Autopsy of cetaceans incidentally caught in fishing operations 1997/98, 1999/2000, and 2000/01

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Pádraig J. Duignan, Nadine J. Gibbs, and Gareth W. Jones

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Part 3 Autopsy report for 2000/01

Pádraig J. Duignan, Nadine J. Gibbs, and Gareth W. Jones

New Zealand Wildlife Health Centre, Institute of Veterinary,
Animal and Biomedical Sciences, Massey University,
PB 11-222, Palmerston North, New Zealand

ABSTRACT

Morphological characteristics, estimated age, gender, reproductive status, stomach contents and cause of death were determined for 18 Hector's dolphins (*Cephalorhynchus hectori*), 3 dusky dolphins (*Lagenorhynchus obscurus*) and one common dolphin (*Delphinus delphis*). The dusky and common dolphins were incidentally killed in commercial fishing operations. The Hector's dolphins were retrieved either from amateur set nets (n = 3), found beachcast on the west coast of the South Island (n = 6), the east coast of the South Island (n = 6) or south of Auckland (n = 3). The stomachs of 7 Hector's dolphins were empty. The stomachs of all remaining dolphins contained the remains of teleost fish such as otoliths and bones, and squid. Fish predominated in the stomachs of Hector's dolphins, but fish and squid were equally represented in the stomachs of the dusky and common dolphins. Salps were found in the stomach of one dusky dolphin. Age was estimated for all dolphins by counting dentinal growth layer groups in stained sections of teeth. The age frequency distribution for the Hector's dolphins examined was similar to that previously reported for this species with an over-representation of immature animals. The female Hector's dolphins were sexually immature and ranged from < 1 year (neonatal) to c.6 years old. Based on estimated age and morphometrics, two other females from which the gonads had been scavenged were either immature or pubertal. Four male Hector's dolphins had mature gonads and were between 4 and 7.5 years old while 4 others, estimated to be between 3 and 5 years, had histologically immature gonads. One of the 2 males with scavenged gonads was a neonate with non-erupted teeth. The female dusky and common dolphins were sexually immature as indicated by the absence of corpora on the ovaries. Both were estimated to be 4.5 years old. The male dusky dolphin was sexually mature at 8 years old. Of the 3 Hector's dolphins and all the dusky and common dolphins known to have been entangled in nets, all had lesions consistent with death from entanglement and asphyxiation. Nine of the 15 remaining beachcast Hector's dolphins had lesions indicative of entanglement, 3 had lesions consistent with trauma and sudden death, 2 were too decomposed to determine cause of death, and 1 had died from natural disease.

Keywords: dolphins, Hector's, *Cephalorhynchus hectori*, dusky, *Lagenorhynchus obscurus*, common, *Delphinus delphis,* autopsy, stomach contents, estimated age, North Island, South Island, New Zealand

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1. Introduction

The primary objective of this study was to fulfil the requirements of DOC contract CSL00/3025 by recording and interpreting data on each animal. 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 18 Hector's dolphins (*Cephalorhynchus hectori),* three dusky dolphins (*Lagenorhynchus obscurus*) and one common dolphin (*Delphinus delphis*) killed incidentally in fishing operations or found beachcast.

A second objective was to examine the carcasses for evidence of disease and to collect material for ongoing and future research projects as outlined in Part 1 of this report.

Part 1, Section 1 contains general information on dusky and Hector's dolphins. Part 2, Section 1 contains general information on common dolphins.

2. Materials and methods

2.1 MATERIALS

Two females and one male dusky dolphin and one female common dolphin were received for autopsy this year. The catch date, time, and location coordinates were recorded by CSL observers for the dusky and common dolphins retrieved from trawl nets (Appendix 1, Table 3.1).

Fifteen South Island Hector's dolphin carcasses were received consisting of 5 females, 9 males and one animal which could not be sexed. One Hector's dolphin (WB01-20Ch), consisted only of skeletal remains, while a second animal (WB01-35Ch) was partially autopsied on the beach by biologists and the carcass submitted did not include the gonads and stomach. Two animals could not be sexed grossly because of decomposition and scavenging, however, one was identified as male by DNA analysis. Three North Island Hector's dolphins were amongst those received, including a decomposed specimen which was sexed by DNA analysis as female, and two others physically identified as male.

While 11 of the 18 Hector's dolphin carcasses had not been labelled, details of their death were available. The 15 South Island Hectors dolphins were either removed from set nets (n =3), found beachcast (n = 11), or floating at sea (n = 1). The three South Island Hector's dolphins retrieved from recreational set nets, were found off Amberley Beach, Christchurch; Granity Beach, Buller; and south of the Waimangaroa River mouth, Hokitika (Appendix 1, Table 3.2). The remaining 12 South Island Hector's dolphins were found along the west and east coasts of the South Island. The three North Island Hector's dolphins were from the Waikato-Manukau area of the North Island, and all were beachcast, one

Figure 3.1. Capture locations for dusky and common dolphins incidentally caught in fishing operations, 2000/01.

with evidence of net entanglement (Appendix 1, Table 3.2). The capture locations for the dusky and common dolphins (all retrieved from nets) are depicted graphically in Fig. 3.1.

The carcasses were delivered to Massey University frozen and wrapped in clear plastic bags and woven nylon sacks. Four were identified by Conservation Services Levy (CSL) observer or Independent Fisheries data sheets, 7 dolphins had orange tags attached around the tailstock, and 11 had no identification, but stranding forms were obtained at a later date. On receipt, the dolphins were stored at –20°C until necropsy. The species and sex was recorded based on external morphology and photographs taken of the external characteristics of each carcass.

2.2. METHODS AND NECROPSY PROTOCOL

See Part 1, Section 2.2 for details.

3. Results for 2000/01

3.1 MORPHOMETRICS

An extensive set of standard measurements was taken from each carcass (Appendix 1, Table 3.3).

3.2 STOMACH CONTENTS

The stomach weight and the weight of the contents were recorded for each animal (Appendix 1, Table 3.4). The contents were not identifiable to species for any animal. Nine Hector's dolphins had contents in at least one stomach compartment. Most of these contents were indigestible remains of teleost fish such as bones, eye lenses and otoliths, and an occasional squid beak. Four Hector's dolphins had empty stomachs. The stomach of one dolphin (WB01-35Ch) had been removed prior to arriving at Massey University, one animal had been scavenged and three dolphins were too decomposed, preventing the retrieval of stomach contents. The dusky and common dolphins had fish otoliths, bones and squid beaks in at least two compartments. Most of the contents were indigestible, except for one dusky dolphin (WB01-12Lo) in which the first chamber of the stomach was full with predominantly whole, fresh squid, as well as indigestible teleost fish remains. Otoliths and invertebrate parts have been stored in alcohol for more detailed analysis of diet at or immediately before the time of death. Blubber samples have also been stored frozen at –80°C for analysis of fatty acid signatures.

3.3 AGE DETERMINATION

Data on tooth size and the number of dentinal growth layer groups (GLGs) counted are given in Appendix 1, Table 3.5. For the South Island Hector's dolphins with teeth (n = 12) the mean tooth weight and size was similar to that reported previously (Slooten 1991; Part 1 and Part 2 of this report). The teeth did not have obvious incremental layers in the cementum, but there were clearly defined bands in the dentine of most animals. The accepted protocol for small cetaceans is that one dark band (stained) and one light band (unstained) constitute one year's growth (Perrin & Myrick 1980; Slooten 1991). Based on this assumption, the South island Hector's dolphins ranged in age from neonates (teeth not erupted and not sectioned) to at least 7.5 years old. The three North Island Hector's dolphins ranged between 4 and 7 years old. The dusky dolphins included two young females both estimated as 4.5 years old, and an 8-year-old mature male, while the female common dolphin was approximately 4 years old. The ages given are minimum estimates based on clearly defined bands. The Hector's dolphin sample was biased with young animals over-represented. The age bias is similar to that in the previous bycatch investigations (Part 1 and Part 2 of this report.) and is similar but even more marked than the age bias reported by Slooten (1991) in which 41 of 60 specimens (68%) were five years or younger.

3.4 REPRODUCTIVE STATUS

Females

Morphometric data on reproductive tracts are given in Appendix 1, Table 3.6. Three female Hector's dolphins (3, 4.5, and 6 years) had small smooth ovaries with no evidence of corpora. The uterine wall was also histologically immature and there was no evidence of lactation. These findings are similar to those for female Hector's dolphins, 6 years and younger, reported by Slooten (1991). The results are also consistent with those of immature female dolphins, 5 years or younger, from previous bycatch reports (Part 1 and Part 2 of this report). The gonads of three dolphins had been scavenged and were not available for examination. However, one of these (WB01-33Ch) was a neonate and would have been immature, while the other two were 6 and 7 years old and would have been either pubertal or in early maturity. The only female North Island Hector's dolphin in the sample had no gonads suitable for examination, due to decomposition.

The dusky dolphins were approximately 4.5 years old and the common dolphin was 4 years old. There were no visible corpora in serial sections of the ovaries. The histology of the uterine horns was consistent with sexual immaturity based on the criteria given in Part 1, Section 2.2.4. Milk was not present in the mammary glands.

Males

The gonads were examined for seven male Hector's dolphins. Of these, two were classed as mature-active, one as mature-inactive, and three as immature, based on histological characteristics (Appendix 1, Table 3.7). The two mature-active males were at least 5 and 6 years old and had combined testicular masses (including the epididymis) of 1053 g and 937 g respectively (Appendix 1, Table

3.7). This is within the range of mature combined testicular masses (266 g to 1210 g) reported by Slooten (1991) and in Parts 1 and 2 of this report. The testes of these males had active spermatogenesis and spermatozoa in the testes, epididymis and penis indicating maturity. The mature-inactive male had a combined testicular mass of 185 g, which is considerably greater than that for the immature dolphins that had combined masses of between 10.9 g and 29.6 g. Although the gradation between immature, pubertal and mature is probably indistinct, pubescent males would be expected to have an intermediate combined testicular mass. This is indicated in previous reports with pubescent males having a combined testicular mass of 65 g (Slooten 1991), 57 g and 32 g (see Part 2 this report). The gonads of two dolphins had been scavenged and could not be examined, but based on morphometrics one was a neonate and therefore sexually immature. The other was at least 2 years old, but could not be accurately aged because of damage to the teeth. The gonads of one dolphin (WB01-35Ch) had been removed and could not be examined, but based on an estimated age of 4 years old and morphometrics it was likely to be sexually pubescent or mature. The only male North Island Hector's dolphin with gonads present was an immature animal.

The male dusky dolphin had mature active testes and was approximately 8 years old.

3.5 PATHOLOGY

Data on entanglement-related pathology is included in this report (Appendix 1, Table 3.8). This Table does not include details of incidental pathology as reported in Part 2 of this report. It should be noted that freezing can compromise the interpretation of subtle pathological changes.

Among the three dusky dolphins and one common dolphin incidentally caught in commercial fishing operations, three had distinct net marks in the skin encircling the rostrum and along the leading areas of the dorsal fin, pectoral flippers and tail flukes. One dusky dolphin (WB01-11Lo) had been decapitated and had deep lacerations along the tailstock probably caused by a sharp implement such as a propeller. Evidence of blunt trauma with erythema of blubber, haemorrhage and oedema of muscle along the mandible, cranium, thorax and abdomen, and free blood-stained fluid in the abdomen was also observed in three dolphins. Trauma was particularly severe in the common dolphin, which had a comminuted fracture of the occipital bone at the posterior of the cranium resulting in laceration of the cerebellum by bone fragments. The tongue was also congested and haemorrhagic and enlarged to fill the oral cavity. All of the dusky dolphins and the common dolphin had moderate to severe pulmonary oedema and congestion, and myocardial hyper-contraction, hyper-eosinophilia and fibre fragmentation (Appendix 1, Table 3.8). Regurgitated stomach contents were observed in the airways of one dusky dolphin. In all animals examined there were no other apparent pathological changes that could have caused death.

Among the three Hector's dolphins known to have been entangled in recreational set nets, all had distinct net marks in the skin encircling the

rostrum and along the leading areas of the dorsal fin, pectoral flipper and tail flukes. Evidence of blunt trauma with erythema of blubber, haemorrhage and oedema of muscle along the thorax and cranium; and free blood-stained fluid in the abdomen was also observed. Two of these dolphins had moderate to severe pulmonary oedema and congestion, and all three dolphins had myocardial hyper-contraction, hyper-eosinophilia, and fibre fragmentation (Appendix 1, Table 3.8). Regurgitated stomach contents were observed in the mouth and oesophagus of two dolphins.

Of the remaining 15 dolphins, including the 3 North Island Hector's dolphins, the probability of entanglement was high for 9 (60%) based on skin lesions and in some cases lesions that would suggest pulmonary asphyxiation and recent trauma; it was moderate for 3 dolphins with signs of sudden death and recent trauma. One beachcast Hector's dolphin died from fulminating mycotic pneumonia and encephalitis caused by *Aspergillus* sp. Two dolphins were too decomposed and scavenged for conclusive assessment of the cause of death. However, one (WB01-34Ch) was a neonate and may have died following separation from its mother.

4. Discussion

The dolphins examined for this contract were received frozen and double bagged. In general the packaging was of a high standard and the animals were identified by CSL observer or Independent Fisheries data sheets, or by orange tags attached around the tailstock. Although tags were missing for 11 Hector's dolphins, stranding forms were sent at a later date. The orange tags around the tailstock were very effective for animal identification. It was beneficial to have a list of animals being shipped forwarded by email to allow a cross-check between animals shipped and those received. In that way, any animal that arrived without a CSL tag or stranding form could be traced. From a health and safety perspective, the packaging was sufficient to prevent contamination of the environment by the carcasses provided they remained frozen.

The number of dusky dolphins was too small to allow any conclusions about the ecology of the species but the life history characteristics of the individuals examined conform to published data for this species (Leatherwood et al. 1983). Dusky dolphins are thought to reach sexual maturity at a standard length of approximately 1.65 m. Both females were close to this length and were classified as sexually immature, while the male was larger and classified as sexually mature. All of the dusky dolphins were caught as a result of commercial fishing activities, and all had pulmonary and cardiac lesions suggestive of asphyxiation, two had trauma, and only two had unequivocal skin lesions attributable to entanglement. This demonstrates that pathological lesions, other than skin lesions alone, need to be considered in determination of cause of death.

The life history characteristics of the common dolphin are similar to those examined in a previous CSL contract (see Part 2), and in previous studies (Leatherwood et al. 1983). The only animal submitted was a sexually immature

female that, at 1.8 m Standard Length should have attained breeding size based on published data (Leatherwood et al. 1983). The dolphin was caught as a result of commercial fishing activities and had pulmonary and cardiac lesions suggestive of asphyxiation, and skin lesions attributable to entanglement.

The morphological features of the South Island Hector's dolphins were consistent with those reported previously (Mörzer Bruyns & Baker 1973; Slooten 1991; Slooten & Dawson 1994). The life history data collected from these dolphins complement data from previous bycatch reports of 15 animals examined in 1999 and 2000 (Parts 1 and 2 of this report.). The sex ratio of the dolphins investigated was slightly biased, comprising 60% males as compared to only 56% in 2000 and up to 83% in 1999. This male bias differs from a female bias reported by Slooten (1991). Whether the bias represents a population bias or a sampling artefact is unknown. Most of the animals examined were sexually immature which is consistent with previous reports on incidentally caught Hector's dolphins (Slooten 1991; Dawson 1991; Part 1 and Part 2 of this report).

Determination of the species of fish and invertebrates ingested by the dolphins was beyond the scope of this investigation, but all hard parts removed from the stomachs were archived for future studies. The stomach contents of the Hector's dolphins were similar to those listed in Part 1 and Part 2 of this report. As in previous studies, the stomach contents consisted predominately of indigestible teleost fish and invertebrate remains, with fish predominating in the stomach of Hector's dolphins, but fish and squid equally represented in the stomach of dusky and common dolphins. One North Island Hector's dolphin had fish bones, otoliths, eye lenses, and a copepod crustacean in its stomach. The presence of mostly indigestible remains suggests that the dolphins had not eaten shortly before death, except for one dusky dolphin, which had a full stomach consisting mostly of whole, fresh squid. The occurrence of regurgitation in two Hector's dolphins is but one of the biases inherent in the use of stomach contents or faeces as an indicator of diet in marine mammals (Jobling & Brieby 1986; Bowen & Harrison 1996). This is because both techniques rely on identifying the remains of prey species and if regurgitation has occurred there are no hard parts available for analysis. Recently, blubber fatty acid signature analysis has been advocated as a more sensitive method of investigating diet. This technique is currently under development at Massey University for future studies on the foraging ecology of marine mammals (Iverson et al. 1997).

Age determination in cetaceans, based on counting growth layers or annuli in teeth, is commonly used on a variety of species (Perrin & Myrick 1980). Although widely used, the technique is subject to difficulties in methodology, interpretation, reader variability, variability among teeth, and the lack of known-age animals (Dapson 1980). The method used to section teeth can also introduce marked biases into the interpretation of age. For this reason, and because teeth from known-age Hector's dolphins were not available, a method similar to that used previously on this species (Slooten 1991; Part 1 of this report) and on the related Commerson's dolphin (Lockyer et al. 1988) was chosen. The age of animals in this study, as determined by counting dentinal GLGs, corresponded to the morphometric data and reproductive status for the animals examined.

Entanglement in fishing gear may result in traumatic lesions immediately apparent in the exterior of the carcass such as abrasions, amputations, penetrating wounds and fractures of limb bones, mandibles or teeth (Garcia Hartmann et al. 1994; Kuiken 1994; Kuiken et al. 1994). 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. Acute blunt trauma to the body may result in contusions, haemorrhages, and skeletal fractures that are apparent at necropsy. More specific indicators are the cardio-pulmonary changes associated with asphyxiation. These changes include diffuse pulmonary oedema, congestion, emphysema, blood-stained froth in airways and pleural congestion. There may also be congestion of pericardial vessels, ecchymotic haemorrhages (haemorrhagic spots) on the endocardium or epicardium. On histological examination, 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 individual 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 experienced 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 pathogenesis is likely in traumatised and asphyxiated dolphins.

External skin lesions, characteristic of net marks, were observed on 12 Hector's dolphins, two dusky dolphins, and the common dolphin. Two Hector's dolphins were too decomposed to definitely determine any skin or subcutaneous lesions, these animals have, therefore, not been included in the following discussion. Eight (53%) of the remaining Hector's dolphins, two dusky dolphins and the common dolphin had evidence of blunt trauma before death as indicated by erythema of the blubber, oedema and haemorrhage of the muscle, or fractures of the skeleton. Of the Hector's dolphins with trauma, one animal had mild trauma limited to the abdomen, 3 animals had cranial trauma, and 4 had severe and extensive trauma involving the head and neck, thorax and abdomen. One North Island Hector's dolphin also had internal trauma. The severe trauma would probably have compromised survival of these dolphins had they not asphyxiated (Szakacs et al. 1959; Bakay & Glasaur 1980; Cebelin & Hirsch 1980). Of the dusky dolphins, one had moderate trauma to the mandible that would be unlikely to cause death, and while the other dolphin had blunt trauma limited to the abdomen it had severe and extensive propeller wounds. Whether the propeller cuts happened after death or close to the time of death could not be determined due to carcass decomposition. In the case of the common dolphin, there was severe and extensive trauma of the cranium that would probably have proved fatal.

Six Hector's dolphins were too decomposed, or scavenged, to allow the determination of pulmonary and cardiac pathology. These animals have,

therefore, not been included in the following discussion. Acute pulmonary changes indicative of asphyxiation were present in 10 Hector's dolphins, all the dusky dolphins, and in the common dolphin. This took the form of acute diffuse congestion and oedema of the lungs, congestion and haemorrhage in the airways, and blood-stained froth in the airways. Nine (68%) Hector's dolphins and all the common and dusky dolphins also appeared to have acute subendocardial cardiomyopathy (hyper-contraction, hyper-eosinophilia and fibre fragmentation) of the thickest part of the left ventricular wall consistent with coagulative myocytolysis or coagulative necrosis. Both lesions are morphologically similar, particularly in the peracute to acute stage of lesion development. Cardiac lesions generally take hours to develop to a stage where necrosis is unequivocal. In humans with myocardial infarction, necrosis is not seen for up to 12 hours post-infarction (Kumar et al. 1992). However, ultrastructural changes as determined by electron microscopy can be seen after 2 hours. In this study, light microscopy was used to examine pre-frozen cardiac tissue (instead of electron microscopy which cannot be applied to pre-frozen tissue). While cardiac damage was sustained by many of the animals examined, due to the limitations of the techniques used, and the length of time before necrosis becomes apparent, cardiac lesions would not have been detected. Freezing may also induce tissue changes that can be confused with true lesions. This problem needs to be addressed by conducting necropsies on fresh, unfrozen Hector's dolphins as soon as possible after death.

Two Hector's dolphins also appeared to have myopathy of the diaphragm that was probably caused by agonal spasm of the muscle associated with asphyxia. As with the possible myopathy in cardiac muscle, the diaphragmatic lesions should be further investigated by sampling fresh carcasses.

Because the morphology of the dolphin larynx keeps the alimentary tract and respiratory tracts separate, it is less likely that reflux would pose a risk of aspiration than in pinnipeds or terrestrial mammals. However, captive dolphins are known to eject food material through their blowholes on occasion, suggesting that the larynx is not necessarily fixed in place (J.R. Geraci pers. comm.) Gastric contents and fish scales were found in the lungs of one of the dusky dolphins suggesting that aspiration can occur. It is not possible to determine when regurgitation occurred relative to the exact time of death but there was no evidence of inflammation suggesting that it happened close to the time of death. Two Hector's dolphins had regurgitated stomach contents in the oesophagus and pharynx. Both of these had evidence of blunt trauma; one animal had severe extensive trauma while the other had moderate trauma limited to the cranium. Trauma may have been implicated in the regurgitation.

In conclusion, the results indicate that entanglement resulted in the death of three dusky dolphins, one common dolphin, and three South Island Hector's dolphins. There is also a high probability that entanglement caused the deaths of seven of the remaining twelve South Island Hector's dolphins, and two North Island Hector's dolphins, examined. The probability of entanglement was moderate for one other North Island Hector's dolphin and two other South Island Hector's dolphins that appear to have died suddenly. Only one South Island Hector's dolphin appears to have died from natural causes and two were too decomposed to establish the cause of death. Most of the animals that were

entangled died of acute asphyxiation and cardiomyopathy probably induced by hypoxia and catecholamine release. Many animals had also been subjected to mild to severe trauma that would probably have compromised survival in some dolphins had they not asphyxiated. Such trauma can result in severe muscular and abdominal haemorrhages and may also result in intestinal accidents such as intussusception, as seen in two dolphins. Trauma to the head may result in concussion that cannot be diagnosed in frozen carcasses and may also cause endogenous catecholamine release from the adrenal glands that is known, at least in humans, to cause lesions in the cardiac muscle that result in heart failure. Animals so affected would be unlikely to survive. Impacts that do not necessarily result in visible trauma may cause reflux that, if aspirated, can cause foreign-body pneumonia in animals that survive the initial impact.

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Appendix 1

TABLES OF RESULTS

TABLE 3.1. CAPTURE DATA FOR DUSKY AND COMMON DOLPHINS, 2000/01.

CODE	PATHOLOGY NO.	CSL NO.	DATE	TIME	LATITUDE	LONGITUDE	SEX
Dusky dolphin							
WB01-01Lo	31440	–	–		41ºS	174ºE	M
WB01-11Lo	32197	1521	7 Feb 01	1452	46ºS	170ºE	F
WB01-12Lo	32198	1160	17 Jan 01	1011	46ºS	170ºE	F
Common dolphin							
WB01-13Dd	32199	1045	15 Dec 00	0200	40ºS	173ºE	F

– Indicates data is not available.

TABLE 3.2. STRANDING DATA FOR BEACHCAST HECTOR'S DOLPHINS, 2000/01.

CODE	PATHOLOGY NO.	DOC TAG NO.	DATE	TIME	CIRCUMSTANCES	LOCATION	COMMENTS
North Island Hector's dolphin—Female							
WB01-06Ch	32074	–	5 Mar 01	–	Beachcast	Karioitahi Beach, Waiuku	Scavenged, DNA*
North Island Hector's dolphin—Male							
WB01-27Ch	32339	–	29 May 01	–	Beachcast	Karioitahi Beach, Waiuku	Decomposed
WB01-41Ch	32441	–	22 Jul 01	–	Beachcast	Port Waikato	
South Island Hector's dolphin—Female							
WB01-02Ch	31818	H34/00	29 Oct 00	1230	At sea	Port Levy, Christchurch	
WB01-16Ch	32209	H37/01	18 Jan 01	1800	Incidental†	Amberley Beach, Christchurch	
WB01-18Ch	32213	–	27 Nov 00	–	Beachcast	Mahinapua Beach, Hokitika	Scavenged, DNA*
WB01-29Ch	32374	WC130	6 Jun 01	1515	Incidental†	Granity Beach, Buller	
WB01-33Ch	32388	–	12 Jan 01	–	Beachcast	Cats Eye Pt, Kakanui	Scavenged
South Island Hector's dolphin—Male							
WB01-03Ch	31853	–	15 Nov 00	0815	Beachcast	N of Hokitika	
WB01-14Ch	32211	–	25 Feb 01	–	Beachcast	North Beach, Westport	
WB01-15Ch	32208	H36/00	19 Dec 00	0945	Beachcast	Leithfield Beach, Christchurch	
WB01-17Ch	32210	H39/01	2 Feb 01	1805	Beachcast	Waimakariri R. mouth, Chch	
WB01-19Ch	32216	–	23 Nov 00	2030	Beachcast	S Arahura R. mouth, Hokitika	Scavenged
WB01-21Ch	32218	–	25 Feb 01	–	Incidental†	S Waimangaroa R. mouth, Hokitika	
WB01-34Ch	32389	–	2 Jan 01	–	Beachcast	Papanui Inlet	Scavenged
WB01-35Ch	32390	WC131	25 Nov 99	–	Beachcast	Nth Hector	Autopsied on beach
WB01-40Ch	32436	H40/01	21 Jul 01	–	Beachcast	Port Levy Harbour	
South Island Hector's dolphin—Unknown sex							
WB01-20Ch	32566	–	5 Mar 01	–	Beachcast	N of Mokihinni R. mouth, Westport	Skeleton only

* Sex determined by DNA analysis. † Incidental to fishing. – Indicates data is not available.

TABLE 3.3. MORPHOMETRIC DATA FOR HECTOR'S, DUSKY AND COMMON DOLPHINS, 2000/01.

CODE	PATH-OLOGY No.	Wt (kg)	Std L (m)	Sn–An (m)	Sn–Gen (m)	Sn–ODF (m)	Sn–OF (m)	F L (m)	F W (m)	DF Ht (m)	DFB L (m)	Flk W (m)	Gt Pec (m)	Blub.D (m)	Blub.L (m)	Blub.V (m)
North Island Hector's dolphin—Female																
WB01-06Ch	32074	–	1.58	1.15	1.07	0.74	0.35	0.27	0.09	0.11	0.23	0.51	–	–	–	–
North Island Hector's dolphin—Male																
WB01-27Ch	32339	–	–	–	–	–	–	0.22	0.08	0.09	0.19	0.36	–	–	–	–
WB01-41Ch	32441	36.0	1.34	0.91	0.77	0.65	0.32	0.23	0.09	0.11	0.22	0.43	–	0.010	0.006	0.007
South Island Hector's dolphin—Female																
WB01-02Ch	31818	26.5	1.08	0.78	0.75	0.52	0.27	0.19	0.07	0.08	0.18	0.30	0.72	0.018	0.018	0.017
WB01-16Ch	32209	31.0	1.21	0.89	0.84	0.58	0.30	0.21	0.07	0.08	0.20	0.36	0.75	0.010	0.013	0.014
WB01-18Ch	32213	–	1.38	1.01	0.94	0.69	0.31	0.21	0.07	0.08	0.21	0.34	–	–	–	–
WB01-29Ch	32374	43.0	1.33	0.95	0.91	0.63	0.31	0.23	0.08	0.10	0.24	0.40	0.83	0.017	0.015	0.018
WB01-33Ch*	32388	6.8	0.76	0.58	0.52	0.39	0.20	0.16	0.06	0.07	0.14	0.25	0.44	0.012	0.011	0.014
South Island Hector's dolphin—Male																
WB01-03Ch	31853	36.0	1.27	0.93	0.81	0.64	0.33	0.24	0.09	0.10	0.21	0.43	0.76	0.015	0.012	0.015
WB01-14Ch	32211	–	1.21	0.84	0.76	0.54	0.26	0.21	0.08	0.10	0.19	0.38	–	0.013	0.012	0.011
WB01-15Ch	32208	34.5	1.22	0.86	0.75	0.60	0.29	0.22	0.08	0.08	0.19	0.41	0.79	0.014	0.013	0.014
WB01-17Ch	32210	24.0	1.09	0.76	0.65	0.50	0.27	0.18	0.07	0.07	0.17	0.33	0.70	0.016	0.013	0.017
WB01-19Ch	32216	27.5	1.23	0.89	0.77	0.60	0.29	0.21	0.08	0.06	0.18	0.36	–	–	–	–
WB01-21Ch	32218	29.0	1.13	0.83	0.72	0.56	0.29	0.20	0.07	0.09	0.19	0.35	0.73	0.014	0.011	0.014
WB01-34Ch*	32389	6.6	0.72	0.53	0.48	0.37	0.22	0.14	0.05	0.06	0.13	0.17	–	0.010	0.009	0.010
WB01-35Ch	32390	–	1.21	0.9	0.76	–	0.31	0.33	0.09	0.11	–	0.46	0.77	–	–	–
WB01-40Ch	32436	19.6	1.10	0.75	0.67	0.54	0.27	0.18	0.07	0.09	0.19	0.35	0.63	0.014	0.013	0.014
South Island Hector's dolphin—Unknown sex																
WB01-20Ch	32566	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dusky dolphin—Female																
WB01-11Lo	32197	70.0	1.63	1.20	1.12	0.71	0.37	0.36	0.10	0.21	0.27	0.47	1.11	0.015	0.014	0.014
WB01-12Lo	32198	74.0	1.70	1.19	1.12	0.80	0.39	0.33	0.10	0.19	0.25	0.46	1.07	0.014	0.010	0.014
Dusky dolphin—Male																
WB01-01Lo	31440	86.0	1.76	1.24	1.07	0.81	0.39	0.36	0.11	0.23	0.31	0.53	1.02	0.015	0.012	0.011
Common dolphin—Female																
WB01-13Dd	32199	74.5	1.82	1.31	1.25	0.82	0.40	0.30	0.10	0.18	0.29	0.42	1.00	0.014	0.014	0.013

Wt = weight; Std L = standard body length; Sn-An = snout to anus length; Sn-Gen = snout to genital slit length; Sn-ODF = snout to origin of dorsal fin length; Sn-OF = snout to origin of flipper; FL = flipper length; FW = flipper width; DF Ht = dorsal fin height; DFB L = dorsal fin length at base; Flk W = fluke width; Gt Pec = girth at pectoral flippers; Blub. D = dorsal blubber depth; Blub. L = lateral blubber depth; Blub .V = ventral blubber depth. * Neonate. – Indicates data is not available.

TABLE 3.4. STOMACH MORPHOMETRICS AND CONTENTS FOR HECTOR'S, DUSKY, AND COMMON DOLPHINS, 2000/01.

CODE	PATH-OLOGY NO.	STOMACH FULL WT (kg)	STOMACH EMPTY WT kg	COMPARTMENT 1 CONTENTS WT (kg)	COMPARTMENT 1 COMPOSITION	COMPARTMENT 2 CONTENTS WT (kg)	COMPARTMENT 2 COMPOSITION	COMPARTMENT 3 CONTENTS WT (kg)	COMPARTMENT 3 COMPOSITION	PARA-SITES	ULCERS
North Island Hector's dolphin—Female											
WB01-06Ch	32074	–	–	–	–	–	–	–	–	–	–
North Island Hector's dolphin—Male											
WB01-27Ch	32339	–	–	–	–	–	–	–	–	–	–
WB01-41Ch	32441	0.735	0.714	0.005	Fish bones, otoliths, lenses, 1 copepod	0.015	Fish bones, otoliths, lenses	0.001	Fish otolith, fluid	N	–
South Island Hector's dolphin—Female											
WB01-02Ch	31818	0.282	0.282	–	–	–	–	–	–	Y	–
WB01-16Ch	32209	0.458	0.401	0.032	Fish otoliths	0.008	Fish otoliths, grit	0.017	Fish otoliths, grit	Y	1 in C2
WB01-18Ch	32213	–	–	TLTM	Fish otoliths, lenses	–	–	–	–	N	–
WB01-29Ch	32374	1.000	0.400	0.400	Fish bones, otoliths, fluid	0.100	Fish bones, fluid	0.100	Fluid	Y	1 in C2
WB01-33Ch	32388	–	–	–	–	–	–	–	–	–	–
South Island Hector's dolphin—Male											
WB01-03Ch	31853	0.454	0.454	TLTM	Fish otoliths	TLTM	Fish otoliths	–	–	Y	1 in C2
WB01-14Ch	32211	0.502	0.45	0.024	Fish bones, otoliths	0.013	Fish bones, lenses, 1 squid beak	0.015	Fluid	Y	1 in C2
WB01-15Ch	32208	0.530	0.509	0.007	Fluid	0.004	Fish otoliths	0.01	Fluid	Y	1 in C2
WB01-17Ch	32210	0.228	0.199	0.021	Fish bones, otoliths	0.004	Fish bones, otoliths	0.004	–	Y	–
WB01-19Ch	32216	–	–	–	–	–	–	–	–	–	–
WB01-21Ch	32218	0.529	0.479	0.009	Fish otoliths, 1 squid beak	0.013	Fish bones, otoliths, lenses	0.028	Fluid	Y	1 in C2
WB01-34Ch	32389	–	–	–	–	–	–	–	–	–	–
WB01-35Ch	32390	–	–	–	–	–	–	–	–	–	–
WB01-40Ch	32436	0.325	–	–	–	–	–	–	–	Y	1 in C1
South Island Hector's dolphin—Unknown sex											
WB01-20Ch	32566	–	–	–	–	–	–	–	–	–	–
Dusky dolphin—Female											
WB01-11Lo	32197	1.054	0.786	0.092	Fish otoliths, lenses, 3 squid beaks, salps	0.099	Fish otoliths, lenses, 6 squid beaks, salps	0.077	Fish otoliths, 1 squid beak, salps	Y	5 in C2
WB01-12Lo	32198	2.882	0.775	2.003	Fish bones, otoliths, lenses, 14 squid, beaks, lenses, parts	0.055 –	Fish otoliths, 1 squid beak	0.049 –	Fish otoliths, fluid, 2 squid beaks, lenses	– Y	– 4 in C2
Dusky dolphin—Male											
WB01-01Lo	31440	1.559	1.314	0.245	Fish bones, otoliths, lenses	TLTM	Fish bones, otoliths	–	–	Y	2 in C2
Common dolphin											
WB01-13Dd	32199	1.115	0.9	0.16	Fish bones, otoliths, 3 squid beaks	0.012	Fish otoliths, squid beaks, fluid	0.043	Fluid	Y	–

TLTM = Too little to measure; C1, C2, etc. = compartment 1, 2, etc. – Indicates data is not available.

TABLE 3.5. AGE ESTIMATION BASED ON DENTINAL GROWTH LAYER GROUPS FOR HECTOR'S, DUSKY, AND COMMON DOLPHINS, 2000/01.

CODE	PATHOLOGY NO.	WT (g)	L (mm)	W (mm)	AGE (years)	COMMENTS
North Island Hector's dolphin—Female						
WB01-06Ch	32074	0.10	8.0	1.0	5.5	
North Island Hector's dolphin—Male						
WB01-27Ch	32339	0.29	12.6	3.0	7	
WB01-41Ch	32441	0.10	12.7	3.2	4	
South Island Hector's dolphin—Female						
WB01-02Ch	31818	0.10	10.0	1.0	4.5	
WB01-16Ch	32209	0.10	10.0	1.0	3	
WB01-18Ch	32213	0.10	9.0	1.0	7	
WB01-29Ch	32374	0.30	12.0	2.6	6	
WB01-33Ch	32388	–	–	–	<1	No teeth—neonate
South Island Hector's dolphin—Male						
WB01-03Ch	31853	0.10	11.0	1.0	5	
WB01-14Ch	32211	0.10	10.0	2.0	7.5	
WB01-15Ch	32208	0.10	9.0	1.0	6	
WB01-17Ch	32210	0.10	15.0	1.0	5	
WB01-19Ch	32216	0.10	9.0	1.0	>2	Damaged tooth
WB01-21Ch	32218	0.29	10.0	1.0	4	
WB01-34Ch	32389	–	–	–	<1	No teeth—neonate
WB01-35Ch	32390	0.29	11.1	2.8	4	
WB01-40Ch	32436	0.10	11.7	2.5	3	
South Island Hector's dolphin—Unknown sex						
WB01-20Ch	32566	–	–	–	–	No teeth
Dusky dolphin—Female						
WB01-11Lo	32197	0.20	17.0	2.0	4.5	
WB01-12Lo	32198	0.20	14.0	2.0	4.5	
Dusky dolphin—Male						
WB01-01Lo	31440	0.30	17.0	2.0	8	
Common dolphin—Female						
WB01-13Dd	32199	0.10	12.0	1.0	4	

– Indicates data is not available.

TABLE 3.6. FEMALE REPRODUCTIVE TRACT MORPHOMETRICS AND CHARACTERISTICS FOR HECTOR'S, DUSKY, AND COMMON DOLPHINS, 2000/01.

CODE	PATH-OLOGY NO.	RIGHT OVARY Wt (g)	RIGHT OVARY L×W×D (mm)	RIGHT OVARY CA	RIGHT OVARY CL	LEFT OVARY Wt (g)	LEFT OVARY L×W×D (mm)	LEFT OVARY CA	LEFT OVARY CL	UTERINE MATURITY	UTERINE GRAVID*	MILK PRESENT
North Island Hector's dolphin												
WB01-06Ch	32074†	–	–	–	–	–	–	–	–	–	–	–
South Island Hector's dolphin												
WB01-02Ch	31818	1.0	25 × 7 × 2	–	–	1.0	23 × 7 × 2	–	–	IM	N	N
WB01-16Ch	32209	1.0	34 × 11 × 2	–	–	1.0	31 × 9 × 2	–	–	IM	N	N
WB01-18Ch	32213†	–	–	–	–	–	–	–	–	–	–	–
WB01-29Ch	32374	1.0	29 × 8 × 4	–	–	1.0	28 × 9 × 4	–	–	IM	N	N
WB01-33Ch	32388†	–	–	–	–	–	–	–	–	IM	–	–
Dusky dolphin												
WB01-11Lo	32197	4.0	36 × 13 × 5	–	–	3.0	33 × 14 × 6	–	–	IM	N	N
WB01-12Lo	32198	3.0	41 × 15 × 7	–	–	6.0	19 × 46 × 10	–	–	IM	N	N
Common dolphin												
WB01-13Dd	32199	5.0	35 × 20 × 12	–	–	3.0	32 × 15 × 10	–	–	IM	N	N

CA = Corpus albicens; CL = Corpus luteum; IM = Immature; N = No.

* Determined by presence of embryo or foetus.

† Scavenged.

– Indicates data is not available.

TABLE 3.7. MALE REPRODUCTIVE MORPHOMETRICS AND CHARACTERISTICS FOR HECTOR'S AND DUSKY DOLPHINS, 2000/01.

CODE	PATH-OLOGY NO.	RIGHT TESTIS Wt+epid (g)	RIGHT TESTIS Wt–epid (g)	RIGHT TESTIS L×W×D (mm)	LEFT TESTIS Wt+epid (g)	LEFT TESTIS Wt–epid (g)	LEFT TESTIS L×W×D (mm)	TESTIS MATURITY	COMBINED TESTICULAR MASS* (g)
North Island Hector's dolphin									
WB01-27Ch	32339	–		–	–	–	–	–	–
WB01-41Ch	32441	12.2	9.0	68 × 17	17.4	12.5	77 × 16	IM	29.6
South Island Hector's dolphin									
WB01-03Ch	31853	513.0	454.0	195 × 85	540.0	476.0	210 × 80	MA	1053.0
WB01-14Ch	32211	95.0	75.0	130 × 48 × 40	90.0	65.0	130 × 50 × 45	MIA	185.0
WB01-15Ch	32208	487.0	419.0	221 × 77 × 65	450.0	386.0	210 × 70 × 60	MA	937.0
WB01-17Ch	32210	10.0	6.0	54 × 15 × 12	6.0	4.0	46 × 14 × 13	IM	16.0
WB01-19Ch	32216	–	–	–	–	–	–	–	–
WB01-21Ch	32218	11.0	8.0	64 × 21 × 13	11.0	8.0	69 × 19 × 12	IM	22.0
WB01-34Ch	32389	–	–	–	–	–	–	–	–
WB01-35Ch	32390	–	–	–	–	–	–	–	–
WB01-40Ch	32436	5.2	3.7	46 × 12	5.7	4.1	50 × 11	IM	10.9
Dusky dolphin									
WB01-01Lo	31440	242.0	160.0	230 × 45 × 27	237.0	159.0	240 × 45 × 28	MIA	479.0

IM = Immature, MA = Mature-active, MIA = Mature-inactive.

* Includes epididymis weight.

– Indicates data is not available.

LEGEND TO SYMBOLS ON TABLE 3.8

1 = Respiratory congestion and oedema
2 = Pulmonary emphysema
3 = Trauma (contusion, free blood in abdomen)
4 = Foreign matter in lungs
5 = External net entanglement marks
6 = Regurgitated food in oesophagus

I = Tracheal & bronchial congestion/haemorrhage
II = Bronchiole excessive mucus
III = Pulmonary interlobular/ lobular oedema/ congestion
IV = Pulmonary aveolar emphysema
V = Cardiac myofibre hypercontraction
VI = Cardiac myofibre fragmentation
VIII = Tricuspid valve oedematous and hemorrhagic
IX = Diaphragmatic myofibre hypercontraction
X = Diaphragmatic myofibre fragmentation
XI = Haemorrhage on aorta

TABLE 3.8. PATHOLOGY OF HECTOR'S, DUSKY, AND COMMON DOLPHINS, 2000/01.

CODE	PATH-OLOGY NO.	ENTANGLEMENT-RELATED PATHOLOGY		ENTANGLE-MENT PROBABILITY
		GROSS	HISTOLOGICAL	
North Island Hector's dolphin				
WB01-06Ch	32074	5	*	High
WB01-27Ch	32339	5	*	High
WB01-41Ch	32441	1, 3	II, III, V, VI	Moderate
South Island Hector's dolphin				
WB01-02Ch	31818	1, 5	III	High
WB01-03Ch	31853	1, 5	III	High
WB01-14Ch	32211	1, 3, 5	I, III, V, VI, IX, X	High
WB01-15Ch	32208	5	V, VI	High
WB01-16Ch	32209	3, 5	V, VI	High
WB01-17Ch	32210	1, 3	I, V, VI	Moderate
WB01-18Ch	32213	5	*	High
WB01-19Ch	32216	5	*	High
WB01-20Ch	32566	Skeleton only		Unknown
WB01-21Ch	32218	1, 3, 5, 6	I, III, V, VI	High
WB01-29Ch	32374	1, 3, 5, 6	I, III, V, VI	High
WB01-33Ch	32388	1, 3	I, III, scavenged	Moderate
WB01-34Ch	32389	*	–	Unknown
WB01-35Ch	32390	1, 3, 5	I, III, V, VI	High
WB01-40Ch	32436	1, 4	II, III, IX, X	Low
Dusky dolphin				
WB01-01Lo	31440	1, 4, 5	III, V, VI	High
WB01-11Lo	32197	1, 3, 6	I, III, V, VI	High
WB01-12Lo	32198	1, 3, 5	1, III, V, VI,	High
Common dolphin				
WB01-13Dd	32199	1, 3, 5	I, III, V, VI	High

* Too decomposed to determine pathology/probability.
– Indicates data is not available.