Autopsy report for seabirds killed and returned from New Zealand fisheries, 1 October 2001 to 30 September 2002

Birds returned by Ministry of Fisheries observers to the Department of Conservation

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C.J.R. Robertson, E. Bell and P. Scofield

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C.J.R. Robertson[1], E. Bell[2] and P. Scofield[3]

[1] Wild Press, PO Box 12-397, Wellington, New Zealand
[2] Wildlife Management International Ltd, PO Box 14-492, Wellington, New Zealand
[3] Canterbury Museum, Rolleston Avenue, Christchurch, New Zealand

ABSTRACT

Forty-seven separate fishing trips between 1 October 2001 and 30 September 2002 with on-board observers returned 689 birds killed as bycatch to various forms of fishing practice. Birds were received from squid, scampi and fish trawlers (36% of returns), domestic bottom longliners (56.9%) and pelagic tuna longliners—mainly chartered (joint-venture) (7.1%). Twenty taxa were represented, with six comprising 94.8% of returns (white-chinned petrel, white-capped albatross, sooty shearwater, Salvin's albatross, Buller's albatross, flesh-footed shearwater). During six years of the autopsy programme (1996–2002), white-chinned petrel (n = 711), white-capped albatross (n = 486), grey petrel (n = 464), sooty shearwater (n = 459), Salvin's albatross (n = 178) and Buller's albatross (n = 105) were the most commonly returned species. From 1996 to 2002, a significant proportion of the birds returned from the combined trawl and domestic bottom longliner fleets had fisheries offal or discards forming a significant part of their stomach contents. In that period the majority of the specimens (78%) were killed by a limited number of vessels (n = 19). Only 91 of the 194 individual observed vessels caught birds. The chartered (joint-venture) pelagic longline fishery, with 100% coverage and changed operating practice over 6 years, demonstrated a significant reduction in bycatch—especially among albatrosses. Each fishing practice has a small number of bird species providing a risk of significant bycatch. These results demonstrate a need to focus mitigation investigations on offal discharge, differences between vessels and their codes of practice, with the trawl fisheries being a priority.

Keywords: seabirds, bycatch, albatross, shearwater, petrel, seabird diet, fishing practice, New Zealand.

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1. Introduction

Between 1 October 2001 and 30 September 2002 (the 2000/01 fishing year), there were 689 specimens returned from 47 separate fishing trips with on-board observers, where birds were incidentally killed as a bycatch to various forms of fishing practice. Most birds were returned from domestic bottom longliners (56.9%). The trawler fleet (various fishing targets—fish, squid and scampi) provided 36% of the birds returned, while tuna longliners, mainly chartered (joint-venture) with 7.1% of the returns, made up the balance. Only the chartered (joint-venture) tuna fleet had 100% observer coverage.

The autopsies were undertaken for the Department of Conservation (DOC) as Conservation Services Programme (CSP) Contract 3051. All costs of labelling and packaging, importation under the Biosecurity Act, transportation from Port of Landing to Wellington by refrigerated truck, cold storage, and autopsy facilities were met by the levy.

In 2001/02, birds were received from squid, scampi and fish trawlers, domestic tuna pelagic longliners, chartered (joint-venture) tuna pelagic longliners, and domestic bottom (demersal) longliners (mainly fishing for ling and snapper). The number of specimens returned for autopsy does not in any way indicate probable overall catch rates for differing classes of vessel or fishing method, as the observer coverage was not equally distributed throughout the fishing effort. Specific catch locations, and the names of the vessels from which the specimens were returned, are not provided here on the grounds of commercial sensitivity as required by the Ministry of Fisheries and some parts of the fishing industry. However, the maps indicate the general location of catches and species returned for the period covered by this report and any other combined analyses. The distributions shown do not imply any specific relationship with total fishing effort or method as indicated above. They only show where the birds that were returned were killed.

2. Methods

To ensure compatibility with previous autopsy programmes, the methods and definitions described by Bartle (2000) have been followed. All species mentioned throughout this report and the Data supplement[1] are listed in Table 1, giving the common and scientific names used.

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[1] The data supplement to this report contains a table of the autopsies of 689 specimens returned from 47 separate fishing trips with on-board observers, between 1 October 2001 and 30 September 2002 (the 2001/02 fishing year). It is available from the website of the Conservation Services Programme at http://csp.org.nz, and also at http://www.doc.govt.nz/Publications/004~Science-and-Research/DOC-Science-Internal-Series/PDF/dsis155sup.pdf

The authors undertook all the autopsies and bird identifications. All birds or parts of birds returned this fishing year were identifiable to species and subspecies, with one exception. Nomenclature for the albatrosses follows Nunn et al. (1996); Robertson & Nunn (1998) and Croxall & Gales (1998). All birds were sexed by dissection, except where the specimen was severely damaged by sea lice or machinery. Full morphometric measurements were made for most specimens.

All specimens were allocated a unique autopsy number and the details of species totals and individual birds in the report are presented in Table 2 of this report and the Data supplement (see above and footnote). The unique specimen autopsy number enables easy correlation of the data within the data supplement. In some

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

COMMON NAME	SCIENTIFIC NAME
Antarctic prion	*Pachyptila desolata*
Antipodean (wandering) albatross	*Diomedea antipodensis*
black petrel	*Procellaria parkinsoni*
black-backed gull	*Larus dominicanus*
black-bellied storm petrel	*Fregetta tropica*
black-browed albatross	*Thalassarche melanophrys*
black-browed albatross spp.	*Thalassarche melanophrys/impavida*
broad-billed prion	*Pachyptila vittata*
Buller's albatross	*Thalassarche bulleri*
Buller's shearwater	*Puffinus bulleri*
Campbell albatross	*Thalassarche impavida*
cape pigeon spp.	*Daption* spp.
Chatham albatross	*Thalassarche eremita*
common diving petrel	*Pelecanoides urinatrix*
fairy prion	*Pachyptila turtur*
flesh-footed shearwater	*Puffinus carneipes hullianus*
fluttering shearwater	*Puffinus gavia*
Gibson's (wandering) albatross	*Diomedea gibsoni*
grey petrel	*Procellaria cinerea*
grey-faced petrel	*Pterodroma macroptera*
light-mantled sooty albatross	*Phoebetria palpebrata*
northern giant petrel	*Macronectes halli*
northern royal albatross	*Diomedea sanfordi*
Pacific albatross	*Thalassarche (platei)* sp. nov.
Salvin's albatross	*Thalassarche salvini*
short-tailed shearwater	*Puffinus tenuirostris*
Snares cape pigeon	*Daption australe*
snowy (wandering) albatross	*Diomedea chionoptera*
sooty shearwater	*Puffinus griseus*
southern cape pigeon	*Daption capense*
southern giant petrel	*Macronectes giganteus*
southern royal albatross	*Diomedea epomophora*
welcome swallow	*Hirundo tahitica*
Westland petrel	*Procellaria westlandica*
white-capped albatross	*Thalassarche steadi*
white-chinned petrel	*Procellaria aequinoctialis steadi*

cases, where specimens were severely damaged, it was not possible to complete all parts of the report in the data supplement. In this case a 'blank' or '?' in the data indicates a deficiency, while 'U' indicates unknown. Paul Scofield of the Canterbury Museum undertook detailed work on the stomach contents of sooty shearwaters only, as part of his studies, and a summary of the information was provided for this report.

TABLE 2. SPECIES, NUMBERS, SEX AND AGE OF BIRDS KILLED AND RETURNED FROM VARIOUS OBSERVED NEW ZEALAND FISHERIES BETWEEN 1 OCTOBER 2001 AND 30 SEPTEMBER 2002.

SPECIES	DOMESTIC BOTTOM LONGLINER	DOMESTIC TUNA LONGLINER	JOINT-VENTURE TUNA LONGLINER	SCAMPI TRAWLER	SQUID TRAWLER	TRAWLER	TOTALS	MALE	FEMALE	UNKNOWN SEX	ADULT	NON-ADULT	UNKNOWN AGE
Antarctic prion					1		**1**	1			1		
Antipodean (wandering) albatross		1					**1**		1		1		
black petrel		3					**3**	1	2		2	1	
black-browed albatross		1		1	1	1	**4**	3	1		3	1	
black-browed albatross spp.						1	**1**			1			1
broad-billed prion	1						**1**	1			1		
Buller's albatross		2	9		7	3	**21**	13	8		18	3	
Campbell albatross						2	**2**	2			1	1	
Chatham albatross	5						**5**	4	1		5		
common diving petrel	1						**1**		1			1	
flesh-footed shearwater		10					**10**	3	7		10		
grey petrel	5						**5**	5			5		
grey-faced petrel		1					**1**		1		1		
Pacific albatross	1						**1**	1			1		
Salvin's albatross	12	4	1	3	1	1	**22**	7	15		16	6	
sooty shearwater	16				74	9	**99**	85	13	1	97	2	
southern cape pigeon	3					1	**4**	3	1		3	1	
southern royal albatross			1		2	2	**5**	4	1		5		
Westland petrel			1				**1**	1			1		
white-capped albatross			10	1	120	9	**140**	87	47	6	115	17	8
white-chinned petrel	348	2	3		7	1	**361**	284	72	5	358	2	1
Totals 2001/02	**392**	**24**	**25**	**5**	**213**	**30**	**689**	**505**	**171**	**13**	**644**	**35**	**10**
Totals 1996–2002	**1091**	**52**	**519**	**22**	**816**	**348**	**2848**	**1709**	**901**	**238**	**2595**	**183**	**70**
% of those returned 2001/02	**56.9**	**3.5**	**3.6**	**0.7**	**30.9**	**4.4**	689	**73.3**	**24.8**	**1.9**	**93.5**	**5.1**	**1.5**
% of those returned 2000/01	47.6	0.5	1.1	0.1	41.5	9.2	1092	58.5	27.1	14.4	93.0	5.0	2.0
% of those returned1999/2000	37.9	1.2	10.7	1.2	18.9	30.0	243	56.0	34.5	9.5	89.7	7.4	2.9
% of those returned 1998/99	25.4	0.7	12.2	3.2	26.9	31.6	279	65.6	25.4	9.0	83.9	6.4	9.7
% of those returned 1997/98	2.0	2.5	74.0	1.5	0.5	19.5	200	34.5	64.0	1.5	93.0	5.0	2.0
% of those returned 1996/97	3.5	3.8	79.4	0.3	8.1	4.9	345	52.8	44.0	3.2	86.1	13.9	0.0
Percentage 1996–2002	*38.3*	*1.8*	*18.2*	*0.8*	*28.7*	*12.2*		*60.0*	*31.6*	*8.4*	*91.1*	*6.4*	*2.5*

3. Corrections and amendments

The 2000/01 autopsy report (Robertson et al. 2003) contained a species recording error on page 72 of the Data supplement. Autopsy # 000835 should be reported as a Pacific albatross *Thalassarche (platei)* nov. sp. The result of this change means that modifications to the totals are required in Tables 2–6 of the main report.

The first 2 years of this autopsy programme (1996–2002) had unequal reporting period lengths that did not relate to the fishing year running from 1 October to 30 September. This present report rectifies this deficiency and all data analysis has now been converted to a fishing year basis for the benefit of the present and future compilations. Only very minor changes in distribution for some earlier analyses have resulted from this change. There has been no change to the overall total of birds returned for autopsy.

4. Results and discussion

4.1 GENERAL

Some specimens showed no obvious signs of injury, even from vessel types where hook damage might have been expected. Specimens caught by trawlers mainly presented with lacerated or broken parts (especially wings), with oil and grease on the plumage indicating a probable association with wires, winches and nets during fishing operations.

A total of 20 taxa (fully distinct species) were represented (Table 2; Appendix 1 Figs A1–A7) in this fishing year. Six taxa comprised 94.8% of the returns (individual numbers were: white-chinned petrel, 361; white-capped albatross, 140; sooty shearwater, 99; Salvin's albatross, 22; Buller's albatross, 21 and flesh-footed shearwater, 10). New taxa returned and recorded for the first time in the programme were the broad-billed prion and Westland petrel.

One banded bird was returned (black petrel, H-31091; banded as a fledgling at the study colony on Great Barrier Island, 31 March 1998).

Table 3 provides a summary of all 2848 birds returned for autopsy for the 6 fishing years between 1 October 1996 and 30 September 2002 according to taxa. Thirty-four distinct taxa are represented with only 4 specimens not being identified to taxa. Table 3 demonstrates that 18 (where 10 or more have been returned) of the taxa make up 98.5% of the total. Some of these taxa are represented in the catch from a wide range of fisheries, while others form major components of single fisheries. Overall, white-chinned petrel (n = 711) has been the most returned species with grey petrel (n = 464), white-capped albatross (n = 486), and sooty shearwater (n = 459), as the most significant contributors (totalling 74% of all returns over 6 years).

Of particular concern is the growing proportion of those killed and returned coming from the trawl fleets and a significant relationship between the birds returned and the presence of fisheries offal in their stomach contents. During the 2001/02 fishing year the percentages of birds containing identifiable fisheries offal or discards according to the fishery where they were caught, was domestic bottom longliners (33%), tuna longliners (domestic & joint-venture, 8% and 12% respectively), scampi trawlers (60%), squid trawlers (49%) and fish trawlers 50%. The trend for the domestic bottom longlining fleet to return a majority of the white-chinned petrels has continued, and was exacerbated by the high catch of one vessel (see Table 7).

TABLE 3. SPECIES AND NUMBERS OF BIRDS KILLED AND RETURNED FROM OBSERVED NEW ZEALAND FISHERIES FOR THE 6 FISHING YEARS BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2002.

SPECIES	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02	TOTALS
Antarctic prion		1				1	**2**
Antipodean (wandering) albatross	52	32	2	4		1	**91**
black petrel	2	1		1	2	3	**9**
black-backed gull					1		**1**
black-bellied storm petrel			1				**1**
black-browed albatross	18	2	4	3		4	**31**
black-browed albatross spp.						1	**1**
broad-billed prion						1	**1**
Buller's albatross	8	10	30	18	18	21	**105**
Buller's shearwater					2		**2**
Campbell albatross	45	12	5	4	3	2	**71**
cape pigeon spp.			1				**1**
Chatham albatross	5				3	5	**13**
common diving petrel				1		1	**2**
fairy prion				2	2		**4**
flesh-footed shearwater	7	1	6	2	12	10	**38**
fluttering shearwater					1		**1**
Gibson's (wandering) albatross	10	19	1	4			**34**
grey petrel	66	73	70	60	190	5	**464**
grey-faced petrel		1			12	1	**14**
light-mantled sooty albatross	36	1	1				**38**
northern giant petrel	5	1	4	2	3		**15**
northern royal albatross	2				1		**3**
Pacific albatross	1				1	1	**3**
Salvin's albatross	13	2	14	23	104	22	**178**
short-tailed shearwater					33		**33**
Snares cape pigeon			1				**1**
snowy (wandering) albatross	2						**2**
sooty shearwater	19	28	62	23	228	99	**459**
southern cape pigeon		1		2	5	4	**12**
southern giant petrel				4			**4**
southern royal albatross	2	1	1	2	2	5	**13**
welcome swallow				1			**1**
Westland petrel						1	**1**
white-capped albatross	33	7	63	52	191	140	**486**
white-chinned petrel	19	7	12	34	278	361	**711**
Unknown			1	1			**2**
Totals	**345**	**200**	**279**	**243**	**1092**	**689**	**2848**

The specimens returned for 2001/02 had the highest male bias (Table 2), of annual returns over the past 4 years (Robertson & Bell 2002a, b; Robertson et al. 2003), but this continued to be primarily caused by the heavy male representation among the white-chinned petrels, white-capped albatrosses and sooty shearwaters returned. By contrast, Salvin's albatrosses continued to have a female bias. Few birds this year were returned in such a damaged state that sexing was impossible.

Table 2 continues to demonstrate that adult birds form the majority of identifiable specimens returned (93.5% for 2001/02 and 91.1% for 1996–2002). Table 4 collates the returns for 1996–2002 according to month of catch per taxa and relates the catch times to the breeding season for each taxon (27 taxa where 2 or more were returned plus the Westland petrel). Present knowledge suggests that most *Diomedea* and *Thalassarche* taxa (albatrosses) disperse or migrate out of the New Zealand Exclusive Economic Zone (EEZ) outside the breeding season (every second year for *Diomedea* if breeding is successful). For albatrosses and, probably, the larger Procellariidae, the death of a mate affects the population not only in the season when the loss occurs, but also for a further one or more non-breeding seasons until the establishment of a new pair bond.

TABLE 4. MONTHLY DISTRIBUTION OF BIRDS KILLED AND RETURNED FOR BIRD SPECIES WITH TWO OR MORE SPECIMENS RETURNED FROM FISHING BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2002.
Shaded months indicate the maximum extent of the breeding season (egg laying to fledging) for each species.

SPECIES	MONTHS											
	J	F	M	A	M	J	J	A	S	O	N	D
Antarctic prion			1			1						
Antipodean (wandering) albatross		1		21	1	16	44	8				
black petrel	2	1	1	1							1	3
black-browed albatross		1			4	9	15		1	1		
Buller's albatross	2	5	3	19	36	35	2	1	2			
Buller's shearwater					2							
Campbell albatross	1		2	4	2	21	38	2		1		
Chatham albatross		2					1	2	7	1		
common diving petrel		1								1		
fairy prion							3	1				
flesh-footed shearwater	2	17	4	13	1						1	
Gibson's (wandering) albatross				2	1	9	13	9				
grey-faced petrel					11	1				1		1
grey petrel	1		1	18	58	54	252	39	41			
light-mantled sooty albatross				36	1	1						
northern giant petrel	1					6	4			1	2	1
northern royal albatross				1		1			1			
Pacific albatross										1	1	1
Salvin's albatross	7	16	2			7	4	1	9	10	54	68
short-tailed shearwater										33		
snowy (wandering) albatross				1			1					
sooty shearwater	4	64	92	212	15	1			3	40	27	1
southern cape pigeon						1	1	3	6	1		
southern giant petrel									4			
southern royal albatross	1	1	3	4	2	1			1			
Westland petrel				1								
white-capped albatross	31	158	175	47	24	22	14	1	6	4	3	1
white-chinned petrel	33	50	26	57	4				6	22	485	30

4.2 BODY CONDITION

The body condition data for 2001/02 suggest that a range of pelagic seabirds were still experiencing a period of shorter food supply than normal (Robertson 2000; Robertson & Bell 2002a, b; Robertson et al. 2003). Table 5 provides a comparison of subcutaneous and visceral fat scores for specimens of taxa caught in significant numbers over the 6 fishing year periods from 1996/97 to 2001/02.

TABLE 5. ANNUAL COMPARATIVE SUBCUTANEOUS FAT SCORES FOR SELECTED BIRD SPECIES KILLED DURING THE 1996/97 TO 2001/02 FISHING YEARS.

SPECIES	TOTAL SPECIMENS						FAT SCORES						
	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	1	2	3	4	5	U	MEAN
Buller's albatross	**8**								1	2	5		**4.5**
		10					2	4	1	1		2	**2.1**
			30				8	11	3	2	5	1	**2.5**
				18			7	3	4		2	2	**2.2**
					18		4	4	3	2	3	2	**2.8**
						21	9	5	4		3		**2.2**
grey petrel	**66**								2	40	23	1	**4.3**
		73						24	45	4			**2.7**
			70				5	13	13	10	3	26	**2.8**
				60			11	20	7	2		20	**2.0**
					190		12	16	5	2	1	154	**2.0**
						5	4		1				**1.4**
Salvin's albatross	**13**								3	3	7		**4.3**
		2					1		1				**2.0**
			14				2	8	1	1	2		**2.5**
				23			9	9	1	3	1		**2.0**
					104		45	26	19	7	7		**2.1**
						22	7	6	2	2	5		**2.6**
sooty shearwater	**19**									7	12		**4.6**
		28					6	13	6	2	1		**2.3**
			62				8	22	21	10	1		**2.6**
				23			2	9	4	4	4		**3.0**
					228		57	85	58	20	6	2	**2.3**
						99	19	34	36	4	5	1	**2.4**
white-capped albatross	**33**								10	4	11	8	**4.0**
		7					3	1	3				**2.0**
			63				14	17	13	7	5	7	**2.5**
				52			11	10	9	7	12	3	**3.0**
					191		85	37	26	16	17	10	**2.1**
						140	54	29	20	14	8	15	**2.1**
white-chinned petrel	**19**							2	4	8	5		**3.8**
		7					1	2	2	1	1		**2.9**
			12				5	3	2		2		**2.3**
				34			2	8	9	8	6	1	**3.2**
					278		38	65	80	50	40	5	**3.0**
						361	120	104	72	42	14	9	**2.2**

U = unknown.

For all species where there is reasonable comparable data, the fat scores from 1997/98 to 2001/02 remain significantly lower than for 1996/97. This result suggests continuing food shortages for some species, or that there was something different about the scoring in 1996/97. However, when the contractors changed in 1998, there was an initial period where specimens were scored by both teams to ensure consistency of the fat scoring method. Noted again during 2001/02, principally among the white-capped albatrosses, but also among Salvin's, Buller's, black-browed and Chatham albatrosses, and southern cape pigeons, were birds presenting enlarged gall-bladders, which is generally a sign of poor feeding or fasting (Robertson et al. 2003). Some of this effect may relate to fasting at the nest site during incubation (previously noted with Salvin's and white-capped albatrosses in 2000/01), but this enlargement was also present in white-capped albatrosses during chick rearing.

Among the 6 taxa (Table 5) selected for examining fat score differences, there has been a steadily increasing yearly proportion of the lowest fat scores (= 1), reaching 34.1% of all specimens (where a score could be determined) this year. The previous 5 fishing years recorded 0%, 11%, 20%, 23% and 29% (1996–2001) respectively. The most noticeable improvement over the past 12 months has been in Salvin's albatrosses, while sooty shearwaters and white-capped albatrosses had a second consecutive year of poor condition, and the scores for white-chinned petrels declined markedly.

As shown in Appendix 1 (Figs A8–A13), the most regularly caught species come from different locations and parts of the various fishing fleets. However, there seems to be growing evidence that some species may be more at risk in some years than others if their natural food supply, and time in the breeding season, leaves them in poor body condition (Robertson et al. 2003). Fisheries that provide significant attractants in the form of offal, displaced or slow-sinking baits seem to increase their risk of bird interaction (Robertson et al. 2003). Environmental indicators of bycatch risk, additional to fishing practices, may need to be considered when setting any catch limits via proposed population management plans.

Also supporting a scenario of food shortage for some bird species have been the changes in the range of taxa (and numbers of specimens) containing extraneous (primarily) non-food or exotic food items (e.g. barnacles). Table 6 summarises the numbers of specimens containing these items for 1998–2002. There was a relationship for Salvin's and white-capped albatrosses between low fat score and the presence of seaweed or barnacles in stomach contents. Plastic scraps were the most common item overall, with one sooty shearwater containing 34 pieces. For all but one bird among the sooty shearwaters, the plastic material was found in the gizzard, which indicates the probability of its collection during their over-wintering in the Northern Hemisphere, where plastic ingestion is more prevalent (Baltz & Morejohn 1976; Day et al. 1985; Ryan 1988; Spear et al. 1995).

The high level of plastic in white-chinned petrels was probably also indicative of food scavenging practice. Unlike the hard plastic items commonly found in the shearwaters, a high proportion of those white-chinned petrels containing plastic had small pieces of clear flexible plastic (possibly pieces of bait bags) which may have looked similar to salps in the water. Of interest for this species was that, as in 2000–01 (Robertson et al. 2003), most of the gizzard contents (natural food?) rarely matched the stomach contents (baits and offal), which further supports a suggested tendency for opportunistic scavenging.

4.3 VESSEL EFFECT

Robertson et al. (2003) remarked on the significance of the small number of vessels annually killing the majority of the birds returned to the autopsy programme. In the 2001/02 fishing year 80 individual vessels were observed and 47 (59%)of them were responsible for the killing and return of the 689 birds received this year. One vessel contributed nearly 50% of the birds returned. During the 6 years (1996–2002) of the autopsy programme, some 194 separate vessels carried official Ministry of Fisheries observers on one or more voyages. Only 91 (47%) of these vessels were responsible for killing the 2848 birds that have been received for autopsy.

Robertson et al. (2003) reported that 10 vessels contributed 78% of the birds in the 2000/01 year. Table 7 shows that 19 vessels (of the 91 which returned birds) with single catches of 20 or more birds during one trip from 1996–2002 returned 78% of all birds. In 2001/02, 15 of these vessels contributed 85% of the birds returned with one vessel contributing over 50% of the returns.

It is also important to note that while some vessels catch birds on all trips, others have significant proportions of their observed trips catch-free. Figure 1 demonstrates the highly skewed distribution of the total numbers of birds caught in relation to the 91 individual vessels returning birds. However, the

TABLE 6. SUMMARY OF EXTRANEOUS (PRIMARILY) NON-FOOD ITEMS RECORDED IN BIRD STOMACH AND GIZZARD CONTENTS FOR 4 YEARS FROM 1 OCTOBER 1998 TO 30 SEPTEMBER 2002.
The numbers of birds containing the relevant items are shown by year, separated by commas, and the most indicative numbers are shown in bold type.

SPECIES	PLASTIC & RUBBER	STONES & GRIT	SEAWEED	BARNACLES & SHELL	SEEDS & VEGETATION	CORD & ROPE	WOOD	FEATHERS & HAIR	PAINT FLAKES
Antarctic prion		0, 0, 0, 1							
Antipodean (wandering) albatross	0, 1, 0, 0								
black petrel	0, 0, 1, 0								
black-backed gull			0, 0, 1, 0						
Buller's albatross	1, 0, 0, 0		2, 0, 0, 1	1, 0, 1, 2					
cape pigeon spp.	1, 0, 0, 0								
Chatham albatross			0, 0, 0, 2	0, 0, 1, 3					
flesh-footed shearwater	2, 1, 4, 6	2, 0, 3, 0							
grey petrel	0, 0, 0, 1	0, 0, 3, 0							
northern giant petrel	1, 0, 0, 0	1, 0, 0, 0	1, 0, 1, 0			3, 1, 2,0			
Salvin's albatross	1, 0, 1, 0	0, 0, 1, 0	1, 2, **20,** 4	0, 3, **11, 6**	0, 0, 1, 0	0, 0, 1, 0	1, 0, 0, 0		
short-tailed shearwater	0, 0, **27,** 0	0, 0, **19,** 0	0, 0, 1, 0	0, 0, 1, 0		0, 0, 1, 0	0, 0, 2, 0	0, 0, 1, 0	
sooty shearwater	**20**, 4, **79, 30**	6, 1, **26, 15**	2, 0, 0, 3	0, 0, 0, 1		1, 1, 0, 4	4, 0, 0, **8**	0, 0, 0, 1	
southern cape pigeon	0, 0, 2, 1	0, 1, 1, 3					0, 0, 1, 0		
southern giant petrel			0, 2, 0, 0				0, 3, 0, 0		
white-capped albatross	0, 0, 2, 0		1, 0, **18, 6**	0, 0, **17, 8**		0, 0, 1, 0			
white-chinned petrel	1, 1, **30, 34**	1, 0, **11, 17**	0, 2, **6**, 3	0, 0, 1, 1	0, 0, 4, 4	0, 0, **16, 7**		0, 0, 0, 1	0, 0, 4, 2

mean number of birds caught per observed trip provides a more realistic view of the potential problem vessels. A comparison with Table 7 confirms that some potential problem vessels lie among those that have currently only low to moderate total catches of birds.

There continues to be a fairly consistent 40–60% of vessels annually which do not catch birds throughout the observed fisheries. While there may be many reasons within the complex factors affecting fisheries interaction and bycatch for such a proportion, there continues to be at least one discernable reason why vessels do not catch birds equally. The analyses of stomach contents discussed below (Section 4.4) and in previous autopsy reports (Robertson & Bell 2002b; Robertson et al. 2003) suggests that the discharge of offal while towing or setting fishing gear seems to provide a significant risk of attracting birds into killing situations.

4.4 FISHING PRACTICES

Figure 2A records the differing proportions of offal contained in the bird bycatch specimens for 14 vessels from the squid trawl fishery from 1996–2002. Figure 2B shows the generalised distribution of bird species groups killed by the same vessels. (All vessels shown caught a total of 20 or more birds from 1996–2002.) Each vessel has a variable number of observed trips when birds were caught. Vessels with the highest levels of small albatross bycatch were also those vessels where the specimens returned contained the greatest proportion of offal in the stomach contents. The quite marked difference in offal content of the catch between vessels over a number of years suggests the urgent need for some investigation into the fishing practice or types of vessels involved, to determine the reasons for such variation.

Where small albatrosses were caught, the great majority were snared by the warp cables and were extensively fouled with grease. While most had injuries to one wing consistent with snagging on the cable, some had similar injuries to both wings. This suggests a possible scenario of an initial strike, causing incapacitation, followed by a further strike of the same bird. As birds which are recovered must be entangled enough to be lifted by the warps until they are recovered on board, there must be some concern for the recovery from warp strikes for birds which do not get similarly entangled. Laceration-type injuries from warp strikes at the 'elbow' of the wing, are usually present in trawl specimens with damage to the tendons and breakage of narrow bones. Birds similarly injured, but not recovered on board, would seem to have a poor chance of efficient flight. Clipping the warps with the outer part of the wing may reduce the level of skin, muscle and bone damage, but can result in grease contamination on the primary flight feathers.

Bartle (1991) reported on the incidental capture of albatrosses in the subantarctic squid fishery during 1990. In that year, a specific type of vessel and gear (netsonde cable) was implicated in the killing of 236 white-capped albatrosses. The use of this gear was subsequently discontinued. Robertson et al. (2003) reported for the 2000/01 fishing year that 180 white-capped albatrosses were caught in the squid fishery during a year when there was 100%

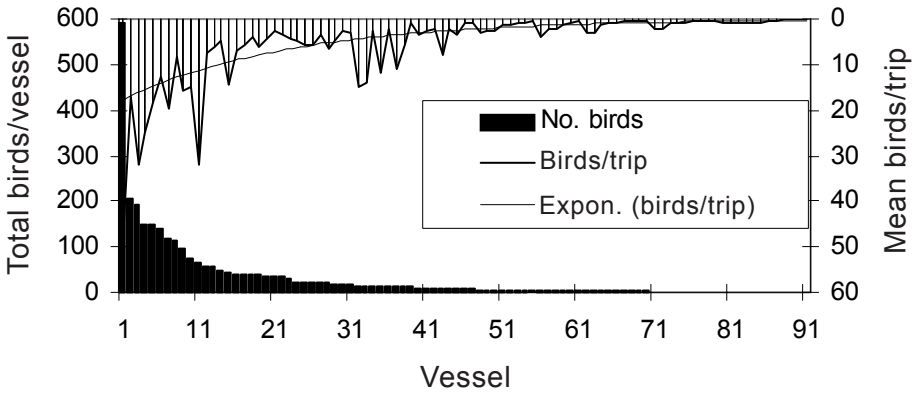

Figure 1. Distribution of birds killed and returned by New Zealand fisheries from 1 October 1996 to 30 September 2002, showing number of birds per vessel for the 91 individual observed vessels that returned birds. The mean number of birds returned per trip is enhanced with an exponential trend line to emphasise those vessels with the highest rates of bycatch. The drop lines from the zero axis to the mean birds/trip line equate to the columns representing the birds per vessel below.

TABLE 7. NUMBER OF BIRDS KILLED AND RETURNED BY INDIVIDUAL VESSELS OVER 6 FISHING YEARS, 1 OCTOBER 1996 TO 30 SEPTEMBER 2002, FOR ALL OBSERVED VESSELS WHICH RETURNED A TAKE OF 20 OR MORE BIRDS, ON ONE OR MORE TRIPS.

VESSEL[1]	FISHERY TYPE[2]	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02	TOTALS	TRIPS WHEN BIRDS CAUGHT	NO. OF OBS. TRIPS
A	BLL	9	1	6	65	178	332	**591**	8	12
B	BLL			33	(78)[3]	169	5	**202**	5	12
C	JVTLL	135	44	8		2	4	**193**	5	6
D	ST+T		1		11	133	6	**151**	6	6
E	ST+T		10	4	9	123	2	**148**	8	8
F	BLL+DTLL	3	2		13	115	7	**140**	5	11
G	JVTLL	47	43	1	23	4	1	**119**	6	6
H	BLL	3	1	32		32	48	**116**	7	14
I	JVTLL	25	53	17				**95**	5	6
J	ST+T				3	49	22	**74**	5	5
K	JVTLL	64						**64**	2	2
L	ST+T	1		4	3	51		**59**	6	8
M	ST			1	2	23	31	**57**	5	9
N	ST+T	1			3	14	28	**46**	6	10
O	ST+T	1		1		2	37	**41**	5	7
P	T		20	20	1			**41**	3	6
Q	ST+T				2	8	24	**34**	5	12
R	DTLL	4					20	**24**	2	5
S	ST+T						20	**20**	1	3
Totals		**293**	**175**	**127**	**135**	**903**	**587**	**2215**	**95**	**148**
Percentage of fishing year birds returned for autopsy		**85%**	**87%**	**46%**	**56%**	**83%**	**85%**	**78%**		

[1] Individual vessels are not named but are coded A to S.

[2] BLL = domestic bottom longliner; JVTLL = joint-venture [chartered] tuna longliner; DTLL = domestic tuna longliner; ST+T = squid trawl [principally] with some fish trawl trips; T = fish trawl.

[3] Birds identified from photos, but not returned and not included in table totals (see Robertson & Bell 2002b).

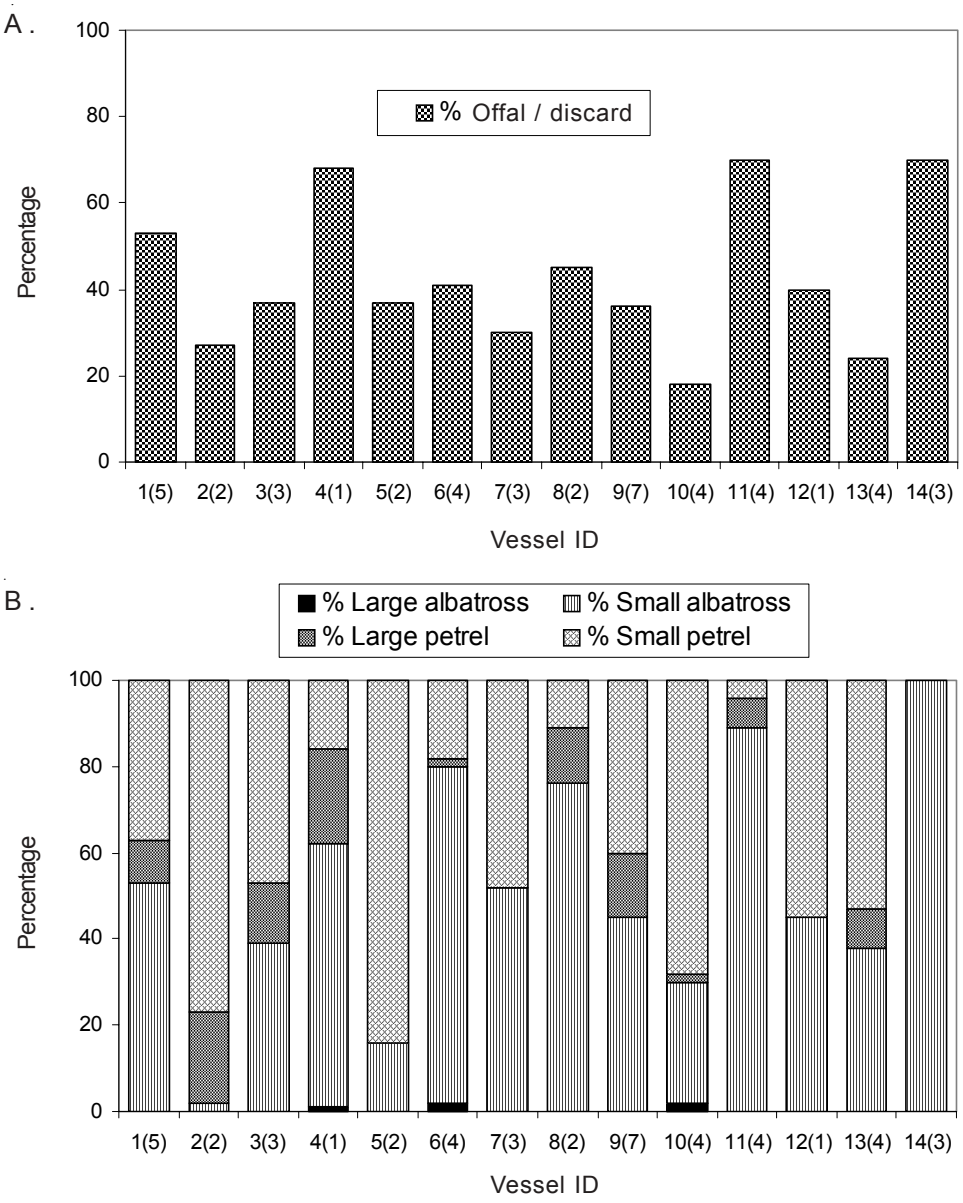

Figure 2. Comparison of 14 vessels from the squid trawl fishery (1996 to 2002). A. Percentage offal / discard in stomach contents of birds caught and returned. B. Percentage of birds caught, broken down by type. (Figures in parentheses with the vessel ID show the number of observed trips in the sample for each vessel.)

observer coverage of that fishery. In the 2001/02 year 120 white-capped albatrosses were caught in this fishery when there was a reported 20% observer coverage. Clearly, there is still a very significant problem, whether it be related to a shortage of the birds' natural food supply causing them to scavenge more waste, or the risk of interaction with the vessel type, the gear used, and the operational fishing practices in that fishery.

Figure 3A shows the differing proportions of offal contained in the bird bycatch specimens for 8 vessels from the trawl fishery from 1996–2002. Figure 3B shows the generalised distribution of bird species groups killed by the same vessels. All the vessels shown in the figure caught a total of 10 or more birds from 1996–2002. A pattern similar to that in the squid trawl fishery is evident, even though the total numbers of birds caught are smaller. However, it is evident from the list of trawl vessels that have been observed over the past 6 years, that some of them consistently did not catch birds. Although it is not possible to comment on their practice here (because there are no specimens to investigate), it may be significant that regular killers of birds seemed to have

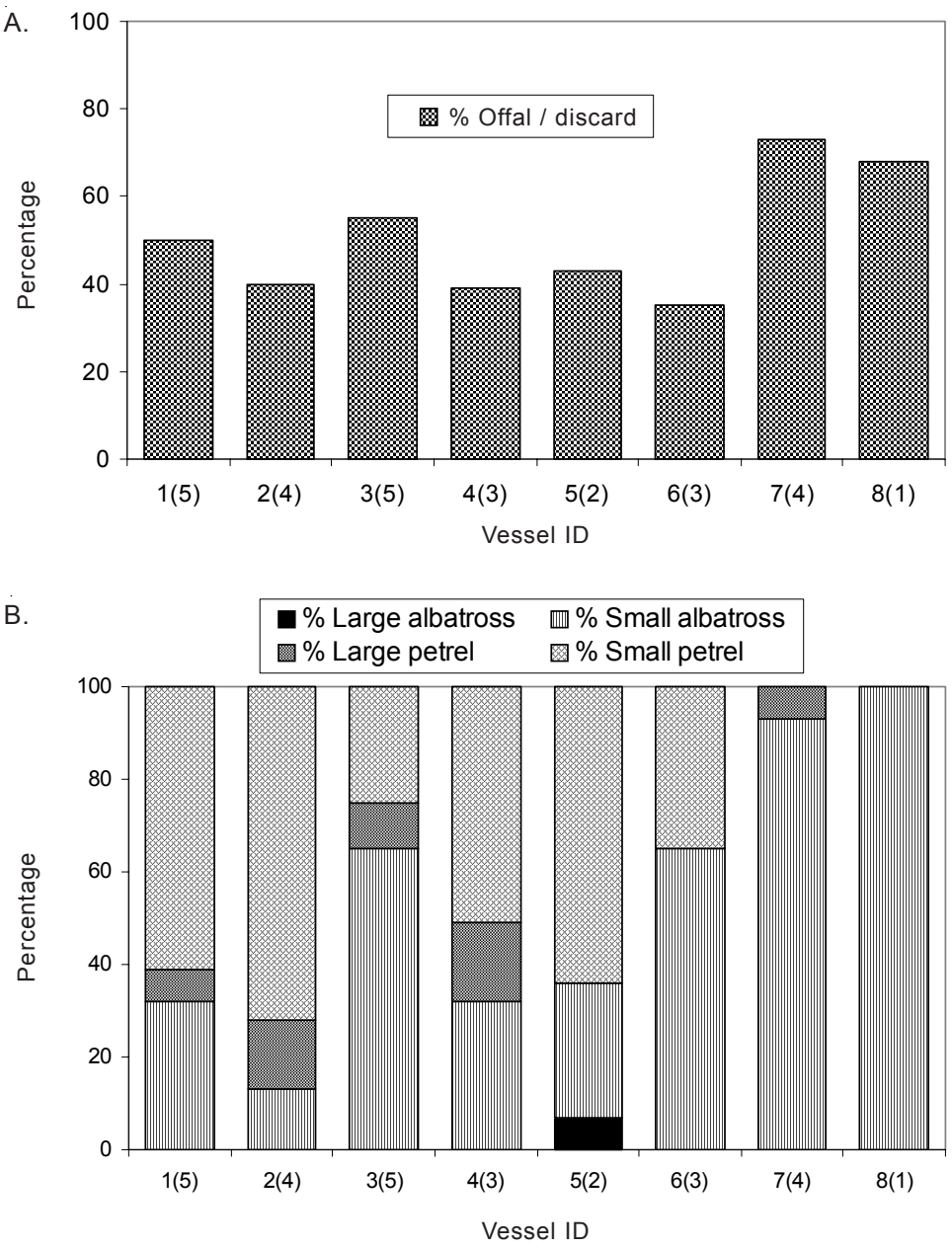

Figure 3. Comparison of 8 vessels from the trawl fishery (1996 to 2002). A. Percentage offal / discard in stomach contents of birds caught and returned. B. Percentage of birds caught, broken down by type. (Figures in parentheses with the vessel ID show the number of observed trips in the sample for each vessel).

long trips, which suggests a relationship with processing their catch at sea, as against shorter trips and processing ashore. Fishing practice which dumps processing offal and discards under trawl wires during trawling would seem to enhance the risk of significant bird bycatch, unless serious mitigation practices are employed.

Figure 4A shows the differing proportions of offal and baits contained in the bird bycatch specimens for 7 vessels from the bottom (demersal) longline fishery from 1996–2002. Figure 4B shows the generalised distribution of bird species groups killed by the same vessels. All vessels shown in the figure caught a total of 10 or more birds from 1996–2002. The majority of the vessels were targeting ling, but vessels '1' and '3' were targeting snapper. While there have been some significant improvements reported in mitigation practices in the bottom longline fishery (following a new industry Code of Practice), both the catch rates and stomach contents point to offal / discards as a significant risk factor for vessels on long trips processing at sea. It has been suggested that as

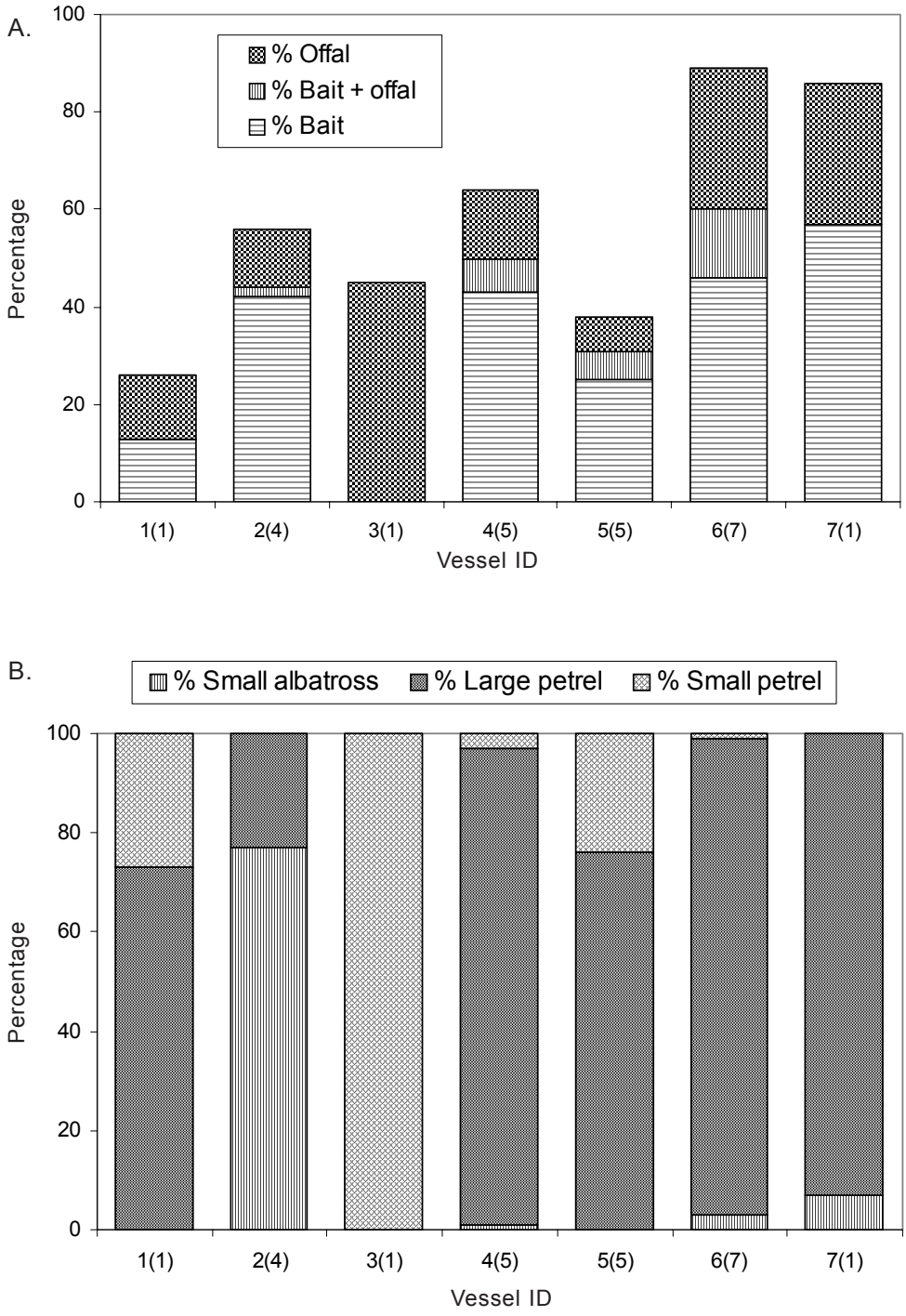

Figure 4. Comparison of 7 vessels from the bottom longliner fishery (1996 to 2002). A. Percentage offal and bait in stomach contents of birds caught and returned. B. Percentage of birds caught, broken down by type. (Figures in parentheses with the vessel ID show the number of observed trips in the sample for each vessel).

much as 25% of bait from auto-baiting machines may be lost from the hooks, some of which may be washed overboard or flung off while the hook is in the air during setting. This suggests that 'discarded' baits could act in much the same way as discarded processing offal, by providing an attractant for birds to scavenge at setting. Very few birds returned for autopsy presented with dry plumage that would indicate capture at the haul.

The ling fishery has recorded significant catches of white-chinned petrels, grey petrels and Salvin's albatrosses. The hook position has been recorded for most of these specimens since 1998. About 15% of specimens for each species showed no evidence of hook presence or damage. Salvin's albatrosses were most likely to be hooked in the mouth / bill (65% of all specimens) while grey

and white-chinned petrels (74% and 58% respectively) were most likely to be foul-hooked either in the wing or the body. Foul-hooked birds often had a complete bait attached to the hook embedded in the body or wing.

The five vessels targeting ling in Fig. 4 showed different patterns of hook position for their bycatch of white-chinned petrels. Vessels '6' and '7' had 66% (n = 338 birds) of their birds foul-hooked on the wing or the body; vessels '2' and '4' had 43% (n = 179). Vessel '5' had 50% (n = 53) foul-hooked, the lowest proportion of birds hooked in the bill (13%) and the highest proportion with no evident hook damage.

4.5 TIME AND LOCATION

While Table 4 shows the distribution of all birds returned according to month and breeding season from the 6 years of the autopsy programme (1996–2002), it is important to look at the distributions according to fishery, and examine the times of the year when species bycatch is the highest, and what fishery is involved.

Table 8 shows that catches from the observed squid trawl fishery are concentrated from January to April / May and that it is predominantly catching birds in the southern and subantarctic parts of the EEZ, during the breeding

TABLE 8. MONTHLY DISTRIBUTION OF BIRDS KILLED AND RETURNED FROM THE SQUID TRAWL FISHERY FOR BIRD SPECIES WITH TWO OR MORE SPECIMENS IN ANY FISHERY BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2002.
Shaded months indicate the maximum extent of the breeding season (egg laying to fledging) for each species.

SPECIES	MONTHS											
	J	F	M	A	M	J	J	A	S	O	N	D
Antarctic prion			1									
Antipodean (wandering) albatross					1							
black petrel												
black-browed albatross					1							
Buller's albatross	1	2	3	8	4							
Buller's shearwater												
Campbell albatross	1											
Chatham albatross												
common diving petrel		1										
fairy prion												
flesh-footed shearwater												
Gibson's (wandering) albatross												
grey-faced petrel												
grey petrel				2								
light-mantled sooty albatross												
northern giant petrel												
northern royal albatross												
Pacific albatross												
Salvin's albatross	1	3	1									
short-tailed shearwater												
snowy (wandering) albatross												
sooty shearwater	4	61	75	180	1							
southern cape pigeon												
southern giant petrel												
southern royal albatross			3									
Westland petrel												
white-capped albatross	28	155	168	20	1							
white-chinned petrel	15	34	23	17								

season for all species. Many of these vessels seem to also target fish during trips where the main target of the trip was squid (Robertson et al. 2003).

Table 9 shows that catches from the trawl fishery are distributed over all months of the year. While the majority of birds are caught during the breeding seasons, a number are being caught outside their breeding seasons, and over a wider area than that for the squid trawl fishery alone (see fig. 12 in Robertson et al. 2003).

Table 10 shows the scampi trawl fishery is generally an insignificant contributor to the observed bird bycatch. However, the mode of capture is similar to the other trawl fisheries. These vessels lack the extensive waste discharge of processing trawlers in the squid and fish fisheries.

Table 11 shows that while the domestic bottom longline fishery occurs throughout the year, it is mainly catching birds during their breeding seasons with a few species at risk outside the breeding periods. As with other fisheries, a limited number of species form the majority of the bycatch.

Tables 12 and 13 show the distribution of incidental bycatch from the chartered (joint-venture) pelagic tuna longline fishery. This fishery has had 100% observer coverage for the full 6 years of the programme and with a combination of mitigation practices has significantly reduced its bycatch rate. Their fishing is

TABLE 9. MONTHLY DISTRIBUTION OF BIRDS KILLED AND RETURNED FROM THE TRAWL FISHERY FOR BIRD SPECIES WITH TWO OR MORE SPECIMENS IN ANY FISHERY BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2002.

Shaded months indicate the maximum extent of the breeding season (egg laying to fledging) for each species.

SPECIES	MONTHS											
	J	F	M	A	M	J	J	A	S	O	N	D
Antarctic prion						1						
Antipodean (wandering) albatross												
black petrel												
black-browed albatross					2		1		1	1		
Buller's albatross		1		2	8	19	1	1	2			
Buller's shearwater												
Campbell albatross			2	1			4	1		1		
Chatham albatross		2								1		
common diving petrel												
fairy prion							3	1				
flesh-footed shearwater												
Gibson's (wandering) albatross												
grey-faced petrel						1						
grey petrel						1		1	3			
light-mantled sooty albatross												
northern giant petrel	1					2				1	2	
northern royal albatross									1			
Pacific albatross										1		
Salvin's albatross	2							1	5	6	10	8
short-tailed shearwater										33		
snowy (wandering) albatross												
sooty shearwater		2	13	31	12				3	29	11	1
southern cape pigeon							1	2	3	1		
southern giant petrel												
southern royal albatross	1	1		1		1			1			
Westland petrel												
white-capped albatross	3	2	6	9	16	12	13	1	6	3	3	1
white-chinned petrel				3					1	11	3	

concentrated primarily from April to August. There has been a marked change, not only in the rate of bycatch, but also in the range of species caught between the 2-year (1996–98) period (Table 12) and the subsequent 4 years (Table 13). These changes in species bycatch composition also reflect a change to the areas being fished, with the area about East Cape largely avoided in more recent years due to early season closures (C. Hufflett pers. comm.).

Table 14 shows the species bycatch distribution for the domestic pelagic longline fishery. Operating principally for 9 months of the year, this fishery is predominantly operated by small vessels and has yet to have significant observer coverage. Captures include some significant 'at risk' species such as black petrel.

Neither of the two pelagic longline fisheries discussed above showed any significant offal content (< 5% in their bycatch birds, 1996–2002) but did have 29–38% of stomach contents showing principally as bait (Robertson et al. 2003). The use of whole squid and fish for bait may lead to less bait loss during setting, compared with the amount of loss which occurs from machine baiting with fish pieces in the bottom longline fishery. There is also less foul-hooking of the birds, which suggests that there are fewer substantial food attractants behind the vessel. Increasing the sink rate of the line lowers the risk of capture for those species that dive for the descending baited hooks during setting (Robertson 2000).

TABLE 10. MONTHLY DISTRIBUTION OF BIRDS KILLED AND RETURNED FROM THE SCAMPI TRAWL FISHERY FOR BIRD SPECIES WITH TWO OR MORE SPECIMENS IN ANY FISHERY BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2002.

Shaded months indicate the maximum extent of the breeding season (egg laying to fledging) for each species.

SPECIES	MONTHS											
	J	F	M	A	M	J	J	A	S	O	N	D
Antarctic prion												
Antipodean (wandering) albatross												
black petrel												
black-browed albatross							1					
Buller's albatross												
Buller's shearwater												
Campbell albatross												
Chatham albatross												
common diving petrel												
fairy prion												
flesh-footed shearwater		3	1								1	
Gibson's (wandering) albatross												
grey-faced petrel												
grey petrel												
light-mantled sooty albatross												
northern giant petrel												
northern royal albatross												
Pacific albatross												1
Salvin's albatross							1			3	1	
short-tailed shearwater												
snowy (wandering) albatross												
sooty shearwater		1	4							1		
southern cape pigeon												
southern giant petrel												
southern royal albatross												
Westland petrel												
white-capped albatross			1			2				1		
white-chinned petrel												

It may be significant that the only fishery to have had extended 100% observer coverage has recorded not only a major reduction in the catch rate of birds, but a change in the species composition of those caught. This is best summarised in Table 15. While it may be argued that the only reason for this change is observer coverage and effective external 'peer' pressure, the fishery should also be credited with some quite significant changes in their operating practices, and procedures to avoid transferring any accompanying flock of birds when changing fishing grounds.

Appendix 1 (Figs A1–A7) summarises the distribution of all birds killed during the period 1 October 2001 to 30 September 2002. Appendix 1 (Figs A8–A13) summarises the distribution of catches, according to fishing type, for the six most commonly caught bird species from 1 October 1996 to 30 September 2002. The latter maps also serve to illustrate significant areas of risk for different fisheries and species of seabird, to match the figures shown in Table 16.

TABLE 11. MONTHLY DISTRIBUTION OF BIRDS KILLED AND RETURNED FROM THE DOMESTIC BOTTOM LONGLINE FISHERY FOR BIRD SPECIES WITH TWO OR MORE SPECIMENS IN ANY FISHERY BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2002.

Shaded months indicate the maximum extent of the breeding season (egg laying to fledging) for each species.

SPECIES	MONTHS											
	J	F	M	A	M	J	J	A	S	O	N	D
Antarctic prion												
Antipodean (wandering) albatross												
black petrel												
black-browed albatross												
Buller's albatross	1					2						
Buller's shearwater					2							
Campbell albatross												
Chatham albatross								2	7			
common diving petrel										1		
fairy prion												
flesh-footed shearwater				11	1							
Gibson's (wandering) albatross												
grey-faced petrel											11	
grey petrel	1		1	7	58	46	139	24	38			
light-mantled sooty albatross												
northern giant petrel						2						1
northern royal albatross												
Pacific albatross											1	
Salvin's albatross	4	8							4	1	43	60
short-tailed shearwater												
snowy (wandering) albatross												
sooty shearwater				1	2	1				10	16	
southern cape pigeon						1		1	3			
southern giant petrel									4			
southern royal albatross												
Westland petrel												
white-capped albatross						1						
white-chinned petrel	18	13	10	3					5	11	482	30

4.6 RISK

The preceding analyses and summaries demonstrate very clearly that, based on the material returned from observed vessels, a pattern of bycatch is starting to appear among the New Zealand fisheries. In spite of there usually not being 100% observer coverage, and some changes in operating practice within fisheries, Table 16 shows (on the basis of numbers caught) the likelihood of bird species being at risk in certain fisheries. Though as yet relatively low in numbers caught, the black petrel and the Chatham albatross are both included because of their endangered status. It is clear from this summary that there is no 'golden mitigation' that will solve the risk across fisheries.

As discussed in Section 4.4, the role of offal as an attractant should be regarded as a major bycatch risk factor in the trawl and the bottom longline fisheries. If that factor was removed or significantly reduced, then it might become more obvious what the underlying problem(s) requiring mitigation in the relevant fisheries may be. The relevant parts of the industry where offal discharge occurs coincident with bird bycatch cannot be deemed to have a sustainable fishery, when their operating practices seem to expose them to the risk of catching birds in significant numbers.

TABLE 12. MONTHLY DISTRIBUTION OF BIRDS KILLED AND RETURNED FROM THE JOINT-VENTURE (CHARTERED) TUNA LONGLINE FISHERY FOR BIRD SPECIES WITH TWO OR MORE SPECIMENS IN ANY FISHERY OVER 2 YEARS BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 1998.
Shaded months indicate the maximum extent of the breeding season (egg laying to fledging) for each species.

SPECIES	MONTHS											
	J	F	M	A	M	J	J	A	S	O	N	D
Antarctic prion												
Antipodean (wandering) albatross				19		13	43	7				
black petrel												
black-browed albatross					1	8	11					
Buller's albatross				3	14							
Buller's shearwater												
Campbell albatross				1	1	19	32					
Chatham albatross							1					
common diving petrel												
fairy prion												
flesh-footed shearwater												
Gibson's (wandering) albatross				1		4	13	9				
grey-faced petrel												
grey petrel				9		6	106	13				
light-mantled sooty albatross				35	1	1						
northern giant petrel						2	4					
northern royal albatross				1		1						
Pacific albatross												
Salvin's albatross						7	3					
short-tailed shearwater												
snowy (wandering) albatross				1			1					
sooty shearwater												
southern cape pigeon												
southern giant petrel												
southern royal albatross				1	1							
Westland petrel												
white-capped albatross				6		5	1					
white-chinned petrel				16	1							

Following an investigation into the operation of the Conservation Services Programme (instigated by a complaint from a body representing the fishing industry), Brady (2002, p. 74–75) noted that the past autopsy reports (Robertson & Bell 2002a, b) drew specific attention to offal / discards and the bycatch activities of a limited number of vessels. He recommended the need for a more active role in ensuring that such findings were translated, where appropriate, into improved fishing practice. His recommendations were addressed to DOC and the Ministry of Fisheries who have a regulatory role. However, it is clear that operationally, while some parts of the industry are actively pursuing mitigation practices, other parts such as the squid fishery seem to have made little obvious change to practice or vessels since those autopsy findings were made public in either draft or published form.

4.7 OBSERVERS

The fisheries observers have a difficult task in recovering specimens and providing the necessary location and identification information for each specimen before it is packed. This is especially so when there are large numbers of birds caught at one time. The nature of exact identification for some species

TABLE 13. MONTHLY DISTRIBUTION OF BIRDS KILLED AND RETURNED FROM THE JOINT-VENTURE (CHARTERED) PELAGIC LONGLINE TUNA FISHERY FOR BIRD SPECIES WITH TWO OR MORE SPECIMENS IN ANY FISHERY OVER 4 YEARS BETWEEN 1 OCTOBER 1998 AND 30 SEPTEMBER 2002.
Shaded months indicate the maximum extent of the breeding season (egg laying to fledging) for each species.

SPECIES	MONTHS											
	J	F	M	A	M	J	J	A	S	O	N	D
Antarctic prion												
Antipodean (wandering) albatross						3	1	1				
black petrel												
black-browed albatross						2	1					
Buller's albatross				6	10	14	1					
Buller's shearwater												
Campbell albatross				1	1		2	1				
Chatham albatross												
common diving petrel												
fairy prion												
flesh-footed shearwater												
Gibson's (wandering) albatross				1		4						
grey-faced petrel												
grey petrel						1	7	1				
light-mantled sooty albatross				1								
northern giant petrel												
northern royal albatross												
Pacific albatross												
Salvin's albatross			1									
short-tailed shearwater												
snowy (wandering) albatross												
sooty shearwater												
southern cape pigeon												
southern giant petrel												
southern royal albatross				2	1							
Westland petrel				1								
white-capped albatross		1		12	7	2						
white-chinned petrel				11								

may be more easily ascertained with experience and improved published descriptions. Table 17 analyses the identifications provided (or not provided) by observers on the labels returned with the specimens. This information is presented for the record only and should not be construed as a criticism of the observers. The results are important, however, when assessing the reliability of identifications for other specimens, not returned for autopsy, but released after capture. Such records of released birds may then be used within other assessments of the total bycatch. The data shown in Table 17 continues to indicate that identifications of birds released at sea may need to be treated with caution.

4.8 SPECIMENS

From 1 January 1998 until 30 March 2003 a wide range of bycatch specimen material following autopsy was provided to a range of institutions and studies. University of Otago and Massey University students have been provided with 519 specimens (mainly sooty shearwaters); New Zealand museums received 53 specimens; museums outside New Zealand 1; University of Wollongong,

TABLE 14. MONTHLY DISTRIBUTION OF BIRDS KILLED AND RETURNED FROM THE DOMESTIC PELAGIC LONGLINE FISHERY FOR BIRD SPECIES WITH TWO OR MORE SPECIMENS IN ANY FISHERY BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2002.
Shaded months indicate the maximum extent of the breeding season (egg laying to fledging) for each species.

SPECIES	MONTHS											
	J	F	M	A	M	J	J	A	S	O	N	D
Antarctic prion												
Antipodean (wandering) albatross	1			2								
black petrel	2	1	1	1							1	3
black-browed albatross		1										
Buller's albatross												
Buller's shearwater												
Campbell albatross				1		2						
Chatham albatross												
common diving petrel												
fairy prion												
flesh-footed shearwater	2	14	3	2								
Gibson's (wandering) albatross					1	1						
grey-faced petrel										1		1
grey petrel												
light-mantled sooty albatross												
northern giant petrel												
northern royal albatross												
Pacific albatross		2										
Salvin's albatross		5										
short-tailed shearwater												
snowy (wandering) albatross												
sooty shearwater												
southern cape pigeon												
southern giant petrel												
southern royal albatross												
Westland petrel												
white-capped albatross												
white-chinned petrel		3	1									

Australia, for a student physiology and energetics study of Procellariiformes, 128; and 9 birds were supplied to a course for training personnel in the recovery of oiled birds. Liver samples for DNA analysis of white-capped albatrosses for comparison with Australian fisheries bycatch specimens were provided to a study at the Australian National University, Canberra. The Department of Conservation was supplied with 16 specimens for Maori traditional use of feathers / bone, or display. Severely damaged specimens unusable for scientific or cultural use were destroyed.

TABLE 15. ANNUAL TOTALS OF BIRDS KILLED AND RETURNED FROM THE JOINT-VENTURE (CHARTERED) PELAGIC LONGLINE TUNA FISHERY FOR GROUPED SPECIES BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2002.

BIRD TYPE	1997	1998	1999	2000	2001	2002
Large albatrosses	65	50	4	8	0	1
Small albatrosses	126	24	18	10	11	20
Large petrels	83	74	12	8	1	4
TOTAL	274	148	34	26	12	25

TABLE 16. TOTALS OF BIRDS KILLED AND RETURNED FROM THE VARIOUS NEW ZEALAND FISHERIES BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2002.
Figures in large type illustrate species most at risk (see text for definition) of being caught in each fishery.

	DOMESTIC BOTTOM LONGLINE	DOMESTIC TUNA LONGLINE	J/V TUNA LONGLINE 1996–98	J/V TUNA LONGLINE 1998–2002	SCAMPI TRAWL	SQUID TRAWL	TRAWL
Antipodean (wandering) albatross		3	**82**	5		1	
black petrel*		**9**					
black-browed albatross		1	**20**	3	1	1	5
Buller's albatross	3	2	**17**	**31**		**18**	**34**
Campbell albatross		3	**53**	5		1	9
Chatham albatross*	**9**		1				**3**
flesh-footed shearwater	**12**	**21**			5		
Gibson's (wandering) albatross		2	**27**	5			
grey petrel	**314**		**134**	9		2	5
Salvin's albatross	**120**	5	10	1	5	5	**32**
sooty shearwater	30				6	**321**	**102**
white-capped albatross	1		12	**22**	4	**372**	**75**
white-chinned petrel	**572**	4	17	11		**89**	18

* Classified by IUCN as endangered.

TABLE 17. ANALYSIS OF IDENTIFICATIONS MADE BY ON-BOARD OBSERVERS AT SEA WHEN COMPARED WITH AUTOPSY IDENTIFICATION FOR BIRDS KILLED BETWEEN 1 OCTOBER 2001 AND 30 SEPTEMBER 2002.

SPECIES AFTER AUTOPSY	OBSERVERS' ID								
	ID CORRECT	ID WRONG	ID AS CORRECT 'SPP.' GROUP	ID AS SEABIRD LARGE OR ALBATROSS	ID AS PETREL UNIDENTIFIED	ID AS SEABIRD SMALL	ID NOT ON LABEL	SPECIES CODE DID NOT EXIST	TOTAL
Antarctic prion	1								1
Antipodean (wandering) albatross		1	(1)						1
black petrel*	3								3
black-browed albatross		4							4
black-browed albatross spp.	1								1
broad-billed prion								1	1
Buller's albatross	18	1	(1)				1	1	21
Campbell albatross		2	(2)						2
Chatham albatross*	5								5
common diving petrel						1			1
flesh-footed shearwater	10								10
grey petrel	5								5
grey-faced petrel	1								1
Pacific albatross		1	(1)						1
Salvin's albatross	17	5	(3)						22
sooty shearwater	89	3	(1)		6			1	99
southern cape pigeon		4	(4)						4
southern royal albatross	4	1							5
Westland petrel		1	(1)						1
white-capped albatross	63	68	(67)	8			1		140
white-chinned petrel	68	1	(1)		289		3		361
TOTALS	285	92	(82)	8	295	1	5	3	689

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