

# Autopsy of pinnipeds incidentally caught in commercial fisheries, 2002/03 and 2003/04

Pádraig J. Duignan and Gareth W. Jones

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## ABSTRACT

Morphological characteristics, estimated age, gender, reproductive status, stomach contents, and cause of death were determined for 38 New Zealand sea lions (*Phocarcos bookeri*), four New Zealand fur seals (*Arctocephalus forsteri*) and one southern elephant seal (*Mirounga leonina*) killed incidentally in fishing operations in the 2002/03 and 2003/04 recording periods. Stomach contents of sea lions consisted of mixed vertebrate and invertebrate prey, with squid predominating. Female sea lions ranged in age from 2 to 12 years while males ranged from 5 to 14 years. Three fur seals were mature animals and the elephant seal was a juvenile (2 years old). One female sea lion and one fur seal could not be aged.

All animals were retrieved from trawl nets and had lesions consistent with death from asphyxiation. Severe lesions sustained by 23 sea lions would probably have compromised survival had they not derowned in the nets. The other sea lions had moderate or mild trauma that probably would not have compromised survival had they escaped the net. All the fur seals and the southern elephant seal sustained severe trauma and/or had aspirated regurgitate.

Keywords: sea lions, *Phocarcos bookeri*, fur seals, *Arctocephalus forsteri*, southern elephant seal, *Mirounga leonina*, autopsy, stomach contents, estimated age, reproduction, pathology, New Zealand

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# 1. Introduction

The New Zealand or Hooker's sea lion (*Phocarctos hookeri*) is New Zealand's only endemic pinniped (Wilson 1979). However, it is listed as threatened (Hitchmough 2007) because of its limited modern distribution, restriction to three principal breeding sites in the subantarctic (Auckland and Campbell Islands), and limited population growth (Childerhouse & Gales 1998), despite protection. The historic range of the sea lion included the main islands in the New Zealand archipelago and also the Chatham Islands (cf. Childerhouse & Gales 1998). At present the species inhabits a range between Cook Strait, Campbell Island, Macquarie Island, and the southwest of the South Island, centred on the Auckland Islands where major rookeries are located (Cawthorn et al. 1985; Crawley 1990).

The sea lion was exploited commercially in the early 1800s and had almost vanished by 1830 (Baker 1990). Commercial sealing ended in 1894, but the impact of the kills on the sea lion population is unknown. The total population of the New Zealand sea lion was estimated to be between 11 600 and 15 200 during the 1995/96 breeding season (Gales & Fletcher 1999). The current data show that pup production at Sandy Bay, Enderby Island, has been stable for the past 30 years, and that no major changes in pup production are apparent at Dundas Island and Figure of Eight (the other rookeries in the Auckland Islands). For Campbell Island, results of a 2003 census of pup production show that it equates to 13% of the total pup production (Childerhouse et al. 2005). Over the past decade, some pups have been born on Stewart Island and on the Otago coast, suggesting limited recolonisation of the historic range (I.S. Wilkinson, pers. comm.).

Among the threats to the species listed in the threatened species recovery plan (Gales 1995) are causes of natural mortality (predation, disease, and environmental factors) and human impact (competition for resources, entanglement, introduced animals, introduced diseases or toxins). Relatively little is known about the impact of predators, but shark bite wounds are frequently observed, and cannibalism of pups by adult males was recently reported (Wilkinson et al. 2000). Disease may also have a significant impact, as demonstrated by a mass mortality event in 1998 which was apparently caused by a previously unknown *Campylobacter* sp. bacterium and perhaps triggered by unusual environmental conditions (Baker 1999; Stratton et al. 2001). Further epidemics among pups during the 2001/02 and 2002/03 breeding seasons caused by the bacterium *Klebsiella pneumoniae* emphasise the role of infectious diseases in sea lion population dynamics (Duignan & Wilkinson 2003; Wilkinson et al. 2004). The mass mortality investigations have also identified parasitic enteritis as an as-yet unquantified cause of neonatal mortality (Duignan in Baker 1999).

Fishing is the most significant human threat to the population (Gales 1995). The southern trawl fishery for squid (SQUÓT) operates on the southern and eastern edges of the Snares shelf and on the Auckland Islands shelf at depths of about 150–250 m. The proximity of the fishing grounds around the edge of the Auckland Islands shelf to New Zealand sea lion foraging areas has resulted in incidental catches (Baird 1994, 1995). To alleviate the impact on sea lions, the Minister of Fisheries established a 12 n.m. fishing exclusion zone around the Auckland Islands in 1982. This zone was

officially confirmed as a marine mammal sanctuary under the Marine Mammal Protection Act 1978 in 1993, and was gazetted as a fully protected Marine Reserve under the Marine Reserves Act 1971 in 2003. Government observers have been placed on some vessels to record the incidental catch of marine mammals since 1988 (Baird 1994, 1995).

The New Zealand fur seal (*Arctocephalus forsteri*) is found around the rocky coast of New Zealand, the subantarctic islands, and along the southern and eastern coasts of Australia (Crawley 1990). Major breeding colonies occur in southern New Zealand and on the subantarctic islands (Crawley & Warneke 1979; Bonner 1981; Wilson 1981). Extensive hunting of fur seals by both Polynesians and Europeans resulted in dramatic population decline and even local extinction in some areas (Falla 1962; Taylor et al. 1995). Fur seals became fully protected by New Zealand in 1894 (Sorensen 1969), and since then protection has rarely been lifted, allowing numbers to increase (Falla 1962). There are no current population estimates for the entire fur seal population; the most recent, of between 50 000 and 100 000 animals, being made over 10 years ago (Taylor 1990; Baird 1994, 1995). The fur seal population appears more susceptible than sea lions to fluctuations in prey-availability caused by El Niño/Southern Oscillation cycles (H. Best, DOC, pers. comm.).

Although the New Zealand fur seal is not listed as threatened (Hitchmough 2007), there are relatively few data available on vital life history parameters, including current population size, age at first reproduction, pupping interval, maximum age, annual survival rate, mortality rates, and causes of natural mortality. Fur seals are sympatric with sea lions on the Auckland Islands, but were not impacted by the 1998 mortality event, although the disease syndrome described for sea lions and the causative agent are present in fur seals (Duignan et al. 1999; Stratton et al. 2001). There is no evidence that they have been impacted by *Klebsiella pneumoniae*, but there have not been any directed studies to look for this pathogen in these animals. Thus, further research into causes of natural mortality is required before the impact of disease on the population can be determined.

The impact of human interactions may be more easily quantified. In the last 20 years there has been a dramatic expansion of middle-depth and deep-water trawl fisheries in New Zealand. Incidental catches of fur seals occur throughout much of New Zealand's 200 n.m. Economic Exclusion Zone. However, catches are most frequent in the middle-depth trawl fisheries off the west coast of the South Island, particularly in fisheries for hoki (*Macruronus novaezelandiae*), southern blue whiting (*Micromesistius australis*) on the Bounty Platform, and arrow squid (*Nototodarus sloanii*) Auckland Islands shelf, Snares Islands shelf. The number of seals caught annually is estimated from observers' reports, but the impact of catches cannot currently be estimated because of lack of population data.

The objective of this study was to record and interpret data on pinnipeds caught incidentally in fisheries operations and submitted for autopsy. These data included species, sex, size, body condition, age, reproductive status, stomach contents, and cause of death. This report details the findings pertinent to this objective and includes data on 38 New Zealand sea lions, four New Zealand fur seals, and one southern elephant seal (*Mirounga leonina*).

## 2. Methods

### 2.1 NECROPSY PROTOCOL

Carcasses were delivered to Massey University, frozen and wrapped in clear plastic bags and woven nylon sacks. Most animals were identified by Conservation Services Programme (CSP) observer data sheets attached to the pectoral flipper with an orange plastic CSP tag. Six sea lions did not have CSP tags, one had no catch data, and three had incomplete data recorded. On receipt, the seals were unwrapped and stored at  $-20^{\circ}\text{C}$  until necropsy.

The species and sex was recorded based on external morphology (Crawley 1990). A unique code and pathology number was assigned to each animal as follows:

SB04-01Ph: SB—seal bycatch, 04—year, 01—animal number, and Ph—abbreviation of species scientific name (in this case, *Phocartos hookeri*).

In the Appendix tables the animals are identified by both of these codes and the CSP code, where known. Pathological examination and sampling were conducted according to a standard protocol. The procedure included recording the body weight (kg), external measurements (m), and examination of the carcass for external lesions such as trauma, hair loss, scars, etc. Both external and internal gross lesions of interest were photographed. On opening of the carcass along the ventral midline, the blubber depth (mm) was recorded over the mid-sternum. Blubber samples were taken from the dorsal aspect of the left pelvis for fatty acid analysis of diet, and stored at  $-80^{\circ}\text{C}$  for further research. The internal organs were examined systematically for lesions and tissues sampled for histopathology, virology, parasitology, bacteriology (faeces routinely and tissues where appropriate), toxicology (blubber), and genetics (skin). The stomach was removed, tied off, and either examined immediately or frozen at  $-20^{\circ}\text{C}$  until the contents could be examined at a later date. The reproductive organs were carefully dissected and stored in 10% buffered formalin. The mandible was dissected out, tagged, and mascerated to remove the teeth, which were prepared for age determination.

### 2.2 PATHOLOGY

Assessment of survival prognosis was required to evaluate the Sea Lion Exclusion Device (SLED) which is being tested in the squid fishery. During the 2000/01 fishing season, decision criteria for survival were based only on video evidence of animals in cover nets. It was felt that autopsies would not uncover differences in pathology between those animals ejected and those not ejected. When autopsies were conducted it became clear that there were differences in the extent of trauma between the two groups, and in 2001, P.J. Duignan and I.S. Wilkinson revised the decision criteria to incorporate autopsy data for the 2001/02 season.

Gross lesions consistent with acute trauma were classified on criteria (Wilkinson 2001) as follows:

- Presence/absence of regurgitate in airways



- Presence/absence of cranial trauma
- Extent of blunt trauma

Trauma is classified as **mild** when limited to the abdomen; **moderate** when limited to the thorax and abdomen unless it is extensive and involves haemorrhage from vital organs such as liver or kidney or perforation of the lungs, in which case it is severe; and **severe** when lesions involve the head, neck, thorax, and abdomen. In the view of the pathologist, the survival prognosis of animals suffering severe or moderate trauma would be poor. Likewise, regurgitate aspirated into the airways would indicate a poor prognosis if an animal were to be released after capture. Prior to the 2000/01 season, pathology findings were not included in the terms of the bycatch autopsy contracts and, therefore, the extent and severity of trauma was not recorded in as much detail as it has been since that season. Thus, it will not be possible to classify the severity of trauma in animals that died prior to 1999 in a manner that is consistent with the methodology adopted and applied for the 2000/01 and subsequent seasons.

### 2.3 STOMACH CONTENTS

The stomachs were weighed (kg) and opened using scissors, and all material was washed into a 1 mm sieve. The stomach was then re-weighed to allow the weight of its contents to be determined. Large, relatively undigested material was removed at this stage. Smaller, more digested material was gradually sorted using a black-bottomed tray. Otoliths are clearly visible against this background, and as they are denser than most of the other material, they sink to the bottom of the tray. Squid beaks and other relevant food material were also collected. Lesions in the gastric mucosa were described and counted, and examples were photographed. Otoliths and squid beaks were stored in 70% alcohol for more detailed analysis of diet at or immediately before the time of death.

### 2.4 AGE DETERMINATION

The mandibles were macerated by being suspended in warm (20°C) water heated by an aquarium heater and agitated by air bubbling from an aquarium pump and airstone. After several days submersion, the canine teeth were removed manually and cleaned. The teeth were weighed (Mettler PM 4800 Delta Range) and the length, depth and width measured using Vernier calipers.

The canine teeth were then placed in sockets drilled into wooden blocks and mounted in place using Selley's Multipurpose Polymer Repair System (Selley's Chemical Company Ltd, Auckland). The teeth were then sectioned longitudinally by placing the blocks in a clamp unit on a movable saw bench. Using a Strues Disoplan T.S. diamond saw (Strues, Copenhagen, Denmark) the teeth were sectioned longitudinally through the pulp cavity from root to crown. The cut surface of each tooth was polished, using graded silicone carbide grit (size grade 200-600, Alanda Engineering, Palmerston North). This was to erase all saw lines. Polished half teeth were etched for 22 hours in a solution of 5% formic acid and 95% formalin (10%) (Stirling 1969). The teeth were neutralised by soaking for 4 hours in an ammonia solution (200:1 0.88% NH<sub>4</sub> in 75 mL dH<sub>2</sub>O). This was followed by rinsing in running tap water for 4 hours and air-drying.

The cut surfaces were then hand-rubbed with graphite paper and graphite powder. To read the etched surface, reflected light was projected across the surface, highlighting light and dark bands, otherwise known as growth layer groups (GLGs). A pair of dark and light bands was interpreted as one year's growth (Stirling 1969). Reading was facilitated by wetting the surface of the cut section and by using a 10× magnifying loop.

The post-canine teeth were processed using a method adapted from Stewart et al. (1996). Briefly, the teeth were decalcified in 5% nitric acid for 24 hours, rinsed in distilled water and trimmed to expose the plane of the section. Decalcification continued for 48–65 hours in a solution of 10 parts formic acid to 90 parts 10% formalin; this was followed by rinsing for several hours in water. The teeth were embedded in O.C.T. (Tissue-Tek®) embedding compound, frozen, and sectioned on a Reichert-Jung Cryocut 1800 cryostat at approximately –20°C, to produce 12-µm-thick longitudinal sections from the centre of the tooth. Sections were floated on slightly alkaline water (pH 8.5) for several minutes, mounted on 60% PVA-coated glass slides and air-dried. The slides were stained for 4–10 minutes in a filtered 0.032% aqueous solution of toluidine blue made with slightly alkaline water (pH 8.5). They were moistened with xylene and mounted under a glass cover slip using DPX mounting medium. The slides were examined using a compound microscope at 40–100 × magnification. Light and dark bands were seen, which corresponded to incremental growth layers deposited during the year. Each pair of light and dark bands was interpreted as equivalent to 1 year's growth (Perrin & Myrick 1980). Two observers read the teeth without knowing which animals were tagged as pups.

## 2.5 REPRODUCTIVE STATUS

### Females

The reproductive tracts were dissected out and examined grossly. The uterine horns were opened and examined for signs of pregnancy. The length, width and diameter of both ovaries were measured (mm) using Vernier calipers, and the ovaries were weighed (g) using a Mettler PM 4800 Delta Range balance. The ovaries were sliced parallel to the attachment of the ovarian ligament at 2 mm intervals with a scalpel. The slices were examined for the presence of corpora lutea (CL) and corpora albicantia (CA), both macroscopically and using a dissecting microscope at 10× magnification. Sections were then fixed in 10% buffered formalin, embedded in paraffin, sectioned at 3 mm, stained with haematoxylin and eosin and examined microscopically. Sexual maturity is defined as the age at which a female has ovulated at least once, and is determined by the presence of at least one corpus in an ovary.

- **Large CAs** (mean diameter 7–10 mm) are clearly visible as a mass on the surface of the ovary and have a clearly defined stigma. Based on microscopic examination, there are few, if any, luteal cells, but abundant fibrous connective tissue and numerous blood vessels. As the CA age, the volume of connective tissue decreases relative to the number of vessels.
- **Medium CAs** (mean diameter 3.5–7 mm) protrude less from the surface of the ovary. Histologically, most of the connective tissue is removed and the blood vessels are more prominent.

- **Small CAs** (mean diameter 1.5–3.5 mm) are visible on the surface of the ovary as small wrinkled scars. Histologically there is very little fibrous tissue, and blood vessels form the bulk of the tissue.

Histological sections of the uterine horns were classified as follows (Lockyer & Smellie 1985; Bacha & Wood 1990):

- **Immature.** The endometrium is thin and lined by a simple cuboidal epithelium. The glands are sparse and small with no clear lumen. The stratum vasculare is poorly developed and the arteries have a thin intima and smooth muscle tunic.
- **Mature–anoestrus.** The endometrium is thicker than in the immature uterus but the glands are equally sparse and relatively small. However, the tunica vasculare is prominent and the arteries have a tunica intima thickened by elastic fibres and smooth muscle.
- **Mature–lactating.** Similar to the previous except that the endometrium appears more vascular post-parturition and the mammary gland is active.
- **Mature–lactating–gravid.** Similar to mature-anoestrus except the glands are more convoluted and active and the endometrium appears more vascular. It is also characterised by an active corpus luteum and mammary gland.
- **Mature–pro-oestrus** and **mature–oestrus.** These stages are characterised by increasing depth of the endometrium and progressively greater development and complexity of the endometrial glands.

The mammary glands of all females were dissected to determine the degree of development and to look for evidence of milk secretion. Where milk was present, a sample was stored frozen at  $-80^{\circ}\text{C}$  for future research.

## Males

The length and midline diameter of the testes (excluding epididymis) were measured (mm) using Vernier calipers, and the testes were weighed (g) using a Mettler PM 4800 Delta Range balance. They were sectioned at 5 mm intervals and examined for evidence of pathological changes. Histological samples were taken from the centre of the testes and epididymis, embedded in paraffin wax, sectioned at 3 mm, mounted on glass slides and stained with haematoxylin and eosin. The sections were then examined microscopically at 40–100 $\times$  magnification to assess the maturity of the seminiferous tubule epithelium and for the presence of spermatozoa. Because the cell associations forming the epithelium vary segmentally in mammalian testes, the gonads were classified as immature, pubertal, mature–inactive, or mature–active based on the predominant cell association in 75% of the tubules in a section.

- **Immature.** The seminiferous tubules/cords are narrow and often have no apparent lumen. Sertoli cells and spermatogonia line the tubules but no further differentiation of germinal cells is apparent. There are abundant interstitial cells. The duct of the epididymis has a completely empty lumen.
- **Pubertal.** The seminiferous tubules are larger than for immature animals and there is consequently less interstitial tissue. The epithelium of the tubules contains spermatogonia, spermatocytes and occasional spermatids but no spermatozoa.
- **Mature–inactive.** The seminiferous tubules occupy most of the cross-sectional area and have a defined lumen. The epithelium has sertoli cells, spermatogonia and early spermatids. Occasional tubule sections may have late spermatids. The

interstitial cells occupy very little space between the seminiferous tubules. The ducts of the epididymis do not contain spermatozoa.

- **Mature–active.** The majority of tubule sections in the testis are lined by an epithelium that has a sequence of differentiation from spermatogonia through to spermatozoa. There is relatively little interstitial tissue present. The lumen of the epididymis may be full of spermatozoa. The baculum was collected and stored frozen at  $-20^{\circ}\text{C}$  for comparative anatomical studies.

## 3. Results

### 3.1 RESULTS 2002/03

#### 3.1.1 Catch data and observers' reports

A total of 14 New Zealand sea lion carcasses were received, consisting of seven females and seven males. In addition, two male and one female fur seal, and one southern elephant seal juvenile male were returned. The CSP observers' data are recorded with the tag numbers, catch date and coordinates (Appendix 1, Table A1.1). Two fur seals were submitted without an orange CSP tag.

#### 3.1.2 Morphometrics

An extensive set of standard measurements was taken from each carcass (Appendix 1, Table A1.2). These data will be further analysed in combination with data collected on pinnipeds that were incidentally caught during previous seasons (Gibbs et al. 2003 a, b).

#### 3.1.3 Stomach contents

The weight of the stomach and its contents were recorded for each animal (Appendix 1, Table A1.3). Squid (probably the arrow squid) and teleost fish were present in the stomachs of the sea lions. Two fur seals had also ingested squid, while the remaining fur seal and the elephant seal had empty stomachs. Most of the teleost fish were not sufficiently intact for gross identification to species level.

#### 3.1.4 Age determination

The animals were aged using growth layer groups (GLGs) in the dentine of canine teeth (Appendix 1, Table A1.4). Three sea lions were tagged as pups; the tagging information, and thus the actual age of the animal, is also presented in the table. For these animals, the estimated age is the same as the actual age, but the dataset is too small for statistical analysis. One fur seal also had a flipper tag that assigned an age of 10 years and 7 months (H. Best, pers. comm.), and for this animal the estimated age was between 10 and 11 years.

The female sea lions ranged in age from 5 to 11 years, with a mean age of c. 8.6 years. For males, the age range was from 4.5 to 12 years, with a mean age of c. 10 years. The fur seals were mature animals, with one female estimated at 10 years (actual age 10

years and 7 months), and two males estimated at between 8 and 9 years for one, and at least 10 for the other. The elephant seal was a juvenile at an estimated 2 years of age.

### **3.1.5 Reproductive status**

#### ***Females***

Based on the presence of CA or CL in serial ovarian sections, all female sea lions were classed as having achieved reproductive maturity (Appendix 1, Table A1.5). Two females were lactating, and thus had given birth in the summer they were caught, and had a CL in one ovary and sparse, inactive endometrial glands. This would suggest that implantation had not yet occurred. Of the four mature females with inactive mammary glands, each had a CL in one ovary and sparse, inactive endometrial glands, suggesting either that they did not have a pup this season, or that they lost a pup and the mammary gland had involuted through lack of suckling. It also showed that implantation had not yet occurred. All females were caught in March and April, which would be pre-implantation or early pregnancy, assuming they had mated in December or January. Freezing of the carcasses precludes the identification of blastocysts in the oviducts or early implantation embryos in the endometrium. The remaining female was pregnant, as would be expected for a mature female caught in October. However, she had inactive mammary glands, suggesting that she may have lost her pup from the 2001/02 season.

#### ***Males***

Based on examination of the testes, six of the sea lions had histological features consistent with maturity (Appendix 1, Table A1.6). Only one animal had immature gonads and, at 4.5, years he was the youngest in the group examined. The male fur seals were classed as mature-inactive based on testicular histology (Table A1.6). All the males were caught between February and September; thus the histological appearance of the testes is consistent with a regression of spermatogenesis outside the breeding season.

### **3.1.6 Pathology**

Data on entanglement-related pathology is included in this report (Appendix 1, Table A1.7). It should be noted that freezing compromises the interpretation of subtle pathological changes.

All of the 14 New Zealand sea lions, the three New Zealand fur seals and the elephant seal entangled in commercial nets had moderate/severe pulmonary oedema and congestion. Acute blunt-trauma lesions were classified as mild, moderate or severe, as described above (section 2.2). Based on this, eight sea lions were determined to have sustained severe lesions that would probably have compromised survival had they not drowned in the cover nets. All of these animals sustained cranial trauma among other lesions such as renal haemorrhage. One female (SB03-06Ph) had also aspirated gastric contents into the lungs and airways. The remaining animals had moderate or mild trauma that probably would not have compromised survival. All three fur seals and the southern elephant seal had sustained severe trauma and/or had aspirated regurgitate.

In all animals examined there were no other apparent pathological changes that could have caused death. These data support the conclusion that asphyxiation was probably the primary cause of death in all the New Zealand sea lions and fur seals necropsied.

The pathology reports of all animals are included as Appendix 2.

## 3.2 RESULTS 2003/04

### 3.2.1 Catch data and observers' reports

A total of 24 New Zealand sea lion carcasses, consisting of 20 females and four males, were received. There was one male fur seal submitted. The CSP observers' data, where known, are recorded with the tag numbers, and the catch date and co-ordinates (see Appendix 3, Table A3.1). Six sea lions were submitted without an orange CSP tag.

### 3.2.2 Morphometrics

A set of standard measurements was taken from each carcass (Appendix 3, Table A3.2). These data will be further analysed in combination with data collected on incidentally caught pinnipeds from previous seasons (Gibbs et al. 2003a, b).

### 3.2.3 Stomach contents

The stomach weight and the weight of its contents were recorded for each animal (Appendix 3, Table A3.3). Squid (probably arrow squid), crabs, and teleost fish were present in the stomachs of the sea lions. The fur seal stomach contained fish parts and otoliths. Most of the teleost fish were not sufficiently intact for gross identification to species level.

### 3.2.4 Age determination

The animals were aged using growth layer groups (GLGs) in the dentine of canine teeth (Appendix 3, Table A3.4). Two sea lions were tagged as pups and the tagging information, and thus the actual age of the animal, is also presented. For these animals, the estimated age is the same as the actual age, but the dataset is too small for statistical analysis. The fur seal was untagged.

The female sea lions ranged in age from 2 to 12 years approximately. For males, the age range was from 5 to 14 years. The fur seal was a mature animal but could not be aged because the mandibular teeth were missing.

### 3.2.5 Reproductive status

#### *Females*

Based on the presence of corpora albicantia (CA) or corpora lutea (CL) in serial ovarian sections, all female sea lions apart from two (SB04-14Ph, SB04-25Ph) were classed as having achieved reproductive maturity (Appendix 3, Table A3.5). Three females (SB04-04, 13, and 20Ph) were lactating (and therefore had given birth in the summer they were caught), and had a CL in one ovary and sparse, inactive endometrial glands. This would suggest that implantation had not yet occurred.

Fifteen females had a CL in one ovary and sparse, inactive endometrial glands, and apparently inactive mammary glands. This is consistent with pre-implantation of early pregnancy. All of these females were caught in February, March, and April, which would be pre-implantation or early pregnancy, assuming they had mated in December or January. Freezing of the carcasses precludes the identification of blastocysts in the oviducts, or early implantation embryos in the endometrium. At least seven of these 15 females ranged in age from 2 to 5 years (SB04-02, 03, 07, 10, 16, 17 and 21Ph) and, although they had ovarian activity, they might not yet have had pups, hence the inactivity of their mammary glands. One female (SB04-18Ph) was pregnant, as would be expected for a mature female caught in late October. The foetus was female and weighed 7.2 kg and was 630 mm long. A second adult female (SB04-24Ph), caught in November, had a small necrotic mass in the left horn of the uterus that was probably the remains of a foetus that died *in utero*.

### ***Males***

Based on examination of the testes, the sea lions had histological features consistent with maturity, but they were not actively producing sperm at the time of death (Appendix 3, Table A3.6). Based on testicular histology, the male fur seal was also classed as mature-inactive (Appendix 3, Table A3.6). All the males were caught between the end of January and early August; thus the histological appearance of the testes is consistent with a regression of spermatogenesis outside the breeding season. One male sea lion (SB04-22Ph) was estimated to be only 5 years old. His testicular mass was below that of the other males, but the histological appearance was that of mature inactive gonads.

### **3.2.6 Pathology**

Data on entanglement-related pathology are included in this report (Appendix 3, Table A3.7). It should be noted that freezing compromises the interpretation of subtle pathological changes.

All of the sea lions and the fur seal caught in fishing nets had moderate/severe pulmonary oedema and congestion. Based on the classification of acute blunt-trauma lesions as mild, moderate, or severe as described above (section 2.2), we determined that 14 females and one male sea lion had sustained severe lesions that would probably have compromised survival had they not drowned in the nets. All of these animals sustained cranial trauma among other lesions such as renal haemorrhage. One male and three females had also regurgitated gastric contents into the oesophagus and pharynx. The remaining animals had moderate or mild trauma that probably would not have compromised survival. The fur seal had sustained severe blunt trauma.

In all animals examined there were no other apparent pathological changes that could have caused death. These data support the conclusion that asphyxiation complicated by acute blunt trauma was the most likely cause of death for all animals examined.

The pathology reports of all animals are included as Appendix 4.

## 4. Discussion

The pinnipeds examined were received frozen and double-bagged. In general, the packaging was of a high standard and the animals were usually identified by an observer's report attached to the pectoral flipper with an orange plastic CSP tag. However, three sea lions from a single vessel were improperly bagged and there were six animals in total for which the submission data were incomplete. This was noted at a Conservation Services Programme Technical Advisory Group meeting. From a health and safety perspective, the packaging was sufficient to prevent contamination of the environment by the seal carcass provided it remained frozen.

The number of sea lions submitted in 2002/03 (14 animals) was less than for previous seasons, but the number submitted in 2003/04 (24 animals) was comparable to the 21 examined from the 2001/02 season, 40 from 2000/01, 28 from 1999/2000, 27 from 1997/98 (Duignan et al. 2003), and 23 from 1996 (Dickie 1999; Dickie & Dawson 2003). The sex ratio was equal in 2002/03, as it was in 1996 and 1999/2000 (Dickie & Dawson 2003; Gibbs et al. 2003a). In 2003/04 the ratio was biased towards females (20 animals). In all other seasons the sex ratio has been biased towards either males or females. It is unknown whether this reflects a skewed sex ratio in the total bycatch or just reflects the selection of animals for examination.

The stomach contents of sea lions were similar to those examined by Dickie (1999) and Duignan et al. (2003). Although specific identification of these prey items was beyond the scope of this contract, the work is ongoing as independent research at Massey University. As in previous studies, the sea lion diet inclined towards arrow squid, based on specimen numbers (35%) and mass (37%) (Bando et al. 2005), although opal fish (*Hemerocetes* sp.) was an important prey by number, while hoki and octopus were important by mass (Bando et al. 2005). In 2002/03 one female sea lion had regurgitated gastric contents and aspirated the material into her lungs. This animal had a full stomach. In 2003/04, four sea lions had regurgitated gastric contents in the oesophagus and mouth but not aspirated into the respiratory tract. Two of these animals had a full stomach. This suggests that, if a sea lion had recently fed, there was an increased risk of regurgitation on capture. Regurgitation of semi-liquid stomach contents could result in aspiration and death from foreign body pneumonia if the animal survives the immediate capture process. A second implication of regurgitation is that it is but one of the biases inherent in the use of stomach contents or faeces as an indicator of diet in pinnipeds (Jobling & Briebly 1986; Bowen & Harrison 1996). Recently, blubber fatty acid signature analysis has been advanced as a more sensitive method of investigating diet among pinnipeds (Iverson 1993; Iverson et al. 1997). This technique is currently under development at Massey University for future studies on foraging ecology of sea lions and fur seals.

Age determination in pinnipeds is based on counting growth layers or annuli in teeth and is commonly used on a variety of species (Laws 1952; Stirling 1969; Anas 1970; Payne 1978; Bengtson & Siniff 1981; Arnborn et al. 1992; Oosthuizen 1997). Although widely used, the technique is subject to difficulties in methodology, interpretation, reader variability, variability among teeth, variability between species, and the lack of known-age animals (Dapson 1980). For the animals under consideration, the number of known age in the sample was too low to allow critical



evaluation of the ageing technique. In previous studies, a total of only 10 of 118 sea lions and three of 254 fur seals examined were of known age (Dickie 1999; Duignan et al. 2003). In this study, five of 38 sea lions were of known age. Among the bycatch sea lions examined previously, and for those in this study for which the tagging date was known, there was good agreement between the actual age and the estimated age.

Previous studies have used several methods of age determination, including dentinal GLGs and root ridges of canine teeth (Perrin & Myrick 1980), and both dentinal and cemental layers of post-canine teeth (Stewart et al. 1996). In a comparative study of age estimation techniques using tooth sections of known-age South African fur seals (*A. pusillus pusillus*) it was found that the best correlation was between dentine layers in canine teeth and actual age. The post-canine teeth of that species lacked dentinal layers and the cemental layers were not highly correlated with actual age (Oosthuizen 1997). Childerhouse et al. (2004) also report that dentine layers in the post-canine teeth of New Zealand sea lions are not reliable for age determination and recommend using cementum layers instead. Our preliminary data comparing canine and post-canine teeth suggest that the dentine of canine teeth gives the best estimate of age and we recommend using this estimate on bycatch New Zealand sea lions. Based on this method, the sea lions in the two seasons' bycatch reported here ranged from 2 to 14 years old and the five known-age animals were aged correctly.

Among the northern sea lion species, female Steller's sea lion (*Eumetopias jubatus*) and California sea lion (*Zalophus californianus*) reach sexual maturity between 3 and 8 years of age (Reeves et al. 1992). The southern sea lion (*Otaria byronia*) reaches maturity at 4 years (Reijnders et al. 1993) and New Zealand sea lions apparently become sexually mature at 3 years old and produce their first pup at 4 years (Cawthorn et al. 1985). Many females do not enter the breeding population for several more years, with first reproduction occurring in animals up to 9 years old (I.S. Wilkinson pers. comm.). In this study, females ranged between 2 and 12 years old and all but two of the younger animals (2 and 4 years old, respectively) had histological evidence of reproductive maturity. However, seven of 15 animals estimated to be from 2 to 5 years old had apparently cycling ovaries but were not lactating. These animals may not yet have commenced pup production. An alternative explanation is that they may have lost their pup, causing the mammary glands to regress. Embryonic diapause has not been reported for New Zealand sea lions, but is likely to occur, as it does so in most other pinnipeds (Gales 1995). None of the females caught between February and April had a detectable foetus, and if they had mated in December, it would be too early for development of a foetus. Two females caught in October each had a foetus, as would be expected given a mean pupping date of mid-December for this species. A second female caught in November had the remains of a foetus that died in-utero and was in the process of being resorbed. The cause of death could not be determined as the degree of decomposition was too advanced.

Cawthorn et al. (1985) reported that male New Zealand sea lions become sexually mature at 5 years old, but do not hold territories or breed for another 3–5 years. Similarly, Australian sea lions (*Neophoca cinerea*) are thought to achieve sexual maturity at 6 years (Reijnders et al. 1993). The data presented here support these observations in that the youngest male sea lion had sexually immature gonads at approximately 4.5 years of age. For New Zealand fur seals, it has been suggested that sexual maturity in males is attained at approximately 7 years, but that social maturity is not achieved until approximately 10 years of age (Mattlin 1978). Similar data have

been reported for Australian fur seals (Shaughnessy & Warneke 1987), Galapagos fur seals (*A. galapagoensis*; Bonner 1981), South American fur seals (*A. australis*, Bonner 1981), subantarctic fur seals (*A. tropicalis*, Bester 1987) and Antarctic fur seals (*A. gazella*; Duck 1990). This study supports these previous studies in that the three male fur seals examined were at least 8 years old and both had mature but inactive testes.

Entanglement in fishing gear may result in traumatic lesions immediately apparent on the exterior of the carcass, such as abrasions, amputations, penetrating wounds, and fracture of limb bones, mandibles or teeth. For cetaceans, diagnosis of the aetiology is relatively simple because the sensitive hairless skin is easily damaged, and characteristic net marks are often left as impression marks around the rostrum, melon, and flippers or dorsal fin. However, such superficial lesions in pinnipeds are rarely seen and probably masked to a large extent by the dense pelage and tougher keratinised epidermis. Acute blunt trauma to the body may, however, result in contusions, haemorrhage, and skeletal fractures that are apparent at necropsy. However, it is not possible to unequivocally attribute these lesions to a specific aetiology unless there is a history of entanglement for the animal in question. More specific are the pulmonary changes associated with asphyxiation. These changes include diffuse pulmonary oedema, congestion, emphysema, bloodstained froth in airways, and pleural congestion. There may also be congestion of pericardial vessels, ecchymotic haemorrhages on the endocardium or epicardium; and, on histology, hypercontraction of myofibres is seen along with fibre fragmentation and vacuolation (Lunt & Rose 1987). Contraction banding is also seen in the media of coronary arteries of people who have died from drowning (Factor & Cho 1985; Lunt & Rose 1987). These acute changes are associated with hypoxia of the myocardium and end in coagulative myocardial necrosis if the animal survives long enough. Similar changes, called coagulative myocytolysis, are associated with excessive endogenous catecholamine (adrenaline) release typical of trapped and stressed animals (Szakacs et al. 1959; Pack et al. 1994). This lesion also occurs in people who have suffered head trauma (Bakay & Glasaur 1980), victim assault (Cebelin & Hirsch 1980), cocaine abuse (Lipscomb 1992), and drowning (Lunt & Rose 1987). Hypoxia, as occurs during drowning or asphyxiation, may exacerbate the effects of catecholamines on the myocardium (Leitch et al. 1976; Pack et al. 1994). Similar changes in the myocardium are seen in these pinnipeds, but it is not possible to be certain of their aetiology in carcasses that have been frozen and thawed, as freezing artifacts can cause marked disruption of the muscle. Therefore data on myocardial lesions have not been included in this report because of the potential that these changes are due to post-mortem artifacts. A more consistent finding in all animals examined for this study was acute pulmonary change indicative of asphyxiation. This took the form of acute diffuse congestion and oedema of the lungs, congestion and haemorrhage in the airways, and bloodstained froth in the airways.

The severe trauma described for many of the animals would probably have compromised their survival had they not asphyxiated (Bakay & Glasau 1980; Cebelin & Hirsch 1980; Szakacs et al. 1959). Five sea lions had also regurgitated stomach contents in the oesophagus and oral cavity. It is not possible to determine when regurgitation occurred relative to the exact time of death. However, regurgitated gastric contents in the upper alimentary tract could pose a risk of aspiration (foreign-body) pneumonia if the animal survived the initial insult that caused reflux. Regurgitation was associated in these animals with other evidence of blunt trauma

that included accumulation of blood in the abdomen and severe extensive contusion of the head and thorax.

In conclusion, the data suggest that most pinnipeds caught during the 2002/03 and 2003/04 seasons died of acute pulmonary asphyxiation possibly exacerbated by severe blunt trauma. Many animals were also subjected to moderate to severe trauma that would probably have compromised survival had they not asphyxiated. Such trauma can result in severe muscular and abdominal haemorrhage. Trauma to the head may result in concussion that cannot be diagnosed in frozen carcasses with frozen brains. Head trauma can also result in endogenous catecholamine release from the adrenal glands, which is known, at least in people, to cause lesions in cardiac muscle that result in heart failure. Animals affected thus would be unlikely to survive. Impacts that do not necessarily result in visible trauma may cause gastric reflux, which, if aspirated, can cause foreign-body or aspiration pneumonia in animals that survive the initial impact.

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# Appendix 1

## TABLES OF RESULTS 2002/3

TABLE A1.1. CAPTURE DATA FOR PINNIPEDS, 2002/03

CODE	PATH- OLOGY	CSP NO. NO.	DATE	LATITUDE ° ' S	LONGITUDE ° ' E	DOC	BRAND TAG NO.
<b>New Zealand sea lion—females</b>							
SB03-06Ph	34597	2	23 Mar 03	51 03S	166 22E		
SB03-07Ph	34598	1	20 Mar 03	50 12S	166 34E		
SB03-08Ph	34599	3	4 Apr 03	50 12S	166 36E	1477RFO	1477
SB03-10Ph	34623	1168	18 Oct 02	50 13S	167 58E		
SB03-12Ph	34678	808	13 Apr 03	50 42S	166 58E		
SB03-14Ph	34720	1031	11 Apr 03	50 16S	166 38E		
SB03-15Ph	34722	1024	23 Apr 03	50 11S	166 37E		
<b>New Zealand sea lion—males</b>							
SB03-01Ph	34005	1621	26 Sept 02	52 34S	170 32E		
SB03-04Ph	34595	1	27 Feb 03	50 57S	166 37E		
SB03-05Ph	34596	1589	7 Apr 03	50 15S	166 32E	3553RFO	
SB03-11Ph	34640	1	6 Feb 03	50 59S	166 34E		
SB03-13Ph	34711	1025	24 Apr 03	50 10S	166 28E	3647RFO	
SB03-16Ph	34727	1023	22 Apr 03	50 11S	166 34E		
SB03-18Ph	34871	1483	10 June 03	50 44S	166 56E		
<b>New Zealand fur sea—females</b>							
SB03-19Af	35116	None	4 Aug 03	42 35S	170 31E	83	
<b>New Zealand fur seal—males</b>							
SB03-03Af	34591	2	4 Mar 03	48 51S	166 64E		
SB03-09Af	34618	None	17 June 02	42 39S	170 38E	OBI tag	
<b>Southern elephant seal—males</b>							
SB03-02MI	34507	1226	5 Nov 02	51 05S	166 29E		

TABLE A1.2. MORPHOMETRIC DATA FOR PINNIPEDS, 2002/03

CODE	PATH- OLOGY NO.	CSP NO.	WEIGHT (kg)	STANDARD LENGTH (m)	PECT. GIRTH (m)	BLUBBER DEPTH (mm)
<b>New Zealand sea lion—females</b>						
SB03-06Ph	34597	2	131	1.64	1.32	70
SB03-07Ph	34598	1	120	1.74	1.21	50
SB03-08Ph	34599	3	103	1.63	1.10	17
SB03-10Ph	34623	1168	118	1.63	1.22	-
SB03-12Ph	34678	808	102	1.60	1.15	15
SB03-14Ph	34720	1031	123	1.88	1.24	60
SB03-15Ph	34722	1024	120	1.76	1.21	37
<b>New Zealand sea lion—males</b>						
SB03-01Ph	34005	1621	337	2.31	2.16	37
SB03-04Ph	34595	1	188	1.87	1.41	18
SB03-05Ph	34596	1589	270	2.25	1.60	25
SB03-11Ph	34640	1	196	2.11	1.40	15
SB03-13Ph	34711	1025	171	1.83	1.50	-
SB03-16Ph	34727	1023	237	2.17	1.52	14
SB03-18Ph	34871	1483	88	1.53	1.07	43
<b>New Zealand fur seal—female</b>						
SB03-19Af	35116	None	50	1.16	0.83	26
<b>New Zealand fur seal—males</b>						
SB03-03Af	34591	2	61	1.30	0.98	23
SB03-09Af	34618	None	54.5	1.43	0.86	25
<b>Southern elephant seal—males</b>						
SB03-02Ml	34507	1226	121	1.68	1.22	23



TABLE A1.3. STOMACH CONTENTS OF PINNIPEDS, 2002/03

CODE	PATH- OLOGY NO.	CSP NO.	FULL (kg)	EMPTY (kg)	CONTENTS (kg)	FISH AND FISH PARTS	SQUID AND INVERTEBRATES
<b>New Zealand sea lion—females</b>							
SB03-06Ph	34597	2	5.02	1.79	3.23	Whole fish (3), otoliths	No
SB03-07Ph	34598	1	2.12	1.73	0.39	Otoliths	Heads (2), beaks (4)
SB03-08Ph	34599	3	1.41	1.24	0.17	Otoliths, bones, lenses	No
SB03-10Ph	34623	1168	1.27	1.16	0.11	Otoliths, bones	No
SB03-12Ph	34678	808	2.98	1.61	1.37	Otoliths	Whole (1), head (1), squid beaks
SB03-14Ph	34720	1031	1.82	1.66	0.16	Otoliths	Squid (2), squid beaks
SB03-15Ph	34722	1024	2.70	1.55	1.15	Otoliths	Squid, squid beaks
<b>New Zealand sea lion—males</b>							
SB03-01Ph	34005	1621	6.67	4.44	2.23	Small fish (3), otoliths	Invertebrate, carapace
SB03-04Ph	34595	1	5.63	2.21	3.42	Eyeballs	Whole squid (3), mantle (3), squid beaks (52)
SB03-05Ph	34596	1589	13.10	4.10	7.70	Otoliths, bones	Whole squid (6), heads (39)
SB03-11Ph	34640	1	6.03	2.07	3.96	Otoliths	Whole squid mantle size 29–32 cm (5)
SB03-13Ph	34711	1025	5.64	2.80	2.84	Partly digested fish (7),	Mantle size 28–30 cm (3) squid beaks
SB03-16Ph	34727	1023	2.85	2.77	0.08	Otoliths	Squid beaks
SB03-18Ph	34871	1483	2.38	1.17	1.21	Otoliths, bones, partly digested fish, eyeballs	Squid beaks (12), shell, invertebrate carapace (2)
<b>New Zealand fur seal—females</b>							
SB03-19Af	35116	None	0.69	0.62	0.07	Bones	Squid beaks
<b>New Zealand fur seal—males</b>							
SB03-03Af	34591	2	4.16	1.56	2.60	Whole fish (1), otoliths	Whole squid (1)
SB03-09Af	34618	None	1.27	1.19	0.08	No	No
<b>Southern elephant seal—males</b>							
SB03-02MI		1226	2.22	1.62	0.60	Fish parts, otoliths	No

TABLE A1.4. AGE ESTIMATION OF PINNIPEDS, 2002/03.

CODE	PATH- OLOGY NO.	CSP NO.	POST CANINE TEETH			CANINE TEETH			RIDGES	DENTINE GLG	ACTUAL AGE	
			WEIGHT (g)	LENGTH (mm)	WIDTH (mm)	DEPTH (mm)	WEIGHT (g)	LENGTH (mm)				WIDTH (mm)
<b>New Zealand sea lion—females</b>												
SB03-06Ph	34597	2	0.91	27.1	6.9	5.6	7.35	55.4	12.0	8.7	10	10-11
SB03-07Ph	34598	1	0.93	23.7	7.5	6.0	5.42	50.4	12.1	8.6		11
SB03-08Ph	34599	3	0.88	23.3	6.0	5.3	6.37	53.4	11.9	9.0	9	8
SB03-10Ph	34623	1168	0.67	24.8	5.1	5.0	4.12	47.1	10.4	10.2	8	6-7
SB03-12Ph	34678	808	0.78	22.6	6.5	5.6	4.86	48.3	11.1	8.9		5
SB03-14Ph	34720	1031	1.08	25.7	7.4	6.3	7.38	55.7	13.4	9.7	12-13	12
SB03-15Ph	34722	1024	0.92	26.2	7.1	5.5	4.64	50.2	10.8	8.9	6-7	7
<b>New Zealand sea lion—males</b>												
SB03-01Ph	34005	1621	1.30	25.5	7.8	6.6	24.70	76.3	20.3	15.1	12	12
SB03-04Ph	34595	1	1.40	25.0	4.7	4.6	17.59	70.1	23.5	15.1		7.5
SB03-05Ph	34596	1589	1.28	22.1	6.9	6.9	38.20	82.1	28.7	17.0	8	11
SB03-11Ph	34640	1	1.30	24.6	8.1	6.2	31.80	84.5	17.1	26.9	11	10-12
SB03-13Ph	34711	1025	1.03	20.7	7.5	5.8	22.41	71.3	25.8	14.4	11	11
SB03-16Ph	34727	1023	1.50	24.1	9.0	7.5	33.03	77.0	25.8	16.9	14	14
SB03-18Ph	34871	1483	1.00	23.2	7.1	5.6	7.80	57.1	17.4	14.2	5	4.5
<b>New Zealand fur seal—females</b>												
SB03-19Af	35116		0.30	15.4	4.4	3.2	1.30	35.7	7.2	4.9	11	10
<b>New Zealand fur seal—males</b>												
SB03-03Af	34591	2	0.27	13.4	5.0	3.8	5.79	49.0	13.5	8.0	9-10	8.0-9.0
SB03-09Af	34618		0.31	27.0	8.0	6.3	7.65	54.0	14.6	8.4	8	10.0+
<b>Southern elephant seal—males</b>												
SB03-02Ml	34507	1226	0.38	14.3	6.4	5.8	5.51	55.3	24.3	19.4		2.0

TABLE A1.5. FEMALE REPRODUCTIVE STATUS OF PINNIPEDS, 2002/03.

CODE	PATH- OLOGY NO.	RIGHT OVARY			LEFT OVARY			UTERINE MATURITY*	PREGNANT	MILK PRESENT			
		WT (g)	L × W × D (mm)	CA (mm)	CL (mm)	WT (g)	L × W × D (mm)				CA (mm)	CL (mm)	
<b>New Zealand sea lion</b>													
SB03-06Ph	34597	34.0	46 × 33 × 31		22 × 26 × 20			25	38 × 31 × 27	30 × 15 × 21	MA	No	No
SB03-07Ph	34598	25.0	36 × 28 × 27	13 × 12 × 10			32	44 × 34 × 31		26 × 15 × 26	ML	No	Yes
SB03-08Ph	34599	34.0	51 × 34 × 32		22 × 25 × 23		25	36 × 33 × 19	18 × 28 × 18		MA	No	No
SB03-10Ph	34623	16.0	38 × 22 × 21		16 × 25 × 33		45	52 × 46 × 35	41 × 33 × 43		MG	Yes	No
SB03-12Ph	34678	26.0	39 × 38 × 22	6 × 7 × 9	8 × 9 × 11		23	40 × 38 × 21	7 × 8 × 9		MA	No	No
SB03-14Ph	34720	26.0	37 × 24 × 29				36	48 × 33 × 34			ML	No	Yes
SB03-15Ph	34722	49.0	52 × 35 × 36	24 × 19 × 30			25	41 × 27 × 29		19 × 13 × 26	MA	No	No
<b>New Zealand fur seal</b>													
SB03-19Af	35116	4.9	27 × 18 × 18		15 diameter		2.5	19 × 17 × 12			MG	Yes	No

\* Uterine maturity: MA = mature uterus, anoestrus; ML = mature uterus, lactating mammary gland; MG = mature uterus, gravid.

TABLE A1.6. MALE REPRODUCTIVE STATUS OF PINNIPEDS, 2002/03.

CODE	PATH- OLOGY NO.	BACULUM LENGTH (mm)	WT+EPID (g)	RIGHT TESTIS WT-EPID (g)	L × D (mm)	WT+EPID (g)	LEFT TESTIS WT-EPID (g)	L × D (mm)	TESTIS MATURITY*
<b>New Zealand sea lion</b>									
SB03-01Ph	34005	198	67	42	99 × 26	64	38	102 × 29	MI
SB03-04Ph	34595	168	51	39	80 × 19	54	43	80 × 23	MI
SB03-05Ph	34596	198	45	34	66 × 34	46	34	71 × 35	MI
SB03-11Ph	34640	185	29	15	82 × 25	24	18	76 × 26	MI
SB03-13Ph	34711	178	31	21	71 × 23	38	17	70 × 23	MI
SB03-16Ph	34727	179	37	25	65 × 27	35	26	63 × 25	MI
SB03-18Ph	34871	122	14	12	52 × 17	15	13	58 × 16	I
<b>New Zealand fur seal</b>									
SB03-03Af	34591	96.6	12	8	40 × 14	12	9	39 × 12	MI
SB03-09Af	34618	95.5	10	7	48 × 13	10	7	48 × 12	MI
<b>Southern elephant seal</b>									
SB03-02MI	34507	109	28	24	64 × 26	32	25	62 × 28	I

\* Testis maturity: I = immature; MI = mature inactive.

TABLE A1.7. PATHOLOGY OF BYCATCH PINNIPEDS, 2002/03

CODE	PATH- OLOGY NO.	CSP NO.	GROSS*	ENTANGLEMENT-RELATED		PATHOLOGY LIKELY TO SURVIVE?	REASON
				TRAUMA SEVERITY			
<b>New Zealand sea lion—females</b>							
SB03-06Ph	34597	2	1,2,3,4,6	Severe		No	Extensive thoracic and cranial trauma. Aspiration of food. Renal haemorrhage.
SB03-07Ph	34598	1	1,2,4,5	Moderate		Yes	Focal thoracic and abdominal trauma with renal haemorrhage.
SB03-08Ph	34599	3	1,3,4,	Severe		No	Extensive cranial, thoracic and abdominal trauma with renal haemorrhage.
SB03-10Ph	34623	1168	1,4	Severe		No	Thoracic, cranial and abdominal trauma with renal haemorrhage.
SB03-12Ph	34678	808	1, 4	Mild		Yes	Thoracic trauma (focal and superficial).
SB03-14Ph	34720	1031	1,3,4,5	Severe		No	Head, thoracic and abdominal trauma with renal haemorrhage.
SB03-15Ph	34722	1024	1,2,3,4	Severe		No	Head and thoracic trauma with intra-abdominal haemorrhage.
<b>New Zealand sea lion—males</b>							
SB03-01Ph	34005	1621	1,2,3,4,5	Moderate		Yes	Thoracic trauma and superficial contusion over mandibles. Renal haemorrhage.
SB03-04Ph	34595	1	1,2,3,4,5	Severe		No	Trauma to head and thorax, renal haemorrhage.
SB03-05Ph	34596	1589	1,2,3,4,5	Severe		No	Deep trauma to crown of head and thorax. Renal haemorrhage.
SB03-11Ph	34640	1	1,2,3,4,5	Severe		No	Trauma to head and thorax, renal haemorrhage.
SB03-13Ph	34711	1025	1,2,4	Moderate		Yes	Thoracic trauma with intra-abdominal haemorrhage.
SB03-16Ph	34727	1023	1,4,5	Mild/moderate		Yes	Superficial thoracic and abdominal trauma with peri-renal haemorrhage.
SB03-18Ph	34871	1483	1,2,3,5	Moderate		Yes	Thoracic and abdominal trauma renal haemorrhage.
<b>New Zealand fur seal—females</b>							
SB03-19Af	35116	None	1,2,3,4	Moderate/severe		No	Trauma to head and thorax.
<b>New Zealand fur seal—males</b>							
SB03-03Af	34591	2	1,2,4,6	Moderate		No	Aspirated gastric contents. Thoracic trauma.
SB03-09Af	34618	None	1,2,3,4	Severe		No	Trauma to head/thorax, renal haemorrhage.
<b>Southern elephant seal—males</b>							
SB03-02MI	34507	1226	1,2,3,4,5	Severe		No	Extensive trauma on head, thorax and abdomen.

\* Gross pathology: 1—respiratory congestion and oedema; 2—pulmonary emphysema; 3—cranial trauma (contusion); 4—other blunt trauma (contusion, free blood in abdomen); 5—regurgitate in oral cavity or oesophagus; 6—regurgitate in airways.

# Appendix 2

## ENTANGLEMENT-RELATED PATHOLOGY FOR EACH PINNIPED 2002/03

In the codes used below, 'Af' designates a New Zealand fur seal (*Arctocephalus forsteri*), 'Ph' a New Zealand sea lion (*Phocarctos hookeri*), and 'MI' a southern elephant seal (*Mirounga leonina*).

The listing of findings under 'diagnosis' is related to pathology associated with capture and is written in vernacular terminology.

'Prognosis' is the pathologist's assessment of whether the animal would survive at sea if released with the pathologies listed under 'diagnosis' other than those directly related to asphyxiation (i.e. the respiratory system lesions).

### **SB03-01Ph, CSP 1621**

**External:** No visible lesions (designated NVL in following cases).

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There are areas of contusion (acute haemorrhage and oedema) over the left shoulder, on the central aspect of the head along the mandibles, and on the ventral aspect along the sternum.

*Gastro-intestinal system:* There are regurgitated stomach contents in the oesophagus and pharynx. A moderate quantity (500 mL) of blood-stained fluid is in the peritoneal cavity.

*Respiratory system:* The trachea and bronchi have a congested or haemorrhagic mucosa and the lumen contains stable froth that is blood-stained in the bronchi. The parenchyma of the lungs is diffusely congested and oedematous, and oozes fluid on cut surface. There is diffuse alveolar emphysema and bullous emphysema is also present on the margins of the cranial lobes.

*Cardiovascular system:* NVL.

*Urogenital system:* There is congestion of the renal parenchyma and subcapsular haemorrhage over the cranial poles. The tunica vaginalis surrounding the testes is dilated and filled with blood-stained fluid similar to that in the peritoneum.

*Lymphatic system:* NVL

*Endocrine system:* NVL

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, moderate trauma to thorax and abdomen, with regurgitation and intra-abdominal haemorrhage from kidneys.

*Prognosis:* Likely to survive.

### **SB03-02MI, CSP 1226**

**External:** There are three parallel lacerations up to 11 cm long on the crown of the head between the right ear and the midline.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There are extensive areas of contusion (acute haemorrhage and oedema) involving most of the head and neck and running caudally along the dorsum to the pelvis. The ventral aspect of the neck and the pelvis are also involved.

*Gastro-intestinal system:* There are regurgitated stomach contents in the oesophagus and pharynx. A large quantity (1–2 L) of blood is in the peritoneal cavity, and the right lateral liver lobe is mascerated and contains a large haematoma.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa and the lumen contains stable froth that is blood-stained in the bronchi. The parenchyma of the lungs is diffusely congested and oedematous, and oozes fluid on cut surface. There is multifocal bullous and lobular emphysema in both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is congestion of the renal parenchyma and subcapsular haemorrhage over the cranial poles. The bladder mucosa has multifocal areas of congestion of ecchymotic haemorrhage. The tunica vaginalis surrounding the testes is dilated and filled with blood.

*Lymphatic system:* The spleen had remarkably sharp edges and appears contracted.

*Endocrine system:* The adrenal and thyroid glands appear congested.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, neck, thorax and abdomen, with regurgitation and intra-abdominal haemorrhage from liver and kidneys.

*Prognosis:* Unlikely to survive.

**SB03-03Af, CSP 2**

**External:** The right eye has blood within the anterior chamber. There are several skin-deep lacerations on the fore and hind flippers.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is contusion of the superficial pectoralis muscles over the sternum and distal ribs that extends to the left axilla. There is also an area of contusion beneath the mandibles.

*Gastro-intestinal system:* The stomach is full of ingesta and there are regurgitated stomach contents in the oesophagus and pharynx.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains frozen liquid in which there are fish bones and other material similar to what is present in the oesophagus and stomach. The parenchyma of the lungs is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. It is particularly congested adjacent to the bronchi and bronchioles that contain the aspirated liquid. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is mild congestion of the tunica vaginalis surrounding the testes.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, moderate trauma to head and thorax, with regurgitation and aspiration of gastric contents.

*Prognosis:* Unlikely to survive (due to aspiration).

### ***SB03-04Pb, CSP 1***

**External:** Both eyes have blood within the anterior chamber and the conjunctivae are congested. Both hind flippers have multiple fractures of bones and the tail is also fractured. These injuries appear to have occurred after death.

#### **Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is contusion of the blubber and muscle extending from the forehead to the lumbar region on the dorsal aspect and on the right side of the thorax on the ventral aspect and extending into the axillary region. A focal area of contusion is also present at the mandibular symphysis and extending to mid ramus there is also marked contusion around the right orbit.

*Gastro-intestinal system:* The peritoneal cavity contains approximately 500 mL blood. The stomach is full of ingesta and there are regurgitated stomach contents in the oesophagus and pharynx.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is mild congestion of the tunica vaginalis surrounding the testes and there is free blood in the tunica. The kidneys are markedly congested.

*Lymphatic system:* NVL.

*Endocrine system:* The adrenals are markedly congested.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head and thorax, with regurgitation of gastric contents and intra-abdominal haemorrhage.

*Prognosis:* Unlikely to survive.

### ***SB03-05Pb, CSP 1589, Tag 3553***

**External:** Both eyes have blood within the anterior chamber and the conjunctivae are congested.

#### **Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is contusion of the blubber and muscle involving the dorsal aspect of the cranium and the dorsal and lateral aspects of the thorax. There is also deep muscle contusion of the pectoralis on



the left ventral aspect of the thorax and in the right axilla. A focal area of contusion is also present at the mandibular symphysis and extending to mid ramus.

*Gastro-intestinal system:* The peritoneal cavity contains approximately 1000 mL blood. The stomach is full of ingesta and there are regurgitated squid and fluids in the oesophagus and pharynx.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid (c. 200 mL). The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage over both anterior poles of the kidneys. The bladder mucosa is focally congested.

*Lymphatic system:* The spleen is fleshy and congested.

*Endocrine system:* The adrenals are moderately congested.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head and thorax, with regurgitation of gastric contents and sub-capsular renal haemorrhage.

*Prognosis:* Unlikely to survive.

### ***SB03-06Ph, CSP 02***

**External:** Both eyes have blood within the anterior chamber and the conjunctivae are congested.

#### **Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is contusion of the blubber and muscle involving the left temporal aspect of the cranium and the dorsal and lateral aspects of the thorax. There is also deep muscle contusion of the pectoralis muscles and over the sternum, and there is a focal area of contusion at the mandibular symphysis and extending to mid ramus of the mandibles. On the left side of the body there is a large focus of deep muscle contusion over the scapula.

*Gastro-intestinal system:* There are regurgitated fluid gastric contents in the distal half of the oesophagus and a single small fish is wedged in the choana at the caudal margin of the hard palate that probably was regurgitated from the stomach.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained yellow fluid (possibly aspirated gastric contents). The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage over both anterior poles of the kidneys.

*Lymphatic system:* The left axillary lymph node is haemorrhagic.

*Endocrine system:* The adrenals are moderately congested.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head and thorax, with regurgitation and aspiration of gastric contents and sub-capsular renal haemorrhage.

*Prognosis:* Unlikely to survive.

### **SB03-07Pb, CSP 01**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is contusion of the blubber and muscle involving the left and right lateral aspects of the thorax over the scapula and shoulder, the ventral thoracic region over the sternum, and the right axilla.

*Gastro-intestinal system:* There is at least 500 mL blood in the peritoneal cavity. There are regurgitated fluid gastric contents in the distal half of the oesophagus.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa and the lumen contains blood-tinged fluid and stable froth. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage over both anterior poles of the kidneys and the bladder has focal mucosal congestion.

*Lymphatic system:* The left axillary lymph node is haemorrhagic.

*Endocrine system:* The adrenals are moderately congested.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, moderate trauma to thorax and abdomen, with regurgitation of gastric contents and sub-capsular renal haemorrhage.

*Prognosis:* Likely to survive.

### **SB03-08Pb, CSP 03, Brand 1477**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is contusion of the blubber and muscle involving the dorsal aspect of the cranium and neck, left and right lateral aspects of the thorax over the scapula and shoulder, the ventral thoracic region over the sternum, and the axillae.

*Gastro-intestinal system:* There is at least 500 mL blood in the peritoneal cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa, and the lumen contains blood-tinged fluid and stable froth. The parenchyma is diffusely congested and haemorrhagic. There is also marked

oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage over the ventral and lateral aspects of both kidneys.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax and abdomen, with regurgitation of gastric contents and sub-capsular renal haemorrhage.

*Prognosis:* Unlikely to survive.

### ***SB03-09Af, CSP None, OBI tag***

**External:** Both eyes are congested and haemorrhagic.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is contusion of the blubber and muscle involving the dorsal and lateral aspects of the cranium and neck, left and right lateral aspects of the thorax over the scapula and shoulder, the ventral thoracic region over the sternum, the axillae, and along the mandibular rami.

*Gastro-intestinal system:* There is approximately 300 mL blood in the peritoneal cavity.

*Respiratory system:* There is approximately 200 mL free blood in the thorax. The larynx, trachea and bronchi have a congested or haemorrhagic mucosa and the lumen contains blood-tinged fluid and stable froth. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage over both kidneys.

*Lymphatic system:* There is haemorrhage and oedema surrounding the left retropharyngeal lymph node.

*Endocrine system:* The adrenals are congested on cut surface.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax and abdomen, with sub-capsular renal haemorrhage.

*Prognosis:* Unlikely to survive.

### ***SB03-10Pb, CSP 1168***

**External:** Both eyes have blood within the anterior chamber and the conjunctivae are congested.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is deep contusion of the blubber and muscle involving the dorsal, lateral and ventral aspects of the cranium, and the dorsal and lateral aspects of the thorax. Deep contusions also extend from the mandibular symphysis, along the neck and the sternum to the manubrium. Focal areas of contusion are also present over the pelvis and femurs.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage on the left kidney.

*Lymphatic system:* The right axillary lymph node is haemorrhagic.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, neck, thorax and abdomen, with sub-capsular renal haemorrhage.

*Prognosis:* Unlikely to survive.

### ***SB03-11Pb, CSP 01***

**External:** NVL.

#### **Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is deep contusion of the blubber and muscle involving the dorsal, lateral and ventral aspects of the cranium, and the dorsal and lateral aspects of the thorax. Deep contusions also extend from the xiphoid to the manubrium along the sternum.

*Gastro-intestinal system:* There is approximately 1000 mL blood in the abdominal cavity. Regurgitated gastric contents, including whole squid, are in the oesophagus.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage on both kidneys. There is blood in the tunica vaginalis surrounding the testes.

*Lymphatic system:* The left prescapular lymph node is enlarged and congested.

*Endocrine system:* The adrenals are congested.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax and abdomen, with regurgitate in oesophagus and sub-capsular renal haemorrhage.

*Prognosis:* Unlikely to survive.

**SB03-12Pb, CSP 0808**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is focal superficial contusion of the blubber and muscle fascia of the left and right shoulder, and ventral sternum.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild/moderate thoracic trauma.

*Prognosis:* Likely to survive.

**SB03-13Pb, CSP 1025, tag 3647**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is mild focal contusion of the blubber and muscle involving the dorsal aspect of the cranium, and deeper contusion on the dorsal and lateral aspects of the thorax. Deep contusions also extend from the xiphoid to the manubrium along the sternum.

*Gastro-intestinal system:* There is approximately 600 mL blood in the abdominal cavity. Regurgitated gastric contents, including whole squid, are in the oesophagus.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage on both kidneys but more severe on the left.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild/moderate trauma to head, thorax and abdomen, with sub-capsular renal haemorrhage.

*Prognosis:* Likely to survive.

### ***SB03-14Pb, CSP 1031***

**External:** There is congestion and haemorrhage of the orbits and conjunctivae on both sides.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is extensive deep contusion of the blubber and muscle involving the dorsal, lateral and ventral aspects of the cranium, neck and thorax. Deep contusions also extend along the sternum to the pelvis on the ventral aspect of the body.

*Gastro-intestinal system:* There is approximately 1000 mL blood in the abdominal cavity. Regurgitated gastric contents are in the oesophagus and pharynx.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage on the dorsal aspect of both kidneys but more severe on the left.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax and abdomen, with regurgitation and sub-capsular renal haemorrhage.

*Prognosis:* Unlikely to survive.

### ***SB03-15Pb, CSP 1024***

**External:** There is congestion and haemorrhage of the orbits and conjunctivae on both sides.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is extensive deep contusion of the blubber and muscle involving the dorsal, lateral and ventral aspects of the cranium, neck and thorax. Deep contusions also extend along the sternum to the xiphoid and again around the pelvic region.

*Gastro-intestinal system:* There is approximately 1000 mL blood in the abdominal cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The

parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs. Approximately 200 mL of free blood in the thoracic cavity.

*Cardiovascular system:* There is approximately 50 mL free blood in the pericardial sac.

*Urogenital system:* There is subcapsular haemorrhage on the dorsal aspect of both kidneys. The mesometrium of the uterus is congested and haemorrhagic.

*Lymphatic system:* NVL.

*Endocrine system:* There is periadrenal haemorrhage continuous with the haemorrhage surrounding the kidneys.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax and abdomen, with subcapsular renal and peri-adrenal haemorrhage.

*Prognosis:* Unlikely to survive.

### **SB03-16Pb, CSP 1023**

**External:** There is mild congestion of the conjunctivae on both sides.

#### **Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is extensive deep contusion of the blubber and muscle involving the dorsal, lateral and ventral aspects of the thorax and abdomen.

*Gastro-intestinal system:* There is approximately 1000 mL blood in the abdominal cavity. Regurgitated gastric contents are in the oesophagus.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs. Approximately 100 mL of free blood in the thoracic cavity.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage surrounding both kidneys. The tunica vaginalis is distended with blood on the left side.

*Lymphatic system:* There is oedema and haemorrhage surrounding the prescapular and axillary lymph nodes on both sides.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, moderate trauma to thorax and abdomen, with subcapsular renal haemorrhage and intra-abdominal haemorrhage.

*Prognosis:* Likely to survive.

### **SB03-18Pb, CSP 1483**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is extensive deep contusion of the blubber and muscle involving the lateral and ventral aspects of the thorax and abdomen. Mild superficial subcutaneous contusion is present on the head.

*Gastro-intestinal system:* There is approximately 100 mL blood in the abdominal cavity. Regurgitated gastric contents are in the oesophagus.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs. Approximately 200 mL of free blood in the thoracic cavity.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage surrounding both kidneys and the parenchyma oozes blood on cut surface.

*Lymphatic system:* There is oedema and haemorrhage surrounding the prescapular and axillary lymph nodes on both sides.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, moderate trauma to thorax and abdomen, with subcapsular renal haemorrhage, intra-abdominal and intra-thoracic haemorrhage, and mild superficial cranial trauma.

*Prognosis:* Likely to survive.

***SB03-19Af, CSP None, tag 0083***

**External:** NVL. (Post-mortem damage to snout.)

**Internal:**

*Subcutaneous tissues and musculo skeletal systems:* There is contusion over the left temporal aspect of the cranium, on the sternum and over the left shoulder.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and fluid oozes on cut surface. There is extensive bullous and lobular emphysema throughout both lungs. Approximately 200 mL of free blood in the thoracic cavity.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, moderate/severe trauma to head and thorax.

*Prognosis:* Unlikely to survive.



# Appendix 3

## TABLES OF RESULTS 2003/04

TABLE A3.1. CAPTURE DATA FOR NEW ZEALAND SEA LIONS AND ONE FUR SEAL, 2003/04.

CODE	CSP NO.	TRIP	TOW/ SET	DATE	TIME	LATITUDE ° ' S	LONGITUDE ° ' E	DOC TAG NO.	
<b>New Zealand sea lion, females</b>									
SB04-02Ph	None	NA	1	9 Feb 04	NA	NA	NA	No	
SB04-03Ph	None	NA	2	9 Feb 04	NA	NA	NA	No	
SB04-04Ph	1	1864	24	15 Feb 04	7:48	50 50	166 48	No	
SB04-06Ph	3	1857	56	28 Feb 04	22:55	50 07	166 14	No	
SB04-07Ph	1361	1905	18	14 Mar 04	3:10	10 12	166 17	No	
SB04-09Ph	1516	1893	63	9 Mar 04	10:15	50 10	166 11	No	
SB04-10Ph	1286	1903	51	21 Mar 04	3:15	50 58	166 37	No	
SB04-11Ph	1285	1903	51	21 Mar 04	3:15	50 58	166 37	No	
SB04-12Ph	1512	1893	14	23 Feb 04	7:20	49 39	166 19	No	
SB04-13Ph	155	1907	8	13 Mar 04	12:25	50 01	166 12	No	
SB04-14Ph	1361	1905	18	14 Mar 04	3:10	50 12	166 17	No	
SB04-16Ph	1001	1902	33	9 Mar 04	4:34	50 07	166 12	No	
SB04-17Ph	1515	1893	35	1 Mar 04	22:00	50 02	166 17	No	
SB04-18Ph	None	3303	19	29 Oct 03	6:00	50 40	167 13	No	
SB04-19Ph	1	7	1	13 Feb 04	9:35	52 35	167 40	4036 RFO yellow	
SB04-20Ph	1229	1927	24	19 Apr 04	14:40	50 04	166 11	No	
SB04-21Ph	1230	1927	26	20 Apr 04	5:10	49 53	166 10	No	
SB04-23Ph	1228	1927	10	15 Apr 04	16:00	50 07	166 15	No	
SB04-24Ph	85	1830	95	2 Nov 03	9:10	50 41	167 08	No	
SB04-25Ph	None	35838	No data with carcass						
<b>New Zealand sea lion, males</b>									
SB04-01Ph	None	NA	3	28 Jan 04	NA	NA	NA	2929 RFO yellow	
SB04-05Ph	4	1857	57	29 Feb 04	10:13	50 05	166 13	No	
SB04-15Ph	None	6	18	8 Aug 04	19:35	49 38	166 24	No	
SB04-22Ph	1227	1927	9	15 Apr 04	10:00	50 05	166 15	Double scar	
<b>New Zealand fur seal, male</b>									
SB04-08Af	2	51	10	23 Jun 03	12:14	44 05	174 40	No	

TABLE A3.2. MORPHOMETRIC DATA FOR NEW ZEALAND SEA LIONS AND ONE FUR SEAL, 2003/04.

CODE	PATH. NO.	CSP NO.	WEIGHT (kg)	STANDARD LENGTH (m)	PECT. GIRTH (m)	BLUBBER DEPTH (mm)
<b>New Zealand sea lion, females</b>						
SB04-02Ph	35719	None	110	1.79	1.14	16
SB04-03Ph	35720	None	78	1.61	0.98	19
SB04-04Ph	35735	1	105	1.65	1.12	17
SB04-06Ph	35758	3	116	1.91	1.16	25
SB04-07Ph	35872	1361	76	1.52	1.03	25
SB04-09Ph	35892	1516	143	1.91	1.18	25
SB04-10Ph	35895	1286	81	1.55	1.02	25
SB04-11Ph	35900	1285	105	1.79	1.14	25
SB04-12Ph	35902	1512	101	1.78	1.16	20
SB04-13Ph	35906	155	102	1.74	1.09	30
SB04-14Ph	35910	1361	61	1.54	0.95	24
SB04-16Ph	35923	1001	120	1.78	1.18	35
SB04-17Ph	35925	1515	89	1.74	0.98	19
SB04-18Ph	35942	None	122	1.77	1.24	35
SB04-19Ph	35964	1	132	1.9	1.27	24
SB04-20Ph	35994	1229	119	1.83	1.21	30
SB04-21Ph	36006	1230	105	1.59	1.17	25
SB04-23Ph	36010	1228	121	1.88	1.17	35
SB04-24Ph	36047	85	105	1.55	1.11	30
SB04-25Ph	35838	None	121	1.8	1.19	10
<b>New Zealand sea lion, males</b>						
SB04-01Ph	35709	NA	225	2.28	1.51	21
SB04-05Ph	35750	4	244.5	2.49	1.52	35
SB04-15Ph	35919	None	258	2.08	1.5	25
SB04-22Ph	36009	1227	111	1.74	1.15	30
<b>New Zealand fur seal, male</b>						
SB04-08Af	35880	2	98	1.62	1.22	20

TABLE A3.3. STOMACH CONTENTS FOR NEW ZEALAND SEA LIONS AND ONE FUR SEAL, 2003/04.

CODE	PATH. NO.	CSP NO.	FULL (kg)	EMPTY (kg)	CONTENTS (kg)	FISH AND FISH PARTS	SQUID, INVERTEBRATES
<b>New Zealand sea lion, females</b>							
SB04-02Ph	35719	None	8.1	1.6	6.5	6 whole fish, 31-36 cm	9 whole squid, 21-31 cm mantle
SB04-03Ph	35720	None	2.1	1.3	0.8	otoliths	1 whole squid, 26 cm mantle, beaks
SB04-04Ph	35735	1	5.1	1.4	3.7	otoliths	5 squid, 24-31 cm mantle, beaks
SB04-06Ph	35758	3	2.5	1.4	1.1	bones, otoliths	beaks
SB04-07Ph	35872	1361	1.3	0.9	0.4	bones, otoliths	beaks
SB04-09Ph	35892	1516	9.9	1.7	8.2	6 whole fish, otoliths	
SB04-10Ph	35895	1286	1.2	1.1	0.1		beaks
SB04-11Ph	35900	1285	7.3	1.7	5.6	fish, otoliths	
SB04-12Ph	35902	1512	2.2	1.4	0.8		squid 24 cm, beaks
SB04-13Ph	35906	155	1.9	1.6	0.3	fish, otoliths	beaks, crab
SB04-14Ph	35910	1361	1.8	0.8	1	otoliths	whole squid 20-23 cm, beaks
SB04-16Ph	35923	1001	1.8	1.6	0.2	otoliths	squid
SB04-17Ph	35925	1515	2.4	1.2	1.2	otoliths	squid, beaks
SB04-18Ph	35942	None	2.8	1.3	1.5	2 whole fish, 23 cm	
SB04-19Ph	35964	1	7.9	1.7	6.2	otoliths	6 squid 23-30 cm, beaks
SB04-20Ph	35994	1229	1.9	1.7	0.2	otoliths	squid, beaks
SB04-21Ph	36006	1230	2.8	1.4	1.4	otoliths	beaks
SB04-23Ph	36010	1228	3.9	1.6	2.3	otoliths	squid, beaks
SB04-24Ph	36047	85	5.8	1.43	4.37	fish flesh, otoliths	squid, beaks
SB04-25Ph	35838	None	3.7	2.1	1.6		
<b>New Zealand sea lion, males</b>							
SB04-01Ph	35709	None	8.3	3.1	5.2	bones, otoliths	squid, beaks
SB04-05Ph	35750	4	7.2	3.9	3.3	fish spine 24 cm, otoliths	2 squid mantles 13 and 24 cm, beaks
SB04-15Ph	35919	None	3.2	2.8	0.4	otoliths	
SB04-22Ph	36009	1227	1.9	1.4	0.5	otoliths	beaks
<b>New Zealand fur seal, male</b>							
SB04-08Af	35880	2	4.2	1	3.2	otoliths, fish parts	

TABLE A3.4. AGE ESTIMATION FOR NEW ZEALAND SEA LIONS AND ONE FUR SEAL, 2003/04.

CODE	PATH. NO.	CSP NO.	POST-CANINE TEETH				CANINE TEETH					DENTINE ACTUAL	
			Weight (g)	Length (mm)	Width (mm)	Depth (mm)	Weight (g)	Length (mm)	Width (mm)	Depth (mm)	Ridges	GLG	AGE
<b>New Zealand sea lion, females</b>													
SB04-02Ph	35719	None	0.85	23.8	5.5	6	4.95	47.6	10.7	8.7	6	5	
SB04-03Ph	35720	None	0.56	18.8	5.4	4.6	3.85	43.7	11.1	9.1	7	4	
SB04-04Ph	35735	1	0.71	23	6.3	4.9	4.63	49.1	11.2	8.7	5	5	
SB04-06Ph*	35758	3											
SB04-07Ph	35872	1361	1.08	26.1	8	5.4	3.53	45	10.7	8.2	3	2	
SB04-09Ph	35892	1516	1.64	26.8	6.3	5.8	6.68	41.2	10.2	9.8	9	9	
SB04-10Ph	35895	1286	0.8	23.5	6.4	4.5	4.26	44.8	8.7	8.9	3	3	
SB04-11Ph	35900	1285	0.87	22.8	6.7	5.6	6.84	52.4	10.1	12.9	10	6	
SB04-12Ph	35902	1512	0.76	7.2	6.5	5.1	6.48	51.3	6.8	4.9	6	6	
SB04-13Ph	35906	155	1.34	28.4	8.5	5.6	6.8	52.4	12.4	9.7	7	7	
SB04-14Ph	35910	1361	0.49	20.7	5.2	4	2.06	27.6	9.2	7.5	2	2	
SB04-16Ph	35923	1001	0.88	22	17	15.5	6.69	40.8	13.4	10	5	4+	
SB04-17Ph	35925	1515	1.01	23.4	6.2	8.8	3.5	41.5	10.5	10.8	7	4	
SB04-18Ph	35942	None	0.79	23.9	5.2	6.1	6.8	51.8	12.6	10.7	6	5	
SB04-19Ph	35964	1	0.92	23.5	7.3	5.3	6.31	54.2	10.2	9.7	12	12	12
SB04-20Ph	35994	1229	0.73	20.2	6	5	5.95	41.3	12.2	9.5	6	6	
SB04-21Ph	36006	1230	0.8	20.1	6.2	4.8	6.83	50.5	13.3	10.3	5	5	
SB04-23Ph	36010	1228	1.01	25.9	5.8	5.3	7.25	52.7	10.4	10.4	6	6	
SB04-24Ph	36047	85	0.84	23.9	6.4	4.8	5.97	52.3	8.7	11.6	7	5	
SB04-25Ph	35838	None	1.35	28.4	6.1	2.9	6.8	52.5	12	8.5	5	4	
<b>New Zealand sea lion, males</b>													
SB04-01Ph	35709	None	1.5	23.7	7.8	7.9	39.9	79.2	27.7	16	13	13	13
SB04-05Ph	35750	4	0.6	23.2	8	6	33.3	74.5	26.5	16.2	14	14	
SB04-15Ph	35919	None	1.23	12.03	7.8	7.3	32.7	76.8	26.5	18	11	11	
SB04-22Ph	36009	1227	0.96	25.4	7.1	5.6	12.85	63.9	13.8	18.8	4	5	
<b>New Zealand fur seal, male</b>													
SB04-08A <sup>†</sup>	35880	2											

\* Teeth missing or broken

TABLE A3.5. FEMALE REPRODUCTIVE STATUS FOR NEW ZEALAND SEA LIONS, 2003/04.

CODE	PATH. NO.	CSP NO.	RIGHT OVARY				R. HORN DIAM. (mm)	LEFT OVARY				L. HORN DIAM. (mm)	PREGN. (foetus)	MILK
			WT (g)	L × W × D (mm)	CA (mm)	CL (mm)		WT (g)	L × W × D (mm)	CA (mm)	CL (mm)			
<b>New Zealand sea lion</b>														
SB04-02Ph	35719	None	33.2	46 41 36	25		25	29.6	40 36 36		20	15	No	No
SB04-03Ph	35720	None	26.2	41 37 32		20	9	22.9	41 37 30			9	No	No
SB04-04Ph	35735	1	37.6	42 44 38	16		20	43.1	46 44 38		16	25	No	Yes
SB04-06Ph	35758	3	40.8	46 32 46	18			43.9	46 43 43		24	24	No	No
SB04-07Ph	35872	1361	ND	35 33 25	22			ND	37 35 25	17			No	No
SB04-09Ph	35892	1516	41.5	48 45 42				40.3	47 35 44		17		No	No
SB04-10Ph	35895	1286	26.5	40 37 37		26	12	18.1	39 32 32			10	No	No
SB04-11Ph	35900	1285	33	44 39 34	19			41	47 45 38		20		No	No
SB04-12Ph	35902	1512	34	24 42 34		15	22	38	52 41 35	20		18	No	No
SB04-13Ph	35906	155	28.5	45 40 35	19		23	32.5	48 42 40		24	17	No	Yes
SB04-14Ph	35910	1361	11.9	32 29 25			10	12.3	34 32 25			10	No	No
SB04-16Ph	35923	1001	31.5	42 42 36		19	29	27.3	42 39 35	18		22	No	No
SB04-17Ph	35925	1515	29.8	44 40 38		27	13	19.3	40 40 37			11	No	No
SB04-18Ph	35942	None	61	55 47 47		40			ND				Yes*	No
SB04-19Ph	35964	1	37.7	37 44 38		25	17	26.4	34 32 34			21	No	No
SB04-20Ph	35994	1229	38.2	47 40 40		22	21	23.6	42 37 33			21	No	Yes
SB04-21Ph	36006	1230	36.5	49 39 38		35	19	17.8	38 32 30			17	No	No
SB04-23Ph	36010	1228	22.5	38 38 32	20		16	47.1	55 44 37		36	20	No	No
SB04-24Ph	36047	85	42	50 40 38		30	18	36	46 48 43	22		16	No†	No
SB04-25Ph	35838	None	21	46 37 36				29	46 43 36				No	No

CA = corpus albicans, CL = corpus luteum, ND = no data.

\* Foetus, length 630 mm, weight 7.2 kg, female.

† Dead foetus.

TABLE A3.6. MALE REPRODUCTIVE STATUS FOR NEW ZEALAND SEA LIONS AND ONE FUR SEAL, 2003/04.

CODE	PATH. NO.	CSL NO.	BACULUM LENGTH (mm)	RIGHT TESTIS			LEFT TESTIS			TESTIS MATURITY
				Wt+epid (g)	Wt-epid (g)	L × D (mm)	Wt+epid (g)	Wt-epid (g)	L × D (mm)	
<b>New Zealand sea lion</b>										
SB04-01Ph	35709	None		60	40	62 30	60	40	62 30	MI
SB04-05Ph	35750	4		79.6	55.5	92 37	97.9	60.2	86 40	MI
SB04-15Ph	35919	None	200	44.8	27.1	75 30	51.3	32	80 27	MI
SB04-22Ph	36009	1227	152	35	25.3	82 21	39.6	30	82 22	MI
<b>New Zealand fur seal</b>										
SB04-08Af	35880	2		18.4	12.8	45 12	19.3	12.4	48 20	MI

MI = Mature-inactive.

TABLE A3.7. PATHOLOGY OF BYCATCH NEW ZEALAND SEA LIONS AND ONE FUR SEAL, 2003/04.

CODE	PATH. NO.	CSP NO.	ENTANGLEMENT-RELATED PATHOLOGY			
			GROSS*	SEVERITY OF TRAUMA	LIKELY TO SURVIVE	REASON
<b>New Zealand sea lion, females</b>						
SB04-02Ph	35719	None	1,2,4	Mild	Yes	Blunt trauma limited to trunk
SB04-03Ph	35720	None	1,2,3,4,5	Severe	No	Severe trauma to head and thorax
SB04-04Ph	35735	1	1,2,3,4,5	Severe	No	Severe trauma to head and thorax
SB04-06Ph	35758	3	1,2,3,4	Severe	No	Severe trauma to head and thorax
SB04-07Ph	35872	1361	1,2,3,4	Severe	No	Severe trauma to head, thorax and abdomen
SB04-09Ph	35892	1516	1,2,3,4	Severe	No	Severe trauma to head and thorax
SB04-10Ph	35895	1286	1,2,3,4	Severe	No	Severe trauma to head, thorax and abdomen
SB04-11Ph	35900	1285	1,2,3,4,5	Severe	No	Severe trauma to head, thorax and abdomen
SB04-12Ph	35902	1512	1,2,3,4	Severe	No	Severe trauma to head, thorax and abdomen
SB04-13Ph	35906	155	1,2,3,4	Severe	No	Severe trauma to head, thorax and abdomen
SB04-14Ph	35910	1361	1,2,3,4	Severe	No	Severe trauma to head, thorax and abdomen
SB04-16Ph	35923	1001	1,2,3,4	Severe	No	Severe trauma to head, thorax and abdomen
SB04-17Ph	35925	1515	1,2,3,4,5	Severe	No	Severe trauma to head, thorax and abdomen
SB04-18Ph	35942	None	1,2,3,4	Severe	No	Severe trauma to head, thorax and abdomen
SB04-19Ph	35964	1	1,2,4	Mild	Yes	Limited thoracic and abdominal trauma
SB04-20Ph	35994	1229	1,2,4	Mild	Yes	Trauma limited to thorax and abdomen
SB04-21Ph	36006	1230	1,2,4	Mild	Yes	Trauma limited to thorax and abdomen
SB04-23Ph	36010	1228	1,2,4	Mild	Yes	Trauma limited to thorax and abdomen
SB04-24Ph	36047	85	1,2,4	Mild	Yes	Focal contusion on shoulder, some abdominal blood
SB04-25Ph	35838	None	1,2,3,4	Severe	No	Trauma to head, neck, thorax, abdomen
<b>New Zealand sea lion, males</b>						
SB04-01Ph	35709	None	1,2,3,4,5	Severe	No	Head and thoracic trauma, blood in abdomen
SB04-05Ph	35750	4	1,2,4	Mild	Yes	Trauma limited to trunk
SB04-15Ph	35919	None	1,4	Mild	Yes	Trauma limited to thorax and abdomen
SB04-22Ph	36009	1227	1,2,4	Mild	Yes	Trauma limited to thorax and abdomen
<b>New Zealand fur seal, male</b>						
SB04-08Af	35880	2	1,2,3,4	Severe	No	Head and thoracic trauma

\* 1 = Respiratory congestion and oedema, 2 = Pulmonary emphysema, 3 = Cranial trauma (contusion), 4 = Other blunt trauma  
5 = Regurgitated gastric contents.

# Appendix 4

## ENTANGLEMENT-RELATED PATHOLOGY FOR EACH PINNIPED, 2003/04

In the codes used below, Af designates a New Zealand fur seal (*Arctocephalus forsteri*) and Ph a New Zealand sea lion (*Phocarctos hookeri*). NVL = no visible lesions.

The listing of findings under 'diagnosis' related to pathology associated with capture and is written in vernacular terminology.

'Prognosis' is the pathologist's assessment of whether the animal would survive at sea if released with the pathologies listed under 'diagnosis' other than those directly related to asphyxiation (i.e. the respiratory system lesions).

### **SB04-01Ph, CSP not tagged, DOC tag 2929**

**External:** The left testis is missing. NVL.

#### **Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* The fifth rib on the left has a callous mid-way along the shaft indicating a healed fracture. There are areas of contusion (acute haemorrhage and oedema) over the shoulders, on the central aspect of the head, and on the ventral aspect along the sternum.

*Gastro-intestinal system:* There are regurgitated stomach contents in the oesophagus and pharynx. A moderate volume (1000 mL) blood-stained fluid is in the peritoneal cavity.

*Respiratory system:* The trachea and bronchi have a congested or haemorrhagic mucosa and the lumen contains stable froth that is blood-stained in the bronchi. The parenchyma of the lungs is diffusely congested and oedematous and oozes fluid on cut surface. There is diffuse alveolar emphysema and bullous emphysema is also present on the margins of the cranial lobes.

*Cardiovascular system:* NVL.

*Urogenital system:* There is congestion of the renal parenchyma and subcapsular haemorrhage over the cranial poles. The tunica vaginalis surrounding the right testis is dilated and filled with blood-stained fluid similar to that in the peritoneum.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, moderate to severe trauma to head thorax and abdomen, with regurgitation and intra-abdominal haemorrhage from kidneys. Healed rib fracture and missing left testis as incidental findings.

*Prognosis:* Not likely to survive.

## **SB04-02Ph, CSP not tagged**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There are superficial focal areas of contusion (acute haemorrhage and oedema) involving muscles of the thorax and abdomen.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa and the lumen contains stable froth that is blood-stained in the bronchi. The parenchyma of the lungs is diffusely congested and oedematous and oozes fluid on cut surface. There is multifocal bullous and lobular emphysema in both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild trauma to thorax and abdomen.

*Prognosis:* Likely to survive.

## **SB04-03Ph, CSP not tagged**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is contusion of the superficial and deep pectoralis muscles over the sternum and distal ribs that extends to the axillae. There is also contusion of the left side of the face and crown of the head extending caudally along the dorsal aspect of the neck.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains frozen liquid in which there are fish bones and other material similar to what is present in the oesophagus and stomach. The parenchyma of the lungs is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. It is particularly congested adjacent to the bronchi and bronchioles that contain the aspirated liquid. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.



*Diagnosis:* Asphyxiation, moderate trauma to head and thorax.

*Prognosis:* Unlikely to survive.

#### **SB04-04Ph, CSP 1**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is contusion of the blubber and muscle extending from the forehead to the lumbar region on the dorsal aspect and on the right side of the thorax on the ventral aspect and extending into the axillary region.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, and severe trauma to head and thorax.

*Prognosis:* Unlikely to survive.

#### **SB04-05Ph, CSP 4**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is superficial contusion of the blubber and muscle involving the dorsal aspect of the shoulders and pelvis.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid (approx. 200 mL). The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild focal trauma to thorax and pelvis.

*Prognosis:* Likely to survive.

#### **SB04-06Ph, CSP 02**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is contusion of the blubber and muscle involving the dorsal aspect of the cranium and the dorsal and lateral aspects of the thorax. There is also deep muscle contusion of the pectoralis muscles and over the sternum.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained yellow fluid possibly aspirated gastric contents. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation with severe trauma to head and thorax.

*Prognosis:* Unlikely to survive.

#### **SB04-07Ph, CSP 1362**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* Deep contusion is present over the dorsal aspect of the cranium and extending to the level of the ears and eye sockets. There is contusion of the blubber and muscle involving the left and right lateral aspects of the thorax over the scapula and shoulder, the ventral thoracic region over the sternum, and the right axilla.

*Gastro-intestinal system:* There is at least 500 mL blood in the peritoneal cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa and the lumen contains blood tinged fluid and stable froth. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage over both anterior poles of the kidneys, and the bladder has focal mucosal congestion.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, trauma to head, thorax and abdomen, and sub-capsular renal haemorrhage.

*Prognosis:* Unlikely to survive.

#### **SB04-08Af, CSP 02**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is contusion of the blubber and muscle involving the dorsal aspect of the cranium and neck, left and right lateral aspects of the thorax over the scapula and shoulder, the ventral thoracic region over the sternum, and the axillae and over the dorsal aspect of the pelvis.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa and the lumen contains blood-tinged fluid and stable froth. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax and pelvis.

*Prognosis:* Unlikely to survive.

#### **SB04-09Ph, CSP 1516**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is deep contusion of the blubber and muscle involving the dorsal and lateral aspects of the cranium and neck, left and right lateral aspects of the thorax over the scapula and shoulder, the ventral thoracic region over the sternum, the axillae, and along the mandibular rami.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa and the lumen contains blood-tinged fluid and stable froth. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema

and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe extensive trauma to head, thorax and abdomen.

*Prognosis:* Unlikely to survive.

#### **SB04-10Ph, CSP 1286**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is deep contusion of the blubber and muscle involving the dorsal, lateral and ventral aspects of the cranium, and the dorsal and lateral aspects of the thorax. Deep contusions also extend from the mandibular symphysis, along the neck, and the sternum to the manubrium.

*Gastro-intestinal system:* There is free blood (500 mL) in the abdominal cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, neck, thorax, and abdomen with intra-abdominal haemorrhage.

*Prognosis:* Unlikely to survive.

#### **SB04-11Ph, CSP 1285**

**External:** There are healed shark bite scars on the right hip.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is deep contusion of the blubber and muscle involving the right lateral and ventral aspects of the cranium, and the dorsal and lateral aspects of the thorax. Deep contusions also extend from the xiphoid to the manubrium along the sternum.

*Gastro-intestinal system:* There is approximately 600 mL blood in the abdominal cavity. Regurgitated gastric contents are in the oesophagus and oral cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa and there is free blood and blood-tinged froth in the lumen. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage on both kidneys.

*Lymphatic system:* The bronchial lymph node is enlarged.

*Endocrine system:* The adrenals are congested.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax, and abdomen, and regurgitate in oesophagus.

*Prognosis:* Unlikely to survive.

#### **SB04-12Ph, CSP 1512**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is extensive deep contusion of the blubber and muscle fascia involving the head, neck, thorax, abdomen and pelvis.

*Gastro-intestinal system:* There is approximately 1000 mL free blood in the abdominal cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is haemorrhage in the connective tissue dorsal and lateral to the kidneys.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe extensive deep contusions involving most of the body.

*Prognosis:* Unlikely to survive.

#### **SB04-13Ph, CSP 0155**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is focal contusion of the blubber and muscle involving the dorsal aspect of the cranium and face, and deeper contusion on the dorsal and lateral aspects of the neck and thorax. Deep contusions also extend from the xiphoid to the manubrium along the sternum.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage on both kidneys but more severe on the left.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild/moderate trauma to head, thorax, and abdomen with sub-capsular renal haemorrhage.

*Prognosis:* Unlikely to survive.

**SB04-14Ph, CSP 1361**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is extensive deep contusion of the blubber and muscle involving the dorsal, lateral and ventral aspects of the cranium, neck, and thorax. Deep contusions also extend along the sternum to the pelvis on the ventral aspect of the body.

*Gastro-intestinal system:* There is approximately 500 mL blood in the abdominal cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage on the dorsal aspect of both kidneys.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax, and abdomen with subcapsular renal haemorrhage, and regurgitation.

*Prognosis:* Unlikely to survive.

#### **SB04-15Ph, CSP not tagged**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is focal contusion of the blubber and muscle over the ventral sternum.

*Gastro-intestinal system:* There is approximately 500 mL blood in the abdominal cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage on the dorsal aspect of both kidneys. The mesometrium of the uterus is congested and haemorrhagic.

*Lymphatic system:* There are multifocal white granulomas in the bronchial lymph node.

*Endocrine system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild trauma to the thorax and abdomen.

*Prognosis:* Likely to survive.

#### **SB04-16Ph, CSP 1001**

**External:** There is intra-ocular haemorrhage.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is severe trauma to the head and face causing marked swelling and disfigurement. There is extensive deep contusion of the blubber and muscle involving the dorsal, lateral and ventral aspects of the thorax, abdomen, and pelvis.

*Gastro-intestinal system:* There is approximately 1000 mL blood in the abdominal cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs. Approximately 100 mL free blood in the thoracic cavity.

*Cardiovascular system:* NVL.

*Urogenital system:* There is subcapsular haemorrhage surrounding both kidneys.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax and abdomen with sub-capsular renal haemorrhage and intra-abdominal haemorrhage.

*Prognosis:* Unlikely to survive.

#### **SB04-17Ph, CSP 1515**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is severe trauma to the head and face causing marked swelling and disfigurement. There is extensive deep contusion of the blubber and muscle involving the lateral and ventral aspects of the thorax and abdomen.

*Gastro-intestinal system:* There is approximately 100 mL blood in the abdominal cavity. Regurgitated gastric contents are in the oesophagus.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* There is 50 mL blood in the pericardium.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax and abdomen intra-abdominal and pericardial haemorrhage.

*Prognosis:* Unlikely to survive.

#### **SB04-18Ph, CSP none**

**External:** NVL. Old shark bite scar on abdomen.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is contusion over the right temporal aspect of the cranium, on the sternum and over the right shoulder and left flank.

*Gastro-intestinal system:* There is approximately 1000 mL blood in the abdomen.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface.



*Cardiovascular system:* NVL.

*Urogenital system:* NVL. Pregnant.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head, thorax, and abdomen.

*Prognosis:* Unlikely to survive.

#### **SB04-19Ph, CSP 1, DOC tag 4036**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is focal contusion over the left shoulder and left flank, right shoulder, and anterior sternum.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild trauma to thorax.

*Prognosis:* Likely to survive.

#### **SB04-20Ph, CSP 1229**

**External:** NVL. Old shark bite scar on abdomen.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is limited focal contusion over the scapulae.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild trauma to shoulders.

*Prognosis:* Likely to survive.

#### **SB04-21Ph, CSP 1230**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is superficial contusion extending from the throat to the middle of the sternum on the ventral surface.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic.

*Cardiovascular system:* NVL.

*Urogenital system:* There is peri-renal haemorrhage.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild trauma to ventral neck, sternum, and abdomen.

*Prognosis:* Likely to survive.

#### **SB04-22Ph, CSP 1227. Double tag scars but no PIT chip**

**External:** NVL.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is superficial contusion over both scapulae and along the length of the sternum.

*Gastro-intestinal system:* There is 500 mL bloody fluid in the abdominal cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface.

*Cardiovascular system:* NVL.

*Urogenital system:* There is haemorrhage over the cranial poles of the kidneys.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild to moderate trauma to thorax and abdomen.

*Prognosis:* Likely to survive.

#### **SB04-23Ph, CSP 1228**

**External:** NVL. Old shark bite scars on left flank and abdomen.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is superficial contusion over the right shoulder and flank, over the left shoulder extending as far as the left cheek and over the left flank.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface. There is extensive bullous and lobular emphysema throughout both lungs.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, mild trauma to neck and thorax.

*Prognosis:* Likely to survive.

#### **SB04-24Ph, CSP 0085**

**External:** NVL. The fifth digit of the right hind limb is fractured (probably post mortem). There is granulation tissue on the chin.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is focal contusion over the left shoulder.

*Gastro-intestinal system:* There is 200 mL bloody fluid in the abdominal cavity.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL. There is a 20 mm necrotic mass midway along the left horn of the uterus and the mucosa is congested.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, Mild trauma to shoulder, intra-uterine foetal death.

*Prognosis:* Likely to survive.

**SB04-25Ph, CSP none**

**External:** NVL. There is a contracted scar on the venro-lateral aspect of the right hind flipper.

**Internal:**

*Subcutaneous tissues and musculo-skeletal systems:* There is contusion over the right temporal aspect of the cranium, on the sternum and over the right shoulder and left flank.

*Gastro-intestinal system:* NVL.

*Respiratory system:* The larynx, trachea and bronchi have a congested or haemorrhagic mucosa. The lumen contains froth and blood-stained fluid. The parenchyma is diffusely congested and haemorrhagic. There is also marked oedema and oozes fluid on cut surface.

*Cardiovascular system:* NVL.

*Urogenital system:* NVL.

*Lymphatic system:* NVL.

*Endocrine system:* NVL.

*Nervous system:* Not possible to assess adequately in frozen and thawed carcasses.

*Diagnosis:* Asphyxiation, severe trauma to head and thorax.

*Prognosis:* Unlikely to survive.