Autopsy report for seabirds killed and returned from New Zealand fisheries, 1 October 2000 to 30 September 2001

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

DOC SCIENCE INTERNAL SERIES 96

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

Published by
Department of Conservation
PO Box 10-420
Wellington, New Zealand

DOC Science Internal Series is a published record of scientific research carried out, or advice given, by Department of Conservation staff, or external contractors funded by DOC. It comprises progress reports and short communications that are generally peer-reviewed within DOC, but not always externally refereed. Fully refereed contract reports funded from the Conservation Services Levy (CSL) are also included.

Individual contributions to the series are first released on the departmental intranet in pdf form. Hardcopy is printed, bound, and distributed at regular intervals. Titles are listed in the DOC Science Publishing catalogue on the departmental website http://www.doc.govt.nz and electronic copies of CSL papers can be downloaded from http://www.csl.org.nz

ISSN 1175–6519

ISBN 0–478–22374–9

In the interest of forest conservation, DOC Science Publishing supports paperless electronic publishing. When printing, recycled paper is used wherever possible.

This report was prepared for publication by DOC Science Publishing, Science & Research Unit; editing and layout by Ian Mackenzie. Publication was approved by the Manager, Science & Research Unit, Science Technology and Information Services, Department of Conservation, Wellington.

Email address for C.J.R. Robertson: 100244.1012@compuserve.com

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

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

[1]Wild Press, PO Box 12397, Wellington, New Zealand.
[2]Wildlife Management International Ltd, PO Box 14-492, Wellington.
[3]Canterbury Museum, Rolleston Avenue, Christchurch, New Zealand.

A B S T R A C T

Forty-five separate fishing trips between 1 October 2000 and 30 September 2001 with on-board observers returned 1092 bird specimens killed as bycatch to various forms of fishing practice. Birds were received from squid, scampi and fish trawlers (50.8% of returns), domestic bottom longliners (47.65%) and tuna longliners—mainly chartered (joint-venture) (1.5%). Twenty taxa were represented with seven comprising 95.5% of returns (grey petrel, white-capped albatross, white-chinned petrel, Salvin's albatross, Buller's albatross, sooty shearwater, short-tailed shearwater). During the past five years of the autopsy programme (1996–2001), grey petrel (459), sooty shearwater (360), white-chinned petrel (350), white-capped albatross (346), and Salvin's albatross (156) were the most commonly killed and returned species. Mean subcutaneous fat scores were again low, suggesting a general food shortage. Some 62% of specimens retaining their stomachs, had discernable stomach contents, with the majority containing bait, fisheries discards or offal, depending on the fishery. Between 1996 and 2001 a growing proportion of the birds returned from the trawl and domestic bottom longliner fleets had fisheries offal or discards forming a major part of their stomach contents. Also, between 1996 and 2001 the majority of the returned specimens (71%) were killed by the activities of a limited number of vessels (12), suggesting an urgent need to focus mitigation measure investigations on the differences between vessels and fishing practices.

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

Robertson, C.J.R.; Bell, E.; Scofield, P. 2003. Autopsy report for seabirds killed and returned from New Zealand fisheries, 1 October 2000 to 30 September 2001. *DOC Science Internal Series 96*. Department of Conservation, Wellington. 36 p.
http://www.csl.org.nz/dsis96.pdf

1. Introduction

There were 1092 specimens returned from 45 separate fishing trips with on-board observers, between 1 October 2000 and 30 September 2001 (the 2000/2001 fishing year), where birds were incidentally killed as a bycatch to various forms of fishing practice. Most birds were returned from the trawler fleet (various fishing targets, including 100% observer coverage of the squid trawl fishery) providing 50.7% of the birds returned. Domestic bottom longliners (47.6%) and tuna longliners (mainly chartered [joint-venture]) with 1.5% of the returns, made up the balance. This continues a significant change in the proportions reported last year (Robertson & Bell 2002b). The chartered (joint-venture) tuna fleet (with 100% observer coverage) has continued to reduce its catch contribution to the autopsy programme from 78% in 1996/97 to 1.1% this reporting year (a reduction from 274 specimens per annum to 12).

The autopsies were undertaken for the Department of Conservation as Conservation Services Levy (CSL) 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 2000/2001, birds were received from squid, scampi, and fish trawlers, domestic tuna longliners, chartered (joint venture) tuna longliners, and domestic bottom longliners (mainly 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 (Figs 1–16) provide 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 which 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. All the autopsies and

[1] The data supplement to this report contains a table of the autopsies of 1092 specimens returned from 45 separate fishing trips with on-board observers, between 1 October 2000 and 30 September 2001 (the 2000/01 fishing year). It is available at http://csl.org.nz/dsis96sup.pdf

bird identifications were undertaken by the authors. All birds or parts of birds returned this fishing year were identifiable to species and subspecies. 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.* The unique specimen autopsy number enables easy correlation of the data within the Data supplement. In some cases, where specimens were severely damaged, it was not possible to complete all parts of the report. In this case a 'blank' or '?' in the supplement indicates a

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

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*
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*
white-capped albatross	*Thalassarche steadi*
white-chinned petrel	*Procellaria aequinoctialis steadi*

* For details of the data supplement, see footnote opposite.

deficiency, while 'U' indicates unknown. Paul Scofield of Otago University and the Canterbury Museum undertook detailed work on the stomach contents of sooty and short-tailed shearwaters only, as part of his studies, and a summary of the information was provided for this report.

TABLE 2. SPECIES AND NUMBERS OF BIRDS KILLED AND RETURNED FROM VARIOUS FISHERIES BETWEEN 1 OCTOBER 2000 AND 30 SEPTEMBER 2001.

	DOMESTIC BOTTOM LONGLINER	DOMESTIC TUNA LONGLINER	JOINT VENTURE TUNA LONGLINER	SCAMPI TRAWLER	SQUID TRAWLER	TRAWLER	TOTALS	*MALE SEX*	*FEMALE SEX*	*UNKNOWN SEX*	ADULT	NON-ADULT	UNKNOWN AGE
black petrel		2					2		2		2		
black-backed gull						1	1	1			1		
Buller's albatross	2		7		7	3	19	9	8	2	17	1	1
Buller's shearwater	2						2	1	1		2		
Campbell albatross			1			2	3	1	2		2	1	
Chatham albatross						3	3		3		3		
fairy prion						2	2	1	1		2		
flesh-footed shearwater	12						12	7	5		9	3	
fluttering shearwater	1						1	1			1		
grey petrel	187				2	1	190	43	4	143	179		11
grey-faced petrel	11	1					12	11	1		11	1	
northern giant petrel	1					2	3	2	1		3		
northern royal albatross						1	1	1			1		
Salvin's albatross	90	1			3	10	104	33	71		97	7	
short-tailed shearwater						33	33	16	17		33		
sooty shearwater	13				192	23	228	196	31	1	196	30	2
southern cape pigeon	1					4	5	3	2		4	1	
southern royal albatross					1	1	2	2			2		
white-capped albatross	1		3	1	180	6	191	113	71	7	176	7	8
white-chinned petrel	199	1	1		68	9	278	198	76	4	275	3	
Totals	**520**	**5**	**12**	**1**	**453**	**101**	**1092**	**639**	**296**	**157**	**1016**	**54**	**22**
Percentage 2000 / 2001	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
Percentage 1999 / 2000	39.5	1.3	11.2	1.3	19.7	27.0	233	56.7	33.5	9.9	93.6	3.9	2.6
Percentage 1998 / 99	24.6	0.7	11.8	3.1	26.0	33.9	289	62.6	26.6	10.7	84.4	6.2	9.3
Percentage 1998	0.5	2.5	76.0	1.5	0.5	19.0	195	35.0	63.0	2.0	93.0	5.0	2.0
Percentage 1996 / 97	4.0	3.7	78.0	0.3	5.0	8.0	350	54.0	43.0	3.0	85.0	15.0	0.0
Percentage 1996 / 2001	32.4	1.3	22.9	0.8	22.2	15.5	2159	56.0	33.6	10.4	90.5	6.8	2.7

3. Results and discussion

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, with oil and grease on the plumage indicating a probable association with wires, winches, and nets during fishing operations.

A total of 20 taxa (species) were represented (Table 2; Figs 1–8, see pages 21–28) in this fishing year. Seven taxa comprised 95.5% of the returns [Individual numbers were: white-chinned petrel, 278; sooty shearwater, 228; white-capped albatross, 191; grey petrel, 190; Salvin's albatross, 104; short-tailed shearwater, 33 and Buller's albatross, 19]. These included the same top 6 taxa killed in the previous year (Robertson & Bell 2002b), plus short-tailed shearwaters recorded for the first time. No banded birds were returned.

Table 3 provides a summary of all birds returned for autopsy for the five fishing years between 1 October 1996 and 30 September 2001 according to species and fishing type (the previous 4 years have been previously reported in detail). This summary continues to demonstrate and reinforce a relationship between the killing of certain species and fishing type. Of particular concern is the growing proportion of those killed coming from the trawl fleets and a significant relationship between the birds returned and the presence of offal in their stomach contents. The trend for the domestic bottom longlining fleet to return a majority of the grey and white-chinned petrels has continued. Overall, grey petrel (459) has been the most returned species with sooty shearwater (360), white-chinned petrel (350) and white-capped albatross (346) as the most significant contributors (totalling 70% of all returns over five years).

The specimens returned this year had a high male bias (Table 2), similar to the previous two reporting periods (Robertson & Bell 2002a, b), but this continued to be primarily caused by the heavy male representation among the grey and white-chinned petrels, white-capped albatross, and sooty shearwaters returned. Grey petrels again had a large number of returns which were severely damaged by sea lice where sexing was impossible. By contrast, Salvin's albatrosses had a female bias. About 90% of this latter sample were killed close to the breeding colonies on the Bounty Islands.

Table 4 summarises the sex ratios for all specimens returned from fisheries between 1996 and 2001 inclusive. While Ryan & Boix-Hinzen (1999) refer to the male bias in the Patagonian toothfish longline fishery, a scenario which is generally supported here on an annual basis (and sometimes according to fishery), there are various exceptions starting to show when a greater number of years are analysed. Of 21 species with catches of 3 or greater, 8 have a significant male bias whilst only Salvin's albatross has a significant female bias. Most of the species caught in New Zealand have similar catches for both sexes over the 5 years. While this is the case for grey petrel, it is significant that males and females are being caught in widely disparate areas and mainly by different long-line fisheries (male—bottom longliners; female—tuna longliners), at different times of the year and in different years. With the reduction in returns

TABLE 3. SPECIES AND NUMBERS OF BIRDS KILLED AND RETURNED FROM FISHERIES FOR THE FIVE YEARS BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2001.

	DOMESTIC BOTTOM LONGLINER					DOMESTIC TUNA LONGLINER					JOINT VESSEL TUNA LONGLINER				
	1996/97	1998	1998/99	1999/2000	2000/2001	1996/97	1998	1998/99	1999/2000	2000/2001	1996/97	1998	1998/99	1999/2000	2000/2001
Antarctic prion															
Antipodean (wandering) albatross							2				52	30	2	3	
black-bellied storm petrel															
black petrel						2	1		1	2					
black-backed gull															
black-browed albatross											18	2	2	1	
Buller's albatross			1		2						8	9	11	4	7
Buller's shearwater					2										
Campbell albatross						2			1		42	11	4		1
cape pigeon spp.															
Chatham albatross	4										1				
common diving petrel															
fairy prion															
flesh-footed shearwater					12	7	1	2	1						
fluttering shearwater					1										
Gibson's (wandering) albatross						2					8	19	1	4	
grey-faced petrel					11					1					
grey petrel	4		62	56	187						62	72	8	1	
light-mantled sooty albatross											36	1	1		
northern giant petrel			2		1						5	1			
northern royal albatross											2				
Pacific albatross															
Salvin's albatross	5			13	90					1	9	1			
short-tailed shearwater															
Snares cape pigeon			1												
snowy (wandering) albatross											2				
sooty shearwater		1			13										
southern cape pigeon				1	1										
southern giant petrel				4											
southern royal albatross											1	1	1	1	
welcome swallow															
white-capped albatross					1						12		4	5	3
white-chinned petrel	2		5	18	199		1			1	16	1		7	1
Unknown															
Totals	**15**	**1**	**71**	**92**	**520**	**13**	**5**	**2**	**3**	**5**	**274**	**148**	**34**	**26**	**12**

TABLE 3. SPECIES AND NUMBERS OF BIRDS KILLED AND RETURNED. (*Continued from previous page.*)

SCAMPI TRAWLER					SQUID TRAWLER					TRAWLER					TOTALS
1996/97	1998	1998/99	1999/2000	2000/2001	1996/97	1998	1998/99	1999/2000	2000/2001	1996/97	1998	1998/99	1999/2000	2000/2001	
											1				1
								1							90
												1			1
															6
														1	1
												2	2		27
							4		7		1	14	14	3	85
															2
					1						1	2	2	2	69
												1			1
														3	8
								1							1
													2	2	4
		4	1												28
															1
															34
											1				13
									2		1		3	1	459
															38
												2	2	2	15
														1	3
1															1
		1	1					1	3			14	7	10	156
														33	33
															1
															2
	3	3				1	38	7	192	21	21	27	10	23	360
											1		1	4	8
															4
									1	1			1	1	8
													1		1
		1	1	1	15		29	28	180	6	7	29	18	6	346
					3		4	7	68		3	5		9	350
								1				1			2
1	**3**	**9**	**3**	**1**	**19**	**1**	**75**	**46**	**453**	**28**	**37**	**98**	**63**	**101**	**2159**

from the tuna fishery, variations may occur in future catch sex ratios for this taxa. For white-chinned petrels, although both sexes are caught in similar locations and at similar times of the year, males continue to be the principal catch. This may indicate a feeding location split between sexes, or the behavioural tendency for males to be more aggressive foragers of bait and offal. However, Ryan & Boix-Hinzen (1999) found no significant differences in the stomach contents between male and female white-chinned petrels, an observation supported by the New Zealand material. A behavioural factor may also be important in the high male catch of sooty shearwaters, but the severely disproportionate ratio for them suggests that females may be feeding elsewhere or on different food sources.

TABLE 4. SEX RATIOS FOR ALL BIRDS KILLED AND RETURNED FROM FISHERIES BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2001.

	MALE	FEMALE	UN-KNOWN	TOTALS	PERCENT-AGE MALES	SIGNIF-ICANT (χ^2)
Antarctic prion	1			1		
Antipodean (wandering) albatross	47	40	3	90	54%	
black-bellied storm petrel		1		1		
black petrel	3	3		6		
black-backed gull	1			1		
black-browed albatross	12	15		27	44%	
Buller's albatross	37	41	7	85	47%	
Buller's shearwater	1	1		2		
Campbell albatross	32	34	3	69	48%	
cape pigeon spp		1		1		
Chatham albatross	4	4		8	50%	
common diving petrel		1		1		
fairy prion	3	1		4	75%	Y
flesh-footed shearwater	14	14		28	50%	
fluttering shearwater	1			1		
Gibson's (wandering) albatross	17	15	2	34	53%	
grey-faced petrel	11	2		13	85%	Y
grey petrel	139	135	185	459	51%	
light-mantled sooty albatross	29	9		38	76%	Y
northern giant petrel	8	6	1	15	57%	
northern royal albatross	1	2		3	33%	
Pacific albatross			1	1		
Salvin's albatross	51	102	3	156	33%	
short-tailed shearwater	16	17		33	48%	
Snares cape pigeon			1	1		
snowy (wandering) albatross	2			2		
sooty shearwater	314	45	1	360	87%	Y
southern cape pigeon	5	3		8	63%	
southern giant petrel	3	1		4	75%	Y
southern royal albatross	6	2		8	75%	Y
welcome swallow			1	1		
white-capped albatross	204	131	11	346	61%	Y
white-chinned petrel	247	99	4	350	71%	Y
Unknown			2	2		
Totals	**1209**	**725**	**225**	**2159**	**63%**	

Table 2 continues to demonstrate that adult birds (93.0% for 2000/01) form the majority of identifiable specimens returned (90.5% for 1996–2001). Table 5 collates the returns for 1996–2001 according to month of catch per taxa and relates the catch times to the breeding season for each taxa. Present knowledge suggests that most *Diomedea* and *Thalassarche* taxa (albatrosses) disperse or migrate out of the New Zealand EEZ outside of the breeding season (every second year for *Diomedea* if breeding is successful). The significance of such a high adult catch during the breeding season, is in the year of loss, where there is not only the death of the breeding adult, but also the potential death of an egg or chick (highly probable if one parent dies early in chick development). 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 one or more non-breeding seasons to enable the re-establishment of a new pair bond.

The body condition data for this year continue to suggest that a range of pelagic seabirds, were still in a period of shorter food supply than normal (see Robertson 2000). Table 6 compares the subcutaneous fat scores of specimens of

TABLE 5. MONTHLY DISTRIBUTION OF BIRDS KILLED AND RETURNED FOR BIRD SPECIES WITH THREE OR MORE SPECIMENS RETURNED FROM FISHING BETWEEN 1 OCTOBER 1996 AND 30 SEPTEMBER 2001.

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

	MONTHS											
	J	F	M	A	M	J	J	A	S	O	N	D
Antipodean (wandering) albatross				21	1	16	44	8				
black petrel	1	1	1	1								2
black-browed albatross					3	9	14		1			
Buller's albatross	2	3	2	12	28	35	1		1	1		
Campbell albatross	1		2	4	2	21	36	2		1		
Chatham albatross		2					1		4	1		
fairy prion							2	1				
flesh-footed shearwater	2	8	3	13	1						1	
Gibson's (wandering) albatross				6	1	5	13	9				
grey -faced petrel					11	1						1
grey petrel	1		1	18	58	54	252	35	40			
light-mantled sooty albatross				36	1	1						
northern giant petrel	1					6	4			1	2	1
northern royal albatross				1		1			1			
Salvin's albatross	6	11	1			7	3	1	9	8	44	66
short-tailed shearwater										33		
sooty shearwater	4	55	78	159	11	1				34	17	1
southern cape pigeon						1		2	4	1		
southern giant petrel									4			
southern royal albatross	1	1	1	2	2				1			
white-capped albatross	30	105	119	28	22	21	9		5	4	2	1
white-chinned petrel	26	29	26	46	4				4	11	183	21

taxa caught in significant numbers over 5 reporting periods from 1996/97 to 2000/01. For all species where there is reasonable comparable data, the fat scores from 1998 to 2001 remain significantly lower than for 1996/97. This result strongly supports the suggestion of continuing food shortages for some species or that there was something different about the scoring in 1996/97. Noted during this year among both Salvin's and white-capped albatrosses were a number of birds presenting enlarged gall-bladders which is generally a sign of poor feeding or fasting (C. Reed, pers. comm.). Some of this effect may relate to fasting at the nest site during incubation (Salvin's albatross), but this feature was also present in white-capped albatrosses during chick rearing. Among the six selected taxa there has been a steadily increasing yearly proportion of the lowest fat scores (=1) reaching 29 % of all specimens (where a score could be

TABLE 6. COMPARATIVE FAT SCORES FOR SELECTED BIRD SPECIES FOR THE 1996/97, 1998, 1998/99, 1999/2000 AND 2000/01 REPORTING PERIODS.

	TOTALS					FAT SCORES						
	1996/97	1998	1998/99	1999/00	2000/01	1	2	3	4	5	U	MEAN
Buller's albatross	11							1	5	5		4.4
		10				2	4	1	1		2	2.1
			30			9	10	3	2	5	1	2.4
				18		7	3	4		2	2	2.2
					19	4	4	3	2	4	2	2.9
grey petrel	70							4	42	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
Salvin's albatross	14							4	3	7		4.2
		1				1						1.0
			15			3	8	1	1	2		2.4
				22		8	9	1	3	1		2.1
					104	45	26	19	7	7		2.1
sooty shearwater	24							2	10	12		4.4
		26				6	13	5	1	1		2.2
			68			9	23	21	11	4		2.7
				17		1	8	4	3	1		2.7
					228	57	85	58	20	6	2	2.3
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
white-chinned petrel	21						2	4	9	6		3.9
		5				1	2	2				2.2
			14			5	4	2		3		2.4
				32		2	7	9	8	5	1	3.2
					278	38	65	80	50	40	5	3.0

U = unknown

determined) this year. The previous 4 reporting periods had percentages of 0, 11, 20, and 23% (1996–2000) respectively.

Also supporting a scenario of food shortage for some species have been the changes in the range of taxa (and numbers of specimens) containing extraneous non-food or exotic food items (e.g. barnacles). Table 7 summarises the numbers of specimens containing these items. There was a correlation for Salvin's and white-capped albatrosses between low fat score and the presence of seaweed or barnacles in stomach contents. Overall, plastic scraps were the most common item, with one sooty shearwater having 30 pieces while 23 were found in a short-tailed shearwater. The majority of plastic material was found in the gizzard of both of these species, which indicates the probability of its collection during their over-wintering in the Northern Hemisphere, where plastic ingestion in petrels is more prevalent. The short-tailed shearwater had a major series of beach wrecks of emaciated birds (pers. obs. and autopsies of beach-wrecks) in New Zealand and especially Australia, during the 4–6 weeks prior to our sample being caught in New Zealand waters.

The increase in plastic for white-chinned petrels was probably also indicative of food scavenging practice. Unlike the hard plastic items in the shearwaters, a high proportion of the white-chinned petrels had small pieces of clear flexible plastic (pieces of bait bags perhaps from the bottom longlining fishing that was

TABLE 7. SUMMARY OF EXTRANEOUS (PRIMARILY) NON-FOOD ITEMS RECORDED IN BIRD STOMACH AND GIZZARD CONTENTS FOR THREE YEARS FROM 1 OCTOBER 1998 TO 30 SEPTEMBER 2001.
(The number of birds containing the relevant items are shown by year, separated by commas, and the most significant numbers are shown in bold type.)

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

catching them?) which may have looked similar in the water to salps. Of interest for this species was that most of the gizzard contents (natural food?) rarely matched the stomach contents (baits and offal), which suggests a tendency for opportunistic scavenging.

There was, again, a high proportion of specimens with recordable stomach contents. The data (Table 8) for the 3 years (1998–2001) and 1603 specimens show a differentiation into 3 types of fishery. At least 50% of tuna long-line specimens had empty stomachs and the majority of the balance contained baits, whilst domestic bottom longliners average about 20% empty, with the balance of contents spread between baits and offal/discards. This seems to reinforce the observation from observers that most tuna long-line specimens are hooked at the set when they may be empty or that they regurgitate their stomach contents during drowning.

For the domestic bottom longliners the high proportion of sea-liced specimens in 2000/01 distorts the figures somewhat (the majority of the birds where the stomach was gone). About a third of those specimens containing offal or bait, contained items of both. The tendency for more than 50% of grey and white-chinned petrels to be foul-hooked (pers. obs.) suggests that material floating in the water is often a target for these species during setting, as most birds are returned with fully saturated plumage (or sea-liced skeletons, this year), and many of the foul hooks still have bait attached. The fact that a significant proportion of the birds contained both baits and offal intermixed suggests that discharge of offal occurred during the setting of the line.

Among fish and squid trawlers (Table 8) up to 36% of specimens returned had empty stomachs according to year and fishery, while 44–69% contained offal in various forms, as well as small, deep- or mid-water living fish, probably associated with discarded fish bycatch. In 2000/01 many of the sooty

TABLE 8. ANALYSIS OF GENERAL BIRD STOMACH CONTENTS (NOT INCLUDING GIZZARD) ACCORDING TO FISHERY TYPE FOR THREE YEARS FROM 1 OCTOBER 1998 TO 30 SEPTEMBER 2001.
(Figures in brackets are percentages of the years catch, per fishing type).

FISHING TYPE	FISHING YEAR	n	EMPTY	OFFAL AND/OR DISCARDS	BAIT	GONE, NATURAL, OR INDE-TERMINATE
Domestic bottom longliner	1998–99	71	19 (27)	1 (1)	23 (32)	28 (39)
	1999–00	92	14 (15)	38 (41)	18 (20)	22 (24)
	2000–01	520	74 (14)	83 (16)	148 (28)	215 (41)
Tuna longliner	1998–99	36	21 (58)	1 (3)	12 (33)	2 (6)
(both domestic & chartered)	1999–00	29	15 (52)	–	11 (38)	3 (10)
	2000–01	17	9 (53)	–	5 (29)	3 (18)
Trawl (squid)	1998–99	75	27 (36)	40 (53)	–	8 (11)
	1999–00	46	15 (33)	30 (65)	–	1 (2)
	2000–01	453	72 (16)	232 (52)	–	149 (32)
Trawl (fish)	1998–99	98	21 (21)	68 (69)	–	9 (9)
	1999–00	63	16 (25)	41 (65)	–	6 (6)
	2000–01	101	10 (10)	46 (45)	–	45 (45)
Totals		**1603**	**313**	**653**	**217**	**491**

shearwaters caught had small fish which may have been taken in the net or discarded, but have not been differentiated (i.e. Indeterminate) from natural food prey. Squid trawlers often had offal from hauls mainly associated with fish bycatch, but not containing a high proportion of squid. This may indicate that for part of the observed periods at sea, the target species was sometimes fish and not squid. If this is so, then a proportion of bird bycatch attributed to the squid fishery in our analyses should rightly be placed against the trawl fishery.

This year's data continues to reinforce the previous demonstration of the intimate relationship between fishing practice and the stomach contents of the subsequently caught birds. This suggests that mitigation practices need to address the significant attracting of birds to offal discards about vessels processing their catch at sea. The appearance of offal in the stomach contents of birds associated with domestic bottom longliners reported earlier is again demonstrated. It is our understanding that at least some of the vessels which have been observed in the domestic bottom longlining fishery as regularly returning bird bycatch, also operate under licence in the Antarctic toothfish fishery in the Ross Sea. A condition of their licence to fish in that area states that no offal may be discharged, and waste is required to be frozen or turned into fish meal (Ministry of Foreign Affairs and Trade). Perhaps it is not a coincidence that no birds have been caught in that area under those licence conditions.

Robertson & Bell (2002b) remarked on the significance of the small number of vessels killing the majority of the birds returned to the autopsy programme. During the five years (1996–2001) some 178 separate vessels carried official MoF observers on one or more voyages. Only 85 of these vessels were responsible for returning the 2159 birds which have been received for autopsy. In the 2000/01 fishing year 95 individual vessels were observed and 45 of them were responsible for the killing and return of the 1092 birds received this year. Thus there is a fairly consistent 53% of vessels annually which do *not* catch birds throughout the observed fisheries. There would seem to be at least one discernable reason why all vessels are not catching birds equally and those responsible for mitigation development and management of fishing practice need to explore this further. The analyses of stomach contents referred to above suggests that the discharge of offal while towing or setting fishing gear seems to be providing a significant risk of attracting birds into killing situations especially with some individual vessels.

Table 9, for example, shows that 12 vessels caught 71% of the birds killed and returned from 1996–2001. These twelve were selected because on one or more voyages during that period they had caught 30 or more birds on a single voyage. Five vessels alone caught 44% of the birds returned. The vessels concerned are all closely correlated to the fishing practices discussed above via the data from bird stomach contents analysis. However, Table 9 also shows that while some vessels caught birds on every observed trip, others remained catch free for as many as half their observed voyages. These data suggest that over a number of years some specific vessels or vessel types and/or their methods of operation provide a significant continuing risk of bird bycatch. Both the industry and the developers of mitigation measures need to investigate this further, especially with such a high proportion of the returns coming from such a small number of vessels. We are aware (R. Blezard pers. comm.) that some individual vessels

have been observed equally or more often than any of the vessels shown in Table 9 between 1996 and 2001, and have not killed or returned a single bird.

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 gear in use was subsequently discontinued. In the 2000/01 fishing year 180 white-capped albatross were caught in the squid fishery during a year when there was 100% observer coverage. Clearly there is still a problem, be it related to the birds' natural food supply (shortage of food), the vessel type, the gear used, or the operational fishing practices.

Figure 9 (page 29) summarises the distribution of all birds killed during the period 1 October 1996 to 30 September 2001, while Figs 10–12 summarise the catches according to fishing type. Figures 13–16 (pages 33–36) provide a summary of the principal taxonomic groups of seabirds *(Diomedea, Thalassarche, Procellaria,* and *Puffinus)* returned according to the method of fishing which killed them. The most significant change is the reduction in catches of *Diomedea* and *Thalassarche* at East Cape brought about by the mitigation methods employed in the chartered (joint-venture) tuna longline fishery (see annual maps and data in Bartle 2000; Robertson 2000; Robertson & Bell 2002a, b). The maps also serve to illustrate significant areas of risk for different fisheries and species of seabird.

TABLE 9. NUMBER OF BIRDS KILLED AND RETURNED BY INDIVIDUAL VESSELS OVER FIVE YEARS, 1 OCTOBER 1996 TO 30 SEPTEMBER 2001 FOR ALL OBSERVED VESSELS WHO RECORDED A TAKE OF 30 OR MORE BIRDS, ON ONE OR MORE TRIPS.

VESSEL*	FISHERY TYPE†	1996/97	1998	1998/99	1999/00	2000/01	TOTALS	TRIPS WHEN BIRDS CAUGHT	NO. OF OBSERV'D TRIPS
A	BLL	10		6	65	178	259	4	6
B	BLL			33	(78)‡	169	202	3	5
C	JVTLL	135	44	8		2	189	4	5
D	ST+T		10	13	1	123	147	6	7
E	ST+T	1			11	133	145	4	5
F	BLL	2			13	115	130	4	8
G	JVTLL	47	43	1	23	4	118	5	5
H	JVTLL	25	53	17			95	5	6
I	BLL	3	1	32		32	68	6	7
J	JVTLL	64					64	2	2
K	ST+T	1		4	3	51	59	6	8
L	ST+T				3	49	52	3	3
Totals		**288**	**151**	**114**	**119**	**856**	**1528**	**52**	**67**
Percentage of reporting period birds returned for autopsy		81%	77%	39%	51%	78%	71%		

* Individual vessels are not named, but are coded A to L.

† BLL = Domestic Bottom Longliner; JVTLL = Joint-venture [chartered] Tuna Longliner; ST+T = Squid Trawl [principally] with some Fish Trawl trips. [No Fish Trawl trips had catches of 30 birds].

‡ (78)‡ = Birds identified from photos, but not returned and not included in table totals (see Robertson & Bell 2002b).

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 may be more easily ascertained with experience and improved published descriptions. Table 10 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 validity of 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 analysis shown in Table 10 continues to indicate that such identifications of birds released at sea may need to be treated with caution.

At the time of writing, one specimen from this period had been supplied to the Melbourne Museum. The Department of Conservation requested no specimens to supply to Maori for traditional use of feathers or bone. Severely damaged specimens unusable as scientific or specimens for cultural use were destroyed.

TABLE 10. ANALYSIS OF IDENTIFICATIONS MADE BY ON-BOARD OBSERVERS AT SEA WHEN COMPARED WITH AUTOPSY IDENTIFICATION FOR BIRDS KILLED BETWEEN 1 OCTOBER 2000 AND 30 SEPTEMBER 2001.

	CORRECT ID	WRONG ID	ID AS CORRECT 'SPP'. GROUP	SEABIRD LARGE OR ALBATROSS	PETREL UN-IDENTIFIED	SEABIRD SMALL	SEABIRD OR SEAGULL	ID NOT ON LABEL	SPECIES CODE DID NOT EXIST	TOTAL
black petrel		1				1				2
black-backed gull							1			1
Buller's albatross	15	1		1					2	19
Buller's shearwater					2					2
Campbell albatross	1	2	(1)							3
Chatham albatross	1	1						1		3
fairy prion	1							1		2
flesh-footed shearwater	12									12
fluttering shearwater					1					1
grey petrel	9	1			117	40	1	22		190
grey-faced petrel		12								12
northern giant petrel	2	1	(1)							3
northern royal albatross		1	(1)							1
Salvin's albatross	97	7								104
short-tailed shearwater					11			22		33
sooty shearwater	182	1		1	3	9		4	28	228
southern cape pigeon	1	4	(4)							5
southern royal albatross	2									2
white-capped albatross	140	29	(16)	19				3		191
white-chinned petrel	252	12			10			4		278
Totals	**715**	**50**	**(23)**	**21**	**144**	**50**	**2**	**57**	**30**	**1092**

(1) Numbers in parentheses indicate identifications not provided by observers.

4. Acknowledgments

The scientific observers employed by the Ministry of Fisheries provide dedicated work in often trying conditions to record on-the-spot data and in retaining the birds provided for autopsy. We acknowledge their role in providing the primary material basis for this report. Tranz Rail Limited provided an efficient frozen transport and storage facility while the Ministry of Defence provided leasehold space for the autopsy laboratory facility. L. and P. Bell assisted with data recording in the laboratory and later database entry of information. Reg Blezard provided the essential liaison and administrative link with the observers, while Ian West and Barbara Maas provided institutional CSL management support. S. Baird with L. Griggs, B. Sanders, and C. Sutton correlated the autopsy database for consistency with the NIWA database compiled from the observers non-fish bycatch data. Seabed Mapping New Zealand Ltd constructed the maps from the positional data supplied from the autopsy database and the GEBCO 97 (1997) Bathymetric database. This is a client report funded from the Conservation Services Levy (investigation no. 3051).

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