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New Zealand Sea Lion TMP Risk Assessment

Stakeholder Meeting

16 October 2015

DOC – Level 4 meeting room

Nathan Walker and Igor Debski

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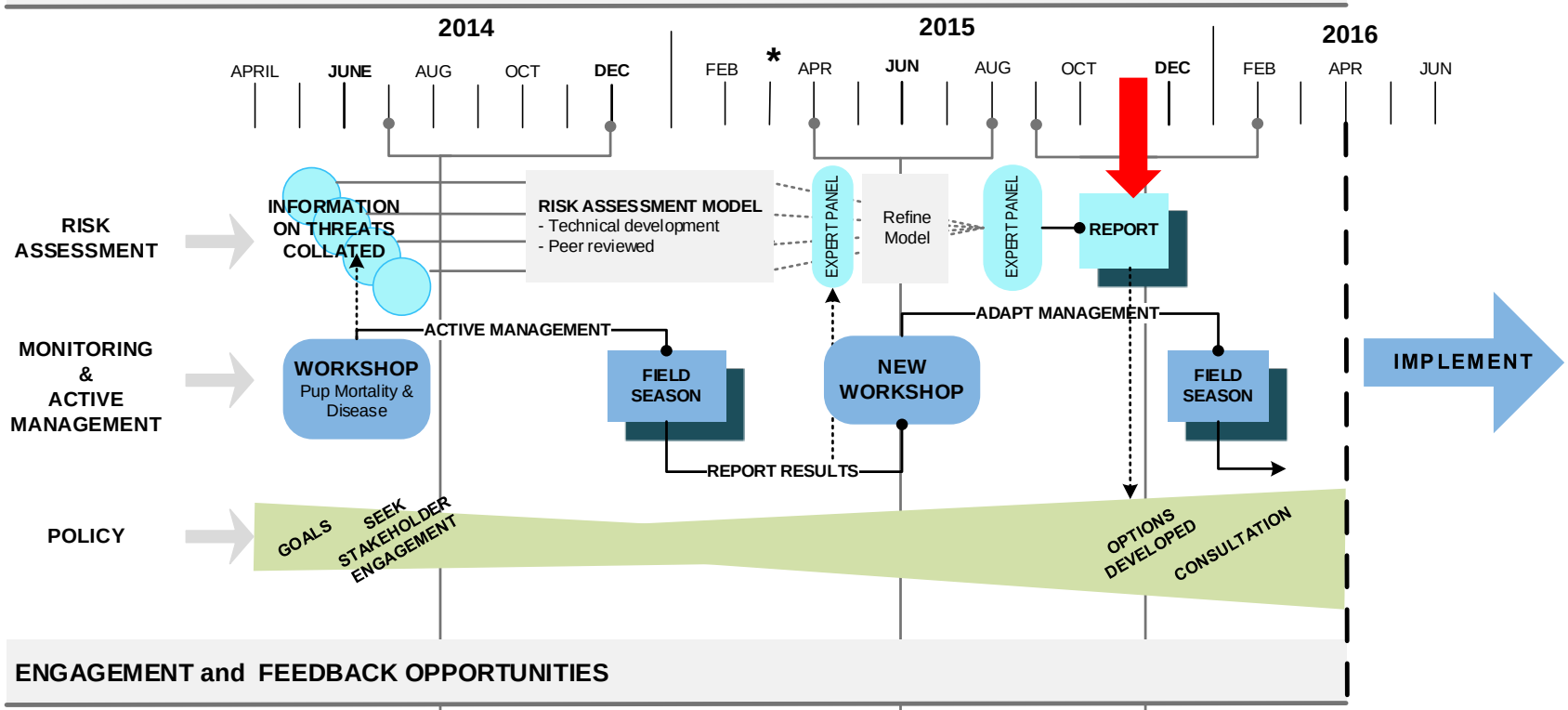
DEVELOPMENT PROCESS FOR THE THREAT MANAGEMENT PLAN (TMP)



ENGAGEMENT and FEEDBACK OPPORTUNITIES

JUNE – DECEMBER

Stakeholders will have opportunities to engage in the development and review of research which will inform the TMP, as well as provide feedback on the TMP goals and high level objectives.

Engagement throughout the TMP will occur through the following groups:

- **Technical Working Groups** (CSP/AEWG)
- **National Environmental Engagement Forum** (EEF)

APRIL - JULY

Stakeholders will have opportunities to engage in the review of the demographic work and risk assessment outputs

***** Interim pup count will be available in March

AUGUST

Experts will be invited to participate in the expert panel risk assessment

JUNE

Stakeholders will have opportunities to review results from the 2014 Auckland Island field season.

SEPTEMBER - FEBRUARY

Stakeholder will have opportunities to review results from the expert panel qualitative risk assessment

Public consultation will occur on proposed options for TMP

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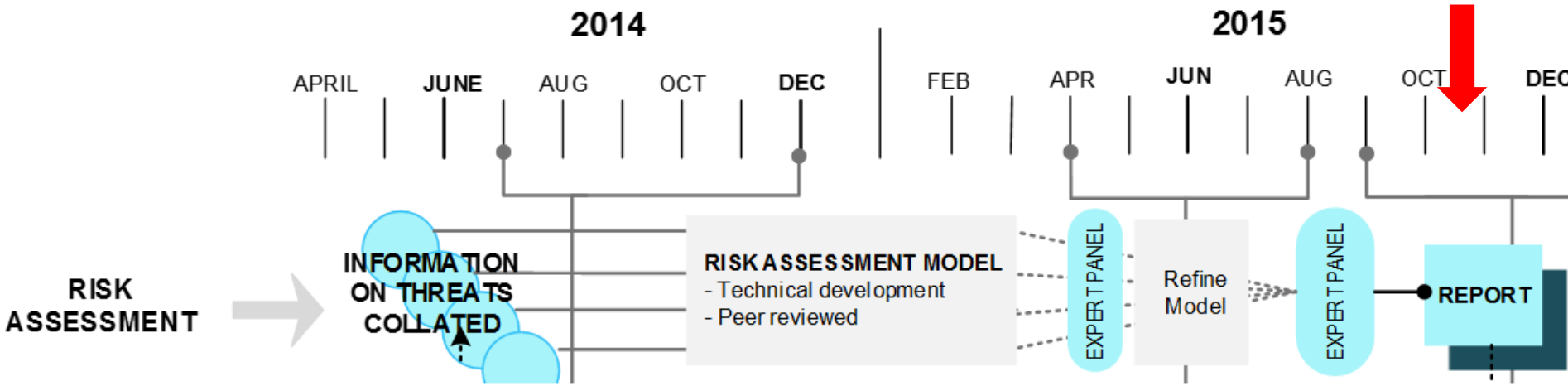
Risk assessment process



1. **Sites**
2. **Data**
3. **Threat identification and characterisation**
4. **Analytical approach**
5. **Results**

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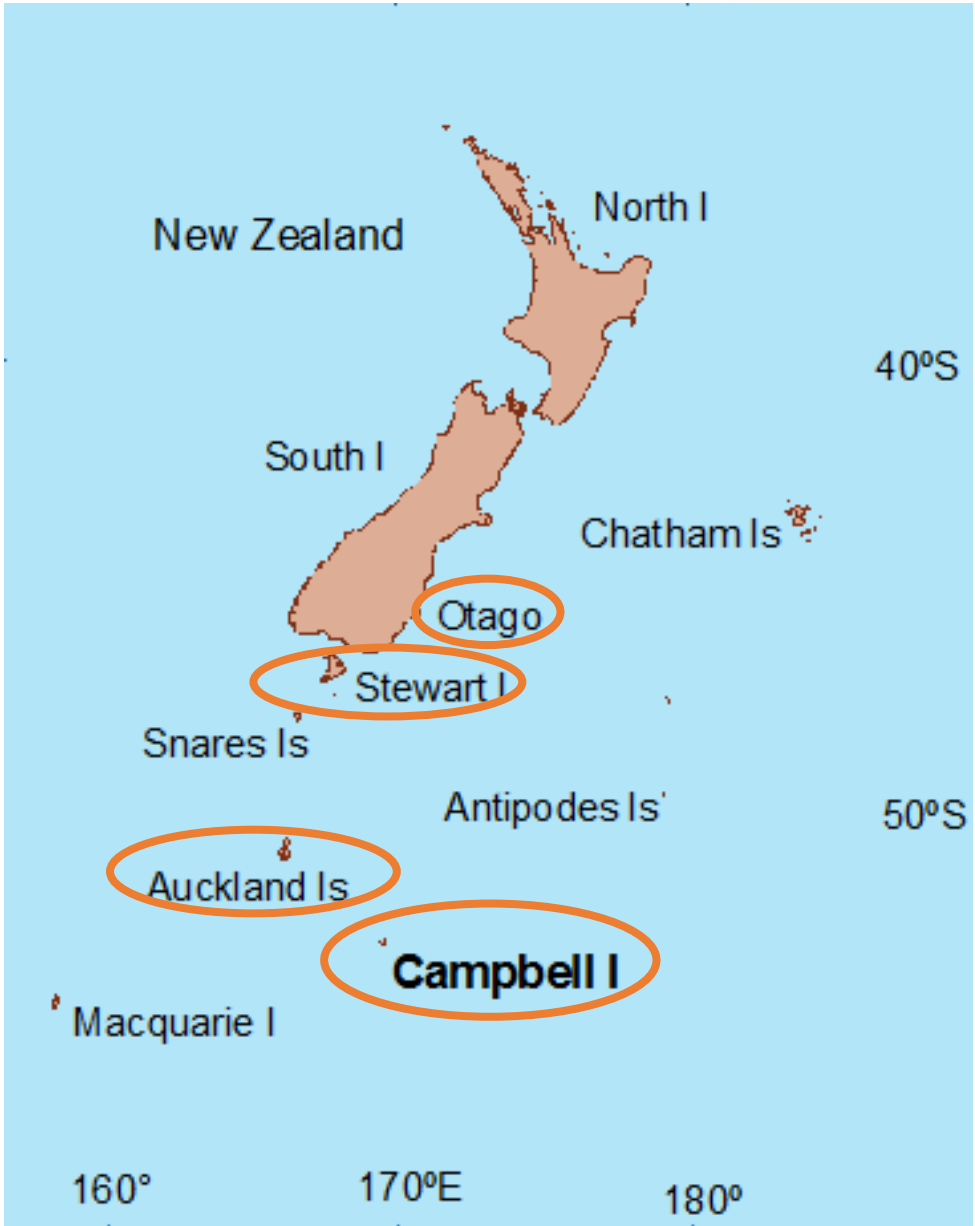
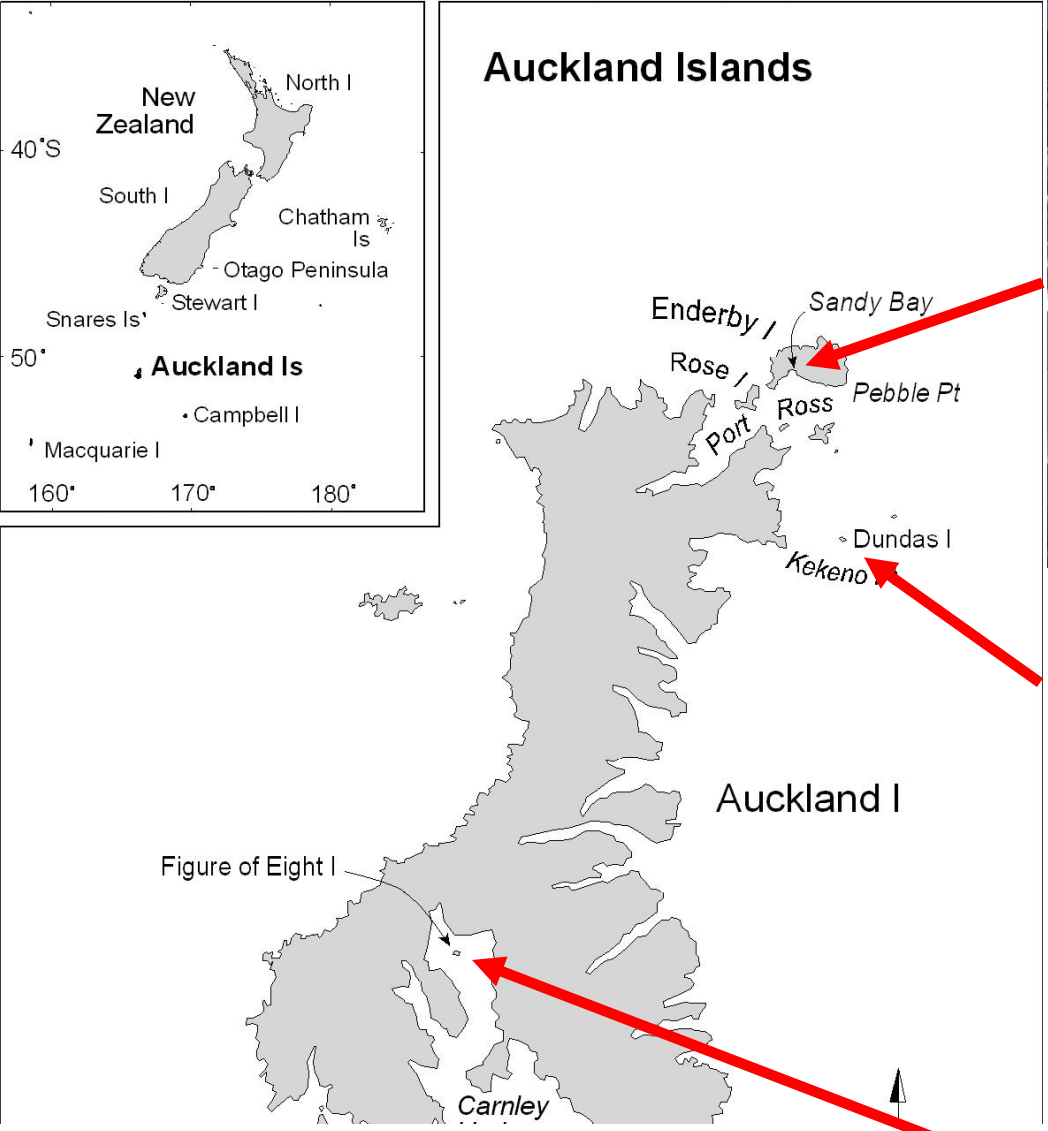
1 Sites



Maps and photos borrowed from Simon Childerhouse's presentation to TMP workshop


Auckland Islands
New Zealand
North I
40°S
South I
Chatham Is
Otago Peninsula
Stewart I
Snares Is
50°
Auckland Is
Campbell I
Macquarie I
160°
170°
180°
Enderby I
Sandy Bay
Rose I
Pebble Pt
Ross
Port
Dundas I
Kekeno
Auckland I
Figure of Eight I
Carnley

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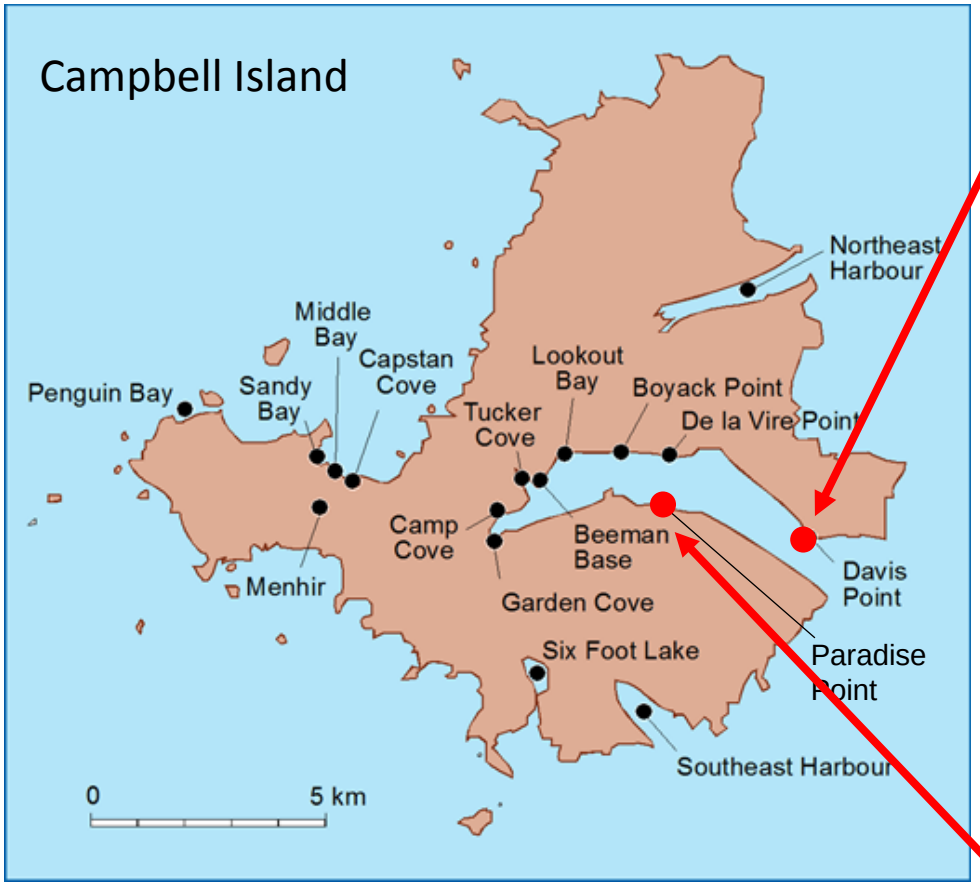

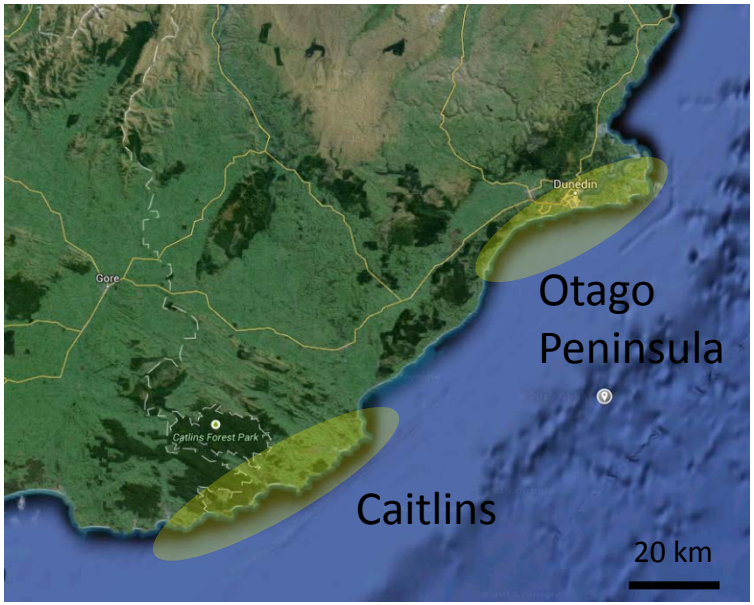
Dunedin
Gore
Otago
Peninsula
Catlins Forest Park
Caitlins
20 km

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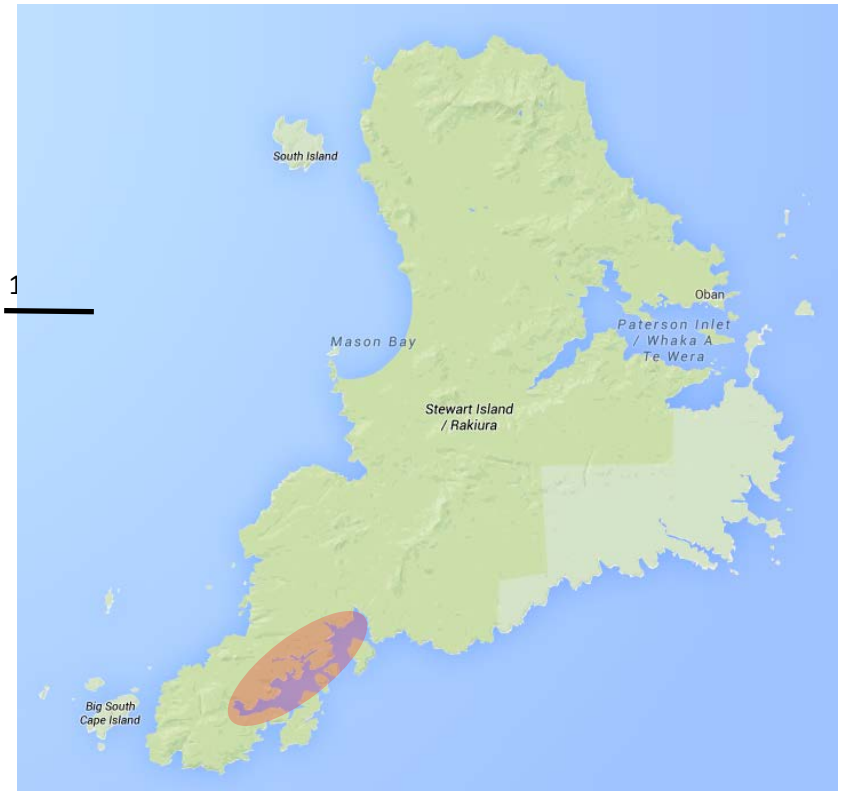
Port Pegasus, Stewart Island



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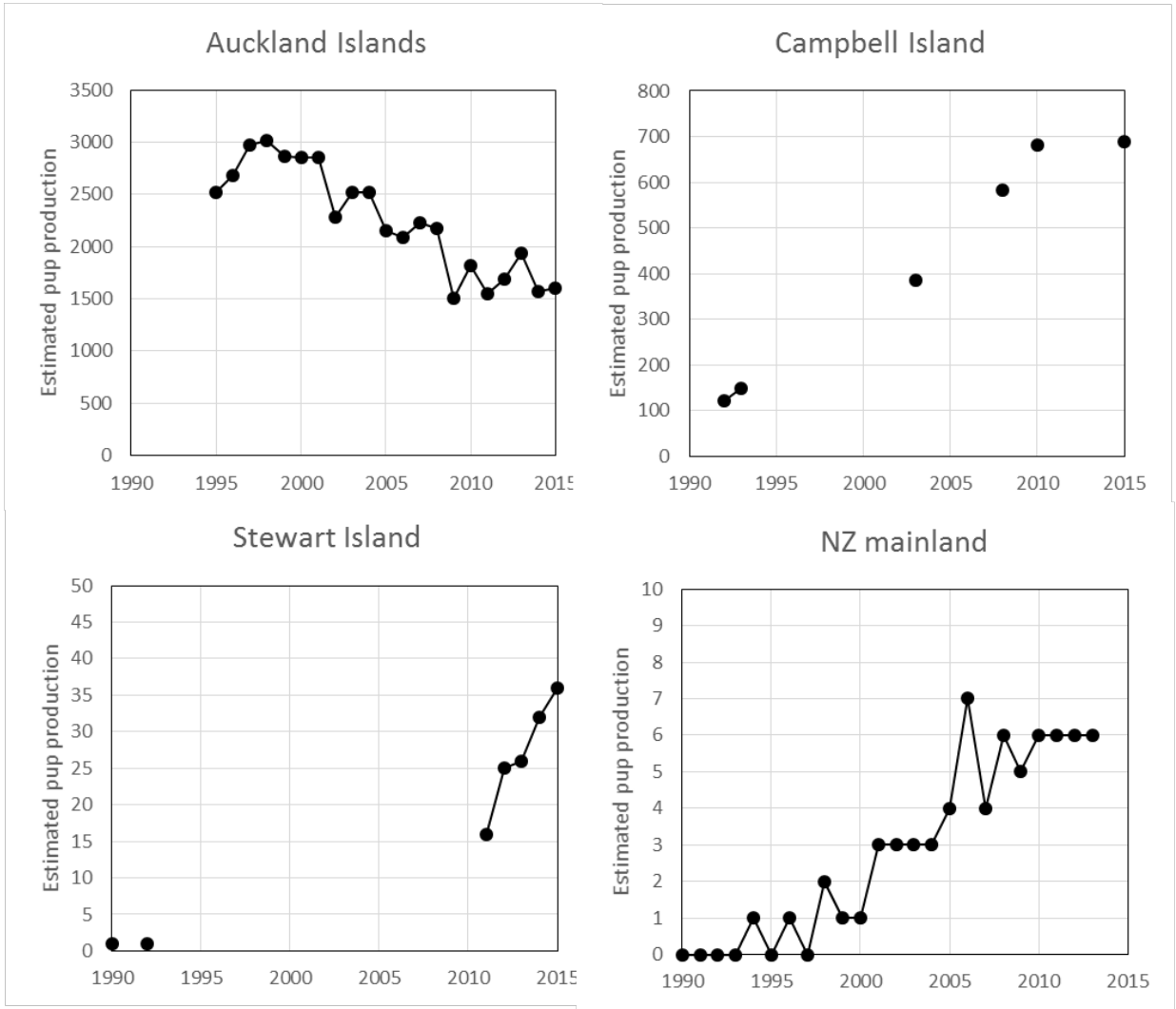
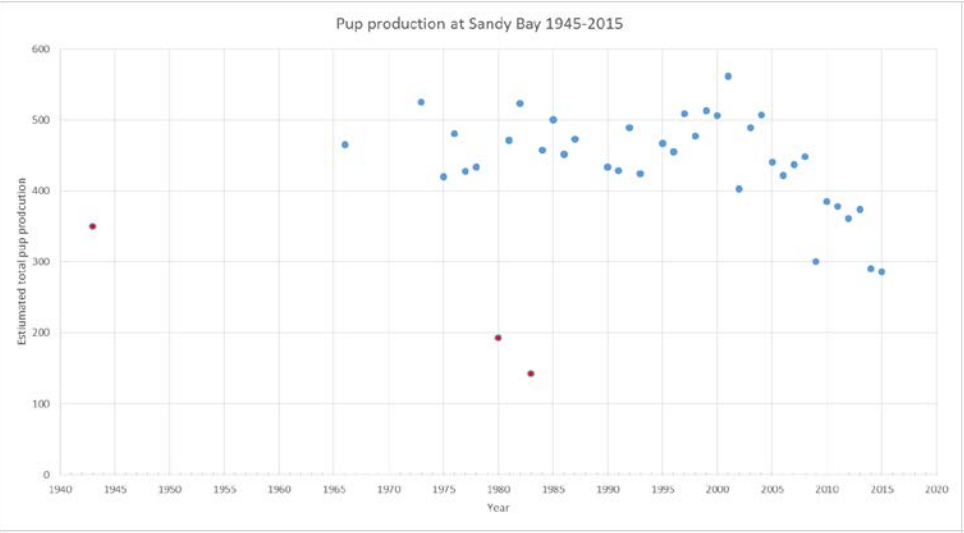
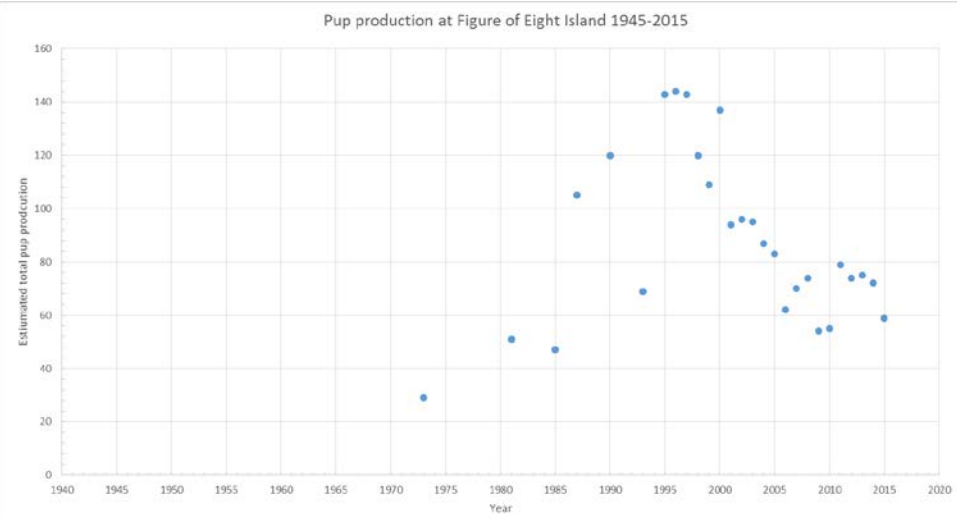
2 Data – Pup counts

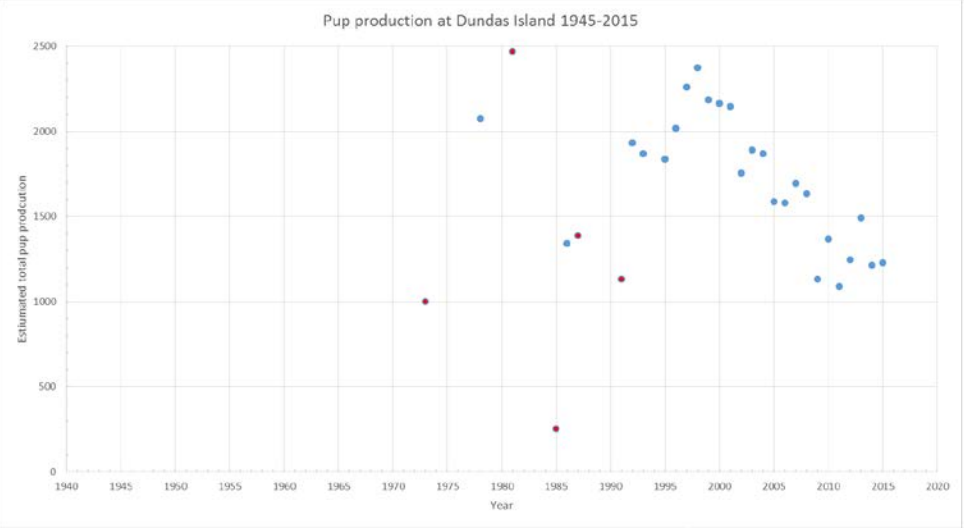


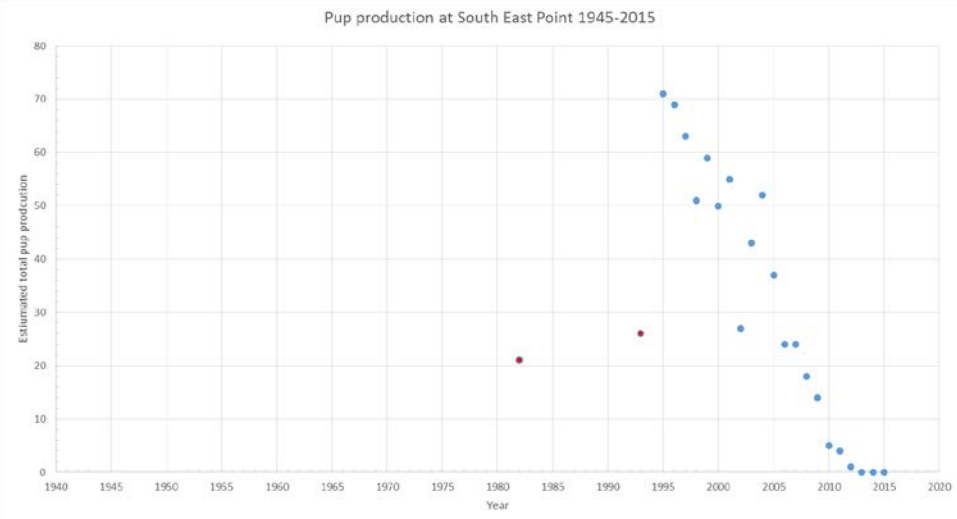
Graphs borrowed from Jim Roberts presentation to TMP workshop

Pup counts - Historic

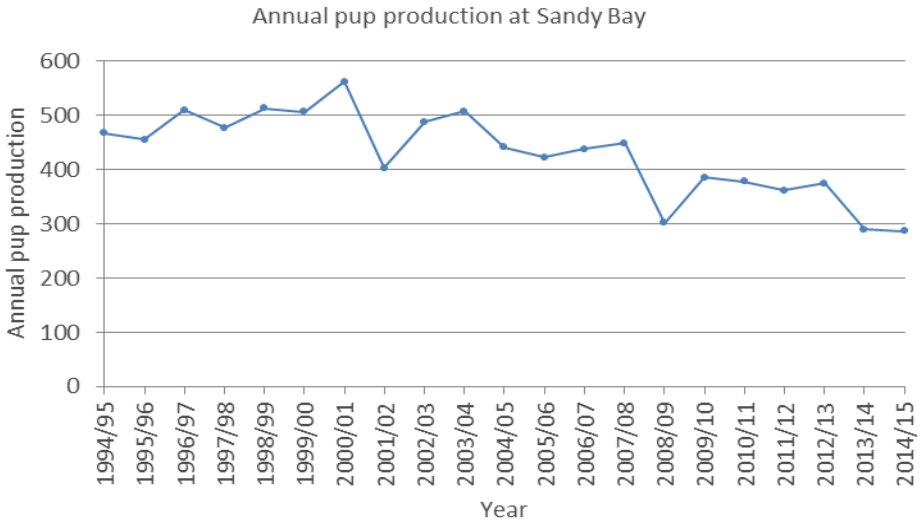


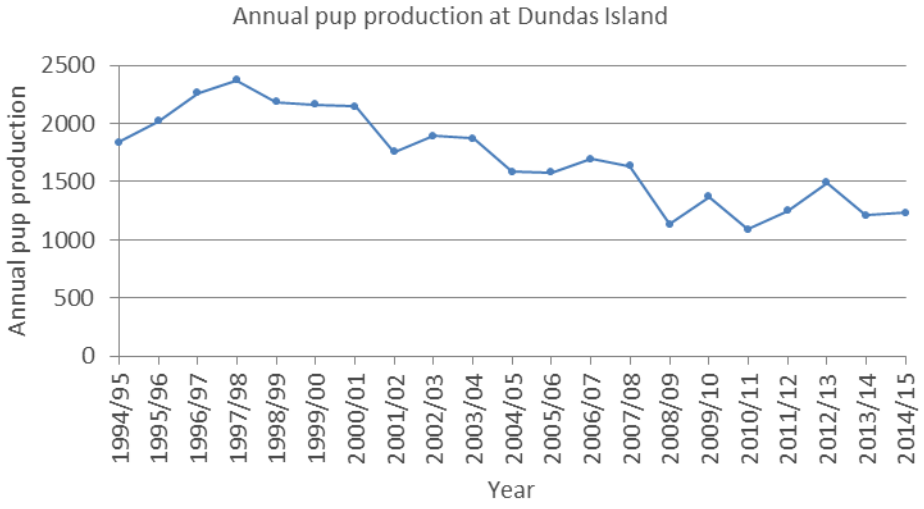


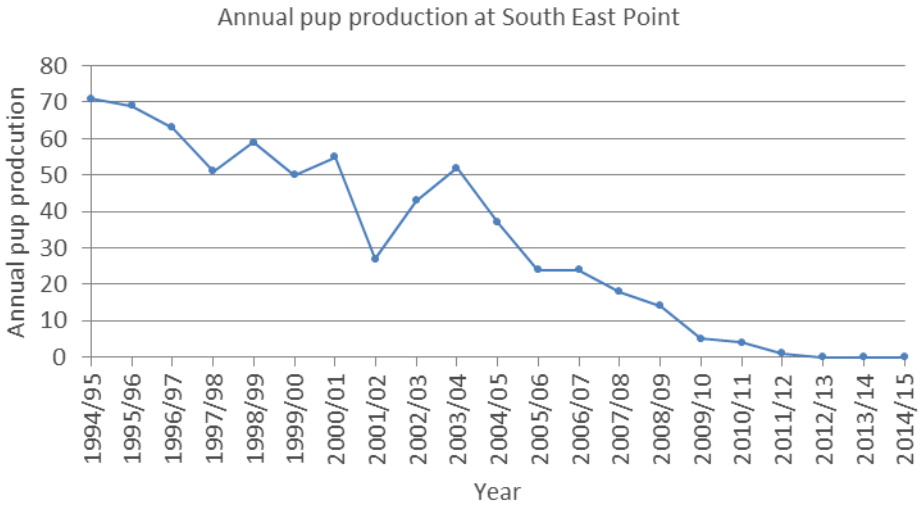


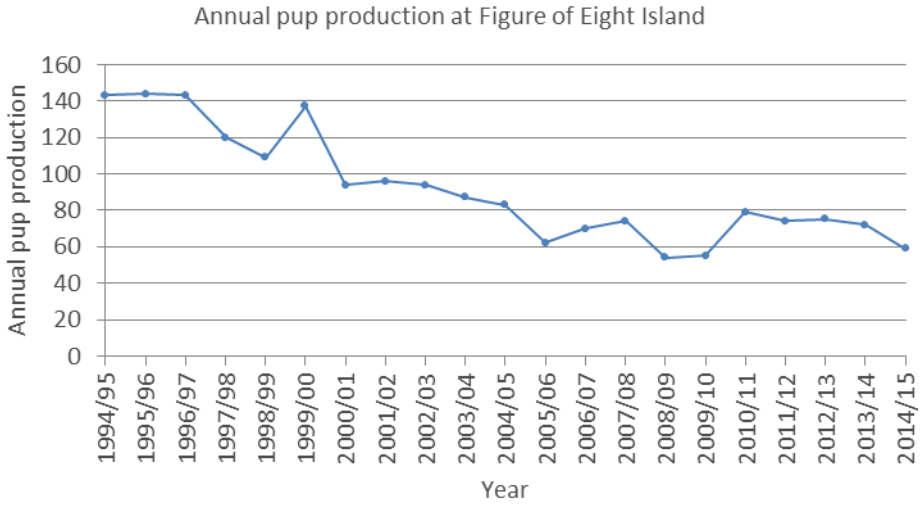


Pup counts – Auckland Islands









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1.2 Data – Most recent pup counts

Region		Estimated pup production 2014/15
Auckland Islands	Dundas Island	1230
	Sandy Bay	286
	Figure of Eight Island	59
	South East Point	0
Campbell Island	Davis Point	515
	Paradise Point	173
	Other	8
Stewart Island	Port Pegasus	36
Otago	Otago Peninsula	8
	Catlins	2
Other	Snares, etc	?
TOTAL		2317

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Data – Tagged animals

Photo stolen from internet

Name	Birth	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Katya	1994	P	1	0	3	B	5	6	B	8	B	B	B	B	B	B	B	B	0	0	0
Leone	1996			P	0	2	0	4	B	B	B	B	B	B	0	B	13	14	B	16	0
Suzie	1998					P	0	2	0	B	5	6	B	0	0	0	0	0	0	0	0
Y2K	2000							P	0	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	2001								P	1	2	3	B	B	0	0	0	0	0	0	0
Teyah	2001								P	1	2	0	B	B	6	B	B	B	B	B	0
Lorelie	2002									P	1	0	3	B	0	B	7	B	9	B	B
Honey	2003										P	1	2	3	0	B	6	7	8	0	0
Aroura	2004											P	1	2	3	B	5	0	0	0	0
Waimarie	2004											P	1	2	3	0	0	0	0	0	0
Nerissa	2005												P	1	2	3	B	B	6	0	0
Zoe	2005												P	1	2	3	B	B	0	B	B
Pani	2005												P	0	0	0	0	0	0	0	0
Gem	2006													P	1	2	3	4	0	B	B
Emma	2006													P	0	0	0	0	0	0	0
Mia	2006													P	0	2	3	4	5	6	0
Hine	2007														P	0	0	3	0	0	0
Madeline	2007														P	1	2	3	4	0	0
Lena	2008															P	1	2	3	4	0
Douce	2008															P	1	0	0	0	0
Cockle	2008															P	1	2	3	4	5
Patti	2009																P	1	2	0	4
Mana	2009																P	1	2	0	0
Huru	2010																	P	1	0	3
Sandy	2010																	P	1	2	0
Becky	2010																	P	1	2	0
Pippa	2010																	P	1	2	3
Ngaio	2011																		P	0	0
Hiriwa	2011																		P	0	2
Joy	2011																		P	1	2
Carleigh	2011																		P	0	0
Marama	2012																			P	0
Moana	2012																			P	0
Female	2013																				P

Data collected by NZ Sea Lion Trust and analysed by Jim Roberts

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Data – Age distribution

Photo borrowed from Brittany Graham's presentation to TMP workshop

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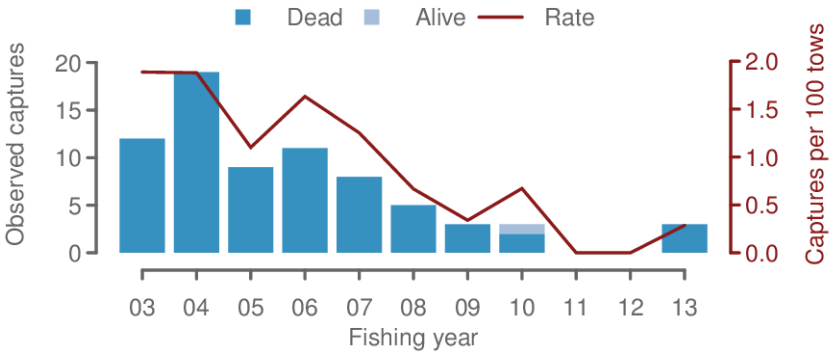
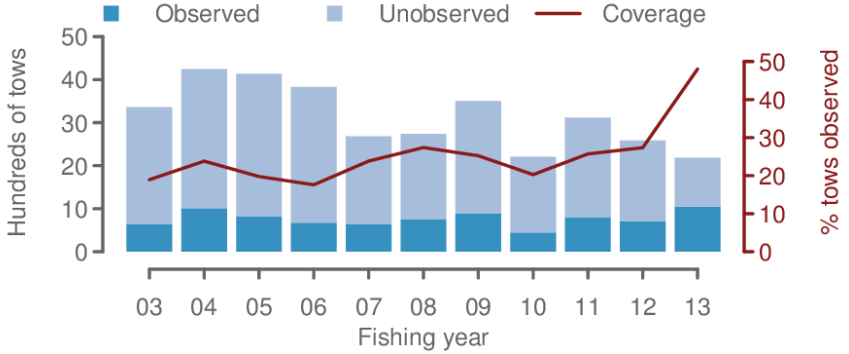
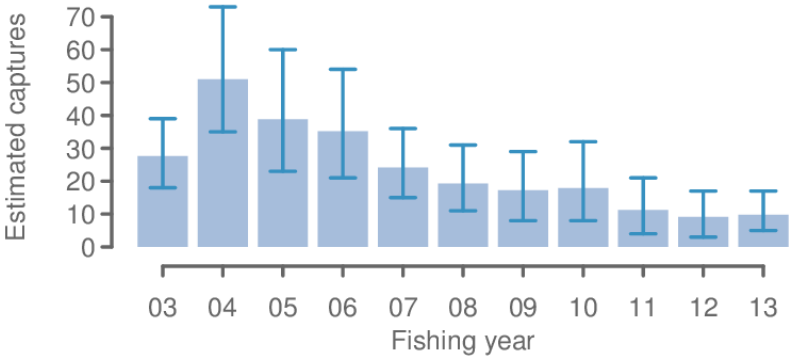
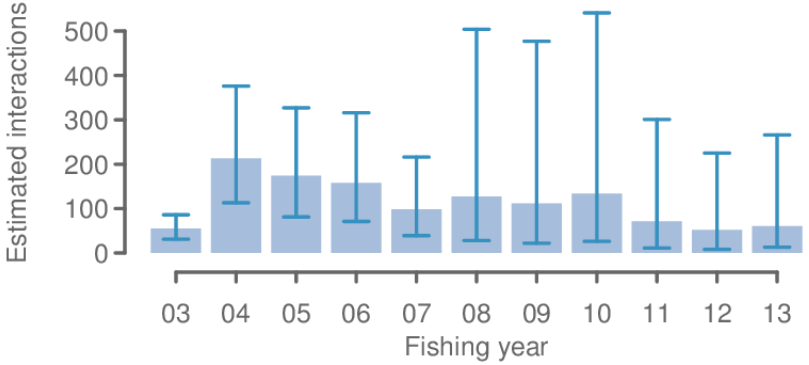
Data – Incidental captures









Graphs from Dragonfly PSC website

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3. Threats

1. Identification of threats

2. Threat Characterisation

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3.1 Identification of threats

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Appendix 2 Table 1: A list of potential threats to New Zealand sea lions based on known threats and threats to other marine mammals. The threats have been assessed for whether they are applicable to sea lions and if so, which population. They are also assessed as to whether they were likely to affect population trends within the next 5 years.

Threat Class	Threat	Applicable to population	Likely to affect population trends within the next 5 years
Fishing	Commercial trawl	All	
	Any other fisheries/recreational etc		
	Trophic effects	All	
	Vessel noise; displacement	NA	
Tourism	Boat strike	All	
	Vehicles	SI, ML	
	Noise	All	
	Disturbance	All	
	Displacement	All	
Other human impacts	Dogs	SI, ML	
	Shooting	SI, ML	
	Deliberate harassment	SI, ML	
Vessel traffic	Boat strike	NA	
	Disturbance	All	
Pollution	Agricultural run off	SI, ML	
	Industrial run off		
	Oil spill		
	Plastics		
	Marine debris/entanglements		
	Trophic effects		
	Sewage Stormwater		
Coastal development	Marinas / Ports	ML	
	Displacement, noise, pollution, sedimentation		
	Wave power generation	NA	
	Tidal power generation	NA	
Mining and oil activities	Noise (non-trauma)		
	Noise (trauma)		
	Pollution (discharge)		
	Habitat degredation		
Research	Physical		
	Disturbance		
Disease	Klebsiella		
	Hookworm		
	Stress induced		
	Domestic animal vectors		
Climate change	Temperature		
	Prey Availability		
	Displacement		
Small population effects	Stochastic and Allee effects		
Predation	Sharks		
Tsunami???? (from the SMP)			

Oct 2014 : initial scan by DOC/MPI

Nov 2014 : presented to stakeholders

Nov 2014-Jan 2015: stakeholder input

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Description of Potentially Threatening Activities			
Threat Class	**Threat**	**Description of threat**	**Population likely to affect**
Coastal development	Noise	Injury/mortality, indirect effect on pup, & compromised health	ML, SI
Coastal development	Habitat alterations & related issues (ex: pollution)	Displacement & compromised health	ML, SI
Disease	Klebsiella	Pup mortality	AI, others?
Disease	Klebsiella	Adult mortality	AI, ML, others?
Disease	Klebsiella	Indirect effect on pup	AI, ML, others?
Disease	Hookworm	Compromised health	AI, others?
Disease	Hookworm	Pup mortality	AI, others?
Disease	Wildlife vectors	Adult & pup mortality, & compromised health	ML, SI
Disease	TB	Adult mortality	ALL
Disease	Novel agent	Pup mortality	ALL
Disease	Novel agent	Adult mortality	ALL

Feb-March 2015: List developed to describe threat and identify population components

April 2015: expert review at first workshop and used as template for characterisation

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First expert workshop - 28 April and 1 May 2015

Expert panel:

- Mike Lonergan
University of Dundee, Scotland
- Jason Baker,
Pacific Islands Fisheries Science Center, NOAA, USA
- Mark Hindell
University of Tasmania, Australia
- David Hayman
Massey University

Advisors:

- Louise Chilvers
- Brittany Graham
- Chris Lalas
- Wendi Roe
- Ros Cole
- Martin Cryer
- Jim Fyfe
- Shaun McConkey
- Ed Abraham
- Darryl McKenzie
- Brent Beaven
- Jim Roberts
- Ian Doonan
- Richard Wells
- Simon Childerhouse
- Richard O'Driscoll
- Catherine Collins
- Paul Breen

Independent Chair: Andrew Penney

3.2 Threat characterisation

First expert workshop - 28 April and 1 May 2015

- For each potential threat identified, the panel were tasked with:
  - identifying one or more population parameter through which each threat is most likely to impact on the population (e.g. adult survival, pup production).
  - Recommending plausible bounds of the impact
  - Identifying the geographic range over which the threat is plausible.

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Large table of outcomes posted on AEWG and DOC CSP websites in early September

Description of Potentially Threatening Activities				Scale of impact								
Threat Class	**Threat**	**Description of threat**	**Population likely to affect**	**Units used**	**Estimated actual Impact**	**Shape of distribution**	**Lower bound of impact**	**Upper bound of impact**	**Justification / Confidence score around estimates**	**Periodicity of threat**	**Model or not?**	**Duration of impact if not annual**
Coastal development	Noise	Injury/mortality, indirect effect on pup, & compromised health	ML, SI		0				1b		No	
Coastal development	Habitat alterations & related issues (ex: pollution)	Displacement & compromised health	ML, SI		0				1b		No	
Disease	Klebsiella	Pup mortality	AI, others?	Pup mortality rate			6%	Highest (from the model) mortality rate from all causes of death	2a	Annual	Yes	N/A
Disease	Klebsiella	Adult mortality	AI, ML, others?	# of adults	1 in 15 yrs (in Otago - ML), none anywhere else (that we know)		0	2 in 15 years (ML)	2b	Annual	Yes	N/A
Disease	Klebsiella	Indirect effect on pup	AI, ML, others?	# of pups			0	1 in 30 years	1c	Annual	Yes	N/A
Disease	Hookworm	Compromised health	AI, others?	Pup mortality rate			0	13% of pup mortality in the first year	2a	Annual	Yes	N/A
Disease	Hookworm	Pup mortality	AI, others?	# of pups			2 pups per year (Enderby)	10 pups per year (Enderby)	2b	Annual	Yes	N/A
Disease	Wildlife vectors	Adult & pup mortality, & compromised health	ML, SI		0				1b		No	
Disease	TB	Adult mortality	ALL	# of adults			3 for AI (0 for ML)	1% of the adult population	2c	Annual	Yes	N/A
Disease	Novel agent	Pup mortality	ALL	# of pups				90% of the pups born at the site in question	2a	Decadal	Yes - Sensitivity	
Disease	Novel agent	Adult mortality	ALL	# of adults				70% of the adults at the site in question	2a	Decadal	Yes - Sensitivity	

Panel recommendations (high priority):

- *Initial model evaluations of threats should focus on using their upper bounds to evaluate whether significant effects are expected at this level. If not, then these insignificant threats can be excluded from further analyses. If yes, then further threat analysis should be based on an appropriate probability distribution of the significant threats between the proposed upper and lower bounds.*
- *Efforts should be made to better quantify strike rates in trawl fisheries, such as by use of cameras to detect entry of sea lions into nets.*

May-Jul 2015 : follow-up work with technical advisers to populate and refine some fields prior to second workshop and detailed modeling

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4. Analytical approach

a. Demographic assessment (model development)

b. Risk triage (prioritise threats)

c. Projections (assess scenarios)

- Review by expert panel at two stages
- Staged technical review by AEWG/CSP TWG

Methods

"SeaBird" modelling framework

- Cormack-Jolly-Seber (CJS) estimation of survival from mark-recapture (MR) observations at core. Allowed integrated assessment also using pup census or age-distribution estimates.
- Flexibility in specifying possible status categories, transitions between states, parameters to be estimated
- MPD (simple projections used for risk triage) with removal of upper bound of risk
- MCMC runs (more complex used for projections including uncertainty) with removal of best estimate

5. Results

1. Demographic modelling
2. Risk triage
3. Population projections with each risk removed separately

5.1 Results – Demographic assessment

- Breeding site relocations from Southeast Point to Sandy Bay – probable cause of different pup census trends
- Tag loss rate estimates similar to previous assessments
- Six consecutive years of low survival estimates (<0.90) at age 6+ from 2004 to 2009
- Improved pup survival since very weak cohorts 2005-2007
- Higher pup survival & pupping rate for Otago Peninsula population v Sandy Bay

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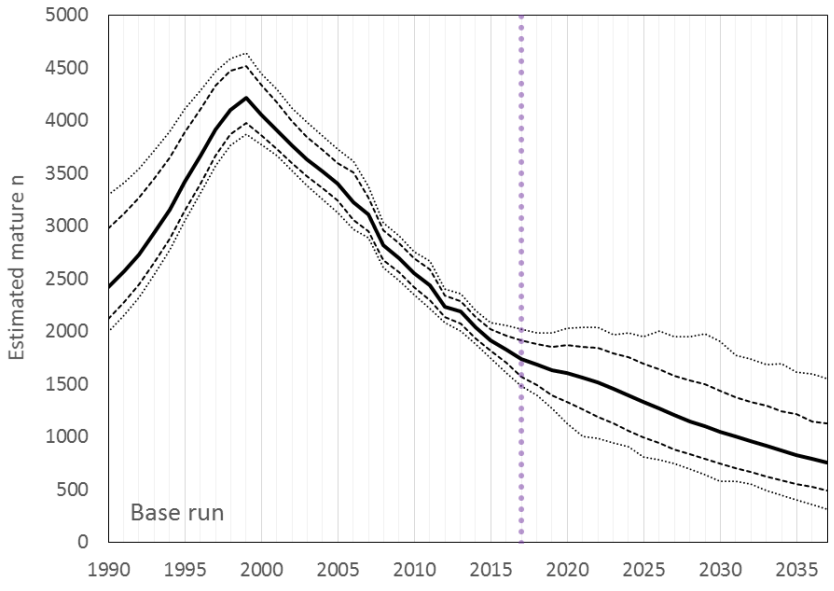
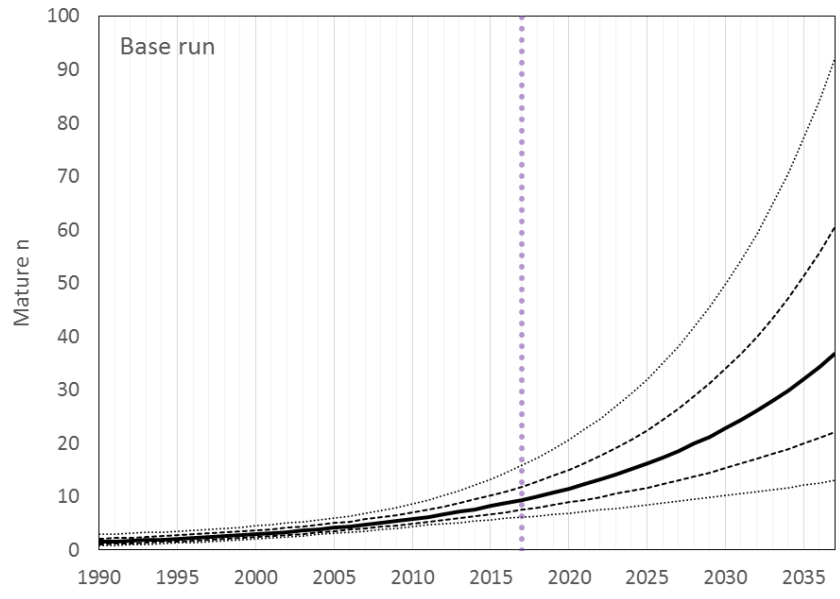
Model outputs

Auckland Islands projection



Otago Peninsula projection



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Auckland Island modelled threats

Threat Class	Threat	Description of threat	Ages
Disease	Klebsiella	Pup mortality	0
Disease	Hookworm	Pup mortality	0
Disease	TB	Adult mortality	5+
Disease	TB	Indirect effect on pup	0
Disease	Novel agent	Pup mortality	0
Disease	Novel agent	Adult mortality	5+
Environmental change	Pups drowning in holes	Pup mortality	0
Trophic effects	Prey availability	Direct & indirect effects of nutritional stress, competition for prey, & changes in prey and predator abundance	rate-specific
Fishing	Commercial trawl	estimated_interactions_mean	3+
Fishing	Commercial trawl	20%	3+
Fishing	Commercial trawl	35%	3+
Fishing	Commercial trawl	82%	3+
Fishing	Commercial trawl	estimated_captures_mean	3+
Fishing	Commercial trawl	estimated_interactions_mean (pup)	0
Fishing	Commercial trawl	20% (pup)	0
Fishing	Commercial trawl	35% (pup)	0
Fishing	Commercial trawl	82% (pup)	0
Fishing	Commercial trawl	estimated_captures_mean (pup)	0
Natural behaviour	Male NZSL aggression	Female mortality	5+
Natural behaviour	Male NZSL aggression	Indirect effect on pup	0
Natural behaviour	Male NZSL aggression	Pup mortality	0
Pollution	Plastics - entanglement	Adult mortality	5+
Pollution	Plastics - entanglement	Indirect effect on pup	0
Pollution	Plastics - entanglement	Juvenile mortality	1 to 4
Predation	Sharks	Injury	1+
Predation	Sharks	Indirect effect of shark bite injury on pup	0

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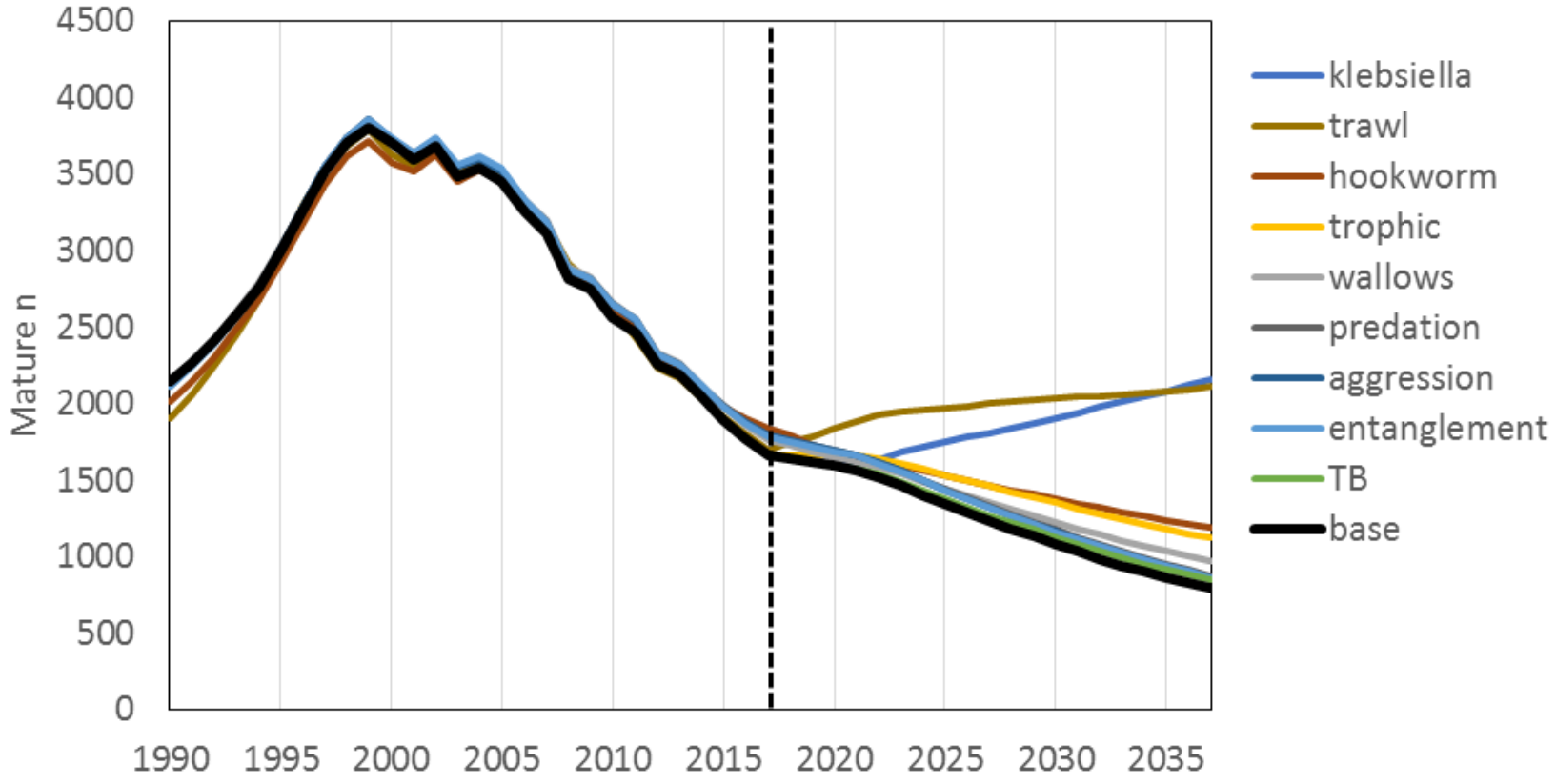
5.2 Results – risk triage – Auckland Islands

Population projections if 'worst case' (potentially unrealistic) scenario of each threat was completely mitigated/removed

NB: some worst case scenarios were considered extreme and highly unrealistic by the expert workshop and projections of those should be considered with care



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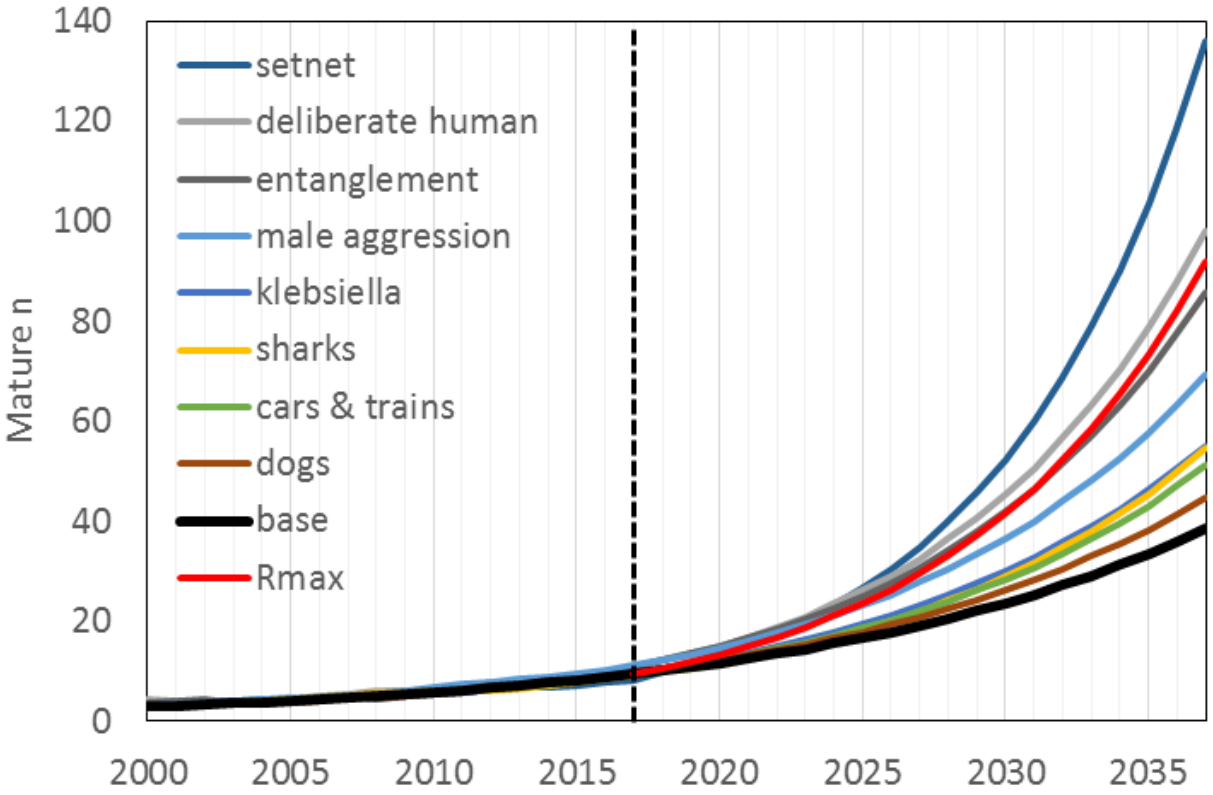
Results – risk triage - Otago

Population projections if 'worst case' (potentially unrealistic) scenario of each threat was completely mitigated/removed

NB: some worst case scenarios were considered extreme and highly unrealistic by the expert workshop and projections of those should be considered with care



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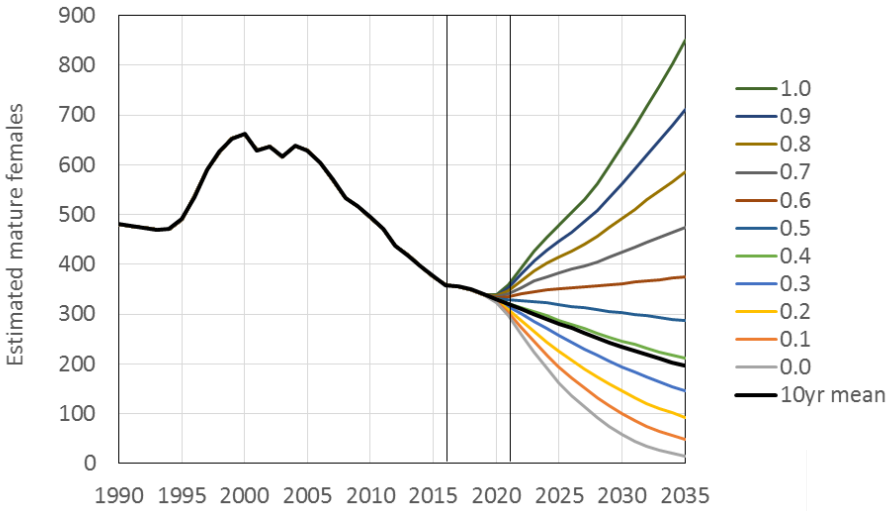
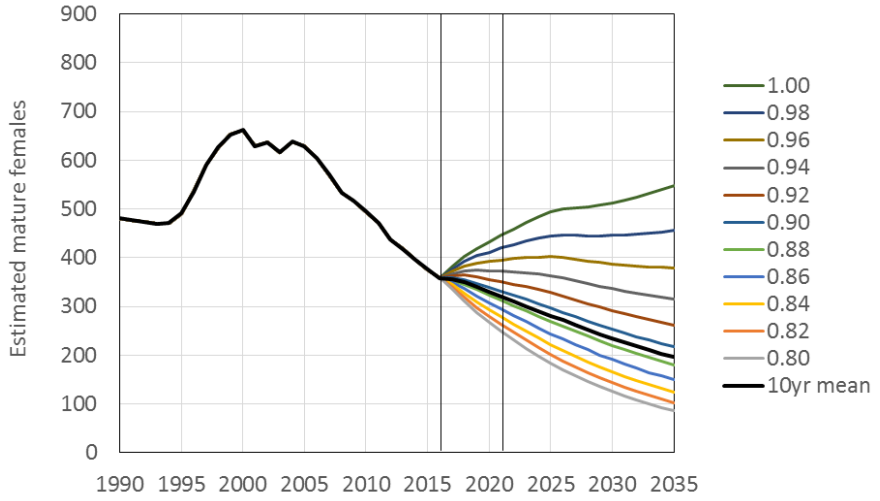
Pup survival (to age 1)



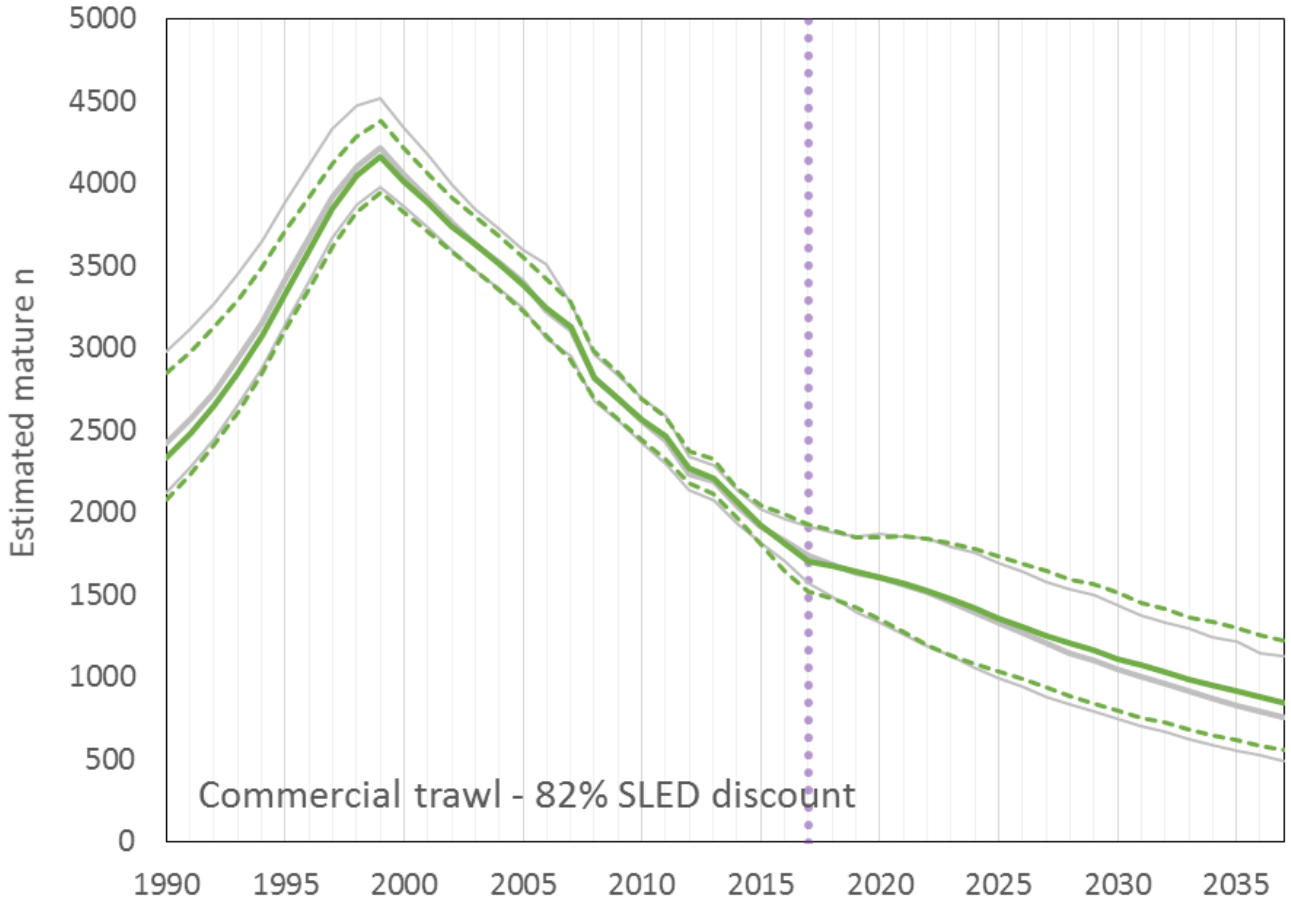
The effect of changing identified demographic parameters from the model for the Auckland Islands.

Adult survival (age 6-14)



Draft MCMC projections - Auckland Islands Commercial trawl captures & 82% discount SLED

Full population projections of impacts of full mitigation/removal of each threat based on best estimates of mortalities

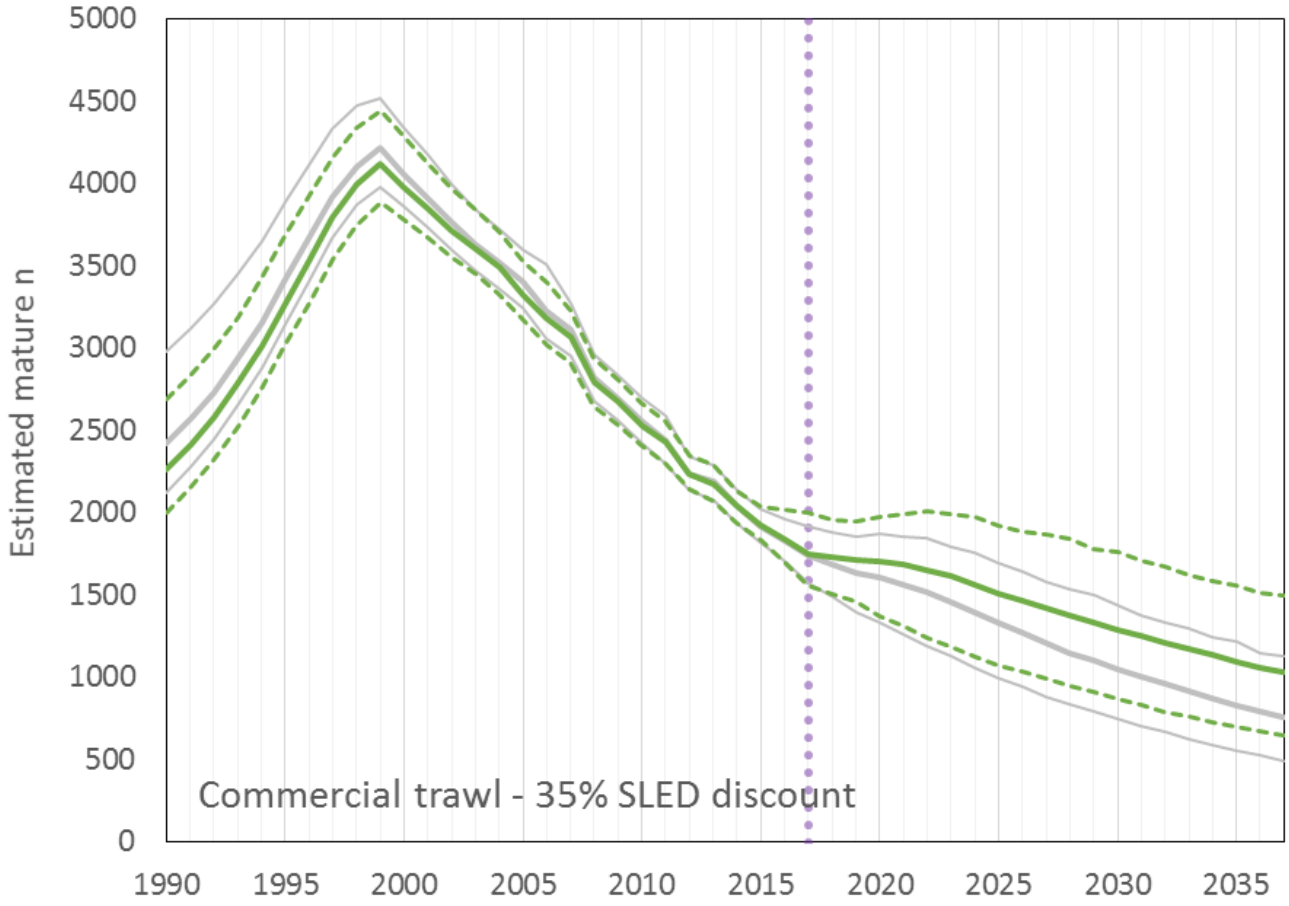


λ_{2037} = 0.96 (0.89–1.02)
N_{2037} = 49% (33–71)

λ_{2037} = 0.96 (0.89–1.02)
N_{2037} = 43% (29–64)

Draft MCMC projections - Auckland Islands Commercial trawl captures & 35% discount SLED

Full population projections of impacts of full mitigation/removal of each threat based on best estimates of mortalities



λ_{2037} = 0.97 (0.90–1.03)

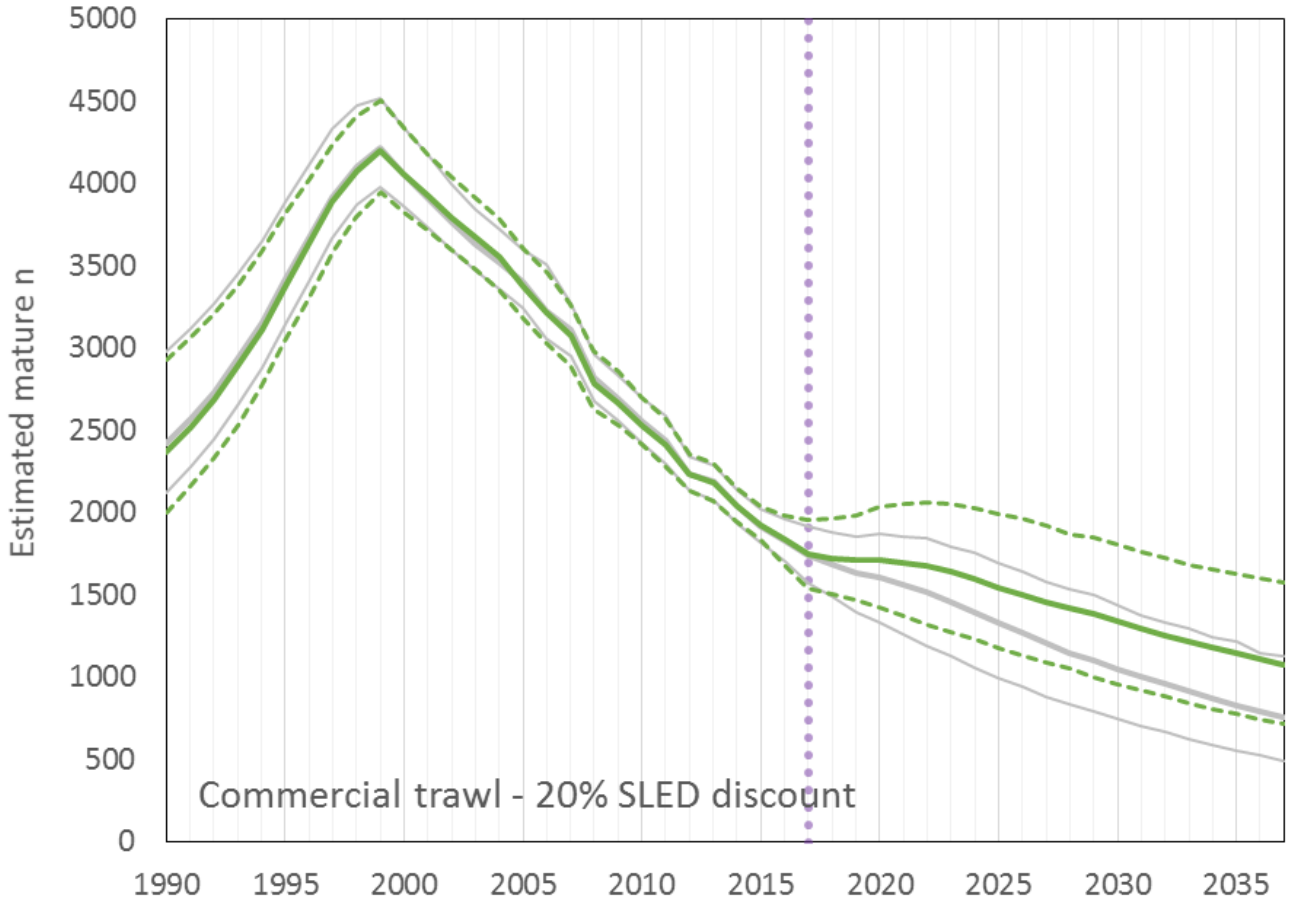
N_{2037} = 58% (38–85)

λ_{2037} = 0.96 (0.89–1.02)

N_{2037} = 43% (29–64)

Draft MCMC projections - Auckland Islands Commercial trawl captures & 20% discount SLED

Full population projections of impacts of full mitigation/removal of each threat based on best estimates of mortalities



λ_{2037} = 0.97 (0.90–1.03)

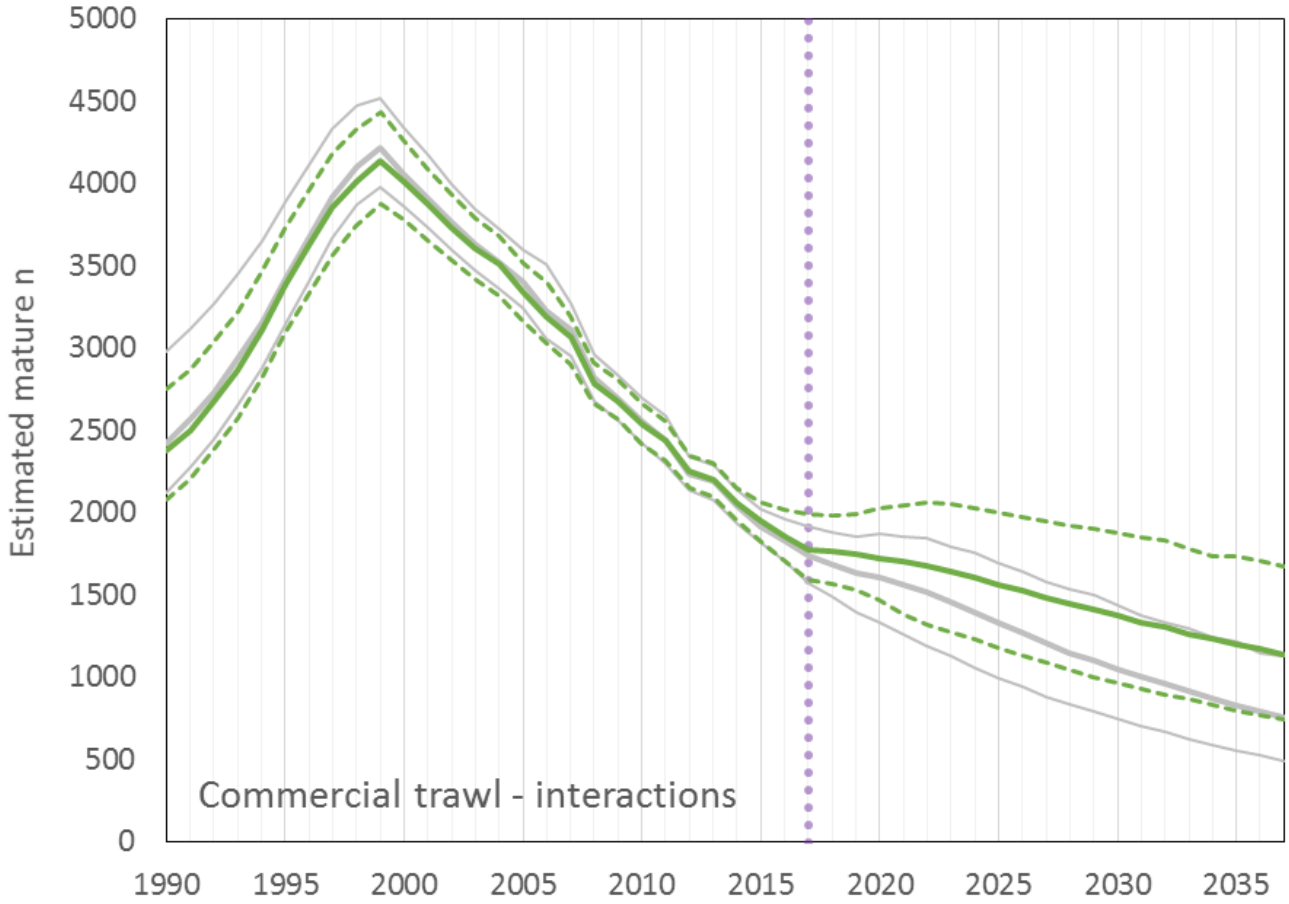
N_{2037} = 62% (43–87)

λ_{2037} = 0.96 (0.89–1.02)

N_{2037} = 43% (29–64)

Draft MCMC projections - Auckland Islands Commercial trawl interactions (0% SLED discount)

Full population projections of impacts of full mitigation/removal of each threat based on best estimates of mortalities

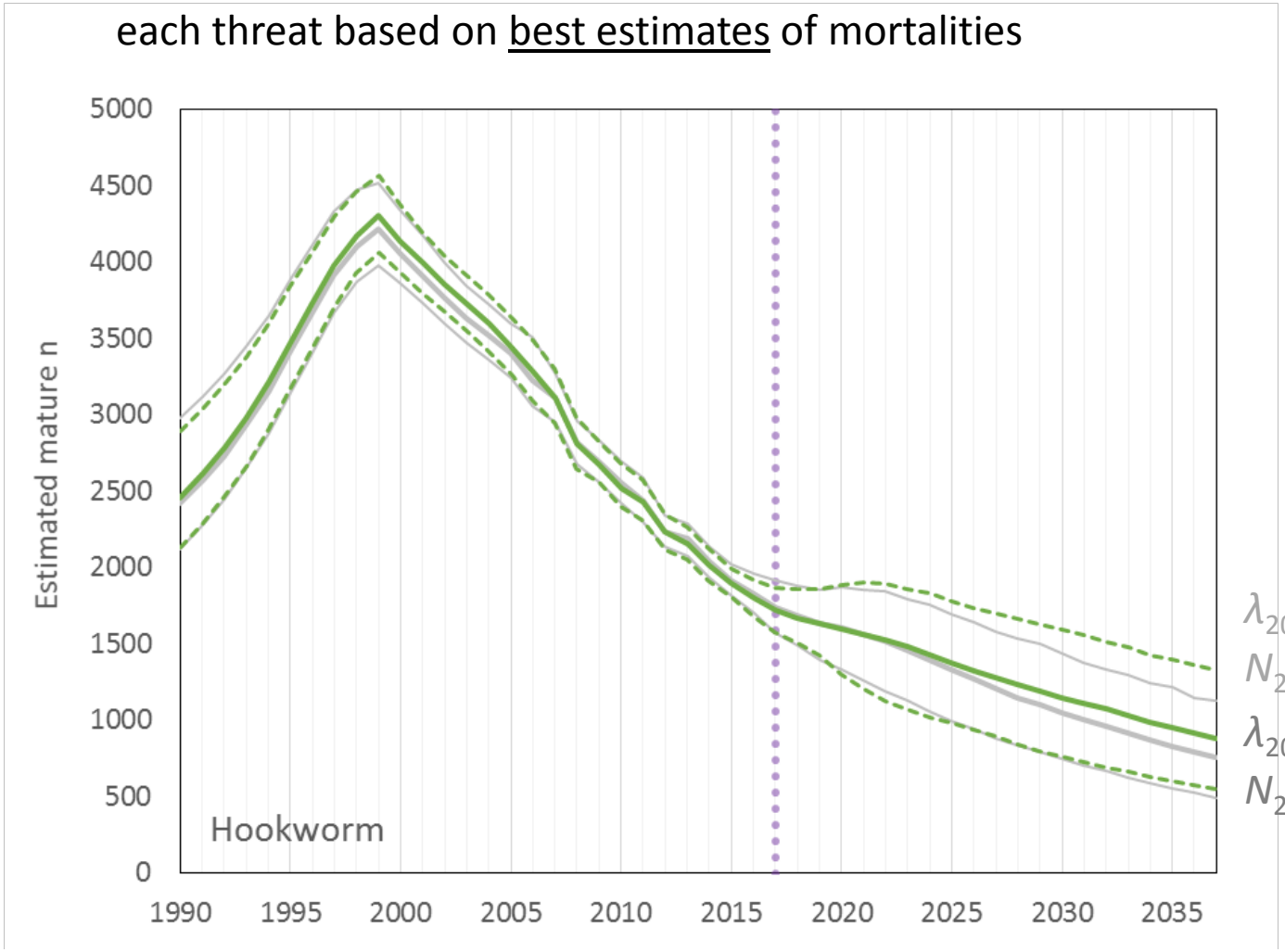


λ_{2037} = 0.98 (0.91–1.03)
N_{2037} = 65% (40–94)

λ_{2037} = 0.96 (0.89–1.02)
N_{2037} = 43% (29–64)

Draft MCMC projections - Auckland Islands Hookworm mortality of pups

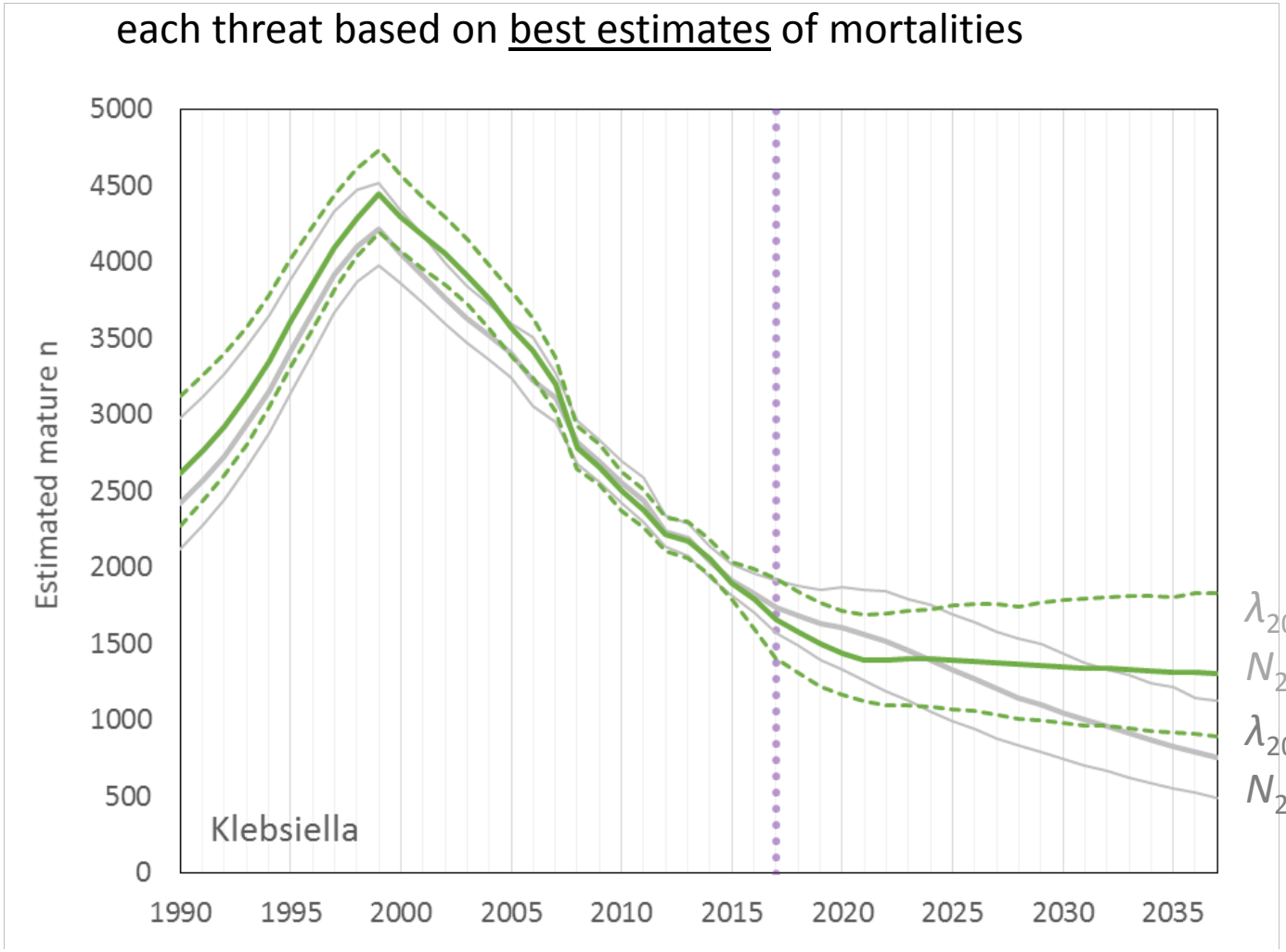
Full population projections of impacts of full mitigation/removal of each threat based on <u>best estimates</u> of mortalities



λ_{2037} = 0.97 (0.90–1.02)
N_{2037} = 51% (33–76)
λ_{2037} = 0.96 (0.89–1.02)
N_{2037} = 43% (29–64)

Draft MCMC projections - Auckland Islands *Klebsiella* mortality of pups

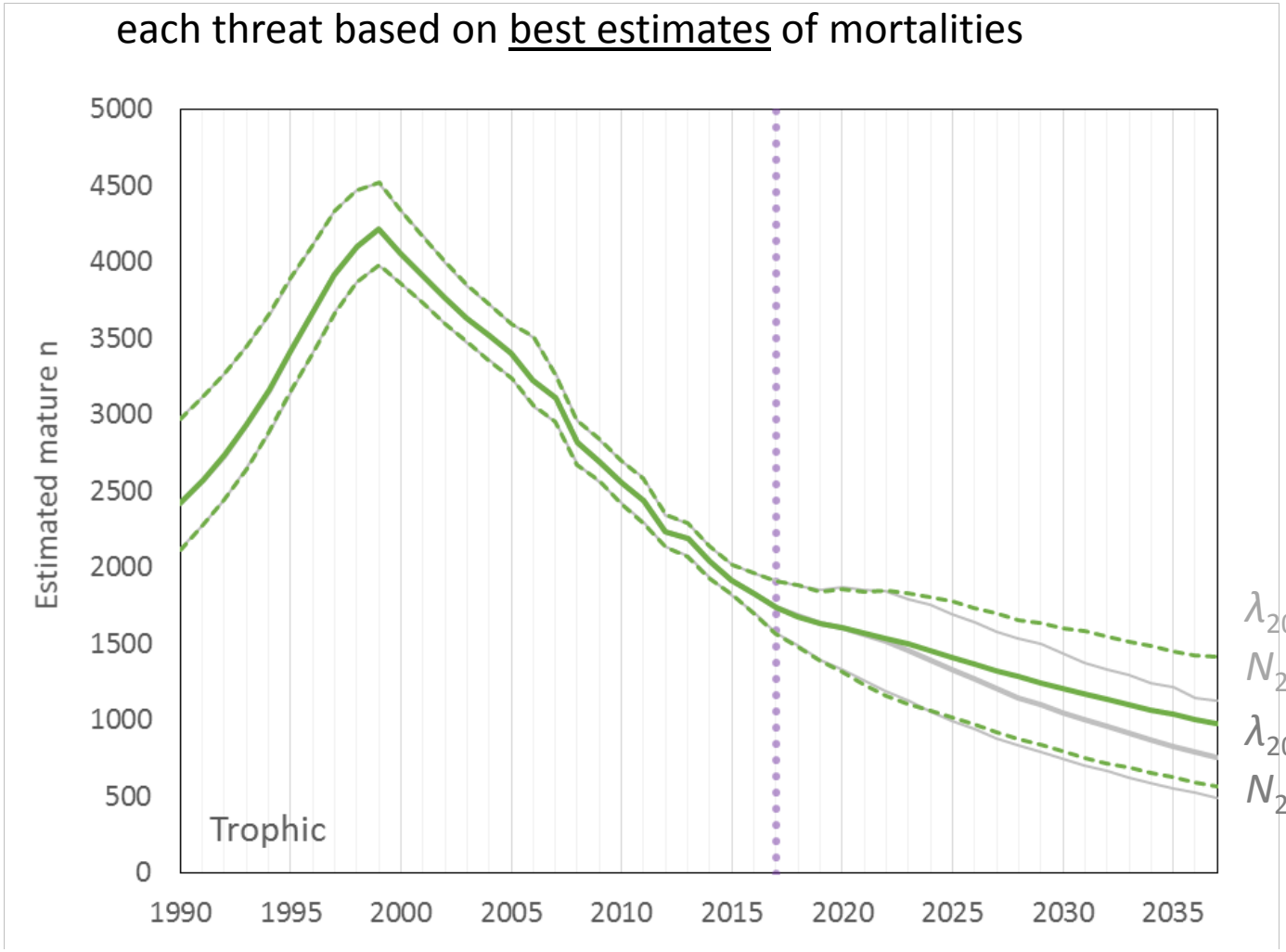
Full population projections of impacts of full mitigation/removal of each threat based on best estimates of mortalities



λ_{2037} = 1.00 (0.91–1.07)
N_{2037} = 79% (58–106)
λ_{2037} = 0.96 (0.89–1.02)
N_{2037} = 43% (29–64)

Draft MCMC projections - Auckland Islands Trophic (prey-related)

Full population projections of impacts of full mitigation/removal of each threat based on best estimates of mortalities



λ_{2037} = 0.97 (0.90–1.03)

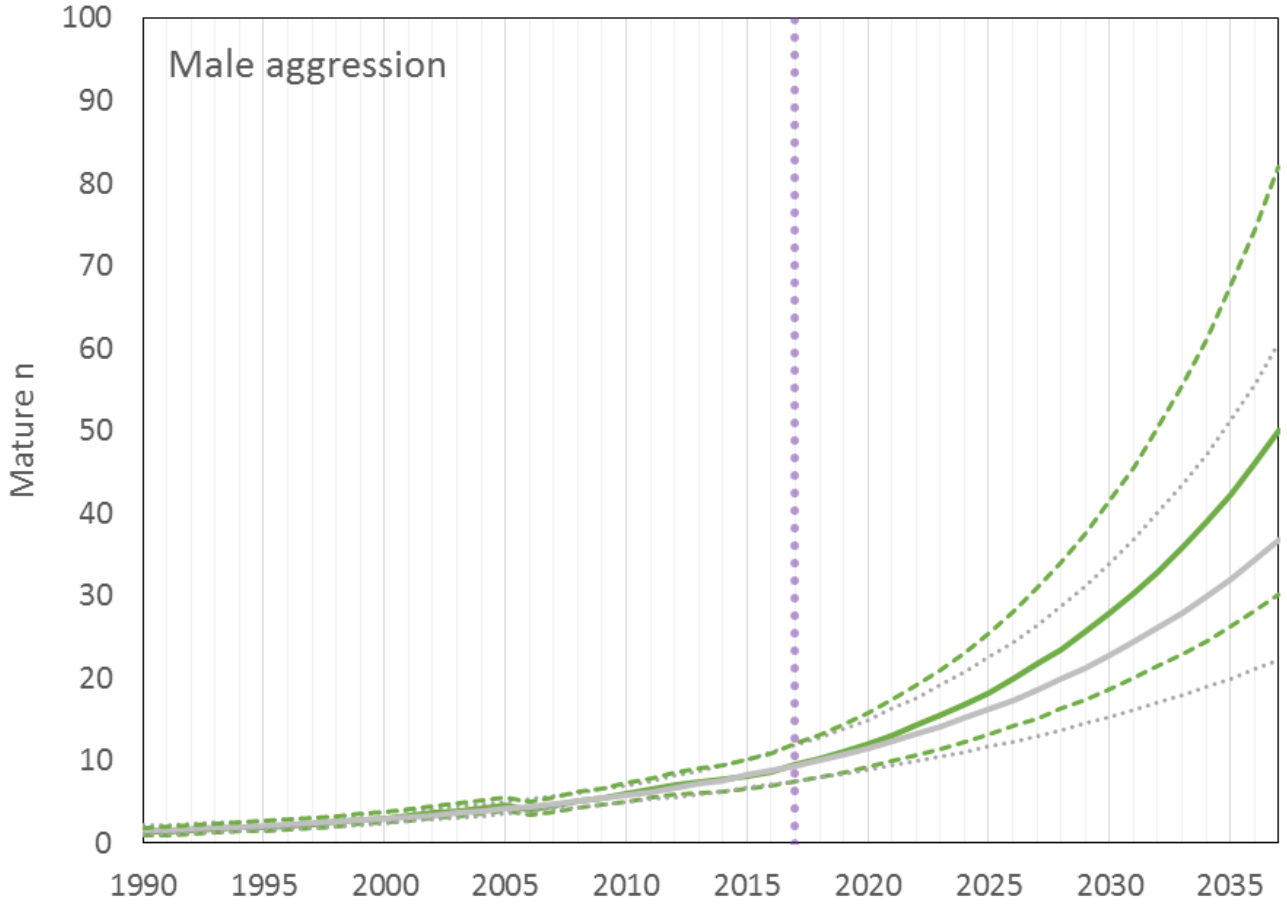
N_{2037} = 56% (33–81)

λ_{2037} = 0.96 (0.89–1.02)

N_{2037} = 43% (29–64)

Draft MCMC projections – Otago peninsula Male aggression

Full population projections of impacts of full mitigation/removal of each threat based on <u>best estimates</u> of mortalities

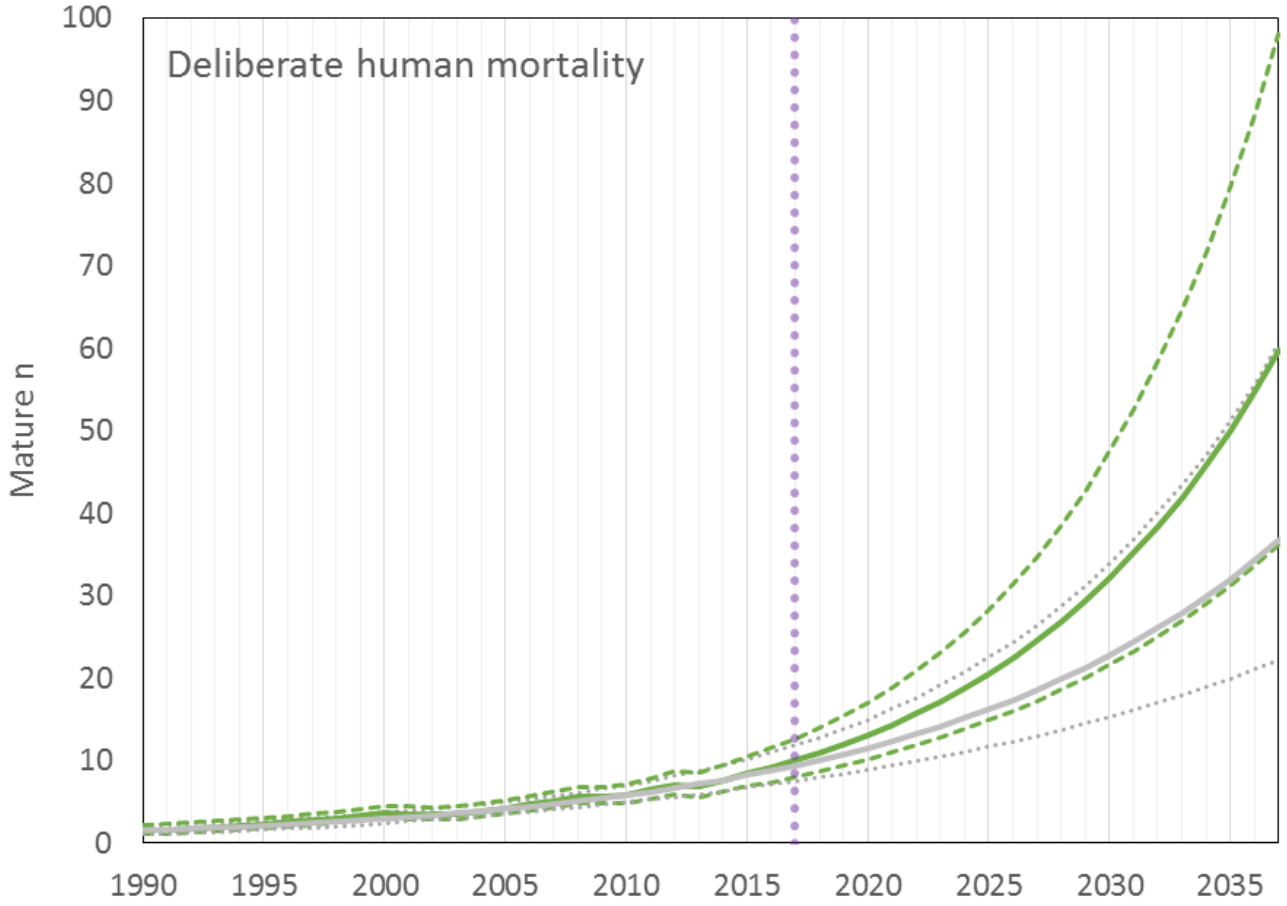


λ_{2037} = 1.09 (1.07–1.10)
N_{2037} = 528% (381–725)

λ_{2037} = 1.07 (1.05–1.09)
N_{2037} = 388% (281–534)

Draft MCMC projections – Otago peninsula
Deliberate human mortality

Full population projections of impacts of full mitigation/removal of each threat based on <u>best estimates</u> of mortalities

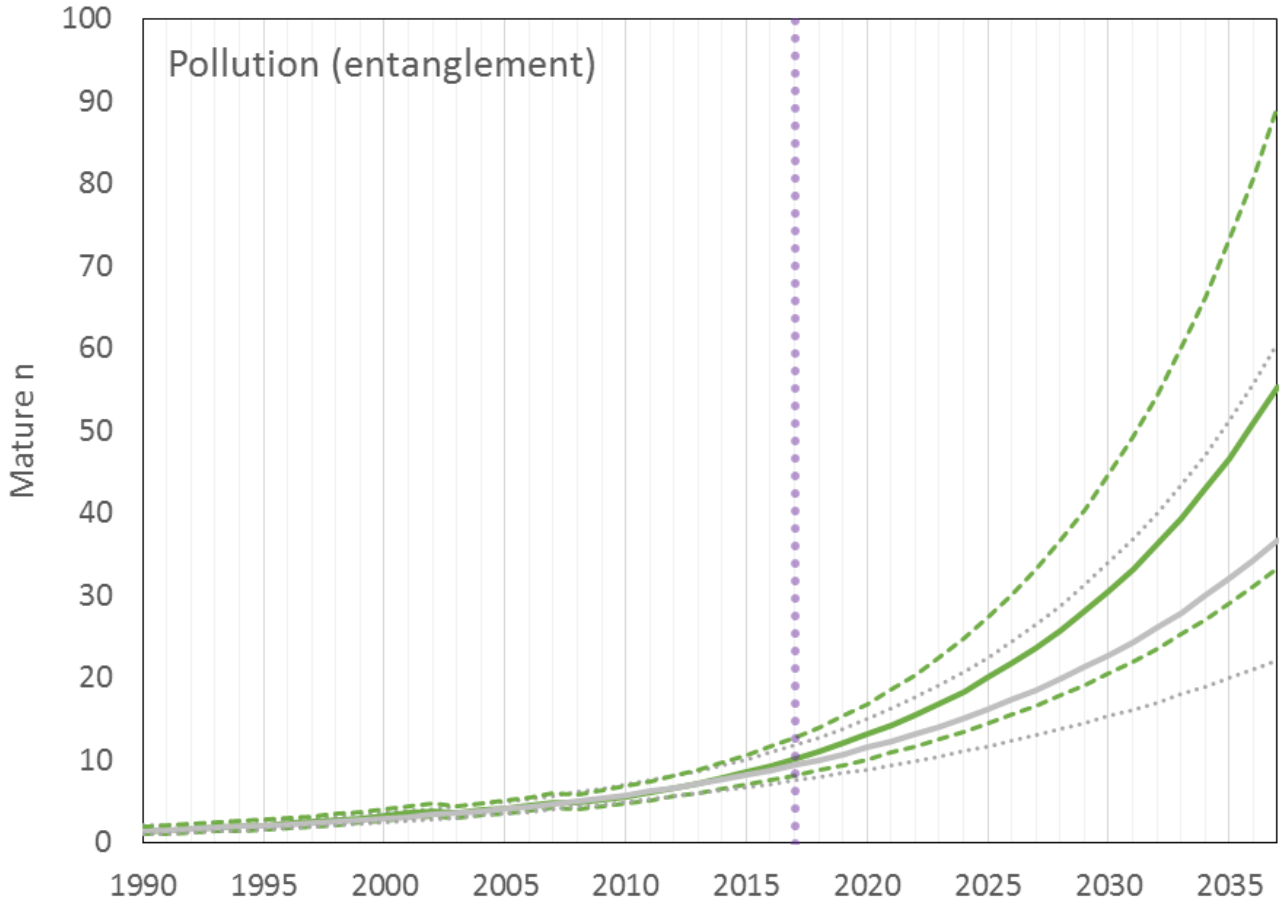


λ_{2037} = 1.09 (1.07–1.11)
N_{2037} = 599% (426–829)

λ_{2037} = 1.07 (1.05–1.09)
N_{2037} = 388% (281–534)

Draft MCMC projections - Otago Peninsula Pollution (entanglement)

Full population projections of impacts of full mitigation/removal of each threat based on best estimates of mortalities

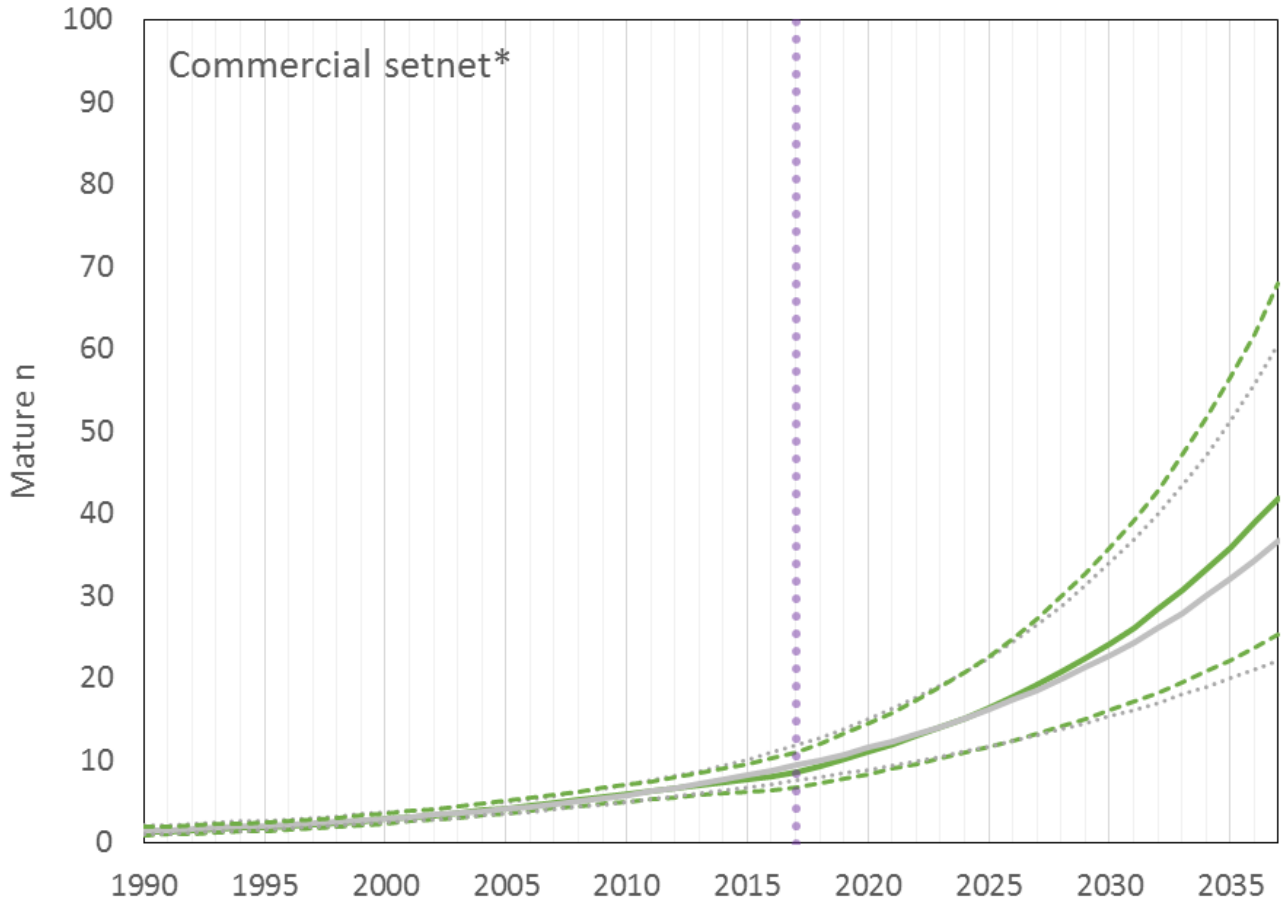


λ_{2037} = 1.09 (1.07–1.11)
N_{2037} = 542% (387–749)

λ_{2037} = 1.07 (1.05–1.09)
N_{2037} = 388% (281–534)

Draft MCMC projections - Otago Peninsula Commercial set net (*did not include injury-related mortality)

Full population projections of impacts of full mitigation/removal of each threat based on best estimates of mortalities



λ_{2037} = 1.08 (1.06–1.10)
N_{2037} = 486% (355–659)

λ_{2037} = 1.07 (1.05–1.09)
N_{2037} = 388% (281–534)

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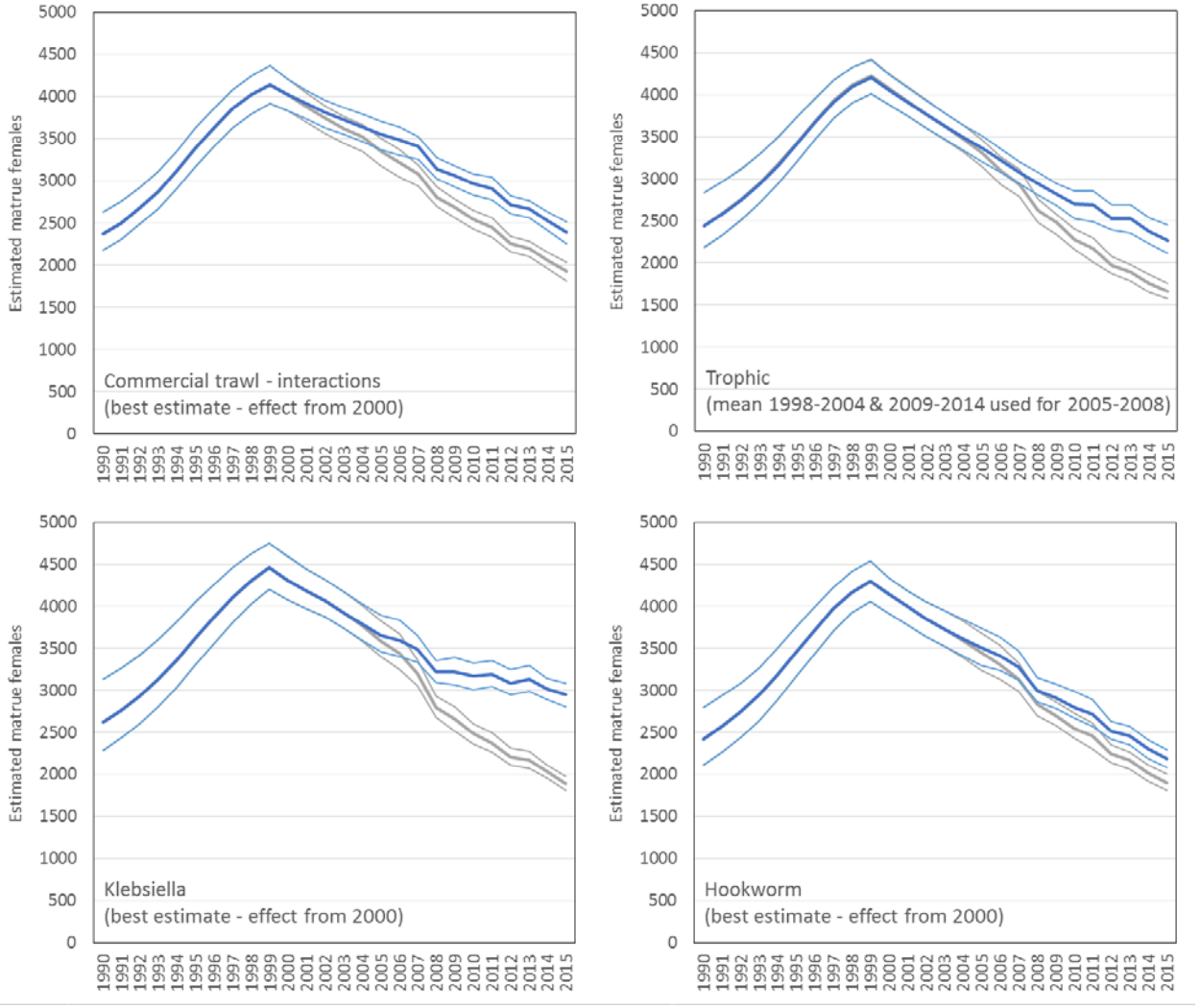
Population trajectory with effects of each threat removed from the year 2000 – Auckland Islands (Draft)



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Review of results by expert panel

Second expert workshop – 1-3 September 2015

Expert panel:

- Mike Lonergan
University of Dundee, Scotland
- Jason Baker,
Pacific Islands Fisheries Science Center, NOAA, USA
- Mark Hindell
University of Tasmania, Australia
- David Hayman
Massey University

Independent Chair: Neil Gilbert

Advisors:

- Ed Abraham
- Darryl McKenzie
- Simon Childerhouse
- Paul Breen

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Key recommendations/conclusions from Expert Panel workshops

- The expert panel made some minor technical recommendations to fine-tune the NIWA demographic modelling, but overall considered the approach to be robust and appropriate to underpin the development of the TMP. Although concern was expressed at the length of time required to run it.
- The panel considered the Otago model provided largely similar outputs to NIWA's model, but was too simple to accurately reflect the complexities of the Auckland Island population dynamics
- The Panel noted that the broadly similar outputs of the two models was comforting, but considered the NIWA model more appropriate to deal with the complex data available.

NB: Subsequent work has been done by NIWA, creating better mixing of the 15+ age group model and developing an alternative 8+ age class model. Both are significantly faster and perform better than the original