Subject: Re: Veterinary update for orca calf 22/07/21

To: [REDACTED]@wellingtonzoo.com>  
Cc: [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>, Ian Angus <iangus@doc.govt.nz>, Marine <marine@doc.govt.nz>, Kirstie Knowles <kknowles@doc.govt.nz>, [REDACTED]@wellingtonzoo.com>, [REDACTED], Ingrid [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>, [REDACTED]@wellingtonzoo.com>

Hi B.

Apologies I didn't give you today's urinalysis result prior to leaving thisafternoon

USG 1.026  
PH 5  
the remaining NAD

I was only present for 2 poos which we are no longer collecting.

He has just been relocated to the ocean pen and I am told it went extremely well. Apparently lots of happy clicks and chirps followed by zooming.

His total volume consumed today is low due to the fussy eating and also the interruption of relocation. The team plan to try to catch up with multiple feeds tonight although they won't feed past midnight so he gets to rest

overnight. I believe his preferred formula is currently Vitrate and Milligans. He is rejecting the Sardine based formula.

Don't panic feeding solids is absolutely not on our radar...we are sticking as closely to you recommendations as we are able throughout this fussy period.

We will tube supplement if required, but hope to see a change no he is back in the ocean.

Very much looking forward to having [REDACTED] on site. And talking to [REDACTED] in the AM.

Speak soon

On Thu, 22 Jul 2021, 6:28 pm [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)> wrote:

Hi everyone,

A veterinary update on Toa from today.

#### 1. Current medical findings

Lab tests:

- Faecal results from samples submitted to the lab yesterday:
  - No nematodes or trematodes were detected (two types of worm parasite).
  - Giardia was not detected.
  - We are still awaiting a gram stain, salmonella culture and occult blood test.
- Blood samples taken by the HUHA team and submitted to the lab today (thank you!):
  - CBC/fibrinogen: pending.
  - Serum electrophoresis: pending.
  - Cholesterol/triglycerides: pending.
- Eye discharge submitted to the lab yesterday from the right eye:
  - Cytology: normal (no signs of inflammation/infection)
  - Culture: pending.

Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. They do not show any sign of infection (no swelling, discharge etc) and are being closely monitored. These appear to be getting worse with time in the pool so may indicate rub/wear injuries from repeatedly contacting/rubbing the edge of the pool as he



swims. He will be trialled in the sea pen again to see if this reduces this rubbing and allows these wounds to heal.

- Volunteers in the water aim to reduce his contact with the walls/floor of whatever space he's in.
- A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reducing in severity. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (was this observed today?) and urination (was this observed today?).

Fluids/feeding:

- We use the following three calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
  - The hand rearing formula that we are feeding is calculated to contain 1450kcal/L.
- He has had some difficulties feeding in the last 24 hours, with seemingly some distaste for the taste of the formula and has been spitting out the bottle teat on some occasions. Team HUHA how did you get on with feeds today, what sort of volumes of what kind of formulas did you get into him? Did you end up stomach tubing any of the feeds?
- Tomorrow we've organised an online meeting with an overseas vet with experience in hand rearing cetaceans to help us trouble shoot this and provide some advice on a feeding/formula plan moving forward and tips on tweaking feeding on a feed-by-feed and day-by-day basis.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.
  - Please let us know when you are running low and we'll get you some more.

Plan for regular monitoring of health and welfare:

- [REDACTED] and I have put together the bare bones of a spreadsheet with some of the data that we've had available to our teams so far, and I've attached it here.
  - Blood results, some girths/measurements, some urine results, some feeding/defaecation data.
- I don't have all the data for urination, defecation, respiration rates, girths/measurements, or volumes/frequencies fed, which might be useful to include in such a spreadsheet to help with health and welfare assessment on a day-to-day basis, and also to help monitor trends.
  - Would it be possible to combine that data with this spreadsheet please?
- Is there interest in making such a spreadsheet a document that can be edited by a few people so that such data can be centralised? And if so, is someone more tech-savvy than myself able to coordinate that please?

I believe he may have been moved back to the sea pen this afternoon, conditions/equipment/personnel permitting.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[REDACTED]

[REDACTED] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
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---

**From:** [REDACTED]  
**Sent:** 21 July 2021 17:52

To: HUHA Helping You Help Animals [REDACTED]  
[REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED] Ian Angus <iangus@doc.govt.nz>; Marine  
<marine@doc.govt.nz>; [REDACTED]  
[REDACTED] Kirstie Knowles <kknowles@doc.govt.nz>; [REDACTED]  
ingrid [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>

**Subject:** Veterinary update for orca calf 21/07/21

Hi everyone,

A veterinary update on Toa from today.

#### 1. Current medical findings

Lab tests:

- A blowhole culture taken 12/07/21 grew a light growth of E.coli and no fungi. This is of no clinical concern given the light growth and no signs of respiratory disease. It is likely that we'll repeat blowhole cultures throughout his time in care to monitor for trends.
- We are awaiting faecal results from samples submitted to the lab today: for parasitology, gram stain, salmonella culture and occult blood.
- A urine sample was collected and tested today:
  - USG today was 1.014. Some reference ranges for urine testing have been circulated amongst the vet teams (thanks [REDACTED]!) which indicate that our urine testing results so far are normal for this species.
- Blood was taken today by the HUHA team (thank you!):
  - In house biochem: Generally of no concern. His blood urea nitrogen (BUN) has increased slightly above normal, but this is likely to do with having recently eaten a protein rich meal (= formula). This analyte also increases with kidney disease/dehydration, but all our other blood and urine tests indicate that he is well hydrated and his kidneys are functioning normally. There are some other minor deviations from normal which are of no clinical significance at this stage but which we will monitor the trends of over time.
  - CBC: will be sent to the lab tomorrow
  - Serum electrophoresis: will be sent to the lab tomorrow
  - Cholesterol/triglycerides: will be sent to the lab tomorrow
  - Some historical blood has been stored in our -80°C freezer.
- We are awaiting cytology and culture on eye discharge submitted to the lab today.

Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.

- The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc). These are being monitored.
- A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reduced in severity today. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- Girth measurement update:
  - On 16/07/21: length 2.12m, girth in front of dorsal fin 1.42m, girth behind dorsal fin 1.17m
  - On 20/07/21: girth at widest point in front of dorsal fin 1.42m, girth at widest point behind dorsal fin 1.17m, girth at pectoral fin insert 1.34m
  - Girth measurements have some limitations in their use to assess body condition, but these results indicate no immediate significant weight loss. We will continue to monitor this over time to assess his response to feeding and the success of feeding.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (regular today) and urination (observed today).

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Today the plan is to feed him 10x feeds of 50:50 formula to 50% vytrate at 1.5 hour-intervals. No colic or other signs of gut disease have been observed since overnight on Monday night/very early Tuesday morning.
  - This is a step back on our diet increases, with a plan to slowly increase again in future when his gut settles so that we can aim to meet his caloric requirements.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 22/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing/communicating.

He is still in the pool, but as of today (21/07/21) he is back in sea water.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

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---

From: [Redacted]

Sent: 20 July 2021 19:15

To: 'HUHA Helping You Help Animals' [Redacted]

Cc: [redacted]@wellingtonzoo.com>; [redacted]  
[redacted]@wellingtonzoo.com>; [redacted] 'Ian  
Angus' <iangus@doc.govt.nz>; 'Marine' <marine@doc.govt.nz>;  
[redacted] 'Kirstie Knowles'  
<kknowles@doc.govt.nz>; [redacted] 'Ingrid'  
<ingrid [redacted]>; [redacted]@wellingtonzoo.com>; [redacted]  
[redacted]@wellingtonzoo.com>; [redacted]wellingtonzoo.com>; [redacted]  
[redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>

**Subject:** Veterinary update for orca calf 20/07/21

Hi everyone,

A veterinary update on Toa from today. Please add anything I may have missed.

#### 1. Current medical findings

##### Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected several faecal samples and these have been submitted for testing for parasitology, gram stain, salmonella culture and occult blood. We will let you know what these results show when we get them.
- A urine sample was collected and tested today:
  - USG today was 1.016 – despite some feeding difficulties in the last 24 hours, it looks like he is not currently dehydrated. We'll continue regular urine monitoring to look for any trends.
- One of our techs performed some water testing today. I will get the full numbers from her for this tomorrow, but I can give you interim findings in the meantime:
  - The chlorine level in the water is negligible. I think there was a misunderstanding here on my part I'm sorry, when I was told that he was in "chlorinated water", I thought you meant "swimming pool level chlorination", which would have been concerning. The level of chlorine in town supply water is much lower and should be fine in the interim if sea water is not available. Thank you for clarifying this today.
- We were not able to get much blood at all today, despite a few attempts. A drop of blood has been made into a blood smear to repeat an estimated white cell count, if the lab deems the size of this sample suitable.
  - We will return on Thursday to try to take some more blood for routine monitoring of his general condition.

##### Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.

- The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc) but we have taken some photos today to allow us to monitor them over time.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. It is possible that this started around the time of his move to the pool, as his eyes appeared normal before then. One of the cetacean vets we have been talking with thinks this is of minimal concern, but an ophthalmologist that has been contacted would like us to double check a couple of things to make sure it is not of concern. The swelling has reduced somewhat in the last couple of days. He would not let us examine the eye itself today, he held his eyelids tightly shut when we tried to have a look. We'll get in touch with some veterinary ophthalmologists in the lower north island and see what their availability is for a second opinion, and in the meantime we will keep monitoring for improvement of the swelling.
  - Some clear mucous from the eye will be sent to the lab for cytology and culture (although worth noting that normal eye secretions from this species are clear and mucousy).
- There is a small blister on the skin near his blowhole, approximately 1cm in diameter. It contains apparently clear fluid and otherwise there is no inflammation surrounding it. It is the only such lesion that we could see on his skin today. As a result, we are not immediately concerned by this lesion but will continue to keep an eye on it with photos and observations.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Yesterday (19/07/21) he received 10x feeds of 800-1000ml (with feed consisting of a ratio of 1L formula to 0.4L 50% vytrate).
- His feeding schedule was delayed by a few things during the day yesterday, such that his last feed was given at 1am this morning. After this feed (and to a lesser degree after the 8pm feed) he showed signs of discomfort – rolling along his long axis, and sinking to the bottom of the pool. Over a period of time he passed 3 faecals (his first faecals for the preceding 24 hour period), after which his signs significantly reduced. By this morning's first feed he was behaviourally normal again. I think this is likely an indication that he was in discomfort from too much pressure in his belly from having recently fed and having not defaecated for a while. However another possible reason could be gut upset from diet increases, or a gut disease such as parasitism. As a result our plan today was:
  - Give just 50% vytrate for the first few feeds.
  - Introduce food again at 50:50 formula to 50% vytrate after the first few feeds and monitor (this is a step back on our diet increases, with a plan to increase again in future when his gut settles so that we can aim to meet his caloric requirements).
  - Send faeces for parasitology and a few other tests.

- **Another thought please** is could we please try to keep 2 hours between feeds? I think his last feed before 1am was at midnight – perhaps this is an indication that a 1 hour feeding interval may be a bit much for him.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 21/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or we could cause quite significant gut upsets.

Additional medications:

- Today was his last day of enrofloxacin (antibiotic) injections.
- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

Formula prep has been handed over to the team on-site at Plimmerton Boat Club today:

- This was done in the hope that this will save all our teams time with regards to organising couriers to and from the zoo to pick up the diet. Let us know if it's not saving you time or if it is causing any other difficulties, we are very happy to take this role on for you again.
- Please also let us know well in advance if you need any of the ingredients topped up or replaced – some of these items will take us a few days to order in.

I have been asked for advice on how to safely increase the salinity for the pool that he is in. Please can you remind me of the dimensions and volume of the pool? With the current estimated whole pool turnover of every four hours, this is going to take a lot of salt. And with the tendency of large volumes of salt to sit on the bottom of pools and dissolve slowly, it is going to take some care to make sure that we don't raise the salinity too high. It may be quite difficult to get the balance right and will take careful monitoring. Will get in touch tomorrow with a plan.

I have received measurements of "107, 135, 134" today – can someone please let me know which of these are length/girth measurements etc?

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.



Kind regards,

[REDACTED]

[REDACTED] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021

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---

**From:** [REDACTED]  
**Sent:** 19 July 2021 17:33  
**To:** HUHA Helping You Help Animals [REDACTED]  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED] Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [REDACTED] Kirstie Knowles <[kknowles@doc.govt.nz](mailto:kknowles@doc.govt.nz)>; [REDACTED] ingrid [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>

**Subject:** RE: Veterinary update for orca calf 18/07/21

Hi everyone,

A shorter veterinary update on Toa from me today :)

As usual, Team HUHA and Whale Rescue please feel free to add to these updates!

1. Current medical findings

#### Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Can take that from you tomorrow when we pop by to send it on to the lab.
- A urine sample was collected and tested today:
  - USG today was 1.018, and there was trace protein and no glucose on the urine dipstick. These findings are of no concern and we'll continue regular urine monitoring to look for any trends.

#### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

#### Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- As of tomorrow he can receive 100% formula (no additional vytrate). According to his requirements of 120-125kcal/kg/d, an estimated weight of 200kg and an estimated caloric content of the food of 1450kcal/L, he requires 16L of formula per day to meet his requirements. This could be divided into several feeds such as 10 x 1.6L feeds or 8 x 2L feeds over the day tomorrow – would that suit how he's currently feeding?
  - If he receives this volume, this should also meet his fluid requirements for the day.

A few quick questions please, as I didn't manage to get anyone on the phone today:

- How was his respiration/defaecation/urination today?
- How much volume did you get into him today formula-wise and vytrate-wise? Was this mostly by bottle or did you tube feed him again today?
- Did you see any signs of post-feed discomfort today?
- Did you see any other signs of gut upset? ie: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.
- We've started him on the oral de-gas medication (simethicone) today (19/07/21) that has been recommended by a few vets that have been involved in hand rearing of cetaceans to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

A few of us from the zoo will pop by tomorrow to:

- Take some repeat bloods.
- Catch up with you about some of the physical exam findings, check in with how feeding is going, check in on a couple of monitoring parameters etc. If you'd like us to bring/check anything specific let me know!
- Bring gear/recipes/instructions to hand over the formula prep.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

Senior Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

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---

From: HUHA Helping You Help Animals [Redacted]

Sent: 18 July 2021 19:14

To: [Redacted]@wellingtonzoo.com>

Cc: [Redacted]@wellingtonzoo.com>

[Redacted]@wellingtonzoo.com>; [Redacted]@doc.govt.nz>; [Redacted]

[Redacted] Ian

Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [Redacted]

[Redacted] Kirstie Knowles <[kknowles@doc.govt.nz](mailto:kknowles@doc.govt.nz)>

[Redacted] ingrid [Redacted]@wellingtonzoo.com>;

[Redacted]@wellingtonzoo.com>;

[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>

Subject: Re: Veterinary update for orca calf 18/07/21

Hi All.

Thanks [Redacted]

Just to confirm that the Ingrid had the pool switched back to sea water thisafternoon.

Cheers

████████

On Sun, 18 Jul 2021, 5:55 pm ██████████@wellingtonzoo.com> wrote:

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversations or if you otherwise have anything to add!

Firstly thank you so much to everyone who worked so hard in such awful weather in the last couple of days, I thought of you often and I hope you managed to stay warm and dry in between caring for Toa.

#### 1. Current medical findings

##### Lab tests:

- The lab has unfortunately said that it can't run lactate on the type of sample that we've given them, but we can run it on the next sample we take using a patient-side machine that we can bring with us on the next blood sampling.
- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Will chat tomorrow about how we get that where it needs to be for analysis.
- A urine sample was collected and tested today:
  - USG today was 1.028, and there was +1 protein and +1 glucose on the urine dipstick. In some animals those dipstick findings can be abnormal, but we'll wait to see if they persist (in some species they can be normal, or at least explained by physiology rather than disease).

##### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage. No significant abnormalities/changes of defaecation have been noted with introducing or increasing the diet.
- He has been observed to urinate in the last 24 hours.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Ultimately we would like him on just formula (no supplementary fluid), as this contains enough fluid to also meet his fluid requirements, but we've been advised to build up to that slowly, which is why his diet is changing a little every day at the moment.
- Today the feeding plan was 1L formula + 1.2L 50% vytrate for the first three feeds (2.2L total) and then 1.5L formula + 0.7L 50% vytrate for the second three feeds (2.2L total). (Total of 7.5L formula and 5.7L 50% vytrate for today).
  - HUHA team if you could fill us in on how you went with this that would be lovely :)
- **Tomorrow's feeding plan:**
  - **1.1L formula + 0.4L 50% vytrate per feed x 8 feeds at 2 hourly intervals**

**(total of 8.8L formula and 3.2L 50% vytrate).**

- We've had to make a few changes to his feed schedule to get to the feeding plan for tomorrow:
  - He has been showing signs of discomfort after tube feeding – sinking to the bottom of the pool and hunching slightly.
    - This may be due to discomfort due to the volume fed - hence smaller meals tomorrow – fed more frequently so that we still try to meet his requirements.
    - Or it may be due to discomfort from the tubing. The cetacean vets that we've been taking advice from say that bottle feeding him would be a good alternative. They say it may contribute to habituation, but that so does being near to humans and being handled for tubings/treatments etc, so they are not concerned about the bottle feeding on its own per-se.
    - A bottle set up has been trialled today with moderate success. The signs of discomfort that were seen post-tubing have not been seen after bottle feeding.
- A few pointers from the cetacean vets:
  - Please make sure he's not gulping air while feeding – this can cause colic and discomfort.
    - They've recommended a de-gas medication be added to the feeds, I will source this asap and let you know when it's ready.
  - Please make sure he's not gulping water while feeding – too much sea water ingestion can affect his electrolyte levels and make him sick.
  - We/you can consider supplement feeding him with tube feeding if some of his bottle feeds are less productive than others.
  - They prefer him to have a break from feeding overnight to allow him to rest, so they do not advise feeding constantly over a 24 hour period at this stage.
- An important piece of information that I received today is that orca abdomens do not expand very easily compared to other mammals. As a result, a build up of anything in the abdomen increases the pressure in the abdomen rather than causing abdominal distension. So a build up of gas can very quickly become uncomfortable, as can ingesting volumes that are too large – so perhaps this is the reason we're seeing some discomfort after tubing.
- Please continue to monitor him for signs of gut upsets: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Today it was noted that some of the volunteers were encouraging him to suck on their thumbs as they thought this might help with feeding. Thank you Whale Rescue and HUHA for realising this was happening and for advising them to stop :)

Due to the suspected/confirmed (?) sewage spill at Plimmerton due to the horrible weather this weekend the team recently changed his pool from salt water to chlorinated water. Please could we change this to fresh water or back to sea water if the Plimmerton sea water is okay again? It was a good idea to change from sea water when the sewage problem was reported, but fresh water is much better for him than chlorinated water, which could negatively affect his skin and eyes.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted signature]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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200 Daniell Street | Newtown | Wellington 6021

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**From:** [REDACTED] <[REDACTED]@wellingtonzoo.com>  
**Sent:** 17 July 2021 16:35  
**To:** [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]  
**Cc:** HUHA Helping You Help Animals [REDACTED]; ingrid [REDACTED]; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hey all, quick update from me today.

- Toa is going really well according to personnel on site – accepting feeds well, and no gastrointestinal comfort seen
- There is possibly a sewerage pipe burst somewhere near the bay, so concerns re: water quality. HUHA vet [REDACTED] is organising water testing.
- [REDACTED] got a urine sample and USG this morning of 1.017
- [REDACTED] mentioned possibly some oedema around caudal oropharynx/throat area (possibly from repeat tubing?) so would like to keep bottle feeding as a back up option in case tubing needs to be abandoned. Toa is currently showing no signs of discomfort or distress during tubing, tolerates it very well. We can check this when we are next on site as well, but in the meantime if HUHA vets can keep a close eye on that please 😊
- We are going to continue upping the ratio of formula to vytrate, so please see the attached feeding schedule for 18/07/21 – there is no hard copy of this, I'm sorry. Had not gotten it printed off before the food was collected this afternoon. At this rate he should be on 100% formula from Monday afternoon, and we can look at making the formula richer or increasing volume if we need to increase caloric intake.
- We will organise a day early next week to revisit Toa to take a repeat blood sample
- I am going to be off for the next two days, but [REDACTED] is here tomorrow and [REDACTED] will both be here on Monday

Thanks again (and again and again) for everyone's hard work and dedication especially in the horrible conditions today.

[Me tiaki, kia ora!](#)

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** 16 July 2021 17:02  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]  
**Cc:** HUHA Helping You Help Animals [REDACTED]; ingrid [REDACTED]; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again, slight update to tomorrow's feed schedule (see attached).

[REDACTED] BA DVM  
Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust  
200 Daniell Street | Newtown | Wellington 6021  
E [REDACTED]@wellingtonzoo.com

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**From:** [REDACTED]  
**Sent:** Friday, 16 July 2021 4:07 pm  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]  
**Cc:** HUHA Helping You Help

[Redacted]

**From:** [Redacted]@wellingtonzoo.com>  
**Sent:** Friday, 23 July 2021 12:13 pm  
**To:** [Redacted]; HUHA Helping You Help Animals; [Redacted]  
**Cc:** [Redacted]; Ian Angus; Marine; [Redacted]  
[Redacted]; Kirstie Knowles; [Redacted]; ingrid@[Redacted]; [Redacted]  
**Subject:** RE: Veterinary update for orca calf 22/07/21

Hello everyone,

For when we go back to fish oils and in case we start running low on current supplies, I've found a couple of options that we could look into trying (see links):

- <https://www.marine-deals.co.nz/softbait-xtras/sea-harvester-raw-fish-oil-1/>
- [https://www.google.com/shopping/product/10384868819401118076?q=nz+fish+oil+liquid&prds=eto:5919830476759656929\\_0;5088664196972984299\\_0;3305632340471422316\\_0&sa=X&ved=0ahUKEwilrLfo8vfxAhW-4zgGHdn7DjoQ9pwGCAU](https://www.google.com/shopping/product/10384868819401118076?q=nz+fish+oil+liquid&prds=eto:5919830476759656929_0;5088664196972984299_0;3305632340471422316_0&sa=X&ved=0ahUKEwilrLfo8vfxAhW-4zgGHdn7DjoQ9pwGCAU)

There are other options as well but most are flavoured which I'm not sure would be helpful...

[Redacted] BA DVM  
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200 Daniell Street | Newtown | Wellington 6021  
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**From:** [Redacted]@wellingtonzoo.com>  
**Sent:** Friday, 23 July 2021 8:24 am  
**To:** HUHA Helping You Help Animals [Redacted]  
[Redacted]@wellingtonzoo.com>  
**Cc:** [Redacted]@wellingtonzoo.com>; [Redacted]  
[Redacted]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [Redacted]  
Kirstie Knowles <kknowles@doc.govt.nz>; [Redacted] ingrid [Redacted]; [Redacted]  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]  
[Redacted] HUHA VETS  
**Subject:** RE: Veterinary update for orca calf 22/07/21

Thanks [Redacted] we've entered these results into his medical file and also into the spreadsheet that [Redacted] sent through!

[Me tiaki, kia ora!](#)

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From: HUHA Helping You Help Animals [redacted]  
Sent: 22 July 2021 19:16  
To: [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>  
Cc: [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>;  
[redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>;  
<[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; Kirstie Knowles <[kknowles@doc.govt.nz](mailto:kknowles@doc.govt.nz)>;  
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[redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>;  
[redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>;  
<[redacted]@wellingtonzoo.com> HUHA VETS  
<[redacted]@wellingtonzoo.com>  
Subject: Re: Veterinary update for orca calf 22/07/21

Hi [redacted].

Apologies I didn't give you today's urinalysis result prior to leaving this afternoon

USG 1.026  
PH 5  
the remaining NAD

I was only present for 2 poos which we are no longer collecting.

He has just been relocated to the ocean pen and I am told it went extremely well. Apparently lots of happy clicks and chirps followed by zooming.

His total volume consumed today is low due to the fussy eating and also the interruption of relocation. The team plan to try to catch up with multiple feeds tonight although they won't feed past midnight so he gets to rest overnight. I believe his preferred formula is currently Vitrate and Milligans. He is rejecting the Sardine based formula.

Don't panic feeding solids is absolutely not on our radar...we are sticking as closely to you recommendations as we are able throughout this fussy period.

We will tube supplement if required, but hope to see a change no he is back in the ocean.

Very much looking forward to having [redacted] on site. And talking to [redacted] in the AM.

Speak soon

[redacted]

On Thu, 22 Jul 2021, 6:28 pm [REDACTED], <[REDACTED]@wellingtonzoo.com> wrote:

Hi everyone,

A veterinary update on Toa from today.

### 1. Current medical findings

Lab tests:

- Faecal results from samples submitted to the lab yesterday:
  - No nematodes or trematodes were detected (two types of worm parasite).
  - Giardia was not detected.
  - We are still awaiting a gram stain, salmonella culture and occult blood test.
- Blood samples taken by the HUHA team and submitted to the lab today (thank you!):
  - CBC/fibrinogen: pending.
  - Serum electrophoresis: pending.
  - Cholesterol/triglycerides: pending.
- Eye discharge submitted to the lab yesterday from the right eye:
  - Cytology: normal (no signs of inflammation/infection)
  - Culture: pending.

Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. They do not show any sign of infection (no swelling, discharge etc) and are being closely monitored. These appear to be getting worse with time in the pool so may indicate rub/wear injuries from repeatedly contacting/rubbing the edge of the pool as he swims. He will be trialed in the sea pen again to see if this reduces this rubbing and allows these wounds to heal.
    - Volunteers in the water aim to reduce his contact with the walls/floor of whatever space he's in.
  - A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reducing in severity. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (was this observed today?) and urination (was this observed today?).

Fluids/feeding:

- We use the following three calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
  - The hand rearing formula that we are feeding is calculated to contain 1450kcal/L.
- He has had some difficulties feeding in the last 24 hours, with seemingly some distaste for the taste of the formula and has been spitting out the bottle teat on some occasions. Team HUHA how did you get on with feeds today, what sort of volumes of what kind of formulas did you get into him? Did you end up stomach tubing any of the feeds?
- Tomorrow we've organised an online meeting with an overseas vet with experience in hand rearing cetaceans to help us trouble shoot this and provide some advice on a feeding/formula plan moving forward and tips on tweaking feeding on a feed-by-feed and day-by-day basis.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.
  - Please let us know when you are running low and we'll get you some more.

Plan for regular monitoring of health and welfare:

- [REDACTED] and I have put together the bare bones of a spreadsheet with some of the data that we've had available to our teams so far, and I've attached it here.
  - Blood results, some girths/measurements, some urine results, some feeding/defaecation data.
- I don't have all the data for urination, defecation, respiration rates, girths/measurements, or volumes/frequencies fed, which might be useful to include in such a spreadsheet to help with health and welfare assessment on a day-to-day basis, and also to help monitor trends.
  - Would it be possible to combine that data with this spreadsheet please?
- Is there interest in making such a spreadsheet a document that can be edited by a few people so that such data can be centralised? And if so, is someone more tech-savvy than myself able to coordinate that please?

I believe he may have been moved back to the sea pen this afternoon, conditions/equipment/personnel permitting.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
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**From:** [Redacted]  
**Sent:** 21 July 2021 17:52  
**To:** HUHA Helping You Help Animals [Redacted]  
[Redacted] [@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com); [Redacted] [@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com);  
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[ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [Redacted] [@wellingtonzoo.com](mailto:[Redacted]@wellingtonzoo.com);  
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**Subject:** Veterinary update for orca calf 21/07/21

Hi everyone,

A veterinary update on Toa from today.

## 1. Current medical findings

Lab tests:

- A blowhole culture taken 12/07/21 grew a light growth of E.coli and no fungi. This is of no clinical concern given the light growth and no signs of respiratory disease. It is likely that we'll repeat blowhole cultures throughout his time in care to monitor for trends.
- We are awaiting faecal results from samples submitted to the lab today: for parasitology, gram stain, salmonella culture and occult blood.
- A urine sample was collected and tested today:
  - USG today was 1.014. Some reference ranges for urine testing have been circulated amongst the vet teams (thanks [REDACTED]!) which indicate that our urine testing results so far are normal for this species.
- Blood was taken today by the HUHA team (thank you!):
  - In house biochem: Generally of no concern. His blood urea nitrogen (BUN) has increased slightly above normal, but this is likely to do with having recently eaten a protein rich meal (= formula). This analyte also increases with kidney disease/dehydration, but all our other blood and urine tests indicate that he is well hydrated and his kidneys are functioning normally. There are some other minor deviations from normal which are of no clinical significance at this stage but which we will monitor the trends of over time.
  - CBC: will be sent to the lab tomorrow
  - Serum electrophoresis: will be sent to the lab tomorrow
  - Cholesterol/triglycerides: will be sent to the lab tomorrow
  - Some historical blood has been stored in our -80°C freezer.
- We are awaiting cytology and culture on eye discharge submitted to the lab today.

Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc). These are being monitored.
  - A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reduced in severity today. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- Girth measurement update:
  - On 16/07/21: length 2.12m, girth in front of dorsal fin 1.42m, girth behind dorsal fin 1.17m
  - On 20/07/21: girth at widest point in front of dorsal fin 1.42m, girth at widest point behind dorsal fin 1.17m, girth at pectoral fin insert 1.34m



- Girth measurements have some limitations in their use to assess body condition, but these results indicate no immediate significant weight loss. We will continue to monitor this over time to assess his response to feeding and the success of feeding.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (regular today) and urination (observed today).

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Today the plan is to feed him 10x feeds of 50:50 formula to 50% vytrate at 1.5 hour-intervals. No colic or other signs of gut disease have been observed since overnight on Monday night/very early Tuesday morning.
  - This is a step back on our diet increases, with a plan to slowly increase again in future when his gut settles so that we can aim to meet his caloric requirements.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 22/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing/communicating.

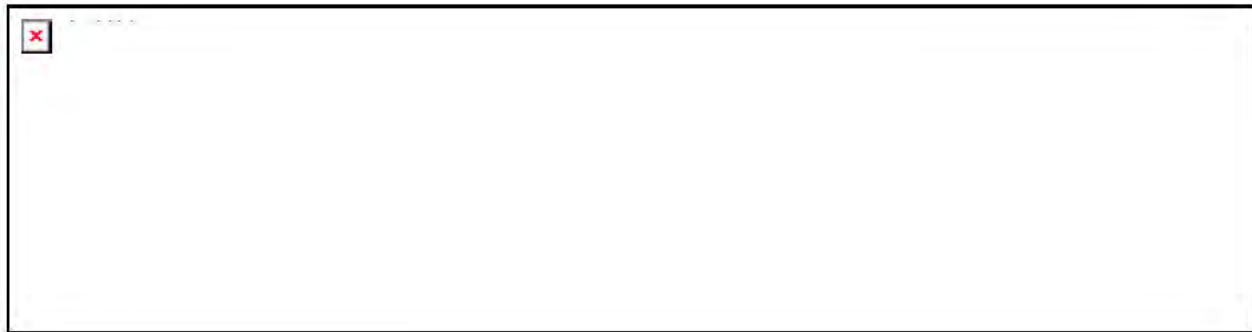
He is still in the pool, but as of today (21/07/21) he is back in sea water.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] **BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
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**From:** [Redacted]  
**Sent:** 20 July 2021 19:15  
**To:** 'HUHA Helping You Help Animals' [Redacted]  
**Cc:** [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted] 'Ian Angus' <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; 'Marine' <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [Redacted] 'Kirstie Knowles' <[kknowles@doc.govt.nz](mailto:kknowles@doc.govt.nz)>; [Redacted] 'Ingrid' <[ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com)>; [Redacted] <[@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [Redacted] <[@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [Redacted] <[@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [Redacted] <[@wellingtonzoo.com](mailto:@wellingtonzoo.com)>>  
**Subject:** Veterinary update for orca calf 20/07/21

Hi everyone,

A veterinary update on Toa from today. Please add anything I may have missed.

## 1. Current medical findings

### Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected several faecal samples and these have been submitted for testing for parasitology, gram stain, salmonella culture and occult blood. We will let you know what these results show when we get them.
- A urine sample was collected and tested today:
  - USG today was 1.016 – despite some feeding difficulties in the last 24 hours, it looks like he is not currently dehydrated. We'll continue regular urine monitoring to look for any trends.
- One of our techs performed some water testing today. I will get the full numbers from her for this tomorrow, but I can give you interim findings in the meantime:
  - The chlorine level in the water is negligible. I think there was a misunderstanding here on my part I'm sorry, when I was told that he was in "chlorinated water", I thought you meant "swimming pool level chlorination", which would have been concerning. The level of chlorine in town supply water is much lower and should be fine in the interim if sea water is not available. Thank you for clarifying this today.
- We were not able to get much blood at all today, despite a few attempts. A drop of blood has been made into a blood smear to repeat an estimated white cell count, if the lab deems the size of this sample suitable.
  - We will return on Thursday to try to take some more blood for routine monitoring of his general condition.

### Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc) but we have taken some photos today to allow us to monitor them over time.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. It is possible that this started around the time of his move to the pool, as his eyes appeared normal before then. One of the cetacean vets we have been talking with thinks this is of minimal concern, but an ophthalmologist that has been contacted would like us to double check a couple of things to make sure it is not of concern. The swelling has reduced somewhat in the last couple of days. He would not let us examine the eye itself today, he held his eyelids tightly shut when we tried to have a look. We'll get in touch with some veterinary ophthalmologists in the lower north island and see what their availability is for a second opinion, and in the meantime we will keep monitoring for improvement of the swelling.
  - Some clear mucous from the eye will be sent to the lab for cytology and culture (although worth noting that normal eye secretions from this species are clear and mucousy).

- There is a small blister on the skin near his blowhole, approximately 1cm in diameter. It contains apparently clear fluid and otherwise there is no inflammation surrounding it. It is the only such lesion that we could see on his skin today. As a result, we are not immediately concerned by this lesion but will continue to keep an eye on it with photos and observations.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Yesterday (19/07/21) he received 10x feeds of 800-1000ml (with feed consisting of a ratio of 1L formula to 0.4L 50% vytrate).
- His feeding schedule was delayed by a few things during the day yesterday, such that his last feed was given at 1am this morning. After this feed (and to a lesser degree after the 8pm feed) he showed signs of discomfort – rolling along his long axis, and sinking to the bottom of the pool. Over a period of time he passed 3 faecals (his first faecals for the preceding 24 hour period), after which his signs significantly reduced. By this morning's first feed he was behaviourally normal again. I think this is likely an indication that he was in discomfort from too much pressure in his belly from having recently fed and having not defaecated for a while. However another possible reason could be gut upset from diet increases, or a gut disease such as parasitism. As a result our plan today was:
  - Give just 50% vytrate for the first few feeds.
  - Introduce food again at 50:50 formula to 50% vytrate after the first few feeds and monitor (this is a step back on our diet increases, with a plan to increase again in future when his gut settles so that we can aim to meet his caloric requirements).
  - Send faeces for parasitology and a few other tests.
  - **Another thought please** is could we please try to keep 2 hours between feeds? I think his last feed before 1am was at midnight – perhaps this is an indication that a 1 hour feeding interval may be a bit much for him.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 21/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or we could cause quite significant gut upsets.

Additional medications:

- Today was his last day of enrofloxacin (antibiotic) injections.
- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

Formula prep has been handed over to the team on-site at Plimmerton Boat Club today:

- This was done in the hope that this will save all our teams time with regards to organising couriers to and from the zoo to pick up the diet. Let us know if it's not saving you time or if it is causing any other difficulties, we are very happy to take this role on for you again.
- Please also let us know well in advance if you need any of the ingredients topped up or replaced – some of these items will take us a few days to order in.


I have been asked for advice on how to safely increase the salinity for the pool that he is in. Please can you remind me of the dimensions and volume of the pool? With the current estimated whole pool turnover of every four hours, this is going to take a lot of salt. And with the tendency of large volumes of salt to sit on the bottom of pools and dissolve slowly, it is going to take some care to make sure that we don't raise the salinity too high. It may be quite difficult to get the balance right and will take careful monitoring. Will get in touch tomorrow with a plan.

I have received measurements of "107, 135, 134" today – can someone please let me know which of these are length/girth measurements etc?

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



 BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
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From: [REDACTED]  
Sent: 19 July 2021 17:33  
To: HUHA Helping You Help Animals [REDACTED]  
Cc: [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED] lan  
Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED] Kirstie Knowles <kknowles@doc.govt.nz>; [REDACTED] ingric [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]omas@wellingtonzoo.com>  
Subject: RE: Veterinary update for orca calf 18/07/21

Hi everyone,

A shorter veterinary update on Toa from me today :)

As usual, Team HUHA and Whale Rescue please feel free to add to these updates!

1. Current medical findings

Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Can take that from you tomorrow when we pop by to send it on to the lab.
- A urine sample was collected and tested today:
  - USG today was 1.018, and there was trace protein and no glucose on the urine dipstick. These findings are of no concern and we'll continue regular urine monitoring to look for any trends.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- As of tomorrow he can receive 100% formula (no additional vytrate). According to his requirements of 120-125kcal/kg/d, an estimated weight of 200kg and an estimated caloric content of the food of 1450kcal/L, he requires 16L of formula per day to meet his requirements. This could be divided into several feeds such as 10 x 1.6L feeds or 8 x 2L feeds over the day tomorrow – would that suit how he's currently feeding?
  - If he receives this volume, this should also meet his fluid requirements for the day.

A few quick questions please, as I didn't manage to get anyone on the phone today:

- How was his respiration/defaecation/urination today?
- How much volume did you get into him today formula-wise and vytrate-wise? Was this mostly by bottle or did you tube feed him again today?
- Did you see any signs of post-feed discomfort today?
- Did you see any other signs of gut upset? ie: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.

- We've started him on the oral de-gas medication (simethicone) today (19/07/21) that has been recommended by a few vets that have been involved in hand rearing of cetaceans to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

A few of us from the zoo will pop by tomorrow to:

- Take some repeat bloods.
- Catch up with you about some of the physical exam findings, check in with how feeding is going, check in on a couple of monitoring parameters etc. If you'd like us to bring/check anything specific let me know!
- Bring gear/recipes/instructions to hand over the formula prep.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



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From: HUHA Helping You Help Animals [REDACTED] >  
Sent: 18 July 2021 19:14  
To: [REDACTED]@wellingtonzoo.com>  
Cc: [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED] Ian  
Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [REDACTED]  
[REDACTED] Kirstie Knowles <[kknowles@doc.govt.nz](mailto:kknowles@doc.govt.nz)>; [REDACTED]  
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[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
Subject: Re: Veterinary update for orca calf 18/07/21

Hi All.

Thanks [REDACTED]

Just to confirm that the Ingrid had the pool switched back to sea water thisafternoon.

Cheers

[REDACTED]

On Sun, 18 Jul 2021, 5:55 pm [REDACTED]@wellingtonzoo.com> wrote:

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversations or if you otherwise have anything to add!

Firstly thank you so much to everyone who worked so hard in such awful weather in the last couple of days, I thought of you often and I hope you managed to stay warm and dry in between caring for Toa.

## 1. Current medical findings

Lab tests:

- The lab has unfortunately said that it can't run lactate on the type of sample that we've given them, but we can run it on the next sample we take using a patient-side machine that we can bring with us on the next blood sampling.
- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Will chat tomorrow about how we get that where it needs to be for analysis.
- A urine sample was collected and tested today:
  - USG today was 1.028, and there was +1 protein and +1 glucose on the urine dipstick. In some animals those dipstick findings can be abnormal, but we'll wait to see if they persist (in some species they can be normal, or at least explained by physiology rather than disease).

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage. No significant abnormalities/changes of defaecation have been noted with introducing or increasing the diet.
- He has been observed to urinate in the last 24 hours.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Ultimately we would like him on just formula (no supplementary fluid), as this contains enough fluid to also meet his fluid requirements, but we've been advised to build up to that slowly, which is why his diet is changing a little every day at the moment.
- Today the feeding plan was 1L formula + 1.2L 50% vytrate for the first three feeds (2.2L total) and then 1.5L formula + 0.7L 50% vytrate for the second three feeds (2.2L total). (Total of 7.5L formula and 5.7L 50% vytrate for today).
  - HUHA team if you could fill us in on how you went with this that would be lovely :)

- **Tomorrow's feeding plan:**

- **1.1L formula + 0.4L 50% vytrate per feed x 8 feeds at 2 hourly intervals**

**(total of 8.8L formula and 3.2L 50% vytrate).**

- We've had to make a few changes to his feed schedule to get to the feeding plan for tomorrow:
  - He has been showing signs of discomfort after tube feeding – sinking to the bottom of the pool and hunching slightly.
    - This may be due to discomfort due to the volume fed - hence smaller meals tomorrow – fed more frequently so that we still try to meet his requirements.
    - Or it may be due to discomfort from the tubing. The cetacean vets that we've been taking advice from say that bottle feeding him would be a good alternative. They say it may contribute to habituation, but that so does being near to humans and being handled for tubings/treatments etc, so they are not concerned about the bottle feeding on its own per-se.
    - A bottle set up has been trialled today with moderate success. The signs of discomfort that were seen post-tubing have not been seen after bottle feeding.
- A few pointers from the cetacean vets:

- Please make sure he's not gulping air while feeding – this can cause colic and discomfort.
    - They've recommended a de-gas medication be added to the feeds, I will source this asap and let you know when it's ready.
  - Please make sure he's not gulping water while feeding – too much sea water ingestion can affect his electrolyte levels and make him sick.
  - We/you can consider supplement feeding him with tube feeding if some of his bottle feeds are less productive than others.
  - They prefer him to have a break from feeding overnight to allow him to rest, so they do not advise feeding constantly over a 24 hour period at this stage.
- An important piece of information that I received today is that orca abdomens do not expand very easily compared to other mammals. As a result, a build up of anything in the abdomen increases the pressure in the abdomen rather than causing abdominal distension. So a build up of gas can very quickly become uncomfortable, as can ingesting volumes that are too large – so perhaps this is the reason we're seeing some discomfort after tubing.
  - Please continue to monitor him for signs of gut upsets: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Today it was noted that some of the volunteers were encouraging him to suck on their thumbs as they thought this might help with feeding. Thank you Whale Rescue and HUHA for realising this was happening and for advising them to stop :)

Due to the suspected/confirmed (?) sewage spill at Plimmerton due to the horrible weather this weekend the team recently changed his pool from salt water to chlorinated water. Please could we change this to fresh water or back to sea water if the Plimmerton sea water is okay again? It was a good idea to change from sea water when the sewage problem was reported, but fresh water is much better for him than chlorinated water, which could negatively affect his skin and eyes.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

#### 4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

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**From:** [Redacted]@wellingtonzoo.com>

**Sent:** 17 July 2021 16:35

**To:** [Redacted]@wellingtonzoo.com>; [Redacted]

[Redacted]@wellingtonzoo.com>; [Redacted]

Ian Angus <iangus@doc.govt.nz>; Marine

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**Cc:** HUHA Helping You Help Animals <[Redacted]>; ingrid [Redacted]; [Redacted]

[Redacted]@wellingtonzoo.com>; [Redacted]

[Redacted]@wellingtonzoo.com>; [Redacted]

[Redacted]@wellingtonzoo.com>; [Redacted]

[Redacted]@wellingtonzoo.com>; [Redacted]

██████████@wellingtonzoo.com>

**Subject:** RE: Veterinary update for orca calf 15/07/21

Hey all, quick update from me today.

- Toa is going really well according to personnel on site – accepting feeds well, and no gastrointestinal comfort seen
- There is possibly a sewerage pipe burst somewhere near the bay, so concerns re: water quality. HUHA vet ██████████ is organising water testing.
- ██████████ got a urine sample and USG this morning of 1.017
- ██████████ mentioned possibly some oedema around caudal oropharynx/throat area (possibly from repeat tubing?) so would like to keep bottle feeding as a back up option in case tubing needs to be abandoned. Toa is currently showing no signs of discomfort or distress during tubing, tolerates it very well. We can check this when we are next on site as well, but in the meantime if HUHA vets can keep a close eye on that please 😊
- We are going to continue upping the ratio of formula to vytrate, so please see the attached feeding schedule for 18/07/21 – there is no hard copy of this, I'm sorry. Had not gotten it printed off before the food was collected this afternoon. At this rate he should be on 100% formula from Monday afternoon, and we can look at making the formula richer or increasing volume if we need to increase caloric intake.
- We will organise a day early next week to revisit Toa to take a repeat blood sample
- I am going to be off for the next two days, but ██████████ is here tomorrow and ██████████ will both be here on Monday

Thanks again (and again and again) for everyone's hard work and dedication especially in the horrible conditions today.

[Me tiaki, kia ora!](#)

██████████ BSc (Hons)

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**From:** ██████████@wellingtonzoo.com>

**Sent:** 16 July 2021 17:02

**To:** ██████████@wellingtonzoo.com>; ██████████

██████████ Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; ██████████

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; [ingric](#) ██████████

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[redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]  
[redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>

**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again, slight update to tomorrow's feed schedule (see attached).

[redacted] BA DVM

Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

E [redacted]@wellingtonzoo.com

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**From:** [redacted]

**Sent:** Friday, 16 July 2021 4:07 pm

**To:** [redacted]@wellingtonzoo.com>; [redacted]

[redacted]@doc.govt.nz>; [redacted]  
; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [redacted]

**Cc:** HUHA Helping You Help

[Redacted]

**From:** [Redacted]@wellingtonzoo.com>  
**Sent:** Friday, 23 July 2021 10:03 am  
**To:** [Redacted]; HUHA Helping You Help Animals; [Redacted]  
**Cc:** [Redacted]; Ian Angus; [Redacted];  
 [Redacted]; Kirstie Knowles; [Redacted]; Ingrid [Redacted]; [Redacted]  
**Subject:** RE: Veterinary update for orca calf 22/07/21  
**Attachments:** Toa Feed without fish.docx

Hello, here is the new feed recipe. When you feed this today could you please dilute to a 50% concentration using half strength vytrate?

[Redacted] **BA DVM**  
 Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust  
 200 Daniell Street | Newtown | Wellington 6021  
 E [Redacted]@wellingtonzoo.com

**From:** [Redacted]@wellingtonzoo.com>  
**Sent:** Friday, 23 July 2021 8:24 am  
**To:** HUHA Helping You Help Animals [Redacted]  
 [Redacted]@wellingtonzoo.com>  
**Cc:** [Redacted]@wellingtonzoo.com>; [Redacted]  
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 [Redacted] Kirstie Knowles <kknowles@doc.govt.nz>; [Redacted]; Ingrid [Redacted]  
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 [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;  
 [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;  
**Subject:** RE: Veterinary update for orca calf 22/07/21

Thanks [Redacted], we've entered these results into his medical file and also into the spreadsheet that B sent through!

[Me tiaki, kia ora!](#)

[Redacted] **BVSc (Hons)**  
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From: HUHA Helping You Help Animals [REDACTED]

Sent: 22 July 2021 19:16

To: [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>

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[ingric@wellingtonzoo.com](mailto:ingric@wellingtonzoo.com); Daniel Warsaw <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>;

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[REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>;

HUHA VETS

Subject: Re: Veterinary update for orca calf 22/07/21

Hi [REDACTED]

Apologies I didn't give you today's urinalysis result prior to leaving this afternoon

USG 1.026

PH 5

the remaining NAD

I was only present for 2 poos which we are no longer collecting.

He has just been relocated to the ocean pen and I am told it went extremely well. Apparently lots of happy clicks and chirps followed by zooming.

His total volume consumed today is low due to the fussy eating and also the interruption of relocation. The team plan to try to catch up with multiple feeds tonight although they won't feed past midnight so he gets to rest overnight. I believe his preferred formula is currently Vitrate and Milligans. He is rejecting the Sardine based formula.

Don't panic feeding solids is absolutely not on our radar...we are sticking as closely to you recommendations as we are able throughout this fussy period.

We will tube supplement if required, but hope to see a change no he is back in the ocean.

Very much looking forward to having [REDACTED] on site. And talking to [REDACTED] in the AM.

Speak soon

[REDACTED]

On Thu, 22 Jul 2021, 6:28 pm [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)> wrote:

Hi everyone,

A veterinary update on Toa from today.

## 1. Current medical findings

### Lab tests:

- Faecal results from samples submitted to the lab yesterday:
  - No nematodes or trematodes were detected (two types of worm parasite).
  - Giardia was not detected.
  - We are still awaiting a gram stain, salmonella culture and occult blood test.
- Blood samples taken by the HUHA team and submitted to the lab today (thank you!):
  - CBC/fibrinogen: pending.
  - Serum electrophoresis: pending.
  - Cholesterol/triglycerides: pending.
- Eye discharge submitted to the lab yesterday from the right eye:
  - Cytology: normal (no signs of inflammation/infection)
  - Culture: pending.

### Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. They do not show any sign of infection (no swelling, discharge etc) and are being closely monitored. These appear to be getting worse with time in the pool so may indicate rub/wear injuries from repeatedly contacting/rubbing the edge of the pool as he swims. He will be trialled in the sea pen again to see if this reduces this rubbing and allows these wounds to heal.
    - Volunteers in the water aim to reduce his contact with the walls/floor of whatever space he's in.
  - A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reducing in severity. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (was this observed today?) and urination (was this observed today?).

#### Fluids/feeding:

- We use the following three calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
  - The hand rearing formula that we are feeding is calculated to contain 1450kcal/L.
- He has had some difficulties feeding in the last 24 hours, with seemingly some distaste for the taste of the formula and has been spitting out the bottle teat on some occasions. Team HUHA how did you get on with feeds today, what sort of volumes of what kind of formulas did you get into him? Did you end up stomach tubing any of the feeds?
- Tomorrow we've organised an online meeting with an overseas vet with experience in hand rearing cetaceans to help us trouble shoot this and provide some advice on a feeding/formula plan moving forward and tips on tweaking feeding on a feed-by-feed and day-by-day basis.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

#### Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.
  - Please let us know when you are running low and we'll get you some more.

#### Plan for regular monitoring of health and welfare:

- [REDACTED] and I have put together the bare bones of a spreadsheet with some of the data that we've had available to our teams so far, and I've attached it here.
  - Blood results, some girths/measurements, some urine results, some feeding/defaecation data.
- I don't have all the data for urination, defecation, respiration rates, girths/measurements, or volumes/frequencies fed, which might be useful to include in such a spreadsheet to help with health and welfare assessment on a day-to-day basis, and also to help monitor trends.
  - Would it be possible to combine that data with this spreadsheet please?
- Is there interest in making such a spreadsheet a document that can be edited by a few people so that such data can be centralised? And if so, is someone more tech-savvy than myself able to coordinate that please?

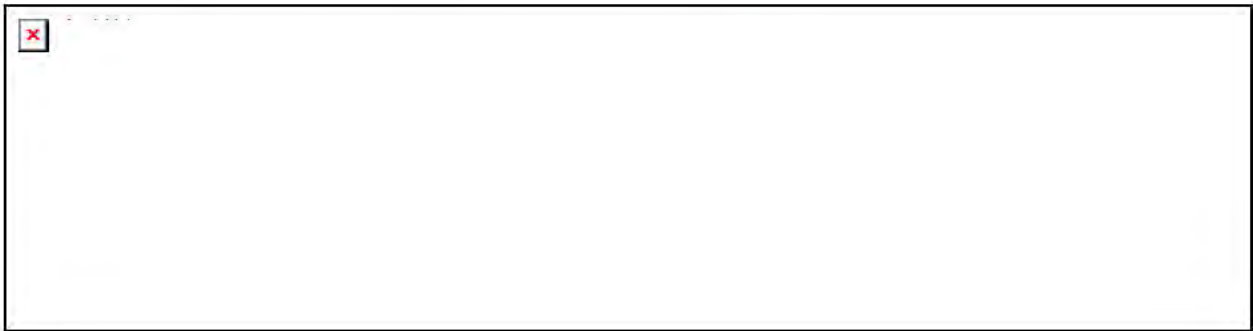
I believe he may have been moved back to the sea pen this afternoon, conditions/equipment/personnel permitting.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

**[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
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**From:** [Redacted]  
**Sent:** 21 July 2021 17:52  
**To:** HUHA Helping You Help Animals <[Redacted]>  
[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;  
[Redacted] Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine  
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[Redacted]; Kirstie Knowles <[kknowles@doc.govt.nz](mailto:kknowles@doc.govt.nz)>; [Redacted]>;  
[ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com)>; [Redacted]@wellingtonzoo.com>; [Redacted]  
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[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>

**Subject:** Veterinary update for orca calf 21/07/21

Hi everyone,

A veterinary update on Toa from today.

1. Current medical findings

## Lab tests:

- A blowhole culture taken 12/07/21 grew a light growth of E.coli and no fungi. This is of no clinical concern given the light growth and no signs of respiratory disease. It is likely that we'll repeat blowhole cultures throughout his time in care to monitor for trends.
- We are awaiting faecal results from samples submitted to the lab today: for parasitology, gram stain, salmonella culture and occult blood.
- A urine sample was collected and tested today:
  - USG today was 1.014. Some reference ranges for urine testing have been circulated amongst the vet teams (thanks [REDACTED]!) which indicate that our urine testing results so far are normal for this species.
- Blood was taken today by the HUHA team (thank you!):
  - In house biochem: Generally of no concern. His blood urea nitrogen (BUN) has increased slightly above normal, but this is likely to do with having recently eaten a protein rich meal (= formula). This analyte also increases with kidney disease/dehydration, but all our other blood and urine tests indicate that he is well hydrated and his kidneys are functioning normally. There are some other minor deviations from normal which are of no clinical significance at this stage but which we will monitor the trends of over time.
  - CBC: will be sent to the lab tomorrow
  - Serum electrophoresis: will be sent to the lab tomorrow
  - Cholesterol/triglycerides: will be sent to the lab tomorrow
  - Some historical blood has been stored in our -80°C freezer.
- We are awaiting cytology and culture on eye discharge submitted to the lab today.

## Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc). These are being monitored.
  - A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reduced in severity today. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- Girth measurement update:
  - On 16/07/21: length 2.12m, girth in front of dorsal fin 1.42m, girth behind dorsal fin 1.17m
  - On 20/07/21: girth at widest point in front of dorsal fin 1.42m, girth at widest point behind dorsal fin 1.17m, girth at pectoral fin insert 1.34m
  - Girth measurements have some limitations in their use to assess body condition, but these results indicate no immediate significant weight loss. We will continue to monitor this over time to assess his response to feeding and the success of feeding.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (regular today) and urination (observed today).

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Today the plan is to feed him 10x feeds of 50:50 formula to 50% vytrate at 1.5 hour-intervals. No colic or other signs of gut disease have been observed since overnight on Monday night/very early Tuesday morning.
  - This is a step back on our diet increases, with a plan to slowly increase again in future when his gut settles so that we can aim to meet his caloric requirements.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 22/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing/communicating.

He is still in the pool, but as of today (21/07/21) he is back in sea water.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



**[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)**  
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**From:** [REDACTED]  
**Sent:** 20 July 2021 19:15  
**To:** 'HUHA Helping You Help Animals' [REDACTED]  
**Cc:** [REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com);  
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[REDACTED] 'Ian Angus' [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); 'Marine' [marine@doc.govt.nz](mailto:marine@doc.govt.nz);  
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[REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com);  
[REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com);  
[REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com);  
**Subject:** Veterinary update for orca calf 20/07/21

Hi everyone,

A veterinary update on Toa from today. Please add anything I may have missed.

1. Current medical findings

Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected several faecal samples and these have been submitted for testing for parasitology, gram stain, salmonella culture and occult blood. We will let you know what these results show when we get them.
- A urine sample was collected and tested today:
  - USG today was 1.016 – despite some feeding difficulties in the last 24 hours, it looks like he is not currently dehydrated. We'll continue regular urine monitoring to look for any trends.
- One of our techs performed some water testing today. I will get the full numbers from her for this tomorrow, but I can give you interim findings in the meantime:
  - The chlorine level in the water is negligible. I think there was a misunderstanding here on my part I'm sorry, when I was told that he was in "chlorinated water", I thought you meant "swimming pool level chlorination", which would have been concerning. The level of chlorine in town supply water is much lower and should be fine in the interim if sea water is not available. Thank you for clarifying this today.
- We were not able to get much blood at all today, despite a few attempts. A drop of blood has been made into a blood smear to repeat an estimated white cell count, if the lab deems the size of this sample suitable.
  - We will return on Thursday to try to take some more blood for routine monitoring of his general condition.

#### Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc) but we have taken some photos today to allow us to monitor them over time.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. It is possible that this started around the time of his move to the pool, as his eyes appeared normal before then. One of the cetacean vets we have been talking with thinks this is of minimal concern, but an ophthalmologist that has been contacted would like us to double check a couple of things to make sure it is not of concern. The swelling has reduced somewhat in the last couple of days. He would not let us examine the eye itself today, he held his eyelids tightly shut when we tried to have a look. We'll get in touch with some veterinary ophthalmologists in the lower north island and see what their availability is for a second opinion, and in the meantime we will keep monitoring for improvement of the swelling.
  - Some clear mucous from the eye will be sent to the lab for cytology and culture (although worth noting that normal eye secretions from this species are clear and mucousy).
- There is a small blister on the skin near his blowhole, approximately 1cm in diameter. It contains apparently clear fluid and otherwise there is no inflammation surrounding it. It is the only such lesion that we could see on his skin today. As a result, we are not immediately concerned by this lesion but will continue to keep an eye on it with photos and observations.

#### 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:



Ongoing recording of respiratory rate, defaecation and urination.

#### Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Yesterday (19/07/21) he received 10x feeds of 800-1000ml (with feed consisting of a ratio of 1L formula to 0.4L 50% vytrate).
- His feeding schedule was delayed by a few things during the day yesterday, such that his last feed was given at 1am this morning. After this feed (and to a lesser degree after the 8pm feed) he showed signs of discomfort – rolling along his long axis, and sinking to the bottom of the pool. Over a period of time he passed 3 faecals (his first faecals for the preceding 24 hour period), after which his signs significantly reduced. By this morning's first feed he was behaviourally normal again. I think this is likely an indication that he was in discomfort from too much pressure in his belly from having recently fed and having not defaecated for a while. However another possible reason could be gut upset from diet increases, or a gut disease such as parasitism. As a result our plan today was:
  - Give just 50% vytrate for the first few feeds.
  - Introduce food again at 50:50 formula to 50% vytrate after the first few feeds and monitor (this is a step back on our diet increases, with a plan to increase again in future when his gut settles so that we can aim to meet his caloric requirements).
  - Send faeces for parasitology and a few other tests.
  - **Another thought please** is could we please try to keep 2 hours between feeds? I think his last feed before 1am was at midnight – perhaps this is an indication that a 1 hour feeding interval may be a bit much for him.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 21/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or we could cause quite significant gut upsets.

#### Additional medications:

- Today was his last day of enrofloxacin (antibiotic) injections.
- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

#### Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

Formula prep has been handed over to the team on-site at Plimmerton Boat Club today:

- This was done in the hope that this will save all our teams time with regards to organising couriers to and from the zoo to pick up the diet. Let us know if it's not saving you time or if it is causing any other difficulties, we are very happy to take this role on for you again.
- Please also let us know well in advance if you need any of the ingredients topped up or replaced – some of these items will take us a few days to order in.

I have been asked for advice on how to safely increase the salinity for the pool that he is in. Please can you remind me of the dimensions and volume of the pool? With the current estimated whole pool turnover of every four hours, this is going to take a lot of salt. And with the tendency of large volumes of salt to sit on the bottom of pools and dissolve slowly, it is going to take some care to make sure that we don't raise the salinity too high. It may be quite difficult to get the balance right and will take careful monitoring. Will get in touch tomorrow with a plan.

I have received measurements of "107, 135, 134" today – can someone please let me know which of these are length/girth measurements etc?

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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From: [Redacted]

Sent: 19 July 2021 17:33

To: HUHA Helping You Help [Redacted]

Cc: [Redacted]@wellingtonzoo.com>; [Redacted]

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<[redacted] Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [redacted]  
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[redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>; [redacted] <[\[redacted\]@wellingtonzoo.com](mailto:[redacted]@wellingtonzoo.com)>

**Subject:** RE: Veterinary update for orca calf 18/07/21

Hi everyone,

A shorter veterinary update on Toa from me today :)

As usual, Team HUHA and Whale Rescue please feel free to add to these updates!

#### 1. Current medical findings

##### Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Can take that from you tomorrow when we pop by to send it on to the lab.
- A urine sample was collected and tested today:
  - USG today was 1.018, and there was trace protein and no glucose on the urine dipstick. These findings are of no concern and we'll continue regular urine monitoring to look for any trends.

##### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- As of tomorrow he can receive 100% formula (no additional vytrate). According to his requirements of 120-125kcal/kg/d, an estimated weight of 200kg and an estimated caloric content of the food of 1450kcal/L, he requires 16L of formula per day to meet his requirements. This could be divided into several feeds such as 10 x 1.6L feeds or 8 x 2L feeds over the day tomorrow – would that suit how he's currently feeding?
  - If he receives this volume, this should also meet his fluid requirements for the day.

A few quick questions please, as I didn't manage to get anyone on the phone today:

- How was his respiration/defaecation/urination today?
- How much volume did you get into him today formula-wise and vytrate-wise? Was this mostly by bottle or did you tube feed him again today?
- Did you see any signs of post-feed discomfort today?
- Did you see any other signs of gut upset? ie: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.
- We've started him on the oral de-gas medication (simethicone) today (19/07/21) that has been recommended by a few vets that have been involved in hand rearing of cetaceans to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

A few of us from the zoo will pop by tomorrow to:

- Take some repeat bloods.
- Catch up with you about some of the physical exam findings, check in with how feeding is going, check in on a couple of monitoring parameters etc. If you'd like us to bring/check anything specific let me know!
- Bring gear/recipes/instructions to hand over the formula prep.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

██████████

██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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**From:** HUHA Helping You Help Animals [REDACTED]

**Sent:** 18 July 2021 19:14

**To:** [REDACTED] <[REDACTED]@wellingtonzoo.com>

**Cc:** [REDACTED] <[REDACTED]@wellingtonzoo.com>;

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Ian

Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>;

[REDACTED] Kirstie Knowles <kknowles@doc.govt.nz>;

[REDACTED] Ingrid

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[REDACTED] <[REDACTED]@wellingtonzoo.com>;

[REDACTED] <[REDACTED]@wellingtonzoo.com>

**Subject:** Re: Veterinary update for orca calf 18/07/21

Hi All.

Thanks [REDACTED]

Just to confirm that the Ingrid had the pool switched back to sea water thisafternoon.

Cheers

[REDACTED]

On Sun, 18 Jul 2021, 5:55 pm [REDACTED] <[REDACTED]@wellingtonzoo.com> wrote:

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversations or if you otherwise have anything to add!

Firstly thank you so much to everyone who worked so hard in such awful weather in the last couple of days, I thought of you often and I hope you managed to stay warm and dry in between caring for Toa.

1. Current medical findings

#### Lab tests:

- The lab has unfortunately said that it can't run lactate on the type of sample that we've given them, but we can run it on the next sample we take using a patient-side machine that we can bring with us on the next blood sampling.
- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Will chat tomorrow about how we get that where it needs to be for analysis.
- A urine sample was collected and tested today:
  - USG today was 1.028, and there was +1 protein and +1 glucose on the urine dipstick. In some animals those dipstick findings can be abnormal, but we'll wait to see if they persist (in some species they can be normal, or at least explained by physiology rather than disease).

#### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

#### 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage. No significant abnormalities/changes of defaecation have been noted with introducing or increasing the diet.
- He has been observed to urinate in the last 24 hours.

#### Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.

- His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Ultimately we would like him on just formula (no supplementary fluid), as this contains enough fluid to also meet his fluid requirements, but we've been advised to build up to that slowly, which is why his diet is changing a little every day at the moment.
  - Today the feeding plan was 1L formula + 1.2L 50% vytrate for the first three feeds (2.2L total) and then 1.5L formula + 0.7L 50% vytrate for the second three feeds (2.2L total). (Total of 7.5L formula and 5.7L 50% vytrate for today).
    - HUHA team if you could fill us in on how you went with this that would be lovely :)
- **Tomorrow's feeding plan:**
    - **1.1L formula + 0.4L 50% vytrate per feed x 8 feeds at 2 hourly intervals**
    - (total of 8.8L formula and 3.2L 50% vytrate).**
- We've had to make a few changes to his feed schedule to get to the feeding plan for tomorrow:
    - He has been showing signs of discomfort after tube feeding – sinking to the bottom of the pool and hunching slightly.
      - This may be due to discomfort due to the volume fed - hence smaller meals tomorrow – fed more frequently so that we still try to meet his requirements.
      - Or it may be due to discomfort from the tubing. The cetacean vets that we've been taking advice from say that bottle feeding him would be a good alternative. They say it may contribute to habituation, but that so does being near to humans and being handled for tubings/treatments etc, so they are not concerned about the bottle feeding on its own per-se.
      - A bottle set up has been trialled today with moderate success. The signs of discomfort that were seen post-tubing have not been seen after bottle feeding.
  - A few pointers from the cetacean vets:
    - Please make sure he's not gulping air while feeding – this can cause colic and discomfort.
      - They've recommended a de-gas medication be added to the feeds, I will source this asap and let you know when it's ready.
    - Please make sure he's not gulping water while feeding – too much sea water ingestion can affect his electrolyte levels and make him sick.
    - We/you can consider supplement feeding him with tube feeding if some of his bottle feeds are less productive than others.
    - They prefer him to have a break from feeding overnight to allow him to rest, so they do not advise feeding constantly over a 24 hour period at this stage.
  - An important piece of information that I received today is that orca abdomens do not expand very easily compared to other mammals. As a result, a build up of anything in the abdomen increases the pressure in



the abdomen rather than causing abdominal distension. So a build up of gas can very quickly become uncomfortable, as can ingesting volumes that are too large – so perhaps this is the reason we're seeing some discomfort after tubing.

- Please continue to monitor him for signs of gut upsets: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Today it was noted that some of the volunteers were encouraging him to suck on their thumbs as they thought this might help with feeding. Thank you Whale Rescue and HUHA for realising this was happening and for advising them to stop :)

Due to the suspected/confirmed (?) sewage spill at Plimmerton due to the horrible weather this weekend the team recently changed his pool from salt water to chlorinated water. Please could we change this to fresh water or back to sea water if the Plimmerton sea water is okay again? It was a good idea to change from sea water when the sewage problem was reported, but fresh water is much better for him than chlorinated water, which could negatively affect his skin and eyes.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

### 4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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**From:** [REDACTED]@wellingtonzoo.com>

**Sent:** 17 July 2021 16:35

**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]

[REDACTED]@wellingtonzoo.com>; [REDACTED]

Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine

<[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [REDACTED]

**Cc:** HUHA Helping You Help Animals [REDACTED];

ingric [REDACTED]; [REDACTED]

[REDACTED]@wellingtonzoo.com>;

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**Subject:** RE: Veterinary update for orca calf 15/07/21

Hey all, quick update from me today.

- Toa is going really well according to personnel on site – accepting feeds well, and no gastrointestinal comfort seen
- There is possibly a sewerage pipe burst somewhere near the bay, so concerns re: water quality. HUHA vet [REDACTED] is organising water testing.
- [REDACTED] got a urine sample and USG this morning of 1.017
- [REDACTED] mentioned possibly some oedema around caudal oropharynx/throat area (possibly from repeat tubing?) so would like to keep bottle feeding as a back up option in case tubing needs to be abandoned.

Toa is currently showing no signs of discomfort or distress during tubing, tolerates it very well. We can check this when we are next on site as well, but in the meantime if HUHA vets can keep a close eye on that please 😊

- We are going to continue upping the ratio of formula to vytrate, so please see the attached feeding schedule for 18/07/21 – there is no hard copy of this, I'm sorry. Had not gotten it printed off before the food was collected this afternoon. At this rate he should be on 100% formula from Monday afternoon, and we can look at making the formula richer or increasing volume if we need to increase caloric intake.
- We will organise a day early next week to revisit Toa to take a repeat blood sample
- I am going to be off for the next two days, but [REDACTED] is here tomorrow and [REDACTED] and [REDACTED] will both be here on Monday

Thanks again (and again and again) for everyone's hard work and dedication especially in the horrible conditions today.

[Me tiaki, kia ora!](#)

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---

**From:** [REDACTED]@wellingtonzoo.com>

**Sent:** 16 July 2021 17:02

**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]

[REDACTED] Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [REDACTED]

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**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again, slight update to tomorrow's feed schedule (see attached).

[REDACTED] BA DVM

Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust

200 Daniell Street | Newtown | Wellington 6021

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**From:** [REDACTED]

**Sent:** Friday, 16 July 2021 4:07 pm

**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]

[REDACTED]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]

**Cc:** HUHA Helping You Help

### **Toa Orca Feeding Formula (without fish)**

6 level cups Milligans lamb milk replacer

3000 mg dicalcium phosphate

1000 mg Taurine

1100 ml water

1100 ml 0.9% NaCl injection

120 ml 50% Dextrose

3 mazuri tablets

[REDACTED]

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**From:** [REDACTED]  
**Sent:** Friday, 23 July 2021 9:36 pm  
**To:** [REDACTED] HUHA Helping You Help Animals; [REDACTED];  
[REDACTED] Ian Angus; [REDACTED]; Kirstie Knowles; [REDACTED];  
**Subject:** RE: Veterinary update for orca calf 22/07/21

Hi everyone,

A fairly short update today unfortunately. The calf appeared to be doing outwardly ok initially today then had a marked change in behaviour this afternoon around 4:30PM suddenly sinking to the bottom of the pool and very little swimming. Team were interpreting as him being "tired" after a week in a small pool followed by a fairly full on day of swimming. Possibly inhaled some water at this time.

At 7PM there was a marked change in breathing rate and quality – suddenly very laboured. Deteriorated very quickly from there. Decision made not to give sedatives and instead was supported by people in the water passing away about an hour later.

Sadly a fairly typical crashing baby – have seen it before in other species. Unfortunately I believe there will not be a necropsy due to iwi (local tribe) request so will never know if there was something underlying.

[REDACTED]

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Thursday, 22 July 2021 6:29 PM  
**To:** HUHA Helping You Help Animals [REDACTED]  
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[REDACTED] Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]  
Kirstie Knowles <kknowles@doc.govt.nz>; [REDACTED] ingrid [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
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[REDACTED]@wellingtonzoo.com>  
**Subject:** Veterinary update for orca calf 22/07/21

Hi everyone,

A veterinary update on Toa from today.

1) Current medical findings

Lab tests:

- Faecal results from samples submitted to the lab yesterday:
  - o No nematodes or trematodes were detected (two types of worm parasite).
  - o Giardia was not detected.
  - o We are still awaiting a gram stain, salmonella culture and occult blood test.
- Blood samples taken by the HUHA team and submitted to the lab today (thank you!):
  - o CBC/fibrinogen: pending.
  - o Serum electrophoresis: pending.
  - o Cholesterol/triglycerides: pending.
- Eye discharge submitted to the lab yesterday from the right eye:

- Cytology: normal (no signs of inflammation/infection)
- Culture: pending.

#### Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. They do not show any sign of infection (no swelling, discharge etc) and are being closely monitored. These appear to be getting worse with time in the pool so may indicate rub/wear injuries from repeatedly contacting/rubbing the edge of the pool as he swims. He will be trialled in the sea pen again to see if this reduces this rubbing and allows these wounds to heal.
    - Volunteers in the water aim to reduce his contact with the walls/floor of whatever space he's in.
  - A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reducing in severity. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

#### 2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (was this observed today?) and urination (was this observed today?).

#### Fluids/feeding:

- We use the following three calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
  - The hand rearing formula that we are feeding is calculated to contain 1450kcal/L.
- He has had some difficulties feeding in the last 24 hours, with seemingly some distaste for the taste of the formula and has been spitting out the bottle teat on some occasions. Team HUHA how did you get on with feeds today, what sort of volumes of what kind of formulas did you get into him? Did you end up stomach tubing any of the feeds?
- Tomorrow we've organised an online meeting with an overseas vet with experience in hand rearing cetaceans to help us trouble shoot this and provide some advice on a feeding/formula plan moving forward and tips on tweaking feeding on a feed-by-feed and day-by-day basis.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

#### Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.
  - Please let us know when you are running low and we'll get you some more.

#### Plan for regular monitoring of health and welfare:

- [REDACTED] and I have put together the bare bones of a spreadsheet with some of the data that we've had available to our teams so far, and I've attached it here.

- Blood results, some girths/measurements, some urine results, some feeding/defaecation data.
- I don't have all the data for urination, defecation, respiration rates, girths/measurements, or volumes/frequencies fed, which might be useful to include in such a spreadsheet to help with health and welfare assessment on a day-to-day basis, and also to help monitor trends.
  - Would it be possible to combine that data with this spreadsheet please?
- Is there interest in making such a spreadsheet a document that can be edited by a few people so that such data can be centralised? And if so, is someone more tech-savvy than myself able to coordinate that please?

I believe he may have been moved back to the sea pen this afternoon, conditions/equipment/personnel permitting.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)  
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From: [Redacted]  
 Sent: 21 July 2021 17:52  
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Subject: Veterinary update for orca calf 21/07/21

Hi everyone,

A veterinary update on Toa from today.

- 1) Current medical findings

Lab tests:



- A blowhole culture taken 12/07/21 grew a light growth of E.coli and no fungi. This is of no clinical concern given the light growth and no signs of respiratory disease. It is likely that we'll repeat blowhole cultures throughout his time in care to monitor for trends.
- We are awaiting faecal results from samples submitted to the lab today: for parasitology, gram stain, salmonella culture and occult blood.
- A urine sample was collected and tested today:
  - o USG today was 1.014. Some reference ranges for urine testing have been circulated amongst the vet teams (thanks [REDACTED]!) which indicate that our urine testing results so far are normal for this species.
- Blood was taken today by the HUHA team (thank you!):
  - o In house biochem: Generally of no concern. His blood urea nitrogen (BUN) has increased slightly above normal, but this is likely to do with having recently eaten a protein rich meal (= formula). This analyte also increases with kidney disease/dehydration, but all our other blood and urine tests indicate that he is well hydrated and his kidneys are functioning normally. There are some other minor deviations from normal which are of no clinical significance at this stage but which we will monitor the trends of over time.
  - o CBC: will be sent to the lab tomorrow
  - o Serum electrophoresis: will be sent to the lab tomorrow
  - o Cholesterol/triglycerides: will be sent to the lab tomorrow
  - o Some historical blood has been stored in our -80°C freezer.
- We are awaiting cytology and culture on eye discharge submitted to the lab today.

Physical exam:

- Wounds:
  - o The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - o The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc). These are being monitored.
  - o A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reduced in severity today. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- Girth measurement update:
  - o On 16/07/21: length 2.12m, girth in front of dorsal fin 1.42m, girth behind dorsal fin 1.17m
  - o On 20/07/21: girth at widest point in front of dorsal fin 1.42m, girth at widest point behind dorsal fin 1.17m, girth at pectoral fin insert 1.34m
  - o Girth measurements have some limitations in their use to assess body condition, but these results indicate no immediate significant weight loss. We will continue to monitor this over time to assess his response to feeding and the success of feeding.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (regular today) and urination (observed today).

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - o His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - o His daily caloric requirements are 120-125kcal/kg/d.

- Today the plan is to feed him 10x feeds of 50:50 formula to 50% vytrate at 1.5 hour-intervals. No colic or other signs of gut disease have been observed since overnight on Monday night/very early Tuesday morning.
  - o This is a step back on our diet increases, with a plan to slowly increase again in future when his gut settles so that we can aim to meet his caloric requirements.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 22/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing/communicating.

He is still in the pool, but as of today (21/07/21) he is back in sea water.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

██████████ BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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From: ██████████

Sent: 20 July 2021 19:15

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**Subject:** Veterinary update for orca calf 20/07/21

Hi everyone,

A veterinary update on Toa from today. Please add anything I may have missed.

1) Current medical findings

Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected several faecal samples and these have been submitted for testing for parasitology, gram stain, salmonella culture and occult blood. We will let you know what these results show when we get them.
- A urine sample was collected and tested today:
  - o USG today was 1.016 – despite some feeding difficulties in the last 24 hours, it looks like he is not currently dehydrated. We'll continue regular urine monitoring to look for any trends.
- One of our techs performed some water testing today. I will get the full numbers from her for this tomorrow, but I can give you interim findings in the meantime:
  - o The chlorine level in the water is negligible. I think there was a misunderstanding here on my part I'm sorry, when I was told that he was in "chlorinated water", I thought you meant "swimming pool level chlorination", which would have been concerning. The level of chlorine in town supply water is much lower and should be fine in the interim if sea water is not available. Thank you for clarifying this today.
- We were not able to get much blood at all today, despite a few attempts. A drop of blood has been made into a blood smear to repeat an estimated white cell count, if the lab deems the size of this sample suitable.
  - o We will return on Thursday to try to take some more blood for routine monitoring of his general condition.

Physical exam:

- Wounds:
  - o The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - o The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc) but we have taken some photos today to allow us to monitor them over time.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. It is possible that this started around the time of his move to the pool, as his eyes appeared normal before then. One of the cetacean vets we have been talking with thinks this is of minimal concern, but an ophthalmologist that has been contacted would like us to double check a couple of things to make sure it is not of concern. The swelling has reduced somewhat in the last couple of days. He would not let us examine the eye itself today, he held his eyelids tightly shut when we tried to have a look. We'll get in touch with some veterinary ophthalmologists in the lower north island and see what their availability is for a second opinion, and in the meantime we will keep monitoring for improvement of the swelling.
  - o Some clear mucous from the eye will be sent to the lab for cytology and culture (although worth noting that normal eye secretions from this species are clear and mucousy).
- There is a small blister on the skin near his blowhole, approximately 1cm in diameter. It contains apparently clear fluid and otherwise there is no inflammation surrounding it. It is the only such lesion that we could see on his skin today. As a result, we are not immediately concerned by this lesion but will continue to keep an eye on it with photos and observations.

## 2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - o His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - o His daily caloric requirements are 120-125kcal/kg/d.
- Yesterday (19/07/21) he received 10x feeds of 800-1000ml (with feed consisting of a ratio of 1L formula to 0.4L 50% vytrate).
- His feeding schedule was delayed by a few things during the day yesterday, such that his last feed was given at 1am this morning. After this feed (and to a lesser degree after the 8pm feed) he showed signs of discomfort – rolling along his long axis, and sinking to the bottom of the pool. Over a period of time he passed 3 faecals (his first faecals for the preceding 24 hour period), after which his signs significantly reduced. By this morning's first feed he was behaviourally normal again. I think this is likely an indication that he was in discomfort from too much pressure in his belly from having recently fed and having not defaecated for a while. However another possible reason could be gut upset from diet increases, or a gut disease such as parasitism. As a result our plan today was:
  - o Give just 50% vytrate for the first few feeds.
  - o Introduce food again at 50:50 formula to 50% vytrate after the first few feeds and monitor (this is a step back on our diet increases, with a plan to increase again in future when his gut settles so that we can aim to meet his caloric requirements).
  - o Send faeces for parasitology and a few other tests.
  - o **Another thought please** is could we please try to keep 2 hours between feeds? I think his last feed before 1am was at midnight – perhaps this is an indication that a 1 hour feeding interval may be a bit much for him.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 21/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or we could cause quite significant gut upsets.

Additional medications:

- Today was his last day of enrofloxacin (antibiotic) injections.
- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

Formula prep has been handed over to the team on-site at Plimmerton Boat Club today:

- This was done in the hope that this will save all our teams time with regards to organising couriers to and from the zoo to pick up the diet. Let us know if it's not saving you time or if it is causing any other difficulties, we are very happy to take this role on for you again.
- Please also let us know well in advance if you need any of the ingredients topped up or replaced – some of these items will take us a few days to order in.

I have been asked for advice on how to safely increase the salinity for the pool that he is in. Please can you remind me of the dimensions and volume of the pool? With the current estimated whole pool turnover of every four hours,

this is going to take a lot of salt. And with the tendency of large volumes of salt to sit on the bottom of pools and dissolve slowly, it is going to take some care to make sure that we don't raise the salinity too high. It may be quite difficult to get the balance right and will take careful monitoring. Will get in touch tomorrow with a plan.

I have received measurements of "107, 135, 134" today – can someone please let me know which of these are length/girth measurements etc?

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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From: [Redacted]  
Sent: 19 July 2021 17:33  
To: HUHA Helping You Help Animals [Redacted]  
Cc: [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;  
[Redacted] Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine  
<[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [Redacted]  
[Redacted] Kirstie Knowles <[kknowles@doc.govt.nz](mailto:kknowles@doc.govt.nz)>; [Redacted]>;  
[ingric@wellingtonzoo.com](mailto:ingric@wellingtonzoo.com)>; Daniel Warsaw [Redacted]  
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Subject: RE: Veterinary update for orca calf 18/07/21

Hi everyone,

A shorter veterinary update on Toa from me today :)

As usual, Team HUHA and Whale Rescue please feel free to add to these updates!

1) Current medical findings

Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Can take that from you tomorrow when we pop by to send it on to the lab.
- A urine sample was collected and tested today:
  - o USG today was 1.018, and there was trace protein and no glucose on the urine dipstick. These findings are of no concern and we'll continue regular urine monitoring to look for any trends.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - o His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - o His daily caloric requirements are 120-125kcal/kg/d.
- As of tomorrow he can receive 100% formula (no additional vytrate). According to his requirements of 120-125kcal/kg/d, an estimated weight of 200kg and an estimated caloric content of the food of 1450kcal/L, he requires 16L of formula per day to meet his requirements. This could be divided into several feeds such as 10 x 1.6L feeds or 8 x 2L feeds over the day tomorrow – would that suit how he's currently feeding?
  - o If he receives this volume, this should also meet his fluid requirements for the day.

A few quick questions please, as I didn't manage to get anyone on the phone today:

- How was his respiration/defaecation/urination today?
- How much volume did you get into him today formula-wise and vytrate-wise? Was this mostly by bottle or did you tube feed him again today?
- Did you see any signs of post-feed discomfort today?
- Did you see any other signs of gut upset? ie: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.
- We've started him on the oral de-gas medication (simethicone) today (19/07/21) that has been recommended by a few vets that have been involved in hand rearing of cetaceans to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

A few of us from the zoo will pop by tomorrow to:

- Take some repeat bloods.
- Catch up with you about some of the physical exam findings, check in with how feeding is going, check in on a couple of monitoring parameters etc. If you'd like us to bring/check anything specific let me know!
- Bring gear/recipes/instructions to hand over the formula prep.

3) Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4) Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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From: HUHA Helping You Help Animals [Redacted]

Sent: 18 July 2021 19:14

To: [Redacted]@wellingtonzoo.com>

Cc: [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;

[Redacted] Ian Angus <iangus@doc.govt.nz>; Marine

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[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>;

[Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>

Subject: Re: Veterinary update for orca calf 18/07/21

Hi All.

Thanks [Redacted]

Just to confirm that the Ingrid had the pool switched back to sea water thisafternoon.

Cheers

[Redacted]

On Sun, 18 Jul 2021, 5:55 pm [Redacted]@wellingtonzoo.com> wrote:

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversations or if you otherwise have anything to add!

Firstly thank you so much to everyone who worked so hard in such awful weather in the last couple of days, I thought of you often and I hope you managed to stay warm and dry in between caring for Toa.

## 1. Current medical findings

### Lab tests:

- The lab has unfortunately said that it can't run lactate on the type of sample that we've given them, but we can run it on the next sample we take using a patient-side machine that we can bring with us on the next blood sampling.
- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Will chat tomorrow about how we get that where it needs to be for analysis.
- A urine sample was collected and tested today:
  - USG today was 1.028, and there was +1 protein and +1 glucose on the urine dipstick. In some animals those dipstick findings can be abnormal, but we'll wait to see if they persist (in some species they can be normal, or at least explained by physiology rather than disease).

### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.



- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage. No significant abnormalities/changes of defaecation have been noted with introducing or increasing the diet.
- He has been observed to urinate in the last 24 hours.

#### Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Ultimately we would like him on just formula (no supplementary fluid), as this contains enough fluid to also meet his fluid requirements, but we've been advised to build up to that slowly, which is why his diet is changing a little every day at the moment.
- Today the feeding plan was 1L formula + 1.2L 50% vytrate for the first three feeds (2.2L total) and then 1.5L formula + 0.7L 50% vytrate for the second three feeds (2.2L total). (Total of 7.5L formula and 5.7L 50% vytrate for today).
  - HUHA team if you could fill us in on how you went with this that would be lovely :)
- **Tomorrow's feeding plan:**
  - **1.1L formula + 0.4L 50% vytrate per feed x 8 feeds at 2 hourly intervals**

**(total of 8.8L formula and 3.2L 50% vytrate).**
- We've had to make a few changes to his feed schedule to get to the feeding plan for tomorrow:
  - He has been showing signs of discomfort after tube feeding – sinking to the bottom of the pool and hunching slightly.
    - This may be due to discomfort due to the volume fed - hence smaller meals tomorrow – fed more frequently so that we still try to meet his requirements.
    - Or it may be due to discomfort from the tubing. The cetacean vets that we've been taking advice from say that bottle feeding him would be a good alternative. They say it may contribute to habituation, but that so does being near to humans and being handled for tubings/treatments etc, so they are not concerned about the bottle feeding on its own per se.
    - A bottle set up has been trialled today with moderate success. The signs of discomfort that were seen post-tubing have not been seen after bottle feeding.
- A few pointers from the cetacean vets:
  - Please make sure he's not gulping air while feeding – this can cause colic and discomfort.
    - They've recommended a de-gas medication be added to the feeds, I will source this asap and let you know when it's ready.
  - Please make sure he's not gulping water while feeding – too much sea water ingestion can affect his electrolyte levels and make him sick.
  - We/you can consider supplement feeding him with tube feeding if some of his bottle feeds are less productive than others.
  - They prefer him to have a break from feeding overnight to allow him to rest, so they do not advise feeding constantly over a 24 hour period at this stage.
- An important piece of information that I received today is that orca abdomens do not expand very easily compared to other mammals. As a result, a build up of anything in the abdomen increases the pressure in the abdomen rather than causing abdominal distension. So a build up of gas can very quickly become

uncomfortable, as can ingesting volumes that are too large – so perhaps this is the reason we're seeing some discomfort after tubing.

- Please continue to monitor him for signs of gut upsets: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Today it was noted that some of the volunteers were encouraging him to suck on their thumbs as they thought this might help with feeding. Thank you Whale Rescue and HUHA for realising this was happening and for advising them to stop :)

Due to the suspected/confirmed (?) sewage spill at Plimmerton due to the horrible weather this weekend the team recently changed his pool from salt water to chlorinated water. Please could we change this to fresh water or back to sea water if the Plimmerton sea water is okay again? It was a good idea to change from sea water when the sewage problem was reported, but fresh water is much better for him than chlorinated water, which could negatively affect his skin and eyes.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

### 4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** 17 July 2021 16:35  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED] Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [REDACTED]  
**Cc:** HUHA Helping You Help Animals <[REDACTED]>; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com)>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hey all, quick update from me today.

- Toa is going really well according to personnel on site – accepting feeds well, and no gastrointestinal comfort seen
- There is possibly a sewerage pipe burst somewhere near the bay, so concerns re: water quality. HUHA vet [REDACTED] is organising water testing.
- [REDACTED] got a urine sample and USG this morning of 1.017
- [REDACTED] mentioned possibly some oedema around caudal oropharynx/throat area (possibly from repeat tubing?) so would like to keep bottle feeding as a back up option in case tubing needs to be abandoned.

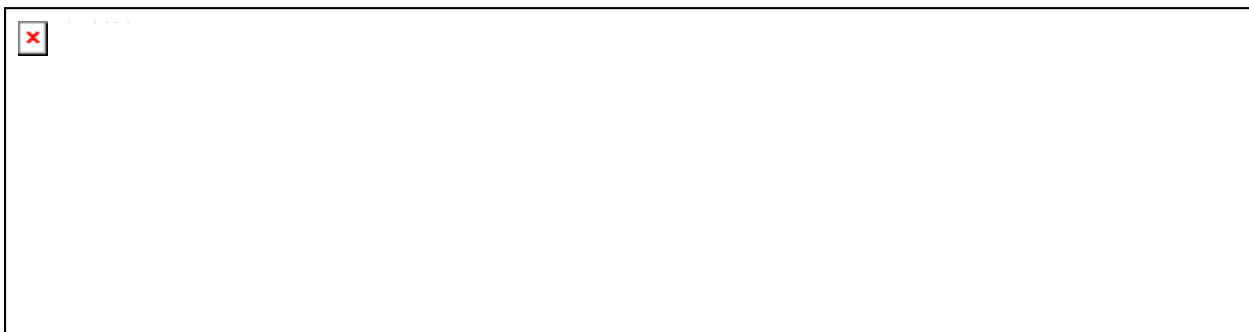
Toa is currently showing no signs of discomfort or distress during tubing, tolerates it very well. We can check this when we are next on site as well, but in the meantime if HUHA vets can keep a close eye on that please 😊

- We are going to continue upping the ratio of formula to vytrate, so please see the attached feeding schedule for 18/07/21 – there is no hard copy of this, I'm sorry. Had not gotten it printed off before the food was collected this afternoon. At this rate he should be on 100% formula from Monday afternoon, and we can look at making the formula richer or increasing volume if we need to increase caloric intake.
- We will organise a day early next week to revisit Toa to take a repeat blood sample
- I am going to be off for the next two days, but [REDACTED] is here tomorrow and [REDACTED] will both be here on Monday

Thanks again (and again and again) for everyone's hard work and dedication especially in the horrible conditions today.

[Me tiaki, kia ora!](#)

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** 16 July 2021 17:02  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]  
**Cc:** HUHA Helping You Help Animals <[REDACTED]>; ingrid [REDACTED]; [REDACTED]  
<[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
<[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again, slight update to tomorrow's feed schedule (see attached).

BA DVM

Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust

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**From:** [REDACTED]  
**Sent:** Friday, 16 July 2021 4:07 pm  
**To:** [REDACTED] [@wellingtonzoo.com](mailto: @wellingtonzoo.com); [REDACTED]  
[REDACTED] Ian Angus <[iangus@doc.govt.nz](mailto: iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto: marine@doc.govt.nz)>; [REDACTED]  
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**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again to everyone!

Thank you all for your amazing continued care of the little calf! I'm just continuing on with a further update on how Toa is doing following the discussion from earlier this afternoon. I'll try to only include new information in this update. Please add anyone I may have forgotten to include!

Due to the change in weather, Toa was moved into a temporary pool yesterday around 5 PM. The move went smoothly and took 20-30 minutes. There have not been any changes noted in his behaviour since changing to the pool and his medical treatments and tubings are taking place at the same intervals. At the moment there is no filtration system in place so, as an alternative, the pool is being continuously filled with sea water via a pump and draining out excess water through holes in the side. The plan is to only keep Toa in the pool until it is safe enough to return him to the sea pen.

As we have increased the concentration of formula being fed, it was observed that Toa is beginning to show a few signs of abdominal discomfort immediately after feeds. He will cramp up and sink to the bottom of the pool briefly. This began last night and happened again this afternoon. In order to hopefully combat this we have come up with the solution of feeding him more frequently throughout the day (every 2 hours instead of every 4) so that he is getting smaller volumes of formula at each feed (but will still receive the same total daily volume). We will still try to increase his volume of formula fed by 50% each day in order to start increasing his caloric intake. It has been difficult to assess the frequency and consistency of his faecal output due to the murkiness/turbulence of water from weather. With increased

In terms of ongoing monitoring, we will continue to do what [REDACTED] has already discussed (semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour) but may also consider adding in blow hole chuff cultures at least once but could repeat if any indication (we need to source the appropriate petri dish to collect these and confirm with Gribbles how it will need to be submitted), urine samples from first thing in morning prior to tubing to check UA and USG (this could be less frequent, maybe every 3 days or so), and body length and girth measurements (and possibly weights! if a suitable scale setup can be sourced which Ingrid is looking into). The body length, girth and weight measurements will be incredibly helpful both in helping to confirm an age and in ongoing monitoring of nutritional status.

For fluids and feedings tomorrow the plan is to give 700 ml formula with 1.5 liters 50% vytrate at 8 AM, 10 AM, and 12 PM. Then for the 2 PM, 4 PM, and 6 PM feeds he can receive 1 liter formula with 2 liters of 50% vytrate. (Total formula volume will be 5 L tomorrow compared to 3.5 liters today, a ~50% increase in volume). I'll email out a feed schedule sheet separately in case it is helpful. 😊 This will increase the total fluid volume he gets during the day by 3 liters but will still be within his recommended fluid needs of 40-80 ml/kg/day. If he is continuing to show signs of discomfort after any of these feedings please get in touch. [REDACTED] will be at work tomorrow at the zoo so can be reached if needed.

For medications, Toa received his last dose of steroid today. There is no need to continue on with steroid treatment at this time. He is still receiving enrofloxacin 5 mg/kg BID which he started Wednesday morning (14/7/21). This is due to last 7 days, finishing after his dose on the evening of 20/7/21.

We are still awaiting results from the veterinary laboratory for samples taken Monday:

- Lactate, blow hole swab culture (fungal and bacterial).

1. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

2. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thank you so much to everyone for all your dedication and care! Looking forward to seeing you and Toa in person again soon!

BA DVM

Resident Veterinarian | Animal Care and Science | Wellington Zoo Trust

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---

**From:** [redacted]@doc.govt.nz>

**Sent:** Thursday, 15 July 2021 6:32 pm

**To:** [redacted]@wellingtonzoo.com>; [redacted] Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [redacted]

**Cc:** HUHA Helping You Help Animals [redacted] >; ingrid [redacted] >; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>

**Subject:** Re: Veterinary update for orca calf 15/07/21

Hi [redacted],

Thank you again for another comprehensive update! Sounds like all is stable which is great news.

Thank you to the wider team as well for all your hard work with this little calf.

Kindest regards,

[redacted]

---

**From:** [redacted]@wellingtonzoo.com>

**Sent:** Thursday, 15 July 2021 6:01 PM

**To:** [redacted] Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [redacted]

<[REDACTED]>  
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[REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED]  
[REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED]  
[REDACTED] [@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>

**Subject:** Veterinary update for orca calf 15/07/21

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!

#### 1. Current medical findings

Lab tests:

- We have a few results back from the lab:
  - Complete blood count and blood parasite check – normal (but see below)
  - Fibrinogen levels (one way of testing for inflammation) – normal
  - Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - Total blood iron levels – normal
  - The lab's interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we'll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Lactate, blow hole swab culture (fungal and bacterial).

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.



The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.
  - Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!)

Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).
- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



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**From:** [REDACTED]  
**Sent:** 14 July 2021 18:47  
**To:** [REDACTED]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz); [REDACTED]  
<[REDACTED]>  
**Cc:** HUHA Helping You Help Animals; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [REDACTED];  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>;  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>;  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>

**Subject:** Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

1. Medical findings

Lab tests:

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also will several deep lacerations near his tail fluke laterally to his spine.

- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

Fluids:

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

Feeding:

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-

regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted signature]

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**From:** [REDACTED]  
**Sent:** 13 July 2021 15:47  
**To:** [REDACTED]; [iangus@doc.govt.nz](mailto:iangus@doc.govt.nz); [marine@doc.govt.nz](mailto:marine@doc.govt.nz)  
**Cc:** HUHA Helping You Help Animals [REDACTED]; [ingrid@wellingtonzoo.com](mailto:ingrid@wellingtonzoo.com); [REDACTED]  
[REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>;  
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[REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>; [REDACTED] [@wellingtonzoo.com](mailto:@wellingtonzoo.com)>  
**Subject:** Veterinary update for orca calf 13/07/21

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet [REDACTED] from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by [REDACTED] also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,

[REDACTED]

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[REDACTED]

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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** Saturday, 24 July 2021 12:15 pm  
**To:** [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** RE: Chat about orca calf feeding plan and tips  
**Attachments:** Toa blood - urine - measurements results.xlsx

So sorry to hear about Toa. Thank you so much to everyone who was so closely involved with his case.

I've attached his results spreadsheet that is up to date as of this morning. I share Todd's opinion, especially with his triglyceride level being low.

[Me tiaki, kia ora!](#)

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**From:** [REDACTED]@SeaWorld.com>  
**Sent:** 24 July 2021 09:30  
**To:** [REDACTED]  
**Cc:** [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Chat about orca calf feeding plan and tips

[REDACTED]

I was sorry to hear about the calf's death, yesterdays' call left me concerned that he wasn't getting enough nutrition and I thought there was a good foundational feeding plan to start. It seems with the colic episodes, the formula was adjusted to a basic electrolyte solution and unfortunately did not likely have significant calories. I'd be happy to be part of a debrief and talk over treatment plan and work on providing a step-by-by protocol with treatment plan for if, rather when this happens again. Let me know, could try for Monday morning (NZ time).

With warm regards, thank you for trying with many odds not in his favor,  
[REDACTED]

---

**From:** [REDACTED] >  
**Sent:** Thursday, July 22, 2021 11:50 PM  
**To:** [REDACTED]@SeaWorld.com>

Cc: [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>

**Subject:** [EXTERNAL] RE: Chat about orca calf feeding plan and tips

Hi [REDACTED]

Thank you so much! The spreadsheet is most informative and I think will be great at highlighting the gaps. I think the on-site team are just so focused on doing what he wants and not realising that after 12 days he is literally starving. I have been trying to gently (or not so gently) nudge them along to getting him back on a schedule and getting the food into him!

I am (gently) pushing to reintroduce tube feeding (which apparently he was starting to resist... today however was the first time I have heard that). I have been trying to observe as many feeds as I can so I can see for myself what he is doing.

Hopefully we will get back to tube feeding tomorrow.

That said he has crashed a bit tonight (sorry Welly Zoo team – full vet update coming soon!). The team here believe he is just very tired. Which makes some sense to me – he was in a small pool for 7 days and has been very active since going back into the sea... But I am worried he may also be going ketotic.

Zoo team – did we get blood results on him today?

Thanks all!

[REDACTED]

---

**From:** [REDACTED]@SeaWorld.com>

**Sent:** Friday, 23 July 2021 12:39 PM

**To:** [REDACTED]

**Subject:** Chat about orca calf feeding plan and tips

---

Hi [REDACTED]

Likewise, pleasure meeting you all from so far away. I sent this info to [REDACTED], but I figured that you also should have it since you are on-site.

Here's are example feeding tally sheets that we would require our staff to initial with each feed to track feeding totals and amounts. Feel free to use, copy, modify or throw out, if not needed... I've separated out formulas by %, which obviously effects total Kcals. It's easy to see if he misses a feed or is not getting enough calories, that weight will be lost.

Hopefully, we've clarified the formula making and the goal of getting to 100% formula. The Team can start with smaller volumes of feeds to ensure that he is consistently getting them, and then try to increase caloric density by adding some form of fat (cream, oil, or shark/ray liver). As [REDACTED] also pointed out with their calves there appeared to be a volume threshold, however if his body is demanding it, we have also found that volume can be increased incrementally if they are tolerating the formula. A lot of it is based on individual.

Fortunately our killer whale moms have been excellent and we haven't needed to intervene, unlike at Loro Parque. However, we have seen maternal neglect in belugas and that is where most of our experience comes from, so in the example provided (doc) one just needs to scale up for the most part. [REDACTED] at SeaWorld San Antonio did hand-raise killer whale calf orphaned by mom. I've asked him if he still has his presentation about that



case... I know [REDACTED] will chime in at some point, because they have needed to intervene with each of their calves.

The important part is getting him formula on a regular schedule, I would try not let him dictate what he wants right now, as I don't think they recognize when they are in a "ketotic" state. I wouldn't worry about a recall at this stage and concentrate on getting him formula that he will tolerate in sequential feedings. At 11 C, he's losing body condition on dilute formula/electrolytes, so the sooner he can get on a 100% formula, progressing from small volume to appropriate volume, the better.

Let me know if there is anything else I can try to help with...

Regards,  
[REDACTED]

HI [REDACTED]

Sorry bounced into two more meetings! Just wanted to say thank you so much for this morning – so wonderful to get to talk through the options and hopefully we can find something he likes.

Lovely to "meet" you in more than just emails and thank you again so much for all your assistance so far!

[REDACTED]  
**From:** [REDACTED] <[REDACTED]@SeaWorld.com>

**Sent:** Friday, 23 July 2021 2:43 AM

**To:** [REDACTED]

**Cc:** [REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]i@wellingtonzoo.com>; [REDACTED]

[REDACTED] <[REDACTED]@wellingtonzoo.com>; [REDACTED] <[REDACTED]@wellingtonzoo.com>; HUHA

VETS <[REDACTED]>

**Subject:** Re: [EXTERNAL] RE: Chat about orca calf feeding plan and tips

Yes, can make that work.

Regards,  
[REDACTED]

On Jul 22, 2021, at 2:00 AM, [REDACTED] wrote:

Hi team,

Thanks so much for getting this going [REDACTED]! I had a quick talk to the HUHA team tonight and they have asked if we could do this at 9am NZT instead as that is when their nurse who has been making the formula will be back onsite.

Hopefully that might still work ok for you [REDACTED]? Please let us know if not!

I am sending an email invite through for 9am to get it in people's calendars

Thanks again everyone!  
[REDACTED]

From: [REDACTED]@wellingtonzoo.com>

Sent: Thursday, 22 July 2021 5:37 PM

To: [REDACTED]@SeaWorld.com>; [REDACTED]

[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; HUHA VETS

Subject: Chat about orca calf feeding plan and tips

Hi everyone,

Interested in talking about options for a short term and medium term feeding plan (recipe, frequency, volumes etc) for Toa the orca calf based on our recent feeding experiences, and talking about some tips on how to tweak things on a feed-by-feed or day-by-day basis, based on how he's going.

Feel free to share with others you think are necessary here. [REDACTED] feel free to invite your vet/s on-site or otherwise.

This is currently booked for 8am on Friday 23/07/21 NZ time, click this link to join (if I've done this right!):

<https://teams.live.com/join/95825385390760>

Thanks so much,

Kind regards,

[REDACTED]

[REDACTED] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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Caution - This message and accompanying data may contain information that is confidential or subject to legal privilege. If you are not the intended recipient you are notified that any use, dissemination, distribution or copying of this message or data is prohibited. If you received this email in error, please notify us immediately and erase all copies of the message and attachments. We apologise for the inconvenience. Thank you.

[Redacted]

**From:** [Redacted]@wellingtonzoo.com>  
**Sent:** Saturday, 24 July 2021 12:14 pm  
**To:** [Redacted]; HUHA Helping You Help Animals; [Redacted];  
 [Redacted]; Ian Angus; Kirstie Knowles; [Redacted];  
**Subject:** RE: Veterinary update for orca calf 22/07/21  
**Attachments:** Toa blood - urine - measurements results.xlsx

So sorry to hear this [Redacted], thanks for being there and of course thank you so much on behalf of all of us for all the excellent work, effort, and knowledge that has been put into looking after Toa for the past weeks by all of you and everyone else involved in his care.

To round off Toa's case I have included the final spreadsheet with lab results as we did receive some blood results yesterday afternoon that I hadn't entered in until today. We may get a few additional results/updates from the lab trickling in, so we will add those as they come in and share them with everyone.

[Me tiaki, kia ora!](#)

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**From:** [Redacted]@doc.govt.nz>  
**Sent:** 23 July 2021 21:36  
**To:** [Redacted]@wellingtonzoo.com>; HUHA Helping You Help Animals  
 [Redacted]@wellingtonzoo.com>; [Redacted]  
 [Redacted]@wellingtonzoo.com>; [Redacted]; Ian Angus  
 <iangus@doc.govt.nz>; [Redacted]>; Kirstie  
 Knowles <kknowles@doc.govt.nz>; [Redacted]@wellingtonzoo.com>;  
 [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]  
 [Redacted]@wellingtonzoo.com>; [Redacted]@wellingtonzoo.com>; [Redacted]

**Subject:** RE: Veterinary update for orca calf 22/07/21

Hi everyone,

A fairly short update today unfortunately. The calf appeared to be doing outwardly ok initially today then had a marked change in behaviour this afternoon around 4:30PM suddenly sinking to the bottom of the pool and very little swimming. Team were interpreting as him being "tired" after a week in a small pool followed by a fairly full on day of swimming. Possibly inhaled some water at this time.

At 7PM there was a marked change in breathing rate and quality – suddenly very laboured. Deteriorated very quickly from there. Decision made not to give sedatives and instead was supported by people in the water passing away about an hour later.

Sadly a fairly typical crashing baby – have seen it before in other species. Unfortunately I believe there will not be a necropsy due to iwi (local tribe) request so will never know if there was something underlying.

---

**From:** [redacted] <[redacted]@wellingtonzoo.com>  
**Sent:** Thursday, 22 July 2021 6:29 PM  
**To:** HUHA Helping You Help Animals [redacted] <[redacted]@wellingtonzoo.com>; [redacted] <[redacted]@wellingtonzoo.com>; [redacted] <[redacted]@wellingtonzoo.com>; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [redacted] <[redacted]@wellingtonzoo.com>; Kirstie Knowles <kknowles@doc.govt.nz>; [redacted] <[redacted]@wellingtonzoo.com>; [redacted] <[redacted]@wellingtonzoo.com>; [redacted] <[redacted]@wellingtonzoo.com>; [redacted] <[redacted]@wellingtonzoo.com>; [redacted] <[redacted]@wellingtonzoo.com>

Hi everyone,

A veterinary update on Toa from today.

1) Current medical findings

Lab tests:

- Faecal results from samples submitted to the lab yesterday:
  - o No nematodes or trematodes were detected (two types of worm parasite).
  - o Giardia was not detected.
  - o We are still awaiting a gram stain, salmonella culture and occult blood test.
- Blood samples taken by the HUHA team and submitted to the lab today (thank you!):
  - o CBC/fibrinogen: pending.
  - o Serum electrophoresis: pending.
  - o Cholesterol/triglycerides: pending.
- Eye discharge submitted to the lab yesterday from the right eye:
  - o Cytology: normal (no signs of inflammation/infection)
  - o Culture: pending.

Physical exam:

- Wounds:
  - o The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - o The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. They do not show any sign of infection (no swelling, discharge etc) and are being closely monitored. These appear to be getting worse with time in the pool so may indicate rub/wear injuries from repeatedly contacting/rubbing the edge of the pool as he swims. He will be trialled in the sea pen again to see if this reduces this rubbing and allows these wounds to heal.
    - Volunteers in the water aim to reduce his contact with the walls/floor of whatever space he's in.
  - o A small blister on the skin near his blowhole (~1cm diameter) is being monitored.

- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reducing in severity. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

## 2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (was this observed today?) and urination (was this observed today?).

Fluids/feeding:

- We use the following three calculations to plan his food and fluid requirements for the day.
  - o His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - o His daily caloric requirements are 120-125kcal/kg/d.
  - o The hand rearing formula that we are feeding is calculated to contain 1450kcal/L.
- He has had some difficulties feeding in the last 24 hours, with seemingly some distaste for the taste of the formula and has been spitting out the bottle teat on some occasions. Team HUHA how did you get on with feeds today, what sort of volumes of what kind of formulas did you get into him? Did you end up stomach tubing any of the feeds?
- Tomorrow we've organised an online meeting with an overseas vet with experience in hand rearing cetaceans to help us trouble shoot this and provide some advice on a feeding/formula plan moving forward and tips on tweaking feeding on a feed-by-feed and day-by-day basis.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.
  - o Please let us know when you are running low and we'll get you some more.

Plan for regular monitoring of health and welfare:

- [REDACTED] and I have put together the bare bones of a spreadsheet with some of the data that we've had available to our teams so far, and I've attached it here.
  - o Blood results, some girths/measurements, some urine results, some feeding/defaecation data.
- I don't have all the data for urination, defecation, respiration rates, girths/measurements, or volumes/frequencies fed, which might be useful to include in such a spreadsheet to help with health and welfare assessment on a day-to-day basis, and also to help monitor trends.
  - o Would it be possible to combine that data with this spreadsheet please?
- Is there interest in making such a spreadsheet a document that can be edited by a few people so that such data can be centralised? And if so, is someone more tech-savvy than myself able to coordinate that please?

I believe he may have been moved back to the sea pen this afternoon, conditions/equipment/personnel permitting.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[REDACTED]

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From: ██████████

Sent: 21 July 2021 17:52

To: HUHA Helping You Help Animals <██████████@wellingtonzoo.com>; ██████████@wellingtonzoo.com>;  
██████████@wellingtonzoo.com>; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>;  
██████████ Kirstie Knowles <kknowles@doc.govt.nz>; ██████████ ingrid ██████████  
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██████████@wellingtonzoo.com>

Subject: Veterinary update for orca calf 21/07/21

Hi everyone,

A veterinary update on Toa from today.

1) Current medical findings

Lab tests:

- A blowhole culture taken 12/07/21 grew a light growth of E.coli and no fungi. This is of no clinical concern given the light growth and no signs of respiratory disease. It is likely that we'll repeat blowhole cultures throughout his time in care to monitor for trends.
- We are awaiting faecal results from samples submitted to the lab today: for parasitology, gram stain, salmonella culture and occult blood.
- A urine sample was collected and tested today:
  - o USG today was 1.014. Some reference ranges for urine testing have been circulated amongst the vet teams (thanks ██████████!) which indicate that our urine testing results so far are normal for this species.
- Blood was taken today by the HUHA team (thank you!):
  - o In house biochem: Generally of no concern. His blood urea nitrogen (BUN) has increased slightly above normal, but this is likely to do with having recently eaten a protein rich meal (= formula). This analyte also increases with kidney disease/dehydration, but all our other blood and urine tests indicate that he is well hydrated and his kidneys are functioning normally. There are some other minor deviations from normal which are of no clinical significance at this stage but which we will monitor the trends of over time.
  - o CBC: will be sent to the lab tomorrow
  - o Serum electrophoresis: will be sent to the lab tomorrow
  - o Cholesterol/triglycerides: will be sent to the lab tomorrow

- Some historical blood has been stored in our -80°C freezer.
- We are awaiting cytology and culture on eye discharge submitted to the lab today.

Physical exam:

- Wounds:
  - The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc). These are being monitored.
  - A small blister on the skin near his blowhole (~1cm diameter) is being monitored.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. These changes are still present but appear reduced in severity today. We have contacted some local veterinary ophthalmologists and are waiting to see if they are able to come examine the eye and what their availability is.
- Girth measurement update:
  - On 16/07/21: length 2.12m, girth in front of dorsal fin 1.42m, girth behind dorsal fin 1.17m
  - On 20/07/21: girth at widest point in front of dorsal fin 1.42m, girth at widest point behind dorsal fin 1.17m, girth at pectoral fin insert 1.34m
  - Girth measurements have some limitations in their use to assess body condition, but these results indicate no immediate significant weight loss. We will continue to monitor this over time to assess his response to feeding and the success of feeding.
- There is some minor swelling at the sites where injections were previously administered. He is not currently receiving injectable medications and these sites will be monitored.

2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation (regular today) and urination (observed today).

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Today the plan is to feed him 10x feeds of 50:50 formula to 50% vytrate at 1.5 hour-intervals. No colic or other signs of gut disease have been observed since overnight on Monday night/very early Tuesday morning.
  - This is a step back on our diet increases, with a plan to slowly increase again in future when his gut settles so that we can aim to meet his caloric requirements.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 22/07/21.
- Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or this could cause quite significant gut upsets.

Additional medications:

- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel

movements, observations/videos of movement/behaviour etc – so similar to what we’re already doing/communicating.

He is still in the pool, but as of today (21/07/21) he is back in sea water.

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

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From: ██████████  
Sent: 20 July 2021 19:15  
To: 'HUHA Helping You Help Animals' ██████████ >  
Cc: ██████████@wellingtonzoo.com>; ██████████@wellingtonzoo.com>;  
██████████ 'Ian Angus' <iangus@doc.govt.nz>; 'Marine'  
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Subject: Veterinary update for orca calf 20/07/21

Hi everyone,

A veterinary update on Toa from today. Please add anything I may have missed.

1) Current medical findings

Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected several faecal samples and these have been submitted for testing for parasitology, gram stain, salmonella culture and occult blood. We will let you know what these results show when we get them.



- A urine sample was collected and tested today:
  - o USG today was 1.016 – despite some feeding difficulties in the last 24 hours, it looks like he is not currently dehydrated. We'll continue regular urine monitoring to look for any trends.
- One of our techs performed some water testing today. I will get the full numbers from her for this tomorrow, but I can give you interim findings in the meantime:
  - o The chlorine level in the water is negligible. I think there was a misunderstanding here on my part I'm sorry, when I was told that he was in "chlorinated water", I thought you meant "swimming pool level chlorination", which would have been concerning. The level of chlorine in town supply water is much lower and should be fine in the interim if sea water is not available. Thank you for clarifying this today.
- We were not able to get much blood at all today, despite a few attempts. A drop of blood has been made into a blood smear to repeat an estimated white cell count, if the lab deems the size of this sample suitable.
  - o We will return on Thursday to try to take some more blood for routine monitoring of his general condition.

Physical exam:

- Wounds:
  - o The abrasions to the underside of the tail flukes and the underside of the chin, and the deep lacerations near his tail fluke laterally to his spine are healing well.
  - o The very outer edges of his pectoral flippers and the outer edge of his right tail fluke have some areas of full thickness skin wounds. These do not show any sign of infection (no swelling, discharge etc) but we have taken some photos today to allow us to monitor them over time.
- His right eye is being held shut more than his left and there is mild swelling of the eyelids of the right eye. It is possible that this started around the time of his move to the pool, as his eyes appeared normal before then. One of the cetacean vets we have been talking with thinks this is of minimal concern, but an ophthalmologist that has been contacted would like us to double check a couple of things to make sure it is not of concern. The swelling has reduced somewhat in the last couple of days. He would not let us examine the eye itself today, he held his eyelids tightly shut when we tried to have a look. We'll get in touch with some veterinary ophthalmologists in the lower north island and see what their availability is for a second opinion, and in the meantime we will keep monitoring for improvement of the swelling.
  - o Some clear mucous from the eye will be sent to the lab for cytology and culture (although worth noting that normal eye secretions from this species are clear and mucousy).
- There is a small blister on the skin near his blowhole, approximately 1cm in diameter. It contains apparently clear fluid and otherwise there is no inflammation surrounding it. It is the only such lesion that we could see on his skin today. As a result, we are not immediately concerned by this lesion but will continue to keep an eye on it with photos and observations.

2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - o His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - o His daily caloric requirements are 120-125kcal/kg/d.
- Yesterday (19/07/21) he received 10x feeds of 800-1000ml (with feed consisting of a ratio of 1L formula to 0.4L 50% vytrate).
- His feeding schedule was delayed by a few things during the day yesterday, such that his last feed was given at 1am this morning. After this feed (and to a lesser degree after the 8pm feed) he showed signs of discomfort – rolling along his long axis, and sinking to the bottom of the pool. Over a period of time he passed 3 faecals (his first faecals for the preceding 24 hour period), after which his signs significantly reduced. By this morning's first feed he was behaviourally normal again. I think this is likely an indication

that he was in discomfort from too much pressure in his belly from having recently fed and having not defaecated for a while. However another possible reason could be gut upset from diet increases, or a gut disease such as parasitism. As a result our plan today was:

- Give just 50% vytrate for the first few feeds.
  - Introduce food again at 50:50 formula to 50% vytrate after the first few feeds and monitor (this is a step back on our diet increases, with a plan to increase again in future when his gut settles so that we can aim to meet his caloric requirements).
  - Send faeces for parasitology and a few other tests.
  - **Another thought please** is could we please try to keep 2 hours between feeds? I think his last feed before 1am was at midnight – perhaps this is an indication that a 1 hour feeding interval may be a bit much for him.
- We will see how we go on this feeding plan for the rest of today and will be in touch in the morning to see how you went and what our plan will be for 21/07/21.
  - Please do not offer him any solid food yet. This needs to be introduced very carefully, and only once he's old enough and once the formula feeding is stable and reliable or we could cause quite significant gut upsets.

Additional medications:

- Today was his last day of enrofloxacin (antibiotic) injections.
- Oral de-gas medication (simethicone) is ongoing since 19/07/21 to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

Formula prep has been handed over to the team on-site at Plimmerton Boat Club today:

- This was done in the hope that this will save all our teams time with regards to organising couriers to and from the zoo to pick up the diet. Let us know if it's not saving you time or if it is causing any other difficulties, we are very happy to take this role on for you again.
- Please also let us know well in advance if you need any of the ingredients topped up or replaced – some of these items will take us a few days to order in.


I have been asked for advice on how to safely increase the salinity for the pool that he is in. Please can you remind me of the dimensions and volume of the pool? With the current estimated whole pool turnover of every four hours, this is going to take a lot of salt. And with the tendency of large volumes of salt to sit on the bottom of pools and dissolve slowly, it is going to take some care to make sure that we don't raise the salinity too high. It may be quite difficult to get the balance right and will take careful monitoring. Will get in touch tomorrow with a plan.

I have received measurements of "107, 135, 134" today – can someone please let me know which of these are length/girth measurements etc?

Thanks so much everyone for all your ongoing time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,



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From: [REDACTED]  
Sent: 19 July 2021 17:33  
To: HUHA Helping You Help Animals [REDACTED]  
Cc: [REDACTED]@wellingtonzoo.com; [REDACTED]@wellingtonzoo.com;  
[REDACTED] Ian Angus <iangus@doc.govt.nz>; Marine  
<marine@doc.govt.nz>;  
[REDACTED] Kirstie Knowles <kknowles@doc.govt.nz>;  
ingric [REDACTED]@wellingtonzoo.com;  
[REDACTED]@wellingtonzoo.com; [REDACTED]@wellingtonzoo.com;  
<[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
Subject: RE: Veterinary update for orca calf 18/07/21

Hi everyone,

A shorter veterinary update on Toa from me today :)

As usual, Team HUHA and Whale Rescue please feel free to add to these updates!

1) Current medical findings

Lab tests:

- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Can take that from you tomorrow when we pop by to send it on to the lab.
- A urine sample was collected and tested today:
  - o USG today was 1.018, and there was trace protein and no glucose on the urine dipstick. These findings are of no concern and we'll continue regular urine monitoring to look for any trends.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

2) Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, defaecation and urination.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - o His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - o His daily caloric requirements are 120-125kcal/kg/d.
- As of tomorrow he can receive 100% formula (no additional vytrate). According to his requirements of 120-125kcal/kg/d, an estimated weight of 200kg and an estimated caloric content of the food of 1450kcal/L, he requires 16L of formula per day to meet his requirements. This could be divided into several feeds such as 10 x 1.6L feeds or 8 x 2L feeds over the day tomorrow – would that suit how he’s currently feeding?
  - o If he receives this volume, this should also meet his fluid requirements for the day.

A few quick questions please, as I didn’t manage to get anyone on the phone today:

- How was his respiration/defaecation/urination today?
- How much volume did you get into him today formula-wise and vytrate-wise? Was this mostly by bottle or did you tube feed him again today?
- Did you see any signs of post-feed discomfort today?
- Did you see any other signs of gut upset? ie: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.
- We’ve started him on the oral de-gas medication (simethicone) today (19/07/21) that has been recommended by a few vets that have been involved in hand rearing of cetaceans to help prevent problems from air that is gulped during feeding.

Plan for regular monitoring:

- We’re still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we’re already doing.

A few of us from the zoo will pop by tomorrow to:

- Take some repeat bloods.
- Catch up with you about some of the physical exam findings, check in with how feeding is going, check in on a couple of monitoring parameters etc. If you’d like us to bring/check anything specific let me know!
- Bring gear/recipes/instructions to hand over the formula prep.

3) Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4) Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don’t hesitate to get in touch.

Kind regards,



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---

From: HUHA Helping You Help Animals <[redacted]>  
Sent: 18 July 2021 19:14  
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Cc: [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>;  
[redacted] Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>;  
[redacted] Kirstie Knowles <kknowles@doc.govt.nz>;  
ingrid [redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>;  
[redacted]@wellingtonzoo.com>; [redacted]@wellingtonzoo.com>  
Subject: Re: Veterinary update for orca calf 18/07/21

Hi All.

Thanks [redacted]

Just to confirm that the Ingrid had the pool switched back to sea water thisafternoon.

Cheers  
[redacted]

On Sun, 18 Jul 2021, 5:55 pm [redacted]@wellingtonzoo.com> wrote:

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversations or if you otherwise have anything to add!

Firstly thank you so much to everyone who worked so hard in such awful weather in the last couple of days, I thought of you often and I hope you managed to stay warm and dry in between caring for Toa.

1. Current medical findings

Lab tests:

- The lab has unfortunately said that it can't run lactate on the type of sample that we've given them, but we can run it on the next sample we take using a patient-side machine that we can bring with us on the next blood sampling.
- We are still awaiting blow hole swab culture (fungal and bacterial) results from samples taken Monday 12/07/21.
- The team on-site have collected a faecal sample – thank you! Will chat tomorrow about how we get that where it needs to be for analysis.
- A urine sample was collected and tested today:
  - USG today was 1.028, and there was +1 protein and +1 glucose on the urine dipstick. In some animals those dipstick findings can be abnormal, but we'll wait to see if they persist (in some species they can be normal, or at least explained by physiology rather than disease).

#### Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.
- His right eye has started to be a bit squinty. There is no discharge or swelling or other abnormalities associated with it. The vet on-site will perform some tests to see whether there might be an abrasion to the surface of the eye or any other abnormalities.
- There is a small ulcer or skin wound next to his blowhole – the vet on-site is planning on taking some samples from that.
- Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect.

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage. No significant abnormalities/changes of defaecation have been noted with introducing or increasing the diet.
- He has been observed to urinate in the last 24 hours.

Fluids/feeding:

- We use the following two calculations to plan his food and fluid requirements for the day.
  - His daily fluid requirements are estimated to be 40-80ml/kg/d (= 8-16L per day).
  - His daily caloric requirements are 120-125kcal/kg/d.
- Ultimately we would like him on just formula (no supplementary fluid), as this contains enough fluid to also meet his fluid requirements, but we've been advised to build up to that slowly, which is why his diet is changing a little every day at the moment.

- Today the feeding plan was 1L formula + 1.2L 50% vytrate for the first three feeds (2.2L total) and then 1.5L formula + 0.7L 50% vytrate for the second three feeds (2.2L total). (Total of 7.5L formula and 5.7L 50% vytrate for today).
  - HUHA team if you could fill us in on how you went with this that would be lovely :)
- **Tomorrow's feeding plan:**
  - **1.1L formula + 0.4L 50% vytrate per feed x 8 feeds at 2 hourly intervals**

**(total of 8.8L formula and 3.2L 50% vytrate).**
- We've had to make a few changes to his feed schedule to get to the feeding plan for tomorrow:
  - He has been showing signs of discomfort after tube feeding – sinking to the bottom of the pool and hunching slightly.
    - This may be due to discomfort due to the volume fed - hence smaller meals tomorrow – fed more frequently so that we still try to meet his requirements.
    - Or it may be due to discomfort from the tubing. The cetacean vets that we've been taking advice from say that bottle feeding him would be a good alternative. They say it may contribute to habituation, but that so does being near to humans and being handled for tubings/treatments etc, so they are not concerned about the bottle feeding on its own per se.
    - A bottle set up has been trialled today with moderate success. The signs of discomfort that were seen post-tubing have not been seen after bottle feeding.
  - A few pointers from the cetacean vets:
    - Please make sure he's not gulping air while feeding – this can cause colic and discomfort.
      - They've recommended a de-gas medication be added to the feeds, I will source this asap and let you know when it's ready.
    - Please make sure he's not gulping water while feeding – too much sea water ingestion can affect his electrolyte levels and make him sick.
    - We/you can consider supplement feeding him with tube feeding if some of his bottle feeds are less productive than others.
    - They prefer him to have a break from feeding overnight to allow him to rest, so they do not advise feeding constantly over a 24 hour period at this stage.
  - An important piece of information that I received today is that orca abdomens do not expand very easily compared to other mammals. As a result, a build up of anything in the abdomen increases the pressure in the abdomen rather than causing abdominal distension. So a build up of gas can very quickly become uncomfortable, as can ingesting volumes that are too large – so perhaps this is the reason we're seeing some discomfort after tubing.
  - Please continue to monitor him for signs of gut upsets: regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea.

Today it was noted that some of the volunteers were encouraging him to suck on their thumbs as they thought this might help with feeding. Thank you Whale Rescue and HUHA for realising this was happening and for advising them to stop :)

Due to the suspected/confirmed (?) sewage spill at Plimmerton due to the horrible weather this weekend the team recently changed his pool from salt water to chlorinated water. Please could we change this to fresh water or back to sea water if the Plimmerton sea water is okay again? It was a good idea to change from sea water when the

sewage problem was reported, but fresh water is much better for him than chlorinated water, which could negatively affect his skin and eyes.

Additional medications:

- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 will be continued until 20/07/21 inclusive.

Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily-weekly basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, girth/length measurements, weight (if possible), bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

4. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,





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**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** 17 July 2021 16:35  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED] Ian Angus <iangus@doc.govt.nz>; Marine  
<marine@doc.govt.nz>; [REDACTED]  
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**Cc:** HUHA Helping You Help Animals [REDACTED]; ingrid [REDACTED]; [REDACTED]  
<[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>;  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
<[REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Veterinary update for orca calf 15/07/21

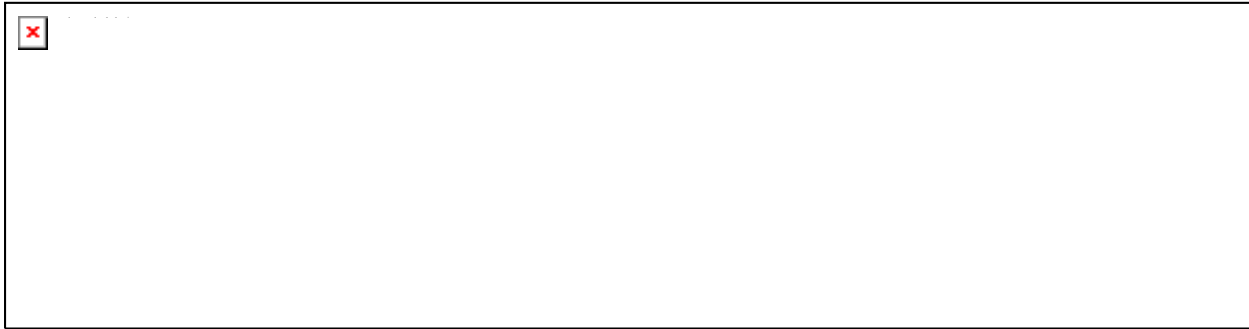
Hey all, quick update from me today.

- Toa is going really well according to personnel on site – accepting feeds well, and no gastrointestinal comfort seen
- There is possibly a sewerage pipe burst somewhere near the bay, so concerns re: water quality. HUHA vet [REDACTED] is organising water testing.
- [REDACTED] got a urine sample and USG this morning of 1.017
- [REDACTED] mentioned possibly some oedema around caudal oropharynx/throat area (possibly from repeat tubing?) so would like to keep bottle feeding as a back up option in case tubing needs to be abandoned. Toa is currently showing no signs of discomfort or distress during tubing, tolerates it very well. We can check this when we are next on site as well, but in the meantime if HUHA vets can keep a close eye on that please 😊
- We are going to continue upping the ratio of formula to vytrate, so please see the attached feeding schedule for 18/07/21 – there is no hard copy of this, I'm sorry. Had not gotten it printed off before the food was collected this afternoon. At this rate he should be on 100% formula from Monday afternoon, and we can look at making the formula richer or increasing volume if we need to increase caloric intake.
- We will organise a day early next week to revisit Toa to take a repeat blood sample
- I am going to be off for the next two days, but [REDACTED] is here tomorrow and [REDACTED] will both be here on Monday

Thanks again (and again and again) for everyone's hard work and dedication especially in the horrible conditions today.

[Me tiaki, kia ora!](#)

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---

**From:** [REDACTED]@wellingtonzoo.com>  
**Sent:** 16 July 2021 17:02  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]; Ian Angus <iangus@doc.govt.nz>; Marine <marine@doc.govt.nz>; [REDACTED]  
>  
**Cc:** HUHA Helping You Help Animals <[REDACTED]>; ingrid [REDACTED]; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>; [REDACTED]  
[REDACTED]@wellingtonzoo.com>; [REDACTED]@wellingtonzoo.com>  
**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again, slight update to tomorrow's feed schedule (see attached).

**[REDACTED] BA DVM**  
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**From:** [REDACTED]  
**Sent:** Friday, 16 July 2021 4:07 pm  
**To:** [REDACTED]@wellingtonzoo.com>; [REDACTED]

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**Subject:** RE: Veterinary update for orca calf 15/07/21

Hello again to everyone!

Thank you all for your amazing continued care of the little calf! I'm just continuing on with a further update on how Toa is doing following the discussion from earlier this afternoon. I'll try to only include new information in this update. Please add anyone I may have forgotten to include!

Due to the change in weather, Toa was moved into a temporary pool yesterday around 5 PM. The move went smoothly and took 20-30 minutes. There have not been any changes noted in his behaviour since changing to the pool and his medical treatments and tubings are taking place at the same intervals. At the moment there is no filtration system in place so, as an alternative, the pool is being continuously filled with sea water via a pump and draining out excess water through holes in the side. The plan is to only keep Toa in the pool until it is safe enough to return him to the sea pen.

As we have increased the concentration of formula being fed, it was observed that Toa is beginning to show a few signs of abdominal discomfort immediately after feeds. He will cramp up and sink to the bottom of the pool briefly. This began last night and happened again this afternoon. In order to hopefully combat this we have come up with the solution of feeding him more frequently throughout the day (every 2 hours instead of every 4) so that he is getting smaller volumes of formula at each feed (but will still receive the same total daily volume). We will still try to increase his volume of formula fed by 50% each day in order to start increasing his caloric intake. It has been difficult to assess the frequency and consistency of his faecal output due to the murkiness/turbulence of water from weather. With increased

In terms of ongoing monitoring, we will continue to do what [redacted] has already discussed (semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour) but may also consider adding in blow hole chuff cultures at least once but could repeat if any indication (we need to source the appropriate petri dish to collect these and confirm with Gribbles how it will need to be submitted), urine samples from first thing in morning prior to tubing to check UA and USG (this could be less frequent, maybe every 3 days or so), and body length and girth measurements (and possibly weights! if a suitable scale setup can be sourced which Ingrid is looking into). The body length, girth and weight measurements will be incredibly helpful both in helping to confirm an age and in ongoing monitoring of nutritional status.

For fluids and feedings tomorrow the plan is to give 700 ml formula with 1.5 liters 50% vytrate at 8 AM, 10 AM, and 12 PM. Then for the 2 PM, 4 PM, and 6 PM feeds he can receive 1 liter formula with 2 liters of 50% vytrate. (Total formula volume will be 5 L tomorrow compared to 3.5 liters today, a ~50% increase in volume). I'll email out a feed

schedule sheet separately in case it is helpful. 😊 This will increase the total fluid volume he gets during the day by 3 liters but will still be within his recommended fluid needs of 40-80 ml/kg/day. If he is continuing to show signs of discomfort after any of these feedings please get in touch. [REDACTED] will be at work tomorrow at the zoo so can be reached if needed.

For medications, Toa received his last dose of steroid today. There is no need to continue on with steroid treatment at this time. He is still receiving enrofloxacin 5 mg/kg BID which he started Wednesday morning (14/7/21). This is due to last 7 days, finishing after his dose on the evening of 20/7/21.

We are still awaiting results from the veterinary laboratory for samples taken Monday:

- Lactate, blow hole swab culture (fungal and bacterial).

1. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

2. Other work in progress

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thank you so much to everyone for all your dedication and care! Looking forward to seeing you and Toa in person again soon!

[REDACTED] BA DVM

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**From:** [REDACTED]  
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**Subject:** Re: Veterinary update for orca calf 15/07/21

Hi [REDACTED],

Thank you again for another comprehensive update! Sounds like all is stable which is great news.

Thank you to the wider team as well for all your hard work with this little calf.

Kindest regards,

[REDACTED]

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**From:** [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>  
**Sent:** Thursday, 15 July 2021 6:01 PM  
**To:** [REDACTED] Ian Angus <[iangus@doc.govt.nz](mailto:iangus@doc.govt.nz)>; Marine <[marine@doc.govt.nz](mailto:marine@doc.govt.nz)>; [REDACTED]  
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**Cc:** HUHA Helping You Help Animals [REDACTED]; [ingrid \[REDACTED\]](mailto:ingrid@[REDACTED]) <[ingrid \[REDACTED\]](mailto:ingrid@[REDACTED])>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>; [REDACTED] <[\[REDACTED\]@wellingtonzoo.com](mailto:[REDACTED]@wellingtonzoo.com)>  
**Subject:** Veterinary update for orca calf 15/07/21

Hi everyone,

A veterinary update on Toa for today. Team HUHA and Whale Rescue please feel free to add to my updates if I've missed anything from our conversation or if you otherwise have anything to add!

## 1. Current medical findings

Lab tests:

- We have a few results back from the lab:
  - Complete blood count and blood parasite check – normal (but see below)
  - Fibrinogen levels (one way of testing for inflammation) – normal
  - Blow hole swab cytology (a measure of respiratory tract infection) – normal
  - Total blood iron levels – normal
  - The lab's interpretation of the blood results suggests a mild regenerative anaemia – worth noting here because the lab mentioned it, but we'll also bear in mind at this stage that the cetacean vets were not immediately concerned about this result. Something to monitor.
  
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Lactate, blow hole swab culture (fungal and bacterial).

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also several deep lacerations near his tail fluke laterally to his spine.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to continue to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- Respiratory rate is being recorded by whale rescue volunteers (thank you!).

- He has been observed to defaecate every day at this stage.
  - Only one faecal was observed today, but further faecals may have been missed due to deteriorating weather conditions and choppy/murky water today.
- He has been observed to urinate in the last 24 hours (great observation thank you!)

#### Fluids/feeding:

- Orca hand rearing formula feeding continued today: 500ml at each of the first two feeds, 750ml at the third feed, and a plan to give 750ml at the final feed also.
- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
  - So at each feed the total volume tubed was 3L, with the remainder of the volume to make up the total being vytrate electrolyte solution (1/2 strength).
- He was monitored for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea). None of these signs were observed.

#### Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21. Advice from the cetacean vets we've been communicating with suggests that we can start weaning this medication off at this stage, so tomorrow morning he will get a half dose (2.5ml)(16/07/21), and from 17/07/21 onwards he will no longer be receiving this medication.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21). The cetacean vets have advised that a 7 day course of this medication should be sufficient given the blood and other test results, and how he is in himself. So this will be continued until 20/07/21 inclusive.
- Ingrid: I haven't been able to get hold of your recommended contact (will keep trying), but in the meantime I have asked the other cetacean vets your question about whether antifungal medications are recommended with the antibiotic course that he is on. The advice we have at this stage is that because our courses of antibiotics and dexamethasone are short and because there are not currently any signs of fungal infections, that these are not necessary at this stage. But worth asking about and bearing in mind!

#### Plan for regular monitoring:

- We're still putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations/videos of movement/behaviour etc – so similar to what we're already doing.

#### 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

#### 4. Other work in progress

We've sent through to the HUHA team a set of veterinary considerations for transport (ie for ocean release) from the cetacean vets we've been communicating with. We'll have a bit more of a think about whether anything needs to be added/changed to this. I think most parties have this info at this stage, let me know if I have not sent it to you and you'd like to see a copy.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[REDACTED]

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**From:** [REDACTED]  
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**Subject:** Veterinary update for orca calf 14/07/21

Hi everyone,

A quick veterinary update for today:

#### 1. Medical findings

Lab tests:

- Repeat blood tests taken today and run in house show no new/additional abnormalities.
- We are still awaiting results from the veterinary laboratory for samples taken Monday:
  - Complete blood count and blood parasite check, fibrinogen, lactate, total iron, blow hole swab culture (fungal and bacterial) and cytology.
- The cetacean vets we are communicating with think that what we initially interpreted as anaemia is actually within the normal reference range of orca calves of this age, so is currently of no concern.

Physical exam:

- There are still superficial and deeper abrasions to the underside of the tail flukes and the underside of the chin. There are also will several deep lacerations near his tail fluke laterally to his spine.
- Further video footage was sent through to cetacean vets of the animal's position in the water and movements in the water. They think his positioning and behaviour is probably normal, as far as it is able to be assessed in the space that he is in. Their reasoning for this is that the tilting behaviour is not consistent and that his respirations appear normal.

So currently the only known medical problems are the abrasions and lacerations. This is based on the diagnostic testing we have done and what is possible to assess on physical examination and distance examination. Due to the size of the animal and the limitations of our diagnostic testing, it is still possible that there is a disease condition present that predisposed him to being separated from his pod and that we have not been able to detect. We'll await further lab results.

The team on-site are going to attempt to collect us a faecal sample (thank you!).

## 2. Proposed medical/nutrition plan moving forward

His current medical care consists of:

Ongoing recording of respiratory rate, and also any observed defaecation and urination.

- This is being recorded by whale rescue volunteers (thank you!).
- He has been observed to defaecate every day at this stage.

Fluids:

- His daily fluid requirements are estimated to be 40-80ml/kg/d (8-16L per day).
- Today he received 3L fluids (1/2 strength vytrate solution) at each of four tubing events (= 12L total)

Feeding:

- He was started on an orca hand rearing formula today – 250ml at the first tubing, 375ml at the second tubing, and 500ml at each of the last two tubings. The volume fed will be slowly increased over the next few days to a point that will attempt to meet his caloric requirements, while carefully monitoring him for signs of gut upsets which may occur with the introduction of a new diet (monitoring for regurgitation, vomiting, signs of abdominal pain, bloating, increased frequency of defaecation and/or diarrhoea).

Additional medications:

- Dexamethasone by intramuscular injection once a day. This was started on the morning of 13/07/21.
- Antibiotics (enrofloxacin 5mg/kg) by intramuscular injection twice a day starting on the morning of 14/07/21 (a long acting antibiotic was given on the afternoon of 12/07/21).

Plan for regular monitoring:

- With a team of people we're putting together some monitoring parameters which will help us assess his health and welfare on a daily basis. Will keep you updated as this develops, it will likely involve semi-regular blood samples if possible (1-2x per week), respiratory rates, bowel movements, observations of movement/behaviour etc.

## 3. Advice regarding management of disease between orca calf and humans, in both directions.

This advice remains the same as at the last update.

## 4. Other work in progress

We're putting together some veterinary aspects/advice associated with transport – in the case of a pending release.

Wetsuit hygiene/biosecurity instructions are still a work in progress

Thanks so much everyone for all your time and expertise. If you have any questions or comments please don't hesitate to get in touch.

Kind regards,

[Redacted]

[Redacted] BVSc, MVSc (Zoo Animal and Wildlife Health), MANZCVS (Avian Health)

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**Sent:** 13 July 2021 15:47

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**Subject:** Veterinary update for orca calf 13/07/21

Hi everyone,

I've created a document of the vet results, findings and recommendations that we have so far for the orca calf at Plimmerton boat club, and I've attached it here. As time goes on and more information comes available, we'll keep updating you.

Today's 1pm stomach tubing with fluids was performed by vet [REDACTED] from HUHA and this went very well, so the follow up tubing at 5pm and at 9pm will be run by [REDACTED] also. DOC staff if you are happy with this plan and timing also?

Our team will be in when DOC arrives in the morning tomorrow (is that 7:30am again?) for the first treatments, which would be an injection of some medications and tube feeding – starting dilute formula feeds in the morning.

Any questions, comments, concerns please don't hesitate to get in touch.

Kind regards,

[REDACTED]

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