Autopsy report for seabirds killed and returned from observed New Zealand fisheries

1 October 2006 to 30 September 2007

D.R. Thompson

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CONTENTS

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1 October 2006 to 30 September 2007

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A B S T R A C T

Large numbers of seabirds frequent New Zealand commercial fishing waters. The accurate determination of the taxa of seabirds captured in New Zealand fisheries is vital for examining the potential threat to population viability posed by incidental fisheries captures. Further, the assessment of the age-class, sex and provenance of captured individuals requires autopsy in the majority of cases. Between 1 October 2006 and 30 September 2007 (the 2006/07 fishing year), a total of 324 seabirds comprising 22 taxa were incidentally killed as bycatch and returned for autopsy by on-board New Zealand government fisheries observers. Birds were returned from longline, trawl and setnet vessels. Seabirds returned during the 2006/07 fishing year were dominated numerically by two species (sooty shearwater *Puffinus griseus* and white-capped albatross *Thalassarche steadi*). Most birds (76%) returned from longline fisheries had injuries consistent with being hooked or entangled in the bill or throat, while most birds (70%) returned from trawl fisheries were killed through entanglement in the net. Warp interaction was the likely cause of death in 29% of trawl specimens. Mean fat scores were generally higher in birds from the 2006/07 fishing year than in most previous years, although mean fat scores were lower in 2006/07 than in 2005/06. Seabirds returned from the 2006/07 fishing year, and from trawl fisheries in particular, showed clear size-related differences in the likely cause of death, and offal appears to continue to be an attractant for many taxa.

Keywords: commercial fishing, seabirds, autopsy, incidental mortality, longline, trawl, setnet

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1. Introduction

The identification of seabirds killed by commercial fishing operations is a necessary and crucial first step towards gaining a better understanding of which species and populations may be at risk from such operations. Therefore, in keeping with previous fishing years, during the 2006/07 fishing year (1 October 2006 to 30 September 2007), Government observers were present on a non-random selection of fishing trips within New Zealand's Exclusive Economic Zone (EEZ).

Government fisheries observers are placed on a range of commercial fishing vessels including longline, trawl and setnet vessels to monitor protected species interactions with fishing activities. The Department of Conservation, through the Conservation Services Programme, requests observers to return for autopsy all seabirds caught and killed as incidental bycatch during fishing operations. Ancillary information (for example, vessel name, location of capture as latitude and longitude coordinates, date of capture, and additional comments provided by the observer) is also recorded by observers.

The correct identification of seabirds killed by commercial fishing operations is a necessary and crucial first step towards a better understanding of which species and populations may be at risk from such operations. Furthermore, although at-sea identifications of birds killed by observers are usually, but not always, accurate, post mortem analysis is generally required in order to correctly assign gender to specimens, and additionally provide information on status, dietary preferences, condition and provenance.

Because of the non-random nature of seabird capture and return, the totals for each species of seabird presented in this report do not reflect 'catch rates' for particular fishing methods or fisheries generally. Specific catch locations and the names of vessels from which specimens were returned have not been provided in this report on the grounds of commercial sensitivity.

2. Methods

Autopsy methods followed those described by Bartle (2000) and used in autopsies in subsequent fishing years (Robertson 2000; Robertson & Bell 2002a, b; Robertson et al. 2003, 2004; Conservation Services Programme 2008; Thompson 2009). The author undertook all autopsies and identifications, to species where possible. Common and scientific names of all species referred to in this report are provided in Table 1. Nomenclature generally follows Marchant & Higgins (1990), but for the albatrosses, where current taxonomy and nomenclature is in a state of flux, it follows a combination of Nunn et al. (1996), Robertson & Nunn (1998) and BirdLife International (see www.birdlife.org; viewed May 2009).

Birds were sexed by internal examination during dissection, except where this was precluded through damage from fishing gear and machinery or from sea lice. Birds were categorised as breeding adult, adult, non-breeding adult or juvenile based on a combination of plumage and other morphological characteristics (e.g. bill morphology), gonadal characteristics and brood patch characteristics. Breeding adults were birds considered to be actively breeding at the time of capture; adults were birds that had breeding adult morphology but for which active breeding could not be confirmed; non-breeding adults were definitely not actively breeding at the time of capture (based on main feather moult and gonadal evidence); and juveniles were birds with non-adult plumage/morphology.

TABLE 1. LIST OF COMMON AND SCIENTIFIC NAMES OF ALL TAXA (SPECIES) REFERRED TO IN THIS REPORT

COMMON NAME	SCIENTIFIC NAME
Antipodean albatross	*Diomedea antipodensis antipodensis*
Black petrel	*Procellaria parkinsoni*
Black-browed albatross	*Thalassarche melanophrys*
Buller's albatross	*Thalassarche bulleri bulleri*
Campbell albatross	*Thalassarche impavida*
Chatham albatross	*Thalassarche eremita*
Common diving petrel	*Pelecanoides urinatrix*
Flesh-footed shearwater	*Puffinus carneipes*
Fluttering shearwater	*Puffinus gavia*
Gibson's albatross	*Diomedea antipodensis gibsoni*
Grey petrel	*Procellaria cinerea*
Grey-faced petrel	*Pterodroma macroptera gouldi*
Indian yellow-nosed albatross	*Thalassarche carteri*
Northern giant petrel	*Macronectes halli*
Salvin's albatross	*Thalassarche salvini*
Sooty shearwater	*Puffinus griseus*
Southern cape petrel	*Daption capense capense*
Southern giant petrel	*Macronectes giganteus*
Southern royal albatross	*Diomedea epomophora*
White-capped albatross	*Thalassarche steadi*
White-chinned petrel	*Procellaria aequinoctialis*
Yellow-eyed penguin	*Megadyptes antipodes*

As in previous years, body condition was assessed by assigning a fat score, initially based on the relative amount of subcutaneous fat and, more recently, including an assessment of the amount of fat deposited on and around organs and structures within the body cavity (Bartle 2000; Conservation Services Programme 2008; Thompson 2009). Fat scores presented in this report combine an assessment of the amount of both subcutaneous fat under the skin in the pectoral region and fat deposited on and around organs within the body cavity. Fat scores ascend from '1' = no fat, '2' = little fat, '3' = moderate fat, '4' = fat, to '5' = very fat (or fat to an extent that internal examination becomes difficult).

For each specimen, feather moult and the condition of the brood patch were recorded, as were the nature of injuries sustained. This information was then combined with observer comments on the autopsy tag to determine a most likely cause of death.

Contents of the proventriculus (stomach) and ventriculus (gizzard) were identified to broad dietary groupings (squid, fish, crustaceans) and any hard parts (cephalopod beaks, otoliths) were retained for future identification. Other materials, such as pieces of plastic, stones, algae and goose barnacle plates were recorded. Fishing-related items such as bait material, offal or other discarded material, were recorded. In this report, 'offal' refers to any discarded material, not just internal organs.

Each autopsy specimen was allocated a unique number. Details relating to each specimen are available on request from the Manager, Marine Conservation Services, DOC (email: csp@doc.govt.nz). In some cases, e.g. those specimens damaged by fishing gear and machinery or by sea lice, it was not possible to determine species, sex, or cause of death. These are reported as 'unidentified' or 'unknown' in the summary tables presented in this report.

3. Results

3.1 SPECIES RETURNED

During the 2006/07 fishing year, a total of 324 seabirds were killed as bycatch and returned from 62 separate fishing trips undertaken by 50 different vessels (ten vessels each made two trips from which seabirds were killed and returned, and one vessel made three trips from which birds were returned). Specimens were identified to one of 22 taxa (distinct species), with 1 specimen (one broken wing only) identified to genus, and recorded as 'unidentified *Thalassarche* albatross' (Table 2). Two unobserved trips also returned birds—ten and two birds, respectively. It has been assumed that all birds killed on these two trips were returned (rather than a sub-set of all birds killed), and these data have been included in subsequent analyses and summary tables. The locations of seabird captures are shown in Appendix 1.

Seabirds returned during the 2006/07 fishing year were dominated numerically by two species which, combined, accounted for 45% of all specimens. Sooty shearwater *Puffinus griseus* was marginally the most numerous species returned (73 birds, 23% of the total), followed by white-capped albatross *Thlassarche steadi* (72 birds, 22%: Table 2). In keeping with the long-term trend of species returned, the remaining specimens were predominantly Buller's albatross *T. bulleri bulleri* (45, 14%), white-chinned petrel *Procellaria aequinoctialis* (36, 11%), grey petrel *P. cinerea* (28, 9%) and Salvin's albatross *T. salvini* (22, 7%). Historically, these six species have been the most commonly returned for autopsy (see summaries in Robertson et al. 2004; Conservation Services Programme 2008). This pattern was maintained during the 2006/07 fishing year, with these six species comprising 85% of all birds returned (Table 2). Of the remaining species returned during the 2006/07 fishing year, only Chatham albatross *T. eremita* achieved double figure status (10 birds, 3% of total), and 12 additional species were represented by only one or two specimens (Table 2).

Only one specimen returned was banded: a Buller's albatross, band number M-83473, which was banded as an adult male non-breeder at Solander Island in March 2001. The single Indian yellow-nosed albatross *Thalassarche carteri* and the two yellow-eyed penguins *Megadyptes antipodes* represented new taxa killed and returned during the 2006/07 fishing year.

The monthly distribution of returned specimens was not evenly spread across the fishing year. The highest monthly total was achieved in April, with 82 specimens representing 25% of all birds returned. Overall, 57% of all specimens were returned during the period February to May, with a further 30% of specimens returned during July to September (Table 2). This reflects an interaction between timing of seabird breeding and, therefore, presence of birds within New Zealand's EEZ, the timing and location of fishery operations, and observer coverage. The 'unevenness' in timing of returns is exemplified by the six most numerous species returned (Fig. 1): approximately, 85% of all white-capped albatrosses were returned in February through to April, 84% of all Buller's albatrosses were returned in April and May, and 82% of all grey petrels were returned in July and August (Table 2; Fig. 1).

TABLE 2. SPECIES AND NUMBERS OF SEABIRDS KILLED AND RETURNED FROM OBSERVED FISHING BOATS BETWEEN 1 OCTOBER 2006 AND 30 SEPTEMBER 2007, BY MONTH OF CAPTURE, SEX (M = MALE, F = FEMALE, U = UNKNOWN) AND AGE (BA = BREEDING ADULT, A = ADULT, N = NON-BREEDING ADULT, J = JUVENILE (IMMATURE), U = UNKNOWN).

SPECIES	MONTH												SEX			AGE					TOTAL	% TOTAL
	J	F	M	A	M	J	J	A	S	O	N	D	M	F	U	BA	A	N	J	U		
Antipodean albatross							1				2		1	2			1	2			3	1
Black petrel				1										1			1				1	<1
Black-browed albatross							1								1				1		1	<1
Buller's albatross			2	18	20	2	3						25	19	1	30	14		1		45	14
Campbell albatross				1			3						2	2			2	2			4	1
Chatham albatross									10				8	2		10					10	3
Common diving petrel				1									1				1				1	<1
Flesh-footed shearwater				1						5			2	4		5	1				6	2
Fluttering shearwater											1		1			1					1	<1
Gibson's albatross				1		1	2				3	2	4	5		1	2	6			9	3
Grey petrel						2	14	9	1		2		4	23	1	6	21			1	28	9
Grey-faced petrel											1	1	2				2				2	1
Indian yellow-nosed albatross								1					1					1			1	<1
Northern giant petrel		1						1						2				2			2	1
Salvin's albatross							1		17	1		3	18	4		15	4		3		22	7
Sooty shearwater	6	10	7	34	7					8	1		65	7	1	24	49				73	23
Southern Cape petrel								2					1	1			2				2	1
Southern giant petrel								1							1				1		1	<1
Southern royal albatross												1	1			1					1	<1
Unidentified *Thalassarche* albatross										1					1					1	1	<1
White-capped albatross	1	17	23	21	2	3	5						30	38	4	37	34	1			72	22
White-chinned petrel	2	11	3	4	1					12	3		25	11		25	10	1			36	11
Yellow-eyed penguin	1											1	1		1		2				2	1
Total	**10**	**39**	**35**	**82**	**30**	**8**	**30**	**14**	**28**	**27**	**13**	**8**	**192**	**121**	**11**	**155**	**146**	**15**	**6**	**2**	**324**	
% Total	**3**	**12**	**11**	**25**	**9**	**2**	**9**	**4**	**9**	**8**	**4**	**2**	**59**	**37**	**3**	**48**	**45**	**5**	**2**	**1**		

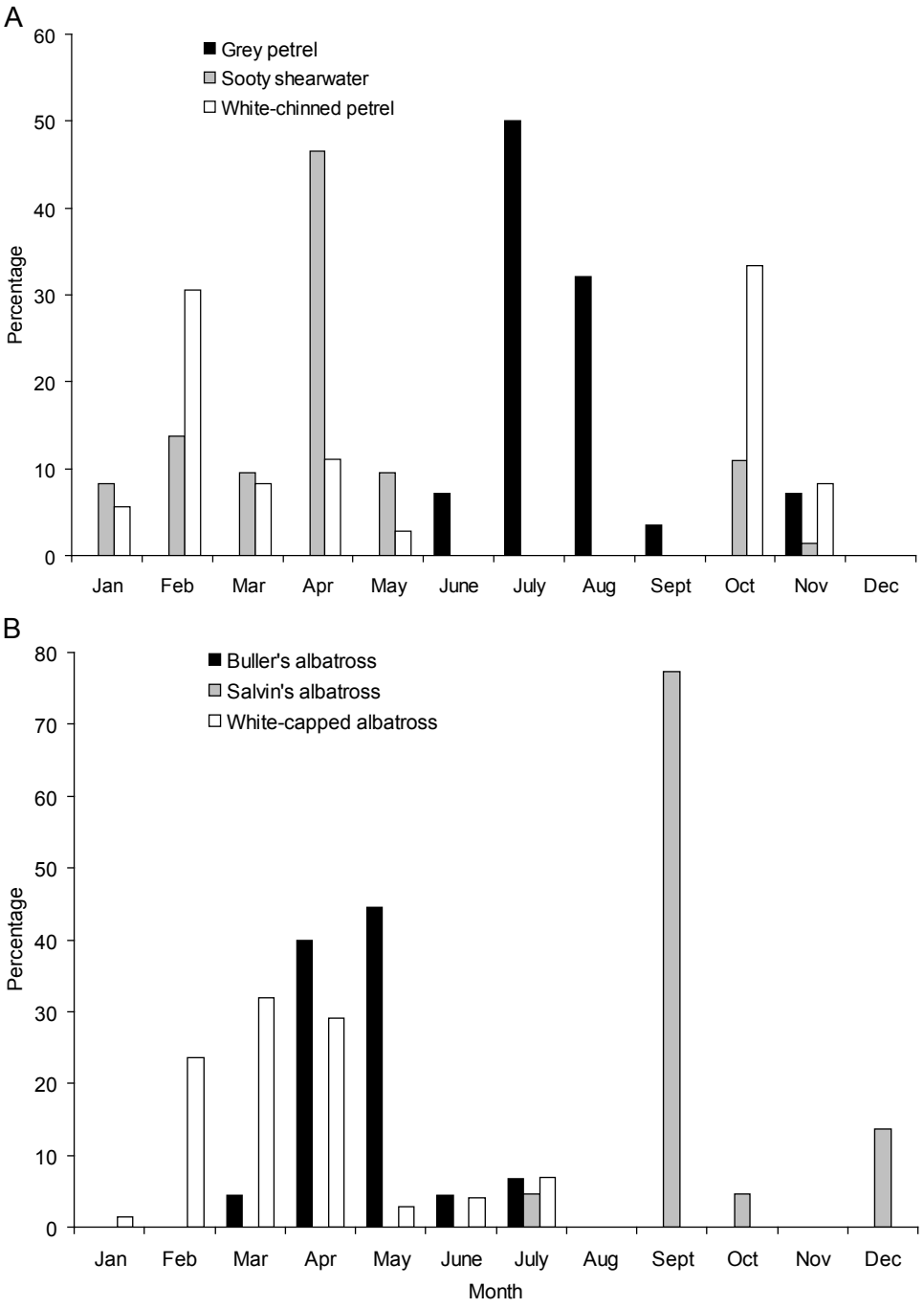

Figure 1. Proportions of A. grey petrels *Procellaria cinerea*, sooty shearwaters *Puffinus griseus* and white-chinned petrels *Procellaria aequinoctialis* and B. Buller's albatrosses *Thalassarche bulleri bulleri*, Salvin's albatrosses *Thalassarche salvini* and white-capped albatrosses *Thalassarche steadi* killed and returned between 1 October 2006 and 30 September 2007, by month.

In keeping with previous years' findings, the majority of birds returned were males (59% of all birds, and 61% of sexed birds; Table 2). This pattern was particularly the case for sooty shearwaters, where 89% of birds returned were males. Females were clearly more numerous than males in only one species—grey petrels—where they comprised 82% of birds returned (Table 2). There was a similarly strong bias in the age/status of birds returned, with 98% classified as either breeding adults, adults or non-breeding adults (Table 2). Intra-specific, competitive exclusion is a possible explanation for the almost complete absence of juvenile birds returned: older, more experienced and dominant adult birds will likely preclude younger birds from gaining access to food sources around fishing vessels.

3.2 TARGET FISHERIES AND VESSELS

Longline fisheries and trawl fisheries contributed approximately equal numbers of seabirds returned for autopsy (longline: 157 birds, 48% of total returns; trawl: 164 birds, 51%of total returns). Within the longline group, the chartered tuna fishery returned most specimens (90, 57% of all longline fishery returns; Table 3), with just two trips accounting for 82% (74 seabirds) of specimens returned in this category. Similarly, within the ling *Genypterus blacodes* longline fishery, one trip returned 64% (27 seabirds) of all specimens (Table 3). Trawlers targeting squid *Nototodarus* spp. accounted for 97 (59% of all trawl returns) specimens, with one trip contributing 29% (28 seabirds) of this total (Table 3). Trawlers targeting 'other' species returned 29 specimens, or 18% of the total trawl returns. Species targeted in this category were barracouta *Thyrsites atun*, hake *Merluccius australis*, jack mackerel *Trachurus* spp., John dory *Zeus faber*, ling, orange roughy *Hoplostethus atlanticus*, silver warehou *Seriolella punctata*, southern blue whiting *Micromesistius australis*, spiny dogfish *Squalus acanthias*, tarakihi *Nemadactylus macropterus* and white warehou *Seriolella caerulea*. The pattern of most trips and vessels returning relatively low numbers of birds,

TABLE 3. SPECIES AND NUMBERS OF SEABIRDS KILLED AND RETURNED FROM OBSERVED FISHING BOATS BETWEEN 1 OCTOBER 2006 AND 30 SEPTEMBER 2007, BY TARGET FISHERY.

SPECIES	LONGLINE				TRAWL				SETNET	TOTAL
	CHARTERED TUNA	DOMESTIC TUNA	SWORDFISH	LING	HOKI	SQUID	SCAMPI	OTHER	SHARKS	
Antipodean albatross	1		2							3
Black petrel								1		1
Black-browed albatross		1								1
Buller's albatross	38	1			1	2		3		45
Campbell albatross	3	1								4
Chatham albatross				10						10
Common diving petrel								1		1
Flesh-footed shearwater							5	1		6
Fluttering shearwater									1	1
Gibson's albatross	3		5					1		9
Grey petrel	15	7	2	1				3		28
Grey-faced petrel			2							2
Indian yellow-nosed albatross				1						1
Northern giant petrel					1		1			2
Salvin's albatross	1			16	1	3		1		22
Sooty shearwater			1	1	7	44	14	6		73
Southern cape petrel				1	1					2
Southern giant petrel					1					1
Southern royal albatross								1		1
Unidentified albatross							1			1
White-capped albatross	25	1			1	34	2	9		72
White-chinned petrel	4		2	12	2	14		2		36
Yellow-eyed penguin									2	2
Total	**90**	**11**	**14**	**42**	**15**	**97**	**23**	**29**	**3**	**324**
% Total	**28**	**3**	**4**	**13**	**5**	**30**	**7**	**9**	**1**	

with a small number of trips and vessels returning relatively large numbers of birds is highlighted in Fig. 2. As expected, the histogram plots show a 'shift to the right' from birds per trip to birds per vessel, as ten vessels made two observed trips from which birds were returned, and a further vessel made three trips from which birds were returned. It is worth noting that there was no significant relationship between the numbers of birds killed on the separate trips for each of these 11 vessels; for example, three vessels returned 40, 10 and 9 birds, respectively, from each of their first trips, but only 4, 1 and 1 birds, respectively, from each of their second trips.

For the 2006/07 fishing year, six species were caught exclusively by longline fisheries: Antipodean albatross *Diomedea antipodensis antipodensis*, black-browed albatross *Thalassarche melanophrys*, Campbell albatross *T. impavida*, Chatham albatross *T. eremita*, grey-faced petrel *Pterodroma macroptera gouldi* and Indian yellow-nosed albatross *T. carteri*. A further three species were caught

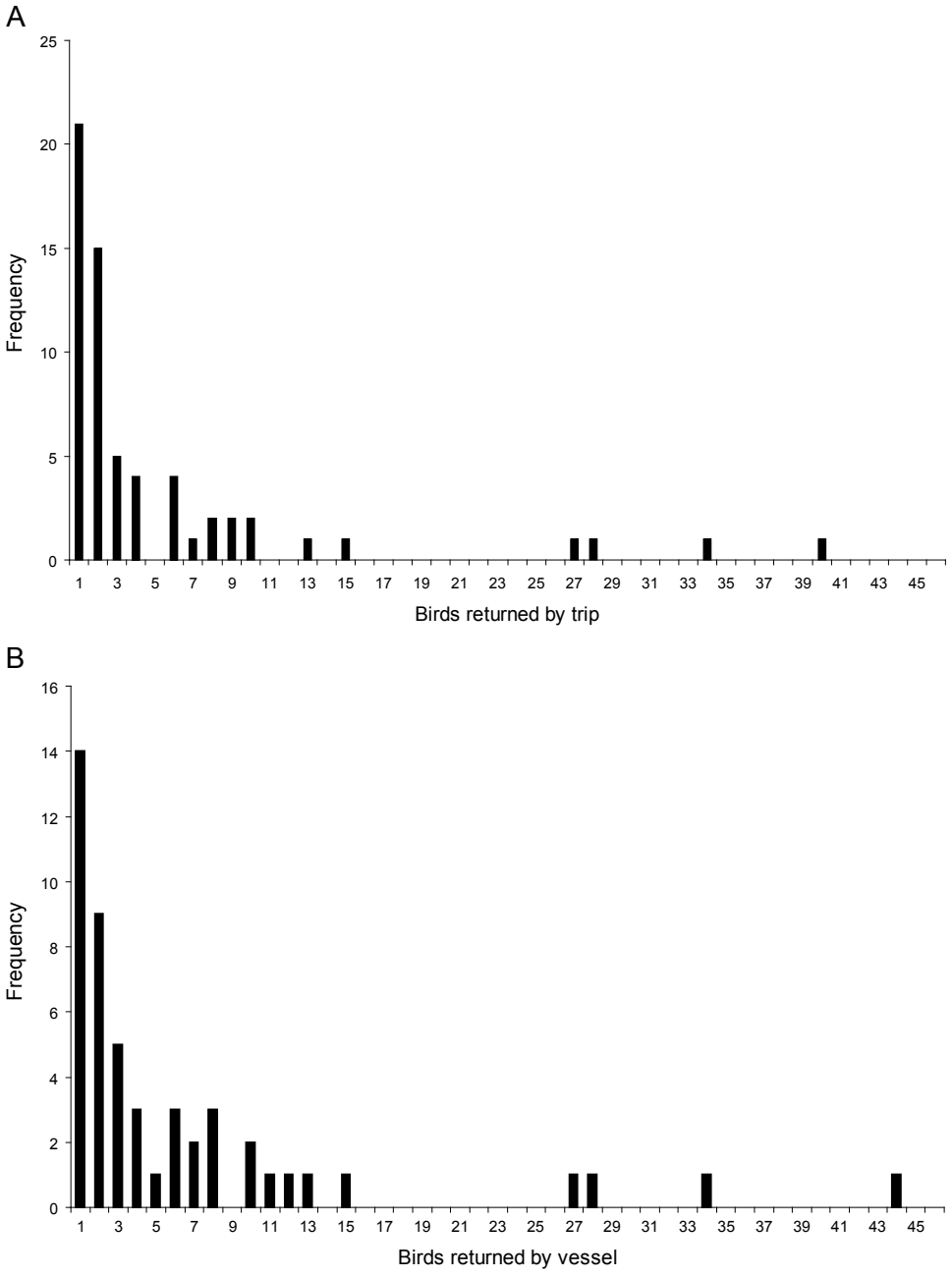

Figure 2. Number of seabirds killed and returned from A. each observed trip and B. each observed vessel between 1 October 2006 and 30 September 2007. Birds returned from two unobserved trips are included, but trips and vessels that returned no birds are not included.

almost exclusively by longline fisheries: Buller's albatross, Gibson's albatross *D. a. gibsoni* and grey petrel (Table 3). Black petrel *Procellaria parkinsoni*, common diving petrel *Pelecanoides urinatrix*, flesh-footed shearwater *Puffinus carneipes*, northern giant petrel *Macronectes halli*, southern giant petrel *M. giganteus* and southern royal albatross *D. epomophora* were captured exclusively in trawl fisheries (Table 3), and all but two sooty shearwater were also returned from trawl fisheries (Table 3). White-chinned petrel and white-capped albatross were returned in approximately equal proportions from both longline and trawl fisheries (Table 3). Yellow-eyed penguins and fluttering shearwater *P. gavia* were only captured in setnets (Table 3).

In longline fisheries overall, albatross taxa made up 69% of returned birds, with the proportion of albatross taxa highest in the chartered tuna fishery (79%) and in the ling fishery (64%; Fig. 3). In trawl fisheries overall, non-albatross taxa made up 63% of all returns, this proportion being highest in the scampi *Metanephrops challengeri* fishery (87%) and hoki fishery (80%; Fig. 3). The squid trawl fishery and 'other' trawl fisheries returned approximately equal proportions of albatross and non-albatross taxa (Fig. 3), in keeping with results from previous fishing years (summaries in Robertson et al. 2004; Conservation Services Programme 2008; Thompson 2009).

3.3 INJURIES OF RETURNED BIRDS AND LIKELY CAUSE OF DEATH

Returned birds exhibited diverse injuries. As in previous years, at one extreme, birds were described as having 'no obvious injury', and were in excellent condition both externally and internally. At the other extreme, some specimens were returned in a completely mangled state, with multiple fractures, crush injuries, pulped internal organs and missing entire organs and/or body parts. Often injury classifications were not exclusive, such that some birds exhibited many separate injuries.

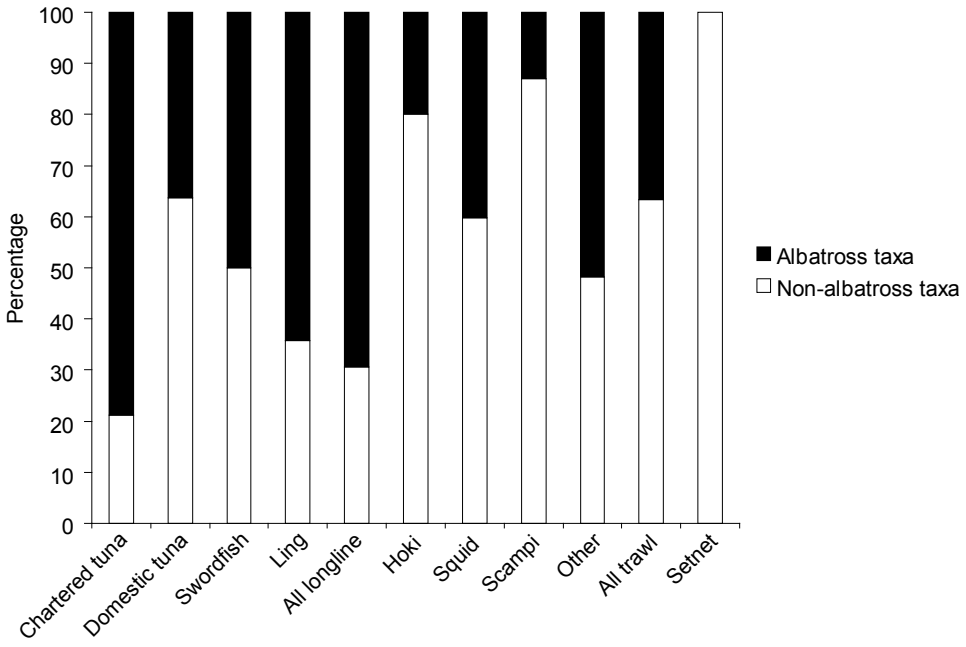

Figure 3. Proportion of albatross and non-albatross taxa killed and returned for autopsy between 1 October 2006 and 30 September 2007, by target fishery.

Not surprisingly, injuries involving hooks and snoods were recorded exclusively from birds captured in longline fisheries. Of all birds (157) returned from all longline fisheries, 144 (92%) had injuries consistent with hook impalement or snood entanglement. Of these, the large majority (84%) had injuries to the bill or throat. Albatrosses were slightly more likely to exhibit hook injuries to the bill or throat (81% of 109 birds) than non-albatrosses (69% of 48 birds), whereas both albatross (6%) and non-albatross (10%) taxa uncommonly exhibited hook and/or entanglement damage to the wing(s). In only 6% of all birds returned from longline fisheries was there no obvious sign of injury, and other injuries, including broken or badly damaged wings (6% of all birds) or legs (7%), and relatively superficial lacerations and abrasions (6%), were generally uncommon or, in the case of injuries/fractures to other bones/parts of the body absent completely.

In contrast to birds from longline fisheries, and in keeping with findings from previous fishing years (summaries in Robertson et al. 2004; Conservation Services Programme 2008; Thompson 2009), birds returned from trawl fisheries exhibited a different set of predominant injuries. For example, of the 164 birds returned from trawl fisheries, 23% had broken or badly damaged wings; the proportion of albatrosses with wing injuries (47% of 59 birds) was far greater than that in non-albatross taxa (10% of 105 birds). Wing injuries were mainly consistent with collision with warps, and included fractures, ripped skin and lacerations at the 'elbow'. They were often associated with thick, brown grease, as reported previously (Robertson et al. 2004). Among albatrosses, 32% of birds exhibited grease on the plumage, compared with less than 1% of non-albatross taxa. Of non-albatross taxa trawl returns, 23% exhibited broken or badly damaged legs. Overall, 47% of trawl returns showed no obvious injury, but only 5% of albatrosses fell into this category compared with 42% of non-albatross taxa.

Using information on injuries, and incorporating extremely valuable comments on how birds were captured (recorded by observers on the autopsy label attached to each bird), the most likely cause of death has been assigned to each bird (Table 4). For birds returned from longline fisheries, the likely cause of death mirrors, to a large extent, the main injuries sustained, and obviously entailed being hooked or entangled by the snood somewhere on the body. Birds were hooked in the bill or throat in 76% of all cases and hooked or entangled in the wing(s) in 9% of cases, legs/feet in 4% of cases and the body in 3% of cases. For a further 7% of birds returned from longline fisheries, it was not obvious how the bird died. Of birds hooked in the bill or throat, 73% were albatrosses (Table 4).

Birds returned from trawl fisheries were assigned to one of two likely cause of death categories: warp interaction and net. Specimens assigned to the 'warp interaction' category were not necessarily recovered from the warp itself; some birds that hit a warp (as shown by their injuries), could ultimately be recovered from the net. However, birds assigned to the 'net' category exhibited none of the injuries typical of interacting with a warp, rarely had brown grease on the wings and often had fish scales on the plumage (indicative of time spent in the net and/or fish pound). For all trawl fisheries combined, there were striking differences in the likely cause of death between albatross and non-albatross taxa. Although only 29% of trawl specimens could be assigned to warp interaction, 83% of these birds were albatrosses, primarily white-capped albatross (Table 4). Conversely, 70% of all birds likely died as a result of becoming entangled in the net or from diving into the net itself, and of these, 79% were non-albatross taxa, primarily sooty shearwaters and white-chinned petrels (Table 4). Indeed, of the 71 sooty

TABLE 4. LIKELY CAUSE OF DEATH OF SEABIRD SPECIES KILLED AND RETURNED FROM OBSERVED FISHING BOATS BETWEEN 1 OCTOBER 2006 AND 30 SEPTEMBER 2007.

Note: Longline specimens were either hooked or entangled by the snood; 'not obvious' indicates that it was not possible to identify a specific part of the body where this occurred. Trawl specimens classified as 'net' were deemed to have been either entangled in, or recovered from, the net.

SPECIES	LONGLINE HOOK/SNOOD					TRAWL		SET-NET	DECK-STRIKE	TOTAL
	BILL/ THROAT	WINGS	LEGS/ FEET	BODY	NOT OBVIOUS	WARP INTER-ACTION	NET			
Antipodean albatross	3									3
Black petrel							1			1
Black-browed albatross					1					1
Buller's albatross	31	2	2		4	2	4			45
Campbell albatross	4									4
Chatham albatross	8	2								10
Common diving petrel									1	1
Flesh-footed shearwater							6			6
Fluttering shearwater								1		1
Gibson's albatross	8					1				9
Grey petrel	22			1	2		3			28
Grey-faced petrel	1				1					2
Indian yellow-nosed albatross		1								1
Northern giant petrel						2				2
Salvin's albatross	13	1		1	2	5				22
Sooty shearwater	1					5	66		1	73
Southern cape petrel		1					1			2
Southern giant petrel							1			1
Southern royal albatross									1	1
Unidentified albatross						1				1
White-capped albatross	20	3	1	2		24	22			72
White-chinned petrel	9	4	3	1	1		18			36
Yellow-eyed penguin								2		2
% of total longline or trawl	**76**	**9**	**4**	**3**	**7**	**29**	**70**			
Albatrosses (%)	**73**	**64**	**50**	**60**	**64**	**83**	**21**	**0**	**33**	
Others (%)	**27**	**36**	**50**	**40**	**36**	**17**	**79**	**100**	**67**	

shearwaters returned from trawl fisheries, 66 (93%) likely died from interactions with the net. Similarly, all the 18 white-chinned petrel trawl returns were net victims (Table 4).

Both yellow-eyed penguins returned, and the single fluttering shearwater, died as a result of entanglement in set nets. In addition, there were three birds classified as killed through deckstrike (Table 4), based mainly on observer comments.

3.4 BODY CONDITION

For the six most numerous species returned historically (Table 5), mean fat scores were generally higher in birds from the 2006/07 fishing year than in previous years, excepting 1996/97 and 2005/06 (summaries in Robertson et al. 2004; Conservation Services Programme 2008; Thompson 2009), suggesting that, overall, these six species were in slightly better condition during 2006/07 than in the majority of previous fishing years for which data have been recorded.

TABLE 5. FAT SCORES FOR THE MOST NUMEROUS SIX SPECIES RETURNED HISTORICALLY.

Fat scores given on a scale of 1–5, where 1 = no fat, 2 = little fat, 3 = moderate fat, 4 = fat and 5 = very fat or so fat that examination of the body cavity was difficult; U = unknown.

SPECIES	FAT SCORE						TOTAL	MEAN ± SD
	1	2	3	4	5	U		
Buller's albatross	1	8	21	7	7	1	44	3.3 ± 1.0
Grey petrel	2	10	13	2		1	27	2.6 ± 0.8
Salvin's albatross	1	4	8	6	3		22	3.3 ± 1.1
Sooty shearwater	1	21	33	12	5	1	72	3.0 ± 0.9
White-capped albatross		19	34	15	1	3	69	3.0 ± 0.7
White-chinned petrel	1	9	10	13	3		36	3.2 ± 1.0
Total	**6**	**71**	**119**	**55**	**19**	**0**	**270**	
% Total	**2**	**26**	**44**	**20**	**7**			

Alternatively, it could be that interpretations of the fat score criteria were different between 2006/07 and all other years except 2005/06, and that birds from 2006/07 were assigned higher fat scores than would have been the case in other years. This is entirely feasible, as no comparisons were made between fat scores assigned to the same birds by different workers. However, the 1–5-point fat score is relatively restricted, given that a score of '1' represents 'no fat' and a score of '5' represents 'very fat' (Bartle 2000), or that a bird was so fat that 'examination of the body cavity becomes difficult' (Conservation Services Programme 2008). There can be little misinterpretation of a score of '1', and birds returning this score (i.e. no fat) were rare during 2006/07, and confined to six individuals (2% of 270 individuals; Table 5) of the species considered here.

In any event, linking a fat score to the probability of being captured by a fishing boat remains fraught with problems, not least of which is detecting a negative relationship between number of captures and fat score, given the non-random nature of bird acquisition.

3.5 STOMACH CONTENTS

In keeping with previous years, stomach (proventriculus) contents have been tentatively identified (presence-absence) as falling within one of nine categories, with 'no stomach' making up a tenth category (see Table 6). Ultimately, it is hoped that it will be possible to produce a more quantitative and detailed dietary account but, to date, identification of many prey remains (particularly of very small cephalopod beaks and small otoliths, which are often eroded) has proved extremely difficult.

For longline fisheries, bait alone was recorded in stomachs of birds returned from all fisheries, occurring in 67% of albatrosses returned from the ling fishery and in 57% of non-albatross taxa returned from the swordfish fishery. Additionally, bait was also recorded in conjunction with natural foods and offal (Table 6). Empty stomachs comprised 19%–75% of albatross and 13%–43% of non-albatross taxa.

For birds returned from trawl fisheries, offal alone was present in 33%–50% of albatross stomachs (Table 6) and in 15%–50% of stomachs from non-albatross taxa, with a further 13%–20% of albatross stomachs and 5%–40% of non-albatross

TABLE 6. STOMACH (PROVENTRICULUS) CONTENTS OF ALBATROSS AND NON-ALBATROSS TAXA KILLED AND RETURNED FROM OBSERVED FISHING BOATS BETWEEN 1 OCTOBER 2006 AND 30 SEPTEMBER 2007, BY TARGET FISHERY AND FISHING METHOD.
Values (except numbers of birds) are percentages of birds within each category.

STOMACH CONTENTS	LONGLINE				TRAWL				SET-NET
	CHARTERED TUNA	DOMESTIC TUNA	SWORDFISH	LING	HOKI	SQUID	SCAMPI	OTHER	SHARKS
ALBATROSSES									
No stomach	1	25			67	8		7	
Empty	62	75	29	19		28	50	20	
Natural?	8		29			5			
Sludge									
Bait	18		43	67					
Bait + natural	4								
Bait + offal	1			4					
Offal	1			11	33	46	50	53	
Offal + natural	3					13		20	
Bait + offal + natural									
Number of birds	71	4	7	27	3	39	2	15	0
NON-ALBATROSS TAXA									
No stomach				7	25	3			33
Empty	16	43	14	13	42	43	35	43	
Natural?	11	43				12	10		67
Sludge									
Bait	42	14	57	47					
Bait + natural	26		29						
Bait + offal	5								
Offal				20	33	36	15	50	
Offal + natural				7		5	40	7	
Bait + Offal + Natural				7					
Number of birds	19	7	7	15	12	58	20	14	3

stomachs containing a mix of natural food and offal. Birds had empty stomachs in 20%–50% of albatross trawl returns and 35%–43% of non-albatross trawl returns (Table 6).

3.6 SEABIRD IDENTIFICATION

Table 7 summarises identification information provided by observers on board fishing vessels, and returned on the autopsy tag attached to each specimen. The majority (80%) of seabirds from the 2006/07 fishing year were identified correctly, with only 9% of identifications inaccurate (falling to 3% if birds identified as 'ID as correct spp. group' were excluded from the 'wrong' total, since the majority of these were identified as 'shy albatross' when they were actually white-capped albatrosses).

TABLE 7. SUMMARY OF IDENTIFICATIONS RECORDED BY ON-BOARD OBSERVERS AT SEA COMPARED WITH AUTOPSY IDENTIFICATION FOR SEABIRDS KILLED AND RETURNED FROM OBSERVED FISHING BOATS BETWEEN 1 OCTOBER 2006 AND 30 SEPTEMBER 2007.

SPECIES	ID CORRECT	ID WRONG	ID AS CORRECT SPP. GROUP	ID AS SEABIRD LARGE OR ALBATROSS	ID AS PETREL OR PRION UNIDENTIFIED	ID AS SEABIRD, SEABIRD SMALL OR SEAGULL	ID NOT ON LABEL	SPECIES CODE DID NOT EXIST	TOTAL
Antipodean albatross		1	(1)	2					3
Black petrel					1				1
Black-browed albatross		1	(1)						1
Buller's albatross	39	1		1					41
Campbell albatross		2	(1)	1					3
Chatham albatross	9	1							10
Common diving petrel							1		1
Flesh-footed shearwater	5	1							6
Fluttering shearwater					1				1
Gibson's petrel		1	(1)	7			1		9
Grey petrel	17				5	1			23
Grey-faced petrel					2				2
Indian yellow-nosed albatross	1								1
Northern giant petrel		2	(2)						2
Salvin's albatross	21	1							22
Sooty shearwater	69	1			1		2		73
Southern cape petrel		1	(1)				1		2
Southern giant petrel		1	(1)						1
Southern royal albatross	1								1
White-capped albatross	55	14	(12)	1			1		71
White-chinned petrel	30				4		1		35
Yellow-eyed penguin	2								2
Total	**249**	**28**	**(20)**	**12**	**14**	**1**	**7**		**311***
% Total	**80**	**9**		**4**	**5**	**<1**	**2**		

* Excludes the single bird identified as 'unknown *Thalassarche* albatross', and 12 birds returned from two unobserved trips.

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