

# SEABIRDS FOUND DEAD ON NEW ZEALAND BEACHES IN 1990, AND A REVIEW OF *Phalacrocorax*, *Leucocarbo*, AND *Stictocarbo* SPECIES RECOVERIES, 1943 TO 1990

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## ABSTRACT

In 1990, as part of the Beach Patrol Scheme, 4145 km of coast of New Zealand were patrolled and 7145 dead seabirds found. An unusual find was a White Tern (*Gygis alba*).

A summary is given of the coastal and monthly distributions of the eight *Phalacrocorax*, *Leucocarbo* and *Stictocarbo* species found during the 1943-1990 period. The Spotted Shag (*Stictocarbo punctatus*) was the most frequently found, mainly during February to June on Canterbury and Otago beaches.

## INTRODUCTION

This paper records the results of the Ornithological Society of New Zealand's Beach Patrol Scheme for 1990, and reviews *Phalacrocorax*, *Leucocarbo* and *Stictocarbo* species recovered from 1943, when the results of patrols were first recorded on Beach Patrol Cards, to 1990. All sections of coast were patrolled (see Powlesland & Imber 1988). In total, 885 Beach Patrol Cards and 5 Specimen Record Cards were submitted.

Kilometres "travelled" are the total distances travelled 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.

## RECOVERIES IN 1990

In 1990, the total length of coast travelled was 4145 km along which 7145 seabirds were found by 146 members of the Ornithological Society of New Zealand, and their friends. The mean number of birds recovered per kilometre of coast covered was 2.04 (Table 1). The total distance travelled was very similar to the mean of 4059 km per year recorded over the past 19 years (1971-1989). However, the number of seabirds found in 1990 was only 69% of the mean of 10 398 birds for the same 19 year period. This period is used for the comparison because the distance travelled annually was fairly constant, whereas from 1943 to 1970 the distance travelled increased gradually (Powlesland 1990).

Table 1 gives the kilometres covered and the number of seabirds found per month and in total for the various coasts, plus the number of birds picked up per kilometre covered for each coast. Coastal and monthly totals for

TABLE 1 — Numbers of dead seabirds recovered and kilometres covered on each coast of New Zealand in 1990

COAST	CODE	MONTH												TOTAL KM	TOTAL BIRDS	BIRDS/KM OF COAST
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC			
AUCKLAND EAST	KM BIRDS	65	13	60	64	39	43	39	29	45	76	74	30	577	1664	2.88
	AE	106	29	142	54	7	9	7	45	109	409	659	88			
AUCKLAND WEST	KM BIRDS	102	148	60	114	98	121	143	111	161	106	156	145	1456	1958	1.34
	AW	122	172	24	63	177	113	569	106	207	93	102	210			
BAY OF PLENTY	KM BIRDS	17	12	15	7	2	5	4	20	6	27	17	11	143	700	4.90
	BP	35	28	24	15	2	12	4	36	14	345	97	88			
CANTERBURY NORTH	KM BIRDS	28	23	33	7	12	6	9	18	20	19	12	15	202	658	3.26
	CN	73	105	54	9	29	2	33	59	89	54	80	71			
CANTERBURY SOUTH	KM BIRDS	9	0	0	10	3	5	5	6	12	0	5	7	62	127	2.05
	CS	14	0	0	30	5	19	7	10	12	0	10	20			
EAST COAST NI	KM BIRDS	20	8	11	5	12	14	11	14	14	13	41	5	168	338	2.01
	EC	19	3	13	15	6	23	7	6	2	5	237	2			
FIORDLAND	KM BIRDS	0	6	0	0	0	0	0	0	0	0	0	0	6	0	0.00
	FD	0	0	0	0	0	0	0	0	0	0	0	0			
NORTH COAST SI	KM BIRDS	2	17	6	1	0	0	0	0	0	5	1	0	32	27	0.84
	NC	5	10	2	4	0	0	0	0	0	3	3	0			
OUTLYING ISLANDS	KM BIRDS	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0.40
	OI	0	0	0	0	0	0	0	0	0	2	0	0			
OTAGO	KM BIRDS	10	16	12	14	11	11	8	8	8	9	7	9	121	194	1.60
	OT	23	50	14	13	26	20	14	12	12	8	2	11			
SOUTHLAND	KM BIRDS	6	20	18	10	13	2	14	6	11	18	14	10	142	446	3.14
	SD	20	18	59	65	39	4	21	11	55	41	73	40			
TARANAKI	KM BIRDS	1	0	8	21	3	11	17	16	4	3	5	5	94	149	1.59
	TA	1	0	13	17	4	8	75	21	4	2	4	0			
WAIKARAPAPA	KM BIRDS	0	1	0	6	0	1	4	6	3	0	8	2	31	20	0.65
	WA	0	7	0	1	0	1	2	2	1	0	6	0			
WESTLAND	KM BIRDS	0	2	4	1	0	0	2	4	0	0	0	0	14	0	0.00
	WD	0	0	0	0	0	0	0	0	0	0	0	0			
WELLINGTON SOUTH	KM BIRDS	4	4	5	3	4	11	4	17	9	4	21	6	92	169	1.83
	WS	4	2	9	7	18	16	4	24	22	21	39	2			
WELLINGTON WEST	KM BIRDS	32	37	7	9	54	15	64	30	34	19	11	34	346	694	2.01
	WW	78	191	12	4	66	13	148	24	25	37	20	76			
TOTAL KILOMETRES TRAVELLED		339	373	274	316	305	296	357	332	416	369	456	311	4145		
TOTAL KILOMETRES COVERED		296	307	239	272	251	247	326	281	339	294	373	276	3501		
TOTAL BIRDS RECOVERED		500	615	366	287	379	240	891	356	553	1012	1338	598	7145		
BIRDS/KM COVERED		1.69	2.00	1.53	1.09	1.51	0.97	2.73	1.27	1.63	3.44	3.39	2.17			2.04

TABLE 2 — Coastal and monthly distribution of seabird species for which 1 to 10 specimens only were found in 1990

SPECIES OR SUBSPECIES	NUMBER FOUND	COAST(S)	MONTH(S)
<i>Diomedea</i> spp.**	7	AW(2), CS, SD(4)	MAY(2), JUL, SEP(3), DEC
<i>exulans</i>	3	AW(2), SD	JUN, OCT, DEC
<i>melanophrys</i>	6	AW(4), CN, WW	FEB, APR, MAY, SEP(2), DEC
<i>cauta</i> subspp.**	3	AW, SD, WW	JAN(2), MAY
<i>cauta salvini</i>	6	CN(5), TA	FEB, MAR(3), MAY, SEP
<i>chlororhynchos</i>	1	AW	SEP
<i>Phoebastria palpebrata</i>	7	AW(6), BP	JAN, FEB, JUN(2), JUL, AUG, NOV
<i>Procellaria cinerea</i>	2	AW(2)	JAN, APR
<i>westlandica</i>	5	CN, WW(4)	MAY, JUL(2), AUG, OCT
<i>aequinoctialis</i>	3	AW(2), SD	JAN, JUL, DEC
<i>Thalassoica antarctica</i>	1	WW	OCT
<i>Pterodroma</i> spp.**	4	AW, BP, SD, TA	FEB, JUN, AUG, NOV
<i>nigripennis</i>	4	AW(3), AE	MAY(2), OCT, DEC
<i>Oceanites nereis</i>	2	BP, EC	JUN, JUL
<i>Eudyptes</i> spp.**	1	SD	MAR
<i>pachyrhynchus</i>	7	SD(7)	MAR(3), APR, MAY, OCT, NOV
<i>Phaethon rubricauda</i>	2	AW(2)	MAY(2)
<i>Phalacrocorax</i> spp.**	7	AE, CN, EC, OT(2), SD(2)	FEB, OCT, NOV(3), DEC(2)
<i>sulcirostris</i>	4	AE, EC, WS(2)	APR, AUG, SEP, OCT
<i>melanoleucos</i>	9	AW, AE(3), BP(2), CS, EC, OT	JAN, MAR, JUN, JUL, AUG(2), SEP(3)
<i>Stictocarbo featherstoni</i>	1	OI	SEP
<i>Catharacta skua lonnbergi</i>	2	AW(2)	JUN, JUL
<i>Stercorarius parasiticus</i>	1	AW	FEB
<i>Larus</i> spp.**	5	BP(5)	SEP(5)
<i>Sterna</i> spp.**	2	AE, SD	MAR, JUL
<i>caspia</i>	6	AW(4), AE(2)	JAN, FEB, APR, JUN(2), OCT
<i>fuscata</i>	3	AW(2), TA	AUG(3)
<i>Gygis alba</i>	1	AW	JUL
<b>TOTALS</b>	<b>105</b>		

\*\*Species or subspecies was not identified by the patroller

TABLE 3 — Coastal distribution of the seabird species more commonly found dead ( $\geq 10$  specimens) in 1990

SPECIES OR SUBSPECIES	COAST											TOTAL BIRDS						
	AW	AE	BP	TA	WW	EC	WA	WS	NC	WD	CN		CS	OT	SD	OI	FD	
<i>Diomedea cauta steadi</i>	6	0	0	1	3	0	0	0	1	0	0	0	0	0	4	0	0	18
<i>Chrysostoma</i>	10	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	13
<i>bulleri</i>	3	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	12
<i>Puffinus spp.</i> **	2	4	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	14
<i>carneipes</i>	22	104	24	0	0	0	0	0	0	0	10	0	0	0	0	0	0	160
<i>bulleri</i>	90	71	65	7	26	25	1	8	0	0	9	0	0	0	0	0	0	302
<i>griseus</i>	163	743	366	2	40	202	2	16	2	0	108	26	8	101	0	0	0	1779
<i>tenuirostris</i>	47	5	2	1	21	1	0	0	0	0	0	0	0	11	0	0	0	88
<i>gavia</i>	124	100	17	24	24	6	0	9	2	0	17	3	1	0	0	0	0	327
<i>huttoni</i>	3	1	0	0	7	9	3	0	0	0	40	5	0	2	0	0	0	70
<i>gavia/huttoni</i>	0	0	0	0	1	0	0	0	0	0	12	1	0	0	0	0	0	14
<i>assimilis</i>	12	0	4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	18
<i>pelecanoides urinatrix</i>	69	56	41	4	27	5	0	4	1	0	2	1	0	44	0	0	0	254
<i>Procellaria parkinsoni</i>	1	4	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
<i>Lugensa brevirostris</i>	77	1	1	12	20	1	0	0	0	0	6	1	0	7	0	0	0	115
<i>Daption capense</i>	12	1	2	1	1	1	0	2	0	0	0	0	0	4	0	0	0	33
<i>Fulmarus glacialisoides</i>	18	0	0	0	2	3	0	0	0	0	0	0	1	0	0	0	0	25
<i>Macronectes spp.</i> **	12	3	0	0	2	3	0	0	0	0	16	2	1	2	0	0	0	22
<i>Pachyptila spp.</i> **	98	7	1	8	121	0	1	1	1	10	0	15	3	18	0	0	0	259
<i>turtur</i>	140	27	12	19	177	4	2	1	10	0	0	0	0	0	0	0	0	428
<i>becheri</i>	95	3	0	5	7	0	0	0	0	0	0	0	1	0	0	0	0	112
<i>desolata</i>	83	1	3	0	5	0	0	0	0	0	3	0	0	0	0	0	0	96
<i>salvini</i>	136	0	0	13	26	2	0	0	0	0	1	0	0	2	0	0	0	180
<i>vittata</i>	16	0	2	7	17	1	1	0	0	0	24	3	0	23	0	0	0	94
<i>Halobaena caerulea</i>	24	1	1	2	6	0	0	1	0	0	1	0	0	0	0	0	0	36
<i>Pterodroma cookii</i>	2	9	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	12
<i>inexpectata</i>	17	0	1	0	3	0	0	0	0	0	0	0	0	5	0	0	0	26
<i>macroptera</i>	19	9	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	37
<i>lessoni</i>	35	2	0	0	2	1	0	0	0	0	0	0	0	1	0	0	0	41
<i>Pelegodroma marina</i>	7	9	5	0	0	2	0	0	0	0	0	0	0	0	0	0	0	23
<i>Megadyptes antipodes</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	12	10	0	0	24
<i>Eudyptula minor</i>	201	337	48	7	46	9	4	11	3	0	52	11	34	118	0	0	0	881
<i>Morus serrator</i>	206	53	9	7	17	6	3	3	2	0	3	0	0	1	0	0	0	310
<i>Phalacrocorax carbo</i>	0	1	0	1	3	8	0	1	0	0	0	0	1	2	5	0	0	22
<i>varius</i>	9	9	7	0	1	0	0	0	0	0	1	1	0	4	0	0	0	32
<i>Leucocarbo chalconotus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	49
<i>Stictocarbo punctatus</i>	2	7	0	0	0	2	0	1	4	0	178	39	49	14	0	0	0	296
<i>Larus dominicanus</i>	126	34	26	15	67	35	3	97	2	0	95	12	13	25	1	0	0	551
<i>novaeollandiae</i>	11	27	36	2	5	3	0	8	0	0	36	5	27	0	0	0	0	160
<i>bulleri</i>	0	1	0	0	0	4	0	1	1	0	1	4	0	2	0	0	0	12
<i>Sterna striata</i>	23	25	5	2	5	3	0	1	0	0	11	3	1	4	0	0	0	83
TOTALS	1921	1655	690	146	687	334	20	166	27	0	650	125	191	427	1	0	0	7040

\*\*Species was not identified by the patroller

TABLE 4 — Monthly distribution of the seabird species more commonly found dead (> 10 specimens) in 1990

SPECIES OR SUBSPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL BIRDS
<i>Diomedea cauta steadi</i>	0	1	2	4	3	0	5	0	1	0	1	1	18
<i>chrysostroma</i>	0	0	0	1	0	3	5	0	3	0	0	1	13
<i>bulleri</i>	0	1	1	3	2	0	1	0	4	0	0	0	12
<i>Puffinus spp.</i>	1	0	1	0	2	1	4	4	0	0	0	1	14
<i>carneipes</i>	11	15	15	7	2	1	0	0	0	54	31	24	160
<i>bulleri</i>	33	20	17	17	15	10	2	1	2	86	80	19	302
<i>griseus</i>	69	38	29	13	67	7	5	0	3	504	867	177	1779
<i>tenuirostris</i>	11	2	0	1	43	2	4	1	1	2	12	9	88
<i>gavia</i>	39	24	26	13	8	12	53	15	13	33	49	42	327
<i>huttoni</i>	9	10	14	6	0	1	0	2	3	4	11	10	70
<i>gavia/huttoni</i>	3	9	1	0	0	0	0	0	0	0	0	1	14
<i>assiniills</i>	1	0	1	0	3	0	0	1	0	0	2	10	18
<i>Pelecanoides urinatrix</i>	34	22	7	6	2	12	34	14	25	35	39	24	254
<i>Procellaria parkinsoni</i>	1	3	2	0	0	1	0	2	1	1	0	1	12
<i>Lugensa brevirostris</i>	0	0	0	0	4	5	65	15	16	10	0	0	115
<i>Daption capense</i>	2	0	0	0	0	2	10	4	2	2	2	9	33
<i>Fulmarus glacialisoides</i>	0	0	0	0	0	0	0	1	11	11	1	1	25
<i>Macronectes spp.</i>	4	0	1	0	1	2	0	0	3	7	2	2	22
<i>Pachyptila spp.</i>	19	61	1	8	13	14	71	16	13	20	10	13	259
<i>turtur</i>	18	117	7	4	18	15	94	33	30	37	26	29	428
<i>belcheri</i>	0	0	0	1	1	2	99	4	2	1	1	1	112
<i>desolata</i>	0	0	0	2	10	1	69	11	3	0	0	0	96
<i>salvini</i>	1	0	0	3	5	6	157	6	1	1	0	0	180
<i>vittata</i>	19	0	1	1	2	3	24	3	4	7	5	25	94
<i>Halobaena caerulea</i>	0	0	0	0	0	0	23	6	3	3	1	0	36
<i>Pterodroma cookii</i>	2	1	3	1	0	0	0	0	0	1	3	1	12
<i>inexpectata</i>	1	1	1	2	6	0	0	0	2	2	11	26	26
<i>macroptera</i>	1	1	1	3	8	1	5	4	3	5	5	0	37
<i>lessonii</i>	1	0	1	3	5	2	6	4	1	13	0	5	41
<i>Pelagodroma marina</i>	3	5	0	1	1	0	1	0	2	4	5	1	23
<i>Megadyptes antipodes</i>	5	3	1	2	4	0	6	3	0	0	0	0	24
<i>Eudyptula minor</i>	54	63	91	83	42	33	36	72	193	102	74	38	881
<i>Morus serrator</i>	16	30	11	21	23	17	28	18	49	12	21	64	310
<i>Phalacrocorax carbo</i>	3	0	1	4	0	3	3	3	1	0	1	3	22
<i>varius</i>	2	4	2	1	0	6	4	2	4	2	3	2	32
<i>Leucocarbo chalconotus</i>	8	20	5	4	1	2	3	0	3	3	0	0	49
<i>Stictocarbo punctatus</i>	17	17	10	14	29	17	21	49	78	17	15	12	296
<i>Larus dominicanus</i>	68	102	47	43	36	41	33	39	45	16	46	35	551
<i>novae-hollandiae</i>	23	22	34	13	7	8	7	9	8	7	12	10	160
<i>bulleri</i>	4	0	1	2	3	0	1	1	0	0	0	0	12
<i>Sterna striata</i>	10	16	22	5	2	1	2	4	5	2	5	9	83
<b>TOTALS</b>	<b>493</b>	<b>608</b>	<b>357</b>	<b>292</b>	<b>368</b>	<b>231</b>	<b>881</b>	<b>347</b>	<b>536</b>	<b>1004</b>	<b>1332</b>	<b>591</b>	<b>7040</b>

\*\*Species was not identified by the patroller

uncommon species (10 or fewer specimens) are given in Table 2, while for more common species (more than 10 specimens) coastal totals are presented in Table 3 and monthly totals in Table 4.

### Unusual finds

A White Tern found on the beach between Tikinui and Maunganui Bluff, near Dargaville (AW), in July (Table 2) is the third record of a species for the Beach Patrol Scheme. The other two specimens were found on Otaki Beach (WW) in May 1986 and Te Horo Beach (WW) in April 1988. For information about five other White Terns on the New Zealand mainland and a brief review of the biology of the species, see Powlesland (1989).

Four species, two penguins and two shags, were found in greater numbers than usual in 1990, all on South Island beaches, in particular those of Otago and Southland. There were 24 Yellow-eyed Penguins (*Megadyptes antipodes*) picked up (Table 3), the second highest annual total. The highest annual total for this species was 49 in 1972, but patrollers have usually found less than 10 each year. Most of the 1990 penguins were on Otago (12) and Southland (10) beaches. This is to be expected because most mainland Yellow-eyed Penguins live along the south-eastern coastline of the South Island. In addition, populations are on Stewart Island, Codfish Island, Auckland Islands and Campbell Island (Moore 1992). The 1990 penguins were found during January to August. As most fledglings first enter the sea in February and March (Marchant & Higgins 1990) and about half die in their first five weeks at sea (Richdale 1949), the 1990 recoveries cannot be attributed principally to deaths of recent fledglings. At the same time as patrollers found more dead Yellow-eyed Penguins than usual, surveys of breeding pairs on Otago Peninsula indicated a substantial decline. During January 1990, 60-70% of adult Yellow-eyed Penguins breeding on Otago Peninsula died from unknown causes (Marchant & Higgins 1990). Censuses in December 1989 and 1990 indicated a reduction, by over 50%, of breeding Yellow-eyed Penguins in the South Island to 140 pairs (Marchant & Higgins 1990, Darby & Paterson 1991). The cause of the deaths was unclear. As many adults were in reasonable condition when they died, food shortage was probably not the only factor (Moore *et al.* 1991).

The 1990 tally of Fiordland Crested Penguins (*Eudyptes pachyrhynchus*) was seven, surpassing the previous highest annual total of five in 1976 and 1977. Typically, only one to three Fiordland Crested Penguins are found each year. All seven penguins in 1990 were on Southland beaches. This restricted distribution is expected, considering the breeding distribution of the species and the short distance patrolled along Westland and Fiordland beaches. Fiordland Crested Penguins breed along the western and southern coasts of the South Island from the Waitangi-toana River in Westland to the Blue Cliffs of Southland and on some islands off this coastline, on Solander Island, on Codfish Island, and on Stewart Island and some of its offshore islands (Marchant & Higgins 1990, McLean & Russ 1991). The beach-wrecked penguins were found in March-May (5) and October-November (2) (Table 2). Immatures complete their moult and leave the colonies in early February, and breeders leave about a month later (Warham 1974). Thus, the few birds found in autumn may have been in very poor

condition after the moult and unable to forage adequately on their return to sea. October-November is the time when fledglings first enter the sea (Warham 1974).

In most years fewer than 10 Stewart Island Shags (*Leucocarbo chalconotus*) are found. However, 49 were picked up in 1990; the previous highest annual total was 26 in 1986 and 1989. The 1990 shags were found on Otago (43) and Southland (6) beaches, which reflects the species' breeding range, on offshore islands and rocks from Moeraki (OT) south to Bluff, in Foveaux Strait, and about Stewart Island (Marchant & Higgins 1990, Turbott 1990). Birds were recovered in most months, but mainly in summer (Table 4). Whether this summer mortality is the result of poor survival of recently fledged nestlings is unknown because little information is available about the timing of the Stewart Island Shag's nesting (Marchant & Higgins 1990). As the mortality occurred over several months it was probably not caused by storms alone. Scarcity of food is a possible explanation.

The 1990 total of Spotted Shags was 296, not quite reaching the previous highest annual total of 309 in 1974. Usually 100-200 are found each year. Most (90%) of the 1990 Spotted Shags were recovered from Canterbury (CN & CS) and Otago beaches (Table 3). The high proportion of recoveries from eastern South Island beaches does not match the Spotted Shag's widespread breeding distribution, about parts of the North Island and most of the South and Stewart Islands (Marchant & Higgins 1990). Spotted Shags were recovered in all months, with a peak in August-September (Table 4). The cause of this apparently increased mortality is unknown.

It is of note that, of the four species found in greater numbers than usual in 1990, three (Yellow-eyed Penguin, Fiordland Crested Penguin and Stewart Island Shag) were found almost entirely on Otago and Southland beaches. All four species were recovered over all or several months, suggesting storms were not the major cause of death. As at least three of the species (Yellow-eyed Penguin, Stewart Island Shag and Spotted Shag) usually forage in coastal waters mainly for fish and/or crustaceans (Marchant & Higgins 1990), food scarcity may have contributed to the increased recoveries, together with other unknown factors. Where Fiordland Crested Penguins forage and what they feed on outside the breeding season are unknown.

### Miscellaneous birds

Birds other than seabirds recovered in 1990 totalled 226. There were 60 Australian Magpies, 21 Mallards, 17 Black Swans, 17 Canada Geese, 13 Rock Pigeons, nine South Island Pied Oystercatchers, seven Paradise Shelducks, six each of Blackbirds, Song Thrushes and Starlings, five each of domestic geese, Australasian Harriers, Variable Oystercatchers and Spur-winged Plovers, four each of White-faced Herons, unidentified ducks and Pukekos, three each of domestic fowls and New Zealand Dotterels, two each of Grey Ducks, Ring-necked Pheasants, Pied Stilts, Lesser Knots, Spine-tailed Swifts, Silvereyes, Tuis, Goldfinches, House Sparrows and Common Mynas, and one each of Reef Heron, Wild Turkey, Bar-tailed Godwit, Morepork, Little Owl and unidentified passerine.

## PHALACROCORAX, LEUCOCARBO AND STICTOCARBO RECOVERIES 1943-1990

The following is a summary of the coastal and monthly distributions of *Phalacrocorax*, *Leucocarbo* and *Stictocarbo* species found by patrollers during 1943-1990. To test whether the annual pattern of recovery for each species depicted in Figures 1 and 2 differed from the theoretical situation whereby 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, p. 47).

In total, 4712 shags were found between 1943 and 1990, of which 58 *Phalacrocorax* and one *Leucocarbo* were not identified to species. The remaining 4653 comprised four species of *Phalacrocorax* and two species each of *Leucocarbo* and *Stictocarbo* (Table 5).

TABLE 5 — Rate of recovery (number of shags found per 100 km of beach covered) of *Phalacrocorax*, *Leucocarbo* and *Stictocarbo* species found on each coast during 1943-1990

SPECIES	COAST														
	AE	AW	BP	CN	CS	EC	NC	OI	OT	SD	TA	WA	WD	WS	WW
<i>Phalacrocorax carbo</i>	0.22	0.23	0.13	0.90	0.44	3.12	0.26	0.42	0.46	0.69	0.70	0.68	0.54	0.61	0.42
<i>P. varius</i>	2.08	0.49	2.76	1.52	0.06	-	1.10	-	0.09	0.61	0.03	-	0.27	0.05	0.03
<i>P. sulcirostris</i>	0.10	0.04	0.23	0.04	0.06	0.47	-	-	-	-	0.03	0.23	-	0.13	0.03
<i>P. melanoleucos</i>	0.25	0.10	0.57	0.23	0.39	0.41	0.30	-	1.06	0.08	0.28	-	-	0.29	0.11
<i>Leucocarbo chalconotus</i>	-	-	-	-	0.11	-	-	-	7.72	5.12	-	-	-	-	-
<i>L. onslowi</i>	-	-	-	-	-	-	-	3.79	-	-	-	-	-	-	-
<i>Stictocarbo punctatus</i>	0.29	0.47	0.23	36.67	82.76	0.34	7.20	-	19.98	4.89	0.15	0.23	0.94	0.63	0.27
<i>S. featherstoni</i>	-	-	-	-	-	-	-	2.31	-	-	-	-	-	-	-

### BLACK SHAG *Phalacrocorax carbo*

The Black Shag is a widespread species, being found in the Palaearctic region, Iceland, Greenland, east coast of temperate North America, Malay Archipelago to New Guinea, Australia and New Zealand (Turbott 1990). There are at least three subspecies, of which *P. c. novaehollandiae* breeds in New Zealand, Chatham Islands, Australia, Tasmania and western and southern New Guinea, straggling to Norfolk Island, The Snares, Campbell Island and Macquarie Island (Turbott 1990). In New Zealand the Black Shag is widespread, inhabiting coastal and inland waters. Although it favours large areas of open water to forage in, such as estuaries, lakes and major rivers, it does feed in shallow lakes and small rivers (Marchant & Higgins 1990).

Although the Black Shag has colonies throughout the New Zealand mainland, little is known about its breeding biology. Falla (1932) stated that Black Shags bred twice a year, laying eggs in May and September, but did not give details of the colony observed or the frequency of his visits. Gales (1984) made at least monthly visits to a small colony at Stony Creek, Dunedin, in 1982. Two clutches were laid in May, neither of which hatched.



In September clutches were laid in the same two nests, and in a third nest a clutch was laid in November. Monthly observations at a colony of about 35 nests near Lake Kohangatera, Wellington, during 1988-1989 indicated that most clutches were laid in April-May and a few in June-August (R.G. Powlesland & P.J. Moore, unpubl. data). Breeding activities ceased at this colony by late November each year. Therefore, because the breeding cycle from egg-laying to fledglings flying from the nest takes nearly three months (Gales 1984, Marchant & Higgins 1990), the few studies mentioned suggest that in New Zealand most Black Shags rear their young mainly in winter, the remainder in spring.

During 1943-1990, patrollers found 317 Black Shags. Between 10 and 20 shags were found in most years during 1970-1990, the lowest and highest annual totals being four in 1970 and 24 in 1977. Overall, the mean rate of recovery was 0.38 birds per 100 km of coast covered. Of the coastal regions, East Coast North Island had the highest rate of recovery (3.03 birds/100 km of coast covered), followed by Canterbury North (0.74) and Taranaki (0.71)(Table 5). Why the recovery rate of Black Shags on East Coast North Island beaches was more than four times the rate for the other sections of coast is unknown.

The monthly rate of recovery of Black Shags did not change significantly through the year (Figure 1). The recovery rate varied from 0.23 shags per 100 km of beach covered in April to 0.50 shags in December. During July-December, when most fledglings leave their colonies, the recovery rate of Black Shags (0.41) was only marginally greater than for the rest of the year (0.35).

#### PIED SHAG *Phalacrocorax varius*

The Pied Shag is endemic to Australasia. Of the two subspecies, *P. v. varius* is found on the three main islands of New Zealand, straggling to The Snares (Turbott 1990). In contrast to the Black Shag, the Pied Shag mainly inhabits coastal marine habitats and has a discontinuous distribution. It is most plentiful from Cape Maria van Dieman to the Waikato River mouth (AW), Cape Maria van Dieman to Gisborne (AE, BP, EC), Motueka to Banks Peninsula (NC, CN), Milford Sound to Nugget Point (FD, SD) and about Stewart Island (SD)(Bull *et al.* 1985).

Pied Shag colonies are usually in trees near the tops of coastal cliffs. A few colonies are in trees about coastal lakes (Marchant & Higgins 1990). The Pied Shag is more approachable than the Black Shag, and so its nesting has been studied at several localities. It has been found nesting in all months at Auckland (Sibson & Davenport 1956, Millener 1972, Taylor 1987), in the Marlborough Sounds (Soper 1972) and in Paterson Inlet, Stewart Island (Lalas 1979). Colonies usually have the greatest number of occupied nests in spring, with sometimes a secondary peak of occupancy in autumn (Millener 1972, Lalas 1979). From the start of nest building to the fledging of the brood takes about 14 weeks, and some fledglings continue to be fed by their parents for a further 10 weeks (Millener 1972).

Between 1970 and 1980, 10 to 20 Pied Shags were found in most years, but since 1980 the annual figure has been about 40 shags. The highest annual

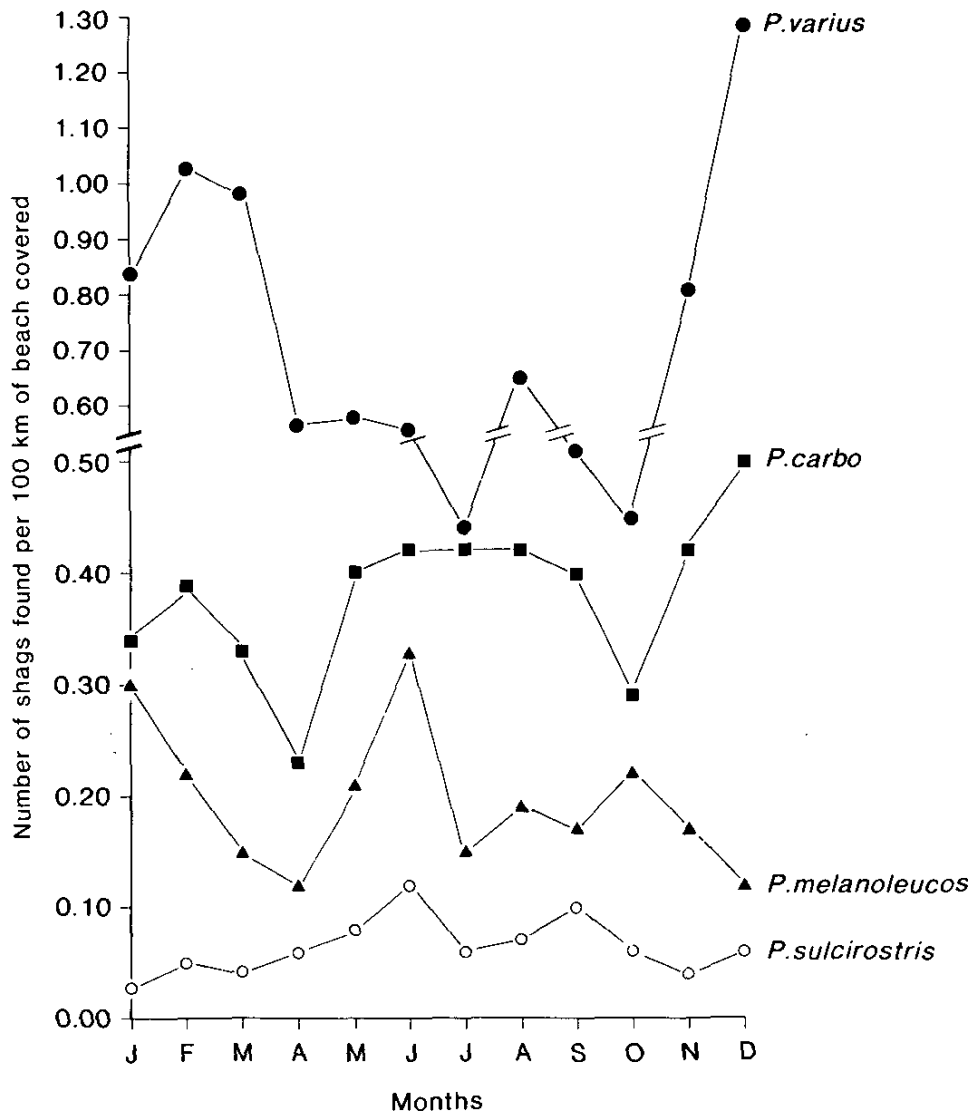


FIGURE 1 — Monthly rate of recovery (number of shags found per 100 km of beach covered) of *Phalacrocorax carbo*, *P. varius*, *P. sulcirostris* and *P. melanoleucos* during 1943-1990

total was 48 Pied Shags in 1989. During 1943-1990, 590 of these shags were found at an average rate of 0.71 shags per 100 km of beach covered. As expected from the known distribution of the Pied Shag (Bull *et al.* 1985), the recovery rates of the species for Auckland West, Auckland East, Bay of Plenty, North Coast South Island, Canterbury North and Southland are greater than for the other coastal sections (Table 5).

The monthly rate of recovery of Pied Shags, depicted in Figure 1, changes significantly through the year ( $p < 0.01$ ). From April to October about 0.5 shags were recovered per 100 km of beach covered, but during November to March the monthly rate of recovery varied from 0.7 to 1.3 shags. If recently fledged birds made up the majority of Pied Shags found by patrollers, the peak in the rate of recoveries in summer is to be expected because more nestlings fledge then than in the other seasons (Millener 1972, Lalas 1979).

**LITTLE BLACK SHAG** *Phalacrocorax sulcirostris*

The Little Black Shag is found in Borneo, Java, Moluccas, Aru Island, New Guinea, New Caledonia, Tasmania, much of Australia, and New Zealand (Turbott 1990). Within New Zealand it is distributed on lakes, estuaries and harbours of the North Island as far south as a line from Kawhia (AW) to Cape Kidnappers (EC), and along the west coast from Wanganui to Wellington (WW), Lake Wairarapa and associated wetlands, but is rarely seen in the South Island (Bull et al. 1985). When foraging inland it tends to favour open water greater than a metre deep and big enough to let the shags feed as a flock (Marchant & Higgins 1990).

It breeds at several sites, particularly in the Auckland, lower Waikato, Rotorua, Taupo and Hawke's Bay districts. At Lake Pupuke, Auckland, in 1954-1956, Little Black Shags seemed to have two periods of egg-laying, October-November and April-May (Sibson & Davenport 1956). In comparison, at Lake Rotorua in 1982-1985, they laid eggs in November-December and the chicks fledged in February-April (J. Innes & G. Taylor, pers.comm.). Banding of nestlings at the Lake Rotorua colony, which contains hundreds of birds in some seasons, has shown that they disperse widely in early winter, such as to the coastal waters of the Hauraki Gulf and Wellington (J. Innes & G. Taylor, pers. comm.).

Five or fewer Little Black Shags have been found annually during the past ten years. During 1943-1990, 55 of these shags were found at an average rate of 0.07 shags per 100 km of beach covered. Of the coastal regions, East Coast North Island had the greatest rate of recovery (0.46 shags per 100 km of coast covered), followed by Bay of Plenty (0.23) and Wairarapa (0.23)(Table 5). Considering that Little Black Shags are rarely seen south of Marlborough-Nelson, it is surprising that one was found beach-wrecked on a Canterbury North beach and three on Canterbury South beaches.

The monthly rate of recovery, as shown in Figure 1, does not change significantly through the year, two to eight birds being found in each month. One might expect seasonal variation, given that numbers of Little Black Shags increase at coastal sites in winter. However, those sites are sheltered coastal waters, such as harbours and estuaries, not the open sea adjacent to which most patrolling is carried out.

**LITTLE SHAG** *Phalacrocorax melanoleucos*

The Little Shag is found beyond the New Zealand region, including Indonesia, New Caledonia, New Guinea, Solomon Islands, Australia and Tasmania (Turbott 1990). However, the subspecies *brevirostris* is restricted to New Zealand waters, breeding from North Cape to Stewart Island (Turbott 1990). Although less widespread, the Little Shag is like the Black Shag in that it may be seen from the coast to far inland, foraging in lakes, ponds, streams and rivers (Matthews 1984, Bull et al. 1985). Stonehouse (1967) found that the Little Shag, when in coastal waters, foraged inshore in waters seldom more than three metres deep.

Most Little Shag breeding colonies are in sheltered locations, such as lakes, ponds, swamps and inlets (Matthews 1984). Often the Little Shag breeds in mixed species colonies with one or more of the other three *Phalacrocorax* species. Little Shag nests are usually in trees over water but

occasionally on *Carex* bushes, emergent snags or mai-mais (waterfowl shooters' hides). From studies at three North Island sites [Lake Pupuke, Auckland, 1952-1955 (Sibson & Davenport 1956); Hamilton's Lagoon and Sexton's Lagoon, Manawatu, 1980-1983 (Matthews 1984); Hobson Bay, Auckland, 1977-1985 (Taylor 1987)], it is evident that the species has a fairly regular breeding cycle. Nest-building and refurbishing start in late July, and eggs are laid from August to February, with a peak in October-November. Although the young of early nesters start leaving colonies in November, the rearing of young can extend into April as a result of some pairs re-nesting after failed first attempts and because a few pairs start their nesting late in the season.

Generally, patrollers find about 10 Little Shags annually, the greatest number being 19 in 1981. During 1943-1990, 163 of these shags were found at an average rate of 0.20 shags per 100 km of beach covered. The Little Shag has been found on all mainland coasts, except Wairarapa and Westland (Figure 5). This is not surprising for the Wairarapa coast, where sightings in the *New Zealand Atlas* were sparse, whereas the species was seen in most 10 000 yard coastal squares of Westland (Bull *et al.* 1985) and so it is strange that Westland patrollers have not picked up any. The coast with the highest rate of recovery was Otago (1.06 birds per 100 km covered), followed by Bay of Plenty (0.52) and East Coast North Island (0.40)(Table 5).

As most young fledge in summer, one would expect an increased recovery rate in autumn. Moreover, from evidence of Little Shag numbers increasing in Wellington Harbour in autumn and winter (Robertson 1992), many Little Shags may move to coastal waters then. However, the monthly rate of recovery of the Little Shag, shown in Figure 2, did not change significantly through the year.

#### STEWART ISLAND SHAG *Leucocarbo chalconotus*

The Stewart Island Shag, a dimorphic species, has a restricted distribution. It has been seen from Oamaru south to Nugget Point (OT), and then west along the southern coast of the South Island as far as Te Waewae Bay (SD). In addition, it has been seen around much of Stewart Island (SD)(Bull *et al.* 1985). Within this range it nests at 15 known sites, from Goat Island, near Moeraki, in the north, to islands about Codfish Island and near the entrance to Paterson Inlet, Stewart Island, in the south (Watt 1975, Cooper 1991). It does not nest at all known nesting sites each year, some sites having been abandoned and then reoccupied several years later (Watt 1975). No detailed study has been published of the Stewart Island Shag's breeding biology, but from observations during infrequent visits to colonies it seems that it nests mainly in spring and summer (Sansom 1956, Blackburn 1968, Watt 1975, Cooper 1991).

During 1943-1990, patrollers found 239 Stewart Island Shags. Since 1970, usually less than 10 shags have been found per year, the lowest and highest annual totals being zero in 1984 and 49 in 1990. Given that Stewart Island Shags inhabit the coastal waters of just Otago and Southland, it is not surprising that all but two of the beach-wrecks were along the coasts of Otago (7.77 birds per 100 km of coast covered) and Southland (5.19)(Table 5).

The monthly rate of recovery for the species changed significantly during the year (Figure 2,  $p < 0.01$ ), being greatest in February-April and least in July-December. Whether the autumn peak is the result of recently fledged young dying, food shortage, or some other factor is unknown.

#### CHATHAM ISLAND SHAG *Leucocarbo onslowi*

This species is restricted to the Chatham Islands group, usually within a few kilometres of the coast (Marchant & Higgins 1990). The Chatham Island Shag nests on exposed headlands and islets of Chatham Island, on Rabbit Island off Pitt Island, and on Star Keys (Fleming 1939). The largest colony is on Star Keys (D.V. Merton & B.D. Bell, pers. comm.). The little information available about the breeding of this shag suggests that egg-laying lasts from September to December (Fleming 1939, Morris 1977). Visits by Fleming (1939) to the Okawa and Tuparonga colonies in December 1937 and by Morris (1977) to the Cape Fournier colony in November 1973 indicate that the breeding season can vary between colonies and within a colony.

Patrolling on Outlying Islands has resulted in 481 km covered, mostly along Chatham Island beaches. Eighteen Chatham Island Shags were found during patrols, 3.74 shags per 100 km covered. Patrolling on Chatham Island outside of December-February (248 km) and May (76 km), has been too little to show any seasonal variation in the recovery rate of the Chatham Island Shag.

#### SPOTTED SHAG *Stictocarbo punctatus*

Two subspecies of this shag are recognised (Turbott 1990), but patrollers did not distinguish between them. *S. p. punctatus* breeds on several islands of the inner Hauraki Gulf (AE), an island and two headlands of the Auckland west coast (AW), on two islands in Wellington Harbour (WS), at many sites in the Marlborough Sounds (NC) and about Banks Peninsula (CN & CS), on coastal cliffs near Palmerston and Otago Peninsula (OT), and on cliffs between Nugget Point and Te Waewae Bay (SD) (Marchant & Higgins 1990, Turbott 1990, Robertson 1992). *S. p. steadi* breeds on Stewart Island and some of its inshore islands, on Codfish and Centre Islands (SD), and at three sites along the west coast of the South Island (FD) (Turbott 1990). Spotted Shags congregate about these sites when nesting, but in the non-breeding season disperse to other coastal areas. For example, shags from Banks Peninsula regularly reach Tasman and Golden Bays, about 400 km north (Owen & Sell 1985). While the species often forages in estuaries and harbours, it also goes well out to sea to feed, for example, as much as 16 km offshore from Kaikoura (Stonehouse 1967).

The breeding season of the Spotted Shag extends over much of the year, particularly at some Hauraki Gulf colonies. For example, peaks of egg-laying have been in March, August and December at a colony on Waiheke Island (Turbott 1956). As eggs take about a month to hatch and chicks about two months to fledge (Turbott 1956, Fenwick & Browne 1975), nesting may occur year round at this colony. At Somes Island, Wellington Harbour, the Spotted Shag has two peaks of nesting, one in June-August and the other in November-January (Miskelly & Benfell 1981). However, nests containing eggs or chicks were seen in October 1972 (Kendrick 1973), indicating that the breeding season can vary from year to year at the same site, as Kinsky

(1970) noted at Perpendicular Point, Westland. South Island colonies seem to have just one peak of nesting annually, with egg-laying starting at Banks Peninsula colonies in mid-September and the last fledglings leaving in late January-February (Fenwick & Browne 1975).

In total, 3259 Spotted Shags have been found beach wrecked, making it the most numerous shag species picked up by patrollers. It was found at a rate of 3.94 birds per 100 km of beach covered from 1943 to 1990. It was found most of all on beaches of the eastern South Island, and Canterbury South had a much greater rate of recovery (82.82 birds per 100 km covered) than Canterbury North (36.31) and Otago (19.99)(Table 5). This distribution of beach-wrecked Spotted Shags reflects their far greater numbers in the coastal waters of the eastern South Island than elsewhere about New Zealand.

The monthly rate of recovery of Spotted Shags changed markedly during the year ( $p < 0.01$ ). From a low in October of 2.3 birds per 100 km of beach covered, the mortality rose gradually in late summer and autumn to a peak of 7.1 shags in May, and then declined in winter (Figure 2). As 74.5% of Spotted Shags were found on Canterbury beaches (CN & CS), many probably originated from colonies on Banks Peninsula. If this was so, the greater mortality during February to June (Figure 2) corresponds with the departure of late fledglings from Banks Peninsula colonies (Fenwick & Browne 1975). Certainly large numbers of juvenile Spotted Shags in poor condition are found in most years on beaches near Christchurch (CN) at about the time of chick departure (Fenwick & Browne 1975). That the high recovery rate continues through to June probably relates to birds not coping with one or more factors, such as the demands of dispersal and poor foraging conditions during storms.

#### PITT ISLAND SHAG *Stictocarbo featherstoni*

This species is restricted to the Chatham Islands (OI) and is estimated to number fewer than 1000 breeding pairs (Robertson & Bell 1984). It forages close inshore, but also far out to sea over reefs (Marchant & Higgins 1990). The Pitt Island Shag's favoured nesting sites are eroded holes or ledges of cliffs (Fleming 1939). Although it nests about Chatham Island, most birds breed south of Pitt Strait, on Pitt, Mangere, Little Mangere, Rabbit and South East Islands, Star Keys and Pyramid Rock (Fleming 1939). Its breeding season has been little studied, but the few published observations indicate that eggs are laid from August to late November (Fleming 1939, Soper 1984). Chicks hatching from eggs laid in November probably do not leave the colonies until March if, as for the Spotted Shag, they have a nestling period lasting at least 57 days (Fenwick & Browne 1975).

Patrolling of Chatham Islands beaches has resulted in 12 Pitt Island Shags being found, 2.49 shags per 100 km covered. Much more patrolling along these beaches is needed in all months to show any seasonal variation in the recovery rate of this species.

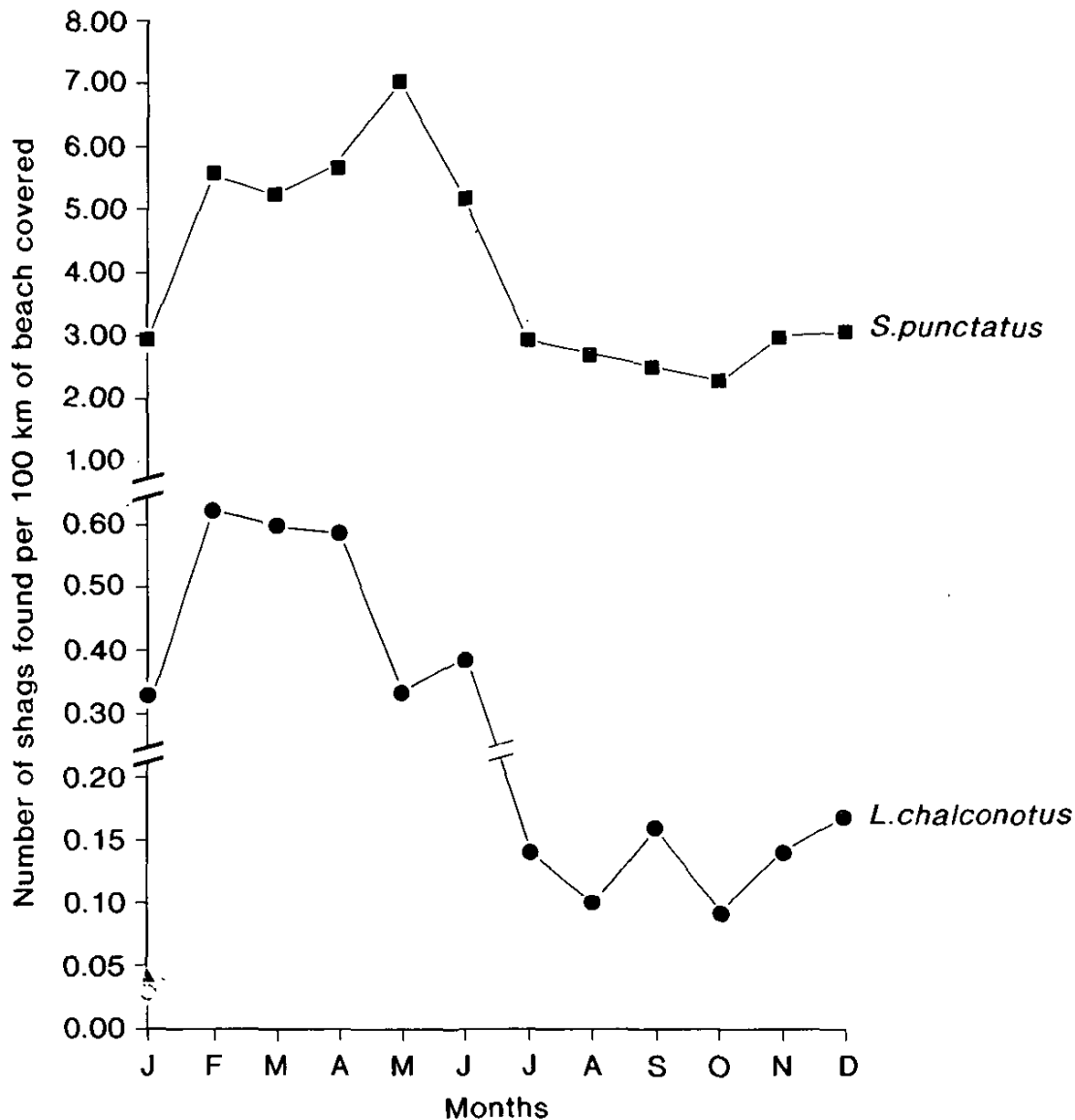


FIGURE 2 — Monthly rate of recovery (number found dead per 100 km of beach covered) of *Leucocarbo chalconotus* and *Stictocarbo punctatus* during 1943-1990

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## SHORT NOTE

### **Common Noddy *Anous stolidus* at Muriwai Beach**

On 16 June 1992, JD found the corpse of a beach-wrecked dark-coloured tern at the south end of Muriwai Beach, north-west of Auckland. The specimen was putrid and the body cavity was empty, but most feathers were still adhering. To stabilise the specimen, BJG washed it in detergent, soaked it in 5% formalin for a week and air-dried it. It is now in the collection at Auckland Museum, registered B3654.

The specimen has a stout black bill with a prominent gonyx on the lower mandible. The small legs and feet are black. On drying it became clear that the primaries and tail are black while the body feathers are dark brown. The head is dark brown but there are traces of white around the eye and between the eye and the frontal area.

Measurements of the wet specimen were: left wing 265 mm, exposed culmen 36 mm, right tarsometatarsus 25 mm. These measurements agree with those given for Common Noddy by Serventy *et al.* (1971). In overall size and shape the specimen agrees closely with two skins of *Anous stolidus* from the Pacific held at Auckland Museum. We consider it to be an immature bird as these often lack the white cap (Serventy *et al.* 1971).

### **Discussion**

Common Noddies are pantropical (Harrison 1983). In the New Zealand area they breed on Lord Howe and Norfolk Islands (Condon 1975). Cheeseman