SEABIRDS FOUND DEAD ON NEW ZEALAND BEACHES IN 1993, WITH A REVIEW OF *Sterna albostriata, S. caspia* AND *S. striata* RECOVERIES, 1943 - 1992

By R.G. POWLESLAND[1] & M.H. POWLESLAND[2]

[1]*Science & Research Division, Department of Conservation, P.O. Box 10420, Wellington;* [2]*64 Roseneath Terrace, Wellington 1, New Zealand*

ABSTRACT

During 1993, participants in the Beach Patrol Scheme patrolled 2954 km of the New Zealand coastline. 4295 dead seabirds of 55 species, plus 117 individuals of 28 other bird species were found. The number of seabirds found in 1993 was only 43% of the annual average of 9997 birds between 1971 and 1992, and was the eighth consecutive year that below average numbers of dead seabirds have been found. Unusual finds were three Yellow-nosed Mollymawks (*Diomedea chlororchrynchos*), two Grey-backed Storm Petrels (*Oceanities nereis*) and a New Caledonian Petrel (*Pterodroma leucoptera*).

A summary is given of the coastal and monthly distributions of three *Sterna* species found between 1943 and 1992. Just nine Black-fronted Terns (*S. albostriata*) were picked up, mainly along eastern and northern South Island coasts. Of 239 Caspian Terns (*S. caspia*), most were found on Auckland West, Auckland East, Bay of Plenty and North Coast South Island beaches. There was no significant change in the recovery rate of Caspian Terns through the year. 1738 White-fronted Terns (*S. striata*) were found, with a peak in mortality during autumn.

KEYWORDS: seabirds, beach patrol, New Zealand, *Sterna*, recoveries

INTRODUCTION & METHODS

This paper records the results of the Ornithological Society of New Zealand's Beach Patrol Scheme for 1993 and reviews *Sterna albostriata, S. caspia* and *S. striata* recoveries since 1943. All sections of coast (see Powlesland & Imber 1988) were patrolled, except Fiordland. Some patrols were carried out on Chatham Island, the results being given under the heading 'Outlying Islands'. In total, 501 Beach Patrol cards were received.

Kilometres 'travelled' are the total distances searched during patrols, whereas kilometres 'covered' are the lengths of coast patrolled monthly. Hence, if the same 1 km stretch of beach is patrolled twice in one month, 2 km have been travelled but only 1 km covered per month. For a detailed description of methods for beach patrolling and of the Beach Patrol Scheme see Powlesland & Imber (1988). The taxonomic nomenclature and sequence are as in Turbott (1990). For the meaning of the abbreviations for each section of coast (e.g. AE = Auckland East), see Table 1.

To test whether the annual pattern of recovery for each species depicted in Figure 1 differed from the uniform distribution (where an equal number of birds per 100 km of beach covered was found each month) we used the Kolmogorov-Smirnov one-sample test (Siegel 1956).

TABLE 1 – Numbers of dead seabirds recovered and kilometres covered on the coasts of New Zealand in 1993

Coast	Code		Month												Total		No. birds/km of coast
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	km	birds	
Auckland East	AE	km	23	12	48	34	24	18	26	27	29	27	27	3	298		
		birds	135	14	86	37	27	7	37	2	7	16	35	6		409	1.37
Auckland West	AW	km	154	152	106	134	173	127	124	123	144	54	41	9	1341		
		birds	437	161	117	126	191	47	71	37	190	139	105	28		1649	1.23
Bay of Plenty	BP	km	8	9	4	3	11	12	2	9	5	7	17	3	90		
		birds	37	5	5	2	27	24	4	22	6	14	37	13		196	2.18
Canterbury North	CN	km	20	15	8	4	11	4	3	3	4	0	0	2	74		
		birds	111	41	34	4	72	4	1	2	1	0	0	2		272	3.68
Canterbury South	CS	km	0	4	0	6	5	0	0	0	0	0	0	0	15		
		birds	0	8	1	8	11	0	0	0	0	2	1	0		31	2.07
East Coast NI	EC	km	0	10	10	8	5	8	19	10	5	3	8	8	94		
		birds	0	3	6	3	2	4	7	6	1	1	3	1		37	0.39
North Coast SI	NC	km	2	20	1	0	20	0	0	0	0	0	27	1	71		
		birds	2	6	1	0	1	0	0	0	0	0	5	3		18	0.25
Outlying Islands	OI	km	0	0	0	0	0	0	1	0	0	0	7	5	13		
		birds	0	0	0	0	0	0	0	0	0	0	11	10		21	1.62
Otago	OT	km	6	6	6	6	8	8	6	8	3	6	6	9	78		
		birds	1	4	1	5	17	2	0	1	0	0	0	4		35	0.45
Southland	SD	km	0	2	6	8	6	12	6	7	7	12	26	13	105		
		birds	0	6	9	11	70	7	6	4	9	120	52	97		391	3.72
Taranaki	TA	km	11	1	0	4	11	4	2	11	3	1	0	0	48		
		birds	3	0	0	4	33	5	6	2	0	1	0	0		54	1.13
Wairarapa	WA	km	0	0	0	0	0	0	5	0	0	0	5	0	10		
		birds	0	0	0	0	0	0	3	0	0	0	0	0		3	0.30
Westland	WD	km	2	0	0	6	0	0	2	2	0	0	0	0	12		
		birds	3	0	0	0	0	0	1	0	0	0	1	0		5	0.42
Wellington South	WS	km	3	10	8	15	18	13	22	11	11	6	7	13	137		
		birds	86	11	91	107	84	10	25	4	7	5	9	31		470	3.43
Wellington West	WW	km	12	24	8	16	10	37	42	0	14	22	4	4	193		
		birds	80	395	21	15	33	50	51	0	6	40	6	7		704	3.65
Total km travelled			291	302	228	249	374	265	296	237	233	198	193	86	2954		
Total km covered			241	265	205	244	302	243	260	211	225	138	175	70	2579		
Total no. of birds recovered			895	654	372	322	568	160	212	80	227	338	265	202		4295	
No. of birds/km coast covered			3.71	2.47	1.81	1.32	1.88	0.66	0.82	0.38	1.01	2.45	1.51	2.89			1.66

RESULTS & DISCUSSION

Recoveries in 1993

In 1993, the total length of coast travelled was 2954 km, along which 4295 seabirds were found by 113 members of the Ornithological Society of New Zealand and their friends. On average, 1.66 birds per kilometre of coast covered were recovered (Table 1). The total distance travelled was 71% of the average of 4136 km per year recorded over the past 22 years (1971-1992), while the number of seabirds found in 1993 was only 43% of the annual average of 9997 birds for the same 22-year period. This period is used for comparison because the distance travelled annually was fairly constant, whereas from 1943 to 1970 the distance travelled increased (Powlesland 1990). It is now eight years since above-average numbers of seabirds per annum have been found. Table 1 shows the kilometres covered, the number of seabirds found per month, and in total, for the various sections of coast, plus the number of birds found per kilometre covered for each coastal section. Coastal and monthly totals for 'uncommon' species (11 or fewer specimens) are given in Table 2, while for 'common' species (more than 11 specimens) coastal totals are presented in Table 3 and monthly totals in Table 4.

Unusual finds

Three Yellow-nosed Mollymawks (*Diomedea chlororhynchos*) were found in 1993, one on Mount Maunganui Beach (BP) in June, one on Motokawanui Island (AE) in July, and one on Whangamata Beach (BP) in August. The first beach-wrecked Yellow-nosed Mollymawk recorded on a New Zealand beach was found in August 1921, and during the following 50 years there were a few reports of live birds sighted mainly about northern New Zealand (Robertson 1975). It was not until May 1980 that the first beach-wrecked Yellow-nosed Mollymawk was recorded in the Beach Patrol Scheme, and 19 more birds were picked up during 1981-92. All the specimens have been found on North Island beaches, particularly Auckland West (8) and Auckland East (5).

Although specimens have been found from April to December, 10 were picked up during August-September. The latter period mainly precedes the egg-laying period (mid September – early October) of *D. c. chlororhynchos* on the Tristan da Cunha group and Gough Island in the southern Atlantic, and just prior to egg-laying (early October) of *D. c. bassi* on St Paul, Prince Edward, Amsterdam, Kerguelen and the Crozet Islands in the southern Indian Ocean (Marchant & Higgins 1990). Only one individual of *D. c. chlororhynchos* has so far been recorded in New Zealand (Robertson 1975).

Two Grey-backed Storm Petrels (*Oceanites nereis*) were found on Pekapeka-Te Horo Beach (WW) in October. Sixteen have previously been found by patrollers, nine of them on the Wellington West and Wellington South coasts. This storm petrel is a circumpolar, predominantly subantarctic species, that remains around its breeding islands throughout the year, but does range as far north as 30°S, which is the latitude of the Kermadec Islands Group (Imber 1985, Turbott 1990). In the New Zealand region, it breeds on the Auckland, Antipodes and Chatham Islands, and possibly on islets off Macquarie and Campbell Islands (Turbott 1990); the nesting season lasts

TABLE 2 – Coastal and monthly distribution of the seabird species rare in 1993 (<12 specimens)

Species/ subspecies	No. found	Coast(s)	Month(s)
Diomedea melanophrys	10	AW(6),BP(2),TA(2)	Jan(2),Apr(2),May(2),Jun(2), Jul, Sep
D.exulans	1	AW	Oct
D.epomophora	1	AW	Apr
D.cauta subspp.**	6	AW,CN(2),OT,SD, WW	Jan(2),Feb,Mar,Jul,Dec
D.cauta salvini	1	AW	Sep
D.chrysostoma	6	AW(5),SD	Mar,Jun,Jul(2),Aug,Dec
D.chlororhynchos	3	AE,BP(2)	Jun,Jul,Aug
D.bulleri	7	AW,OI,SD(4),WS	Apr(2),May,Jun,Oct,Nov,Dec
Phoebetria palpebrata	9	AW(7),AE,BP	Apr,Jul(5),Aug(2),Oct
Puffinus pacificus	1	TA	Jan
P.gavia/huttoni	2	WW(2)	May,Oct
Procellaria spp.**	1	SD	Dec
P.parkinsoni	11	AW(2),AE(8),BP	Jan(2),Feb,Mar(2),Apr(3), May,Sep,Oct
P.westlandica	3	AW(2),WS	Apr,May(2)
P.aequinoctialis	4	AW(4)	Jan,Apr,Jun(2)
Lugensa brevirostris	6	AW(5),WW	Feb(2),Jul(2),Aug,Sep
Fulmarus glacialoides	3	AW,SD(2)	Jul,Dec(2)
Halobaena caerulea	9	AW(5),SD(3),WA	Jun(3),Jul,Aug,Sep,Oct(3)
Pterodroma spp.**	6	AW,BP(3),SD(2)	Jan,Jun(2),Aug,Oct,Dec
P.leucoptera	1	AW	Jan
P.cookii	9	AW(7),AE(2)	Jan,Feb,Mar(2),Apr(4),Sep
P.nigripennis	7	AW(6),AE	Jan(3),Apr(2),May(2)
Oceanites nereis	2	WW(2)	Oct(2)
Eudyptes spp.**	1	CN	Mar
E.pachyrhynchus	3	SD(3)	Mar(2),Oct
Phalacrocorax spp.**	2	AW(2)	Jan,Apr
P.sulcirostris	4	AW,EC,WW(2)	Feb,Mar,Apr,Oct
P.melanoleucos	2	TA(2)	May(2)
Leucocarbo chalconotus	6	OT(5),SD	Apr,May(3),Jun,Oct
Catharacta skua lonnbergi	1	CS	Nov
Stercorarius longicaudus	2	AW(2)	Apr(2)
Larus spp.**	2	CN(2)	Mar(2)
Sterna albostriata	1	OT	May
S.caspia	3	AW(3)	Jan,Feb,Jul
Total	136		

** Species or subspecies was not identified by the patroller

TABLE 3 – Coastal distribution of the seabird species commonly found in 1993 (≥12 specimens)

Species/ subspecies	Coast																Total birds
	AW	AE	BP	TA	WW	EC	WA	WS	NC	WD	CN	CS	OT	SD	OI	FD	
*Diomedea spp.***	4	0	0	0	2	1	0	0	0	0	1	0	0	11	0	0	19
D.cauta steadi	12	1	0	0	3	0	0	2	0	0	0	0	0	3	0	0	21
*Puffinus spp.***	15	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	20
P.carneipes	19	21	5	0	2	0	0	0	0	0	1	0	0	0	0	0	48
P.bulleri	106	24	6	5	15	0	0	3	0	0	7	0	0	0	0	0	166
P.griseus	254	26	27	9	34	5	0	55	0	0	69	8	9	132	5	0	633
P.tenuirostris	29	13	3	14	2	0	0	0	0	0	0	0	0	23	0	0	84
P.gavia	272	57	29	2	16	0	0	1	0	0	1	1	0	0	0	0	379
P.huttoni	4	8	0	1	5	3	0	0	0	0	9	1	0	0	0	0	31
P.assimilis	14	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	19
Pelecanoidesurinatrix	73	26	35	1	15	0	1	1	1	0	1	0	0	58	1	0	213
Daption capense	17	1	2	0	4	0	0	0	0	0	2	0	0	4	0	0	30
*Macronectes spp.***	12	0	1	0	1	0	0	0	0	0	0	0	0	6	0	0	20
*Pachyptila spp.***	68	2	1	4	294	0	0	3	0	0	1	0	1	7	0	0	381
P.turtur	62	4	6	1	208	0	1	2	1	0	6	2	0	45	2	0	340
P.belcheri	9	0	0	1	3	0	0	0	0	0	0	0	0	1	0	0	14
P.desolata	11	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	15
P.salvini	27	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	33
P.vittata	23	1	4	1	9	0	0	0	0	1	7	0	2	30	7	0	85
Pterodroma inexpectata	20	0	0	0	1	0	0	0	0	0	0	0	0	15	1	0	37
P.macroptera	11	3	10	0	0	0	0	1	0	0	0	0	0	0	0	0	25
P.lessonii	17	0	0	0	5	0	0	0	0	0	1	0	0	2	0	0	25
Pelagodroma marina	12	7	5	0	0	0	0	0	0	0	0	0	0	3	0	0	27
Eudyptula minor	149	127	30	3	24	0	0	6	4	0	8	1	2	7	0	0	361
Morus serrator	160	26	9	1	3	2	0	1	1	0	1	0	0	2	0	0	206
Phalacrocorax carbo	1	2	1	1	2	4	0	2	0	0	0	0	0	0	1	0	14
P.varius	6	9	2	0	0	0	0	1	0	0	3	0	0	0	0	0	21
Stictocarbo punctatus	0	2	1	0	0	0	0	1	2	2	69	5	2	3	0	0	87
Larus dominicanus	158	21	2	2	35	18	0	371	9	2	45	8	3	14	2	0	690
L.novaehollandiae	11	9	6	0	3	3	0	16	0	0	29	0	4	1	1	0	83
L.bulleri	0	0	0	0	0	0	0	0	0	0	2	1	5	5	0	0	13
Sterna striata	8	1	1	1	1	0	0	0	0	0	4	3	0	0	0	0	19
Total	1586	404	188	49	696	36	2	468	18	5	267	30	28	373	20	0	4159

** Species not identified by the patroller

TABLE 4 – Monthly distribution of the seabird species commonly found in 1993 (≥12 specimens)

Species/ subspecies	Month												Total no. of birds
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Diomedea spp.**	2	1	0	0	0	3	1	0	1	0	0	11	19
D.cauta steadi	2	3	0	0	4	4	4	1	1	2	0	0	21
Puffinus spp.**	9	1	1	1	0	0	2	0	0	4	1	1	20
P.carneipes	23	4	5	3	2	3	1	0	0	1	5	1	48
P.bulleri	27	18	21	18	23	5	3	0	5	26	13	7	166
P.griseus	83	30	13	22	256	33	12	0	2	34	106	42	633
P.tenuirostris	26	5	1	0	19	3	2	0	0	18	2	8	84
P.gavia	87	31	38	24	14	8	14	6	94	36	23	4	379
P.huttoni	11	4	4	1	2	0	8	0	0	1	0	0	31
P.assimilis	12	1	0	2	3	1	0	0	0	0	0	0	19
Pelecanoides urinatrix	54	7	2	0	13	8	15	10	25	41	24	14	213
Daption capense	2	0	0	0	0	0	2	2	3	11	7	3	30
Macronectes spp.**	0	0	0	1	2	3	2	1	3	4	0	4	20
Pachyptila spp.**	21	255	12	5	26	7	17	4	5	18	3	8	381
P.turtur	49	135	5	9	16	13	12	7	19	50	15	10	340
P.belcheri	0	0	0	0	1	1	5	2	0	4	1	0	14
P.desolata	0	2	0	3	6	1	0	0	2	1	0	0	15
P.salvini	4	0	0	3	7	5	11	1	1	1	0	0	33
P.vittata	25	3	0	1	3	1	6	3	0	18	11	14	85
Pterodroma inexpectata	7	4	4	0	7	0	0	0	0	0	1	14	37
P.macroptera	7	1	2	1	4	4	1	1	1	2	0	1	25
P.lessonii	5	0	0	1	2	0	3	1	1	12	0	0	25
Pelagodroma marina	7	0	1	1	0	0	0	0	7	7	4	0	27
Eudyptula minor	167	43	51	30	18	4	9	7	5	9	10	8	361
Morus serrator	36	13	27	33	11	10	15	9	26	10	13	3	206
Phalacrocorax carbo	2	0	0	0	2	5	0	1	1	0	1	2	14
P.varius	3	2	4	0	1	0	2	1	1	4	1	2	21
Stictocarbo punctatus	43	17	13	4	2	0	4	0	0	1	0	3	87
Larus dominicanus	140	56	140	127	84	23	39	13	16	7	16	29	690
L.novaehollandiae	18	7	14	8	17	1	7	1	2	2	0	6	83
L.bulleri	1	1	1	1	5	0	0	0	0	0	4	0	13
Sterna striata	6	3	1	1	3	1	0	2	0	0	2	0	19
Total	881	648	362	303	554	147	197	73	222	325	263	195	4159

** Species not identified by the patroller

from August to March (Imber 1985). With regard to the timing of the nesting season, it is interesting that all 18 specimens have been found from June to December, and none in autumn directly after nesting.

A New Caledonian Petrel (*Pterodroma leucoptera*) was found in January 1993 on Muriwai Beach (AW). This is the fourteenth specimen of this species to be found by patrollers. Patrollers have not distinguished between the two subspecies of *P. leucoptera*. However, all specimens submitted for critical examination have proved to be New Caledonian Petrels (*P. l. caledonica*) rather than Gould's Petrels (*P. l. leucoptera*)(Imber & Jenkins 1981). Therefore, all specimens found beach-wrecked are assumed to have been *P. l. caledonica*. For a summary of information relating to the previous specimens, see Powlesland (1987).

Miscellaneous birds

A total of 117 birds other than seabirds were recovered in 1993. There were 23 Black Swans (*Cygnus atratus*), 19 Mallards (*Anas platyrhynchos*), 18 Australian Magpies (*Gymnorhina tibicen*), seven Variable Oystercatchers (*Haematopus unicolor*), five Paradise Shelducks (*Tadorna variegata*), four Grey Ducks (*Anas superciliosa*), three each of unidentified duck species, Australasian Harriers (*Circus approximans*), Pukeko (*Porphyrio porphyrio melanotus*) and Rock Pigeons (*Columba livia*), two each of White-faced Herons (*Ardea novaehollandiae*), Cattle Egrets (*Bubulcus ibis*), domestic geese (*Anser* sp.), domestic fowl (*Gallus domesticus*), Spur-winged Plovers (*Vanellus miles novaehollandiae*), unidentified passerine species, Blackbirds (*Turdus merula*), Song Thrushes (*T. philomelos*) and Starlings (*Sturnus vulgaris*), and one each of Royal Spoonbill (*Platalea regia*), Canada Goose (*Branta canadensis*), California Quail (*Callipepla californica*), Wild Turkey (*Meleagris gallopavo*), South Island Pied Oystercatcher (*Haematopus ostralegus finschi*), New Zealand Dotterel (*Charadrius obscurus*), Kereru (*Hemiphaga novaeseelandiae*), Eastern Rosella (*Platycercus eximius*), Sacred Kingfisher (*Halcyon sancta*), Bellbird (*Anthornis melanura*) and Common Myna (*Acridotheres tristis*).

Recoveries of *Sterna* species, 1943-1992

Black-fronted Tern (*Sterna albostriata*)

The Black-fronted Tern is an endemic species, with a breeding population estimated to number less than 5000 pairs (Robertson & Bell 1984). During the non-breeding season (February-July), the majority of the eastern South Island population forages offshore during fine weather (R.J. Pierce pers.comm.) and roosts in coastal habitats, particularly at rivermouths, estuaries and harbours (Lalas 1979). In addition, a small proportion of Black-fronted Terns regularly over-winter along the Wellington, Bay of Plenty and Hawkes Bay coasts, with birds occasionally reaching as far north as Kaipara Harbour (Sibson 1948, Lalas 1979, Latham 1981). During August, the population returns to its breeding grounds, the inland shingle riverbeds of the eastern South Island (Lalas 1979, Robertson *et al.* 1984).

During 1943-1992, patrollers reported just nine Black-fronted Terns, the first not until 1976. The data for these birds were: 1976, WS, June; 1978, BP, July; 1981, OT, April; 1982, CS, July; 1983, NC, January; 1984

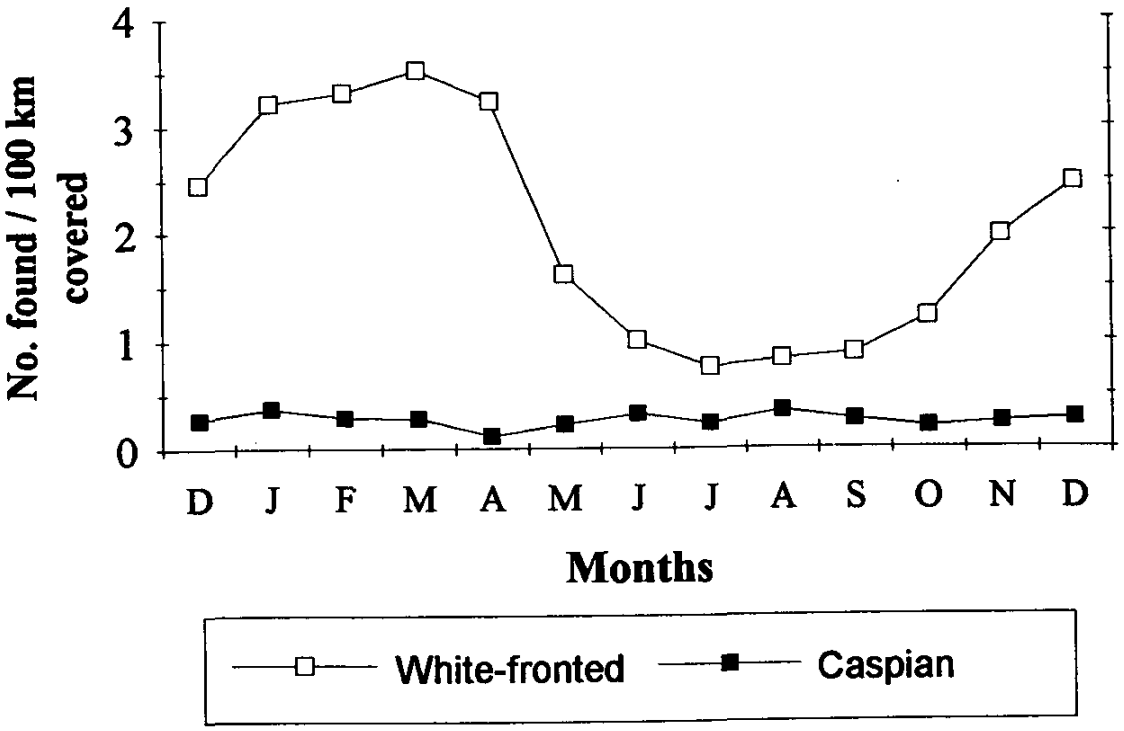

FIGURE 1 – Monthly rates of recovery of *Sterna caspa* and *S. striata*, 1943-1992

(2), CS & CN, December (2); and 1988 (2), WW & CN, July & December. The cause of so few recoveries is possibly due to its small population. Moreover, for nearly half of the year most birds are well inland, and when they are at coastal sites, many frequent estuaries and harbours (Lalas 1979) where little patrolling is carried out. As would be expected from observations of the distribution of live birds in the non-breeding season (Lalas 1979), eight of the beach-wrecked specimens were found on eastern and northern South Island and Wellington coasts. While five of the terns were found during the non-breeding season (February-July), four were picked up in December-January. These birds found in summer may have bred on the coast, as occurred at the Opihi River mouth, South Canterbury, in 1973 (Pierce 1974) or have been first-year birds, a small proportion of which do not migrate to nesting sites in spring (Sibson 1948, Latham 1981). Another possibility is that they were early migrants to coastal sites following unsuccessful breeding attempts.

Caspian Tern (*Sterna caspia*)

The Caspian Tern is almost cosmopolitan (Turbott 1990). There are an estimated 3500 Caspian Terns in New Zealand (Challies 1985), and it apparently was even less numerous during early European settlement (Sibson 1992). It is found throughout the North and South Islands, being most evident along the Auckland West, Auckland East, Bay of Plenty and North Coast South Island coasts (Bull *et al.* 1985). The Caspian Tern regularly forages over coastal waters, including sheltered harbours and coastal lakes, but some birds follow the major rivers inland, reaching the lakes of the lower Waikato, Volcanic Plateau (Sibson 1963) and eastern South Island (Pierce 1984, Robertson *et al.* 1984).

Caspian Terns nest mainly on sandy beaches and spits as individual pairs or colonies of up to 200 pairs (Challies 1985). In addition, isolated pairs nest on the shingle riverbeds and lake margins of inland Canterbury (Pierce 1984). Nesting can start in early September (Pennycook 1949), but most first clutches are laid in October (Pierce 1984, Challies 1985). In Southland, incubation takes 26-28 days, the chicks fledge when 33-38 days old, and fledglings attain independence when about nine months old (M.L. Barlow pers. comm.). The birds disperse once nesting has been completed, with northern North Island terns staying within 100 kilometres of their colonies, but those from southern colonies often migrating north (Challies 1985, Sibson 1992).

Between 1970 and 1992, from five to 15 Caspian Terns were reported by patrollers in most years. The highest annual total was 18 terns in 1974. During 1943-1992, 239 Caspian Terns were found, 0.26 terns per 100 kilometres of beach covered. As expected from the known distribution of the Caspian Tern (Bull *et al.* 1985), the recovery rates of the species for Auckland West, Auckland East, Bay of Plenty and North Coast South Island were greater than for the other coastal sections (Table 5).

TABLE 5 – Rate of recovery (average number of terns found per 100 km of beach covered) of *Sterna caspia* and *S. striata* found on New Zealand coasts during 1943-1992

Species	Coast							
	AE	AW	BP	CN	CS	EC	NC	OI
Sterna caspia	0.32	0.34	0.40	0.25	0.10	0.11	0.88	-
S.striata	1.84	1.76	2.47	6.02	4.32	1.36	3.14	4.68

Species	Coast						
	OT	SD	TA	WA	WD	WS	WW
Sterna caspia	0.04	0.06	0.07	-	0.16	0.05	0.17
S.striata	0.93	0.98	3.07	2.23	0.57	1.11	1.20

The monthly rate of recovery of the Caspian Tern, as depicted in Figure 1, shows a slight increase during the summer months compared with the rest of the year, but the difference is not significant (Kolmogorov-Smirnov one-sample test, $N = 239$, $p > 0.05$). This result is in contrast to that for other coastal species, such as the White-fronted Tern (Figure 1) and three Larus species (Powlesland & Powlesland 1994) which show significantly increased recovery rates in summer and autumn.

White-fronted Tern (*Sterna striata*)

This tern inhabits the coastal waters of New Zealand, venturing not more than a few kilometres out to sea to forage. The breeding colonies, containing from a few birds to thousands, have been found from Northland to Stewart Island, at Chatham and Auckland Islands, and recently on some islands in Bass Strait (Whinray 1980, Napier 1982, Bull *et al.* 1985, Turbott 1990).

In keeping with the capricious nesting behaviour of terns generally, the White-fronted Tern may use a site one year but not return to nest there the following year (MacCullock 1985). The breeding season extends from October to February, with a mean laying date of about 7 November at the Kaikoura Peninsula during 1971-76 (Mills & Shaw 1980). The chicks fledge when 29-35 days old, but may receive food from their parents for a further three months (MacCullock 1985). This lengthy dependence on parents for food may reflect the time required to perfect their skills at locating and catching patchily distributed prey. The majority of juveniles remain around New Zealand. For example, from 1050 nestlings colour-banded on the Boulder Bank, Nelson, during 1981-87, several were sighted along the northern coast of the South Island, and the coasts of Westland, Canterbury North and Wellington West (J.M. Hawkins & G.B. Wilkinson pers. comm.). From the above and other banding studies, it is apparent that a small proportion of the population, mainly juveniles and immatures, disperses across the Tasman Sea, and during May to November occur mainly along the coasts of eastern Tasmania, New South Wales and Victoria (Hindwood 1946, Clark & Dawson 1957, Blakers *et al.* 1984, J.M. Hawkins & G.B. Wilkinson pers. comm.).

During 1943-92, patrollers found 1738 White-fronted Terns. Between 50 and 100 terns were reported in most years during 1970-1992, the lowest and highest annual totals being 25 in 1970 and 133 in 1985. Overall, the mean rate of recovery was 1.92 birds per 100 km of coast covered. Canterbury North had the highest rate of recovery (6.02 birds/100 km of coast covered), followed by Outlying Islands (mainly Chatham Island)(4.68) and Canterbury South (4.32)(Table 5). Little is known about the distribution of the White-fronted Tern in New Zealand at any particular time of the year.

The monthly rate of recovery of White-fronted Terns changed significantly through the year (Figure 1)(Kolmogorov-Smirnov one-sample test, $N = 1738$, $p < 0.01$). From a low in July-September of about 0.8 birds per 100 km of beach covered, the mortality rose gradually during late spring and summer to a peak of 3.5 terns in March, and then declined (Figure 1). The factors that contribute to the autumn peak in mortality are unknown, but it coincides with the independence of young and the moult of adults. Given the skills required to catch prey (find prey by sight and then perform exacting aerial manoeuvres to plunge for and capture it), it is interesting that there is no second peak of mortality during winter when persistent stormy weather can significantly reduce feeding success (Sagar & Sagar 1989).

ACKNOWLEDGEMENTS

The succes of the Beach Patrol Scheme in 1993 was due to the members listed below whose names were entered on the cards, and to many other people who carried out or took part in patrols. P. Agnew, Auckland Team, D. Baker, M. Barnes, B. Binning, B. Boeson, K. Bond, D. Booth, P. Bovill, G. Bremner, R. Buchanan, R. Carter, B. Challinor, W. Chelley, H. Clifford, W. Cook, R. Cossee, R. & S. Cotter, P. Cozens, J. & M. Crawford, A. Crossland, P. Cuming, J. Davenport, J. Dawn, B. Dingle, J. Driersen, A. Eagle, G. Eller, L. Esler, E. Fillery, P. Fleming, L. Fogg, B. Friend, A. Giblin, D. & I. Godbert, A. Goodwin, M. Graham, K. Haslett, D. Hawke, J. Hawken, J. Hawkins, H. Heinekamp, W. Hutton, B. Jones, J. Kendrick, P. Langlands, P. Latham, S. Lauder, D. Lawrie, B. Lewis, A. Lindores,

W. Lock, M. Looney, J. Luke, I. May, D. & J. Medway, W. Messenger, A. Miller, K. & P. Miller, C. Morris, J. & K. Morrison, T. Morrison, A. Munro, F. & S. Nieuwland, J. Northe, G. Nye, L. Oakes, M. Olsen, D. Onley, M. & R. Powlesland, E. Price, G. Pulham, P. Reese, P. Rhodes, H. Robertson, J. & S. Rowe, C. Scadden, P. Schweigman, C. Schischka, L. Scott, L. Simpkin, P. & R. Slack, M. Smith, P. Smith, South Auckland Team, H. Stewart, R. Talbot, B. Taylor, A., B. & D. Tennyson, K. Todd, K. & R. Trumper, M. & T. Turner, M. Twydle, B. Walsh, A. Williams, B. & B. Woolley, J. Woon, B. Wright.

E. & O.E.

We thank the Department of Conservation for institutional support, the New Zealand Lottery Grants Board for financial support, and Maida Barlow, Ray Pierce and Chris Robertson for their constructive comments on drafts of the paper.

LITERATURE CITED

BLAKERS, M.; DAVIES, S.J.J.F.; REILLY, P.N. 1984. The Atlas of Australian Birds. Royal Australasian Ornithologists Union, Melbourne.

BULL, P.C.; GAZE, P.D.; ROBERTSON, C.J.R. 1985. The Atlas of Bird Distribution in New Zealand. Ornithological Society of New Zealand, Wellington.

CHALLIES, C.N. 1985. Caspian Tern. p. 226 *in* Robertson C.J.R. (ed.). Complete Book of New Zealand Birds. Reader's Digest, Sydney.

CLARK, W.C.; DAWSON, E.W. 1957. The trans-tasman dispersal of the White-fronted Tern (*Sterna striata*). Notornis 7: 65-69.

HINDWOOD, K.A. 1946. The White-fronted Tern (*Sterna striata*) in Australia. Emu 45: 179-200.

IMBER, M.J. 1985. Grey-backed Storm Petrel. p. 103 *in* Robertson, C.J.R. (ed.). Complete Book of New Zealand Birds. Reader's Digest, Sydney.

IMBER, M.J.; JENKINS, J.A.F. 1981. The New Caledonian Petrel. Notornis 28: 149-160.

LALAS, C. 1979. Seasonal movements of Black-fronted Terns. Notornis 26: 69-72.

LATHAM, P.C.M. 1981. Black-fronted Terns wintering in the Bay of Plenty. Notornis 28: 221-239.

MACCULLOCH, A. 1985. White-fronted Tern. p. 232 *in* Robertson, C.J.R. (ed.). Complete Book of New Zealand Birds. Reader's Digest, Sydney.

MARCHANT, S. & HIGGINS, P.J. (Eds). 1990. Handbook of Australian, New Zealand & Antarctic Birds. Vol. 1. Oxford University Press, Melbourne.

MILLS, J.A.; SHAW, P.W. 1980. The influence of age on laying date, clutch size, and egg size of the White-fronted Tern, *Sterna striata*. N.Z. J. Zool. 7: 147-153.

NAPIER, J.R. 1982. Note on the breeding of the White-fronted Tern in Franklin Sound, Furneaux Group, Tasmania. Australian Bird Watcher 9: 210-212.

PENNYCOOK, C.S. 1949. Caspian Tern colony. Notornis 3: 129.

PIERCE, R.J. 1974. Presumed attempted breeding of the White-winged Black Tern in New Zealand. Notornis 21: 129-134.

PIERCE, R.J. 1984. Breeding success of isolated pairs of Caspian Terns in Canterbury. Notornis 31: 185-190.

POWLESLAND, R.G. 1987. Seabirds found dead on New Zealand beaches in 1985, and a review of *Pterodroma* species recoveries since 1960. Notornis 34: 237-252.

POWLESLAND, R.G. 1990. Beach Patrol Scheme. Pp. 20-23 *in* Gill, B.J. & Heather, B.D. (eds). A Flying Start. Random Century New Zealand, Auckland.

POWLESLAND, R.G. & IMBER, M.J. 1988. OSNZ Beach Patrol Scheme: information and instructions. Notornis 35: 143-153.

POWLESLAND, R.G.; POWLESLAND, M.H. 1994. Seabirds found dead on New Zealand beaches in 1992, and a review of *Larus* species recoveries, 1943 to 1992. Notornis 41: 117-132.

ROBERTSON, C.J.R. 1975. Yellow-nosed Mollymawk (*Diomedea chlororhynchus*) recorded in the Chatham Islands. Notornis 22: 342-344.

ROBERTSON, C.J.R.; BELL, B.D. 1984. Seabird status in the New Zealand region. Pp. 573-586 *in* Croxall, J.P., Evans, P.G.H., Schreiber, R.W. (eds). Status and Conservation of the World's Seabirds. ICBP Technical Publication No. 2. ICBP. Cambridge, U.K.

ROBERTSON, C.J.R.; LAW, E.; DE HAMEL, R.J.B.; WAKELIN, D.J.; COURTNEY, S.P. 1984. Habitat requirements of wetland birds in the lower Waitaki River catchment, New Zealand. Vol. 3. Occasional Publication No. 6. New Zealand Wildlife Service, Wellington.

SAGAR, P.M.; SAGAR, J.L. 1989. The effects of wind and sea on the feeding of Antarctic Terns at the Snares Islands, New Zealand. Notornis 36: 171-182.

SIBSON, R.B. 1948. Black-fronted Terns in the north. Notornis 3: 10-12.

SIBSON, R.B. 1963. Caspian Terns in the lower Waikato. Notornis 10: 413-414.

SIBSON, R.B. 1992. Some thoughts on Caspian Terns in New Zealand. Notornis 39: 87-93.

SIEGEL, S. 1956. Nonparametric Statistics for the Behavioural Sciences. McGraw-Hill, Tokyo.

TURBOTT, E.G. (Convener) 1990. Checklist of the Birds of New Zealand and the Ross Dependency, Antarctica. 3rd ed. OSNZ & Random Century, Auckland.

WHINRAY, J.S. 1980. The first Australian breeding record of the White-fronted Tern. Australian Bird Watcher 8: 137-146.

★