

# BEHAVIOUR OF SEABIRDS AROUND FISHING TRAWLERS IN NEW ZEALAND SUBANTARCTIC WATERS

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## ABSTRACT

Observations of birds were made while working on fishing trawlers intermittently for a total of almost a year in New Zealand subantarctic waters. Large numbers of several species of albatrosses and petrels are attracted to trawlers to scavenge and their numbers vary throughout the year. Species not attracted are seen less commonly. Scavenging behaviour around trawlers is discussed. There seems to have been an increase in scavenging by certain species in the last 30 years.

**KEYWORDS:** Seabirds, fishing trawlers, abundance, behaviour, subantarctic.

## INTRODUCTION

During 1987-1995 I spent in total almost a year in the subantarctic waters of New Zealand, working on fishing boats as a Scientific Observer for MAF Fisheries. I kept notes of the birds seen, now covering most of the year, and these are summarised here.

Observations were mainly restricted to the area south of 46°S; this includes Nugget Point and Puysegur Point, the SE and SW corners of the South Island (Figure 1), and some major fishing grounds. My trips have all been on large (60-100 m long) foreign trawlers which fish exclusively outside the 12 nautical mile (1 NM = 1.85kms) territorial waters, so all observations are well offshore. Observation periods occurred unevenly throughout the year, mostly during February to April (squid fishing season). There was one winter trip (June-August), and three visits during October - November (Table 1). Most observations early in the year were restricted to the Snares and Auckland Shelves, and the surrounding waters, while to Puysegur Point and Nugget Point at other times of the year. The Campbell Shelf, Pukaki Rise and Bounty Platform were only visited during the single winter trip. Previous accounts of birds in these waters are mainly by people en route to and from the Antarctic during summer (Darby 1970, Dell 1960, Hick 1973, Jenkins 1981, Vooren 1973), and there are no records in winter.

Large numbers of seabirds, almost exclusively albatrosses and petrels, are attracted to trawlers to feed on fish and squid which fall from the net during haulback and on offal and spillage discharged from the fish factory during processing. The turbulence of the waters caused by the vessel and its net also seems to bring plankton to the surface which attracts prions and storm petrels far back in the wake. If the vessel is steaming, or fishing without

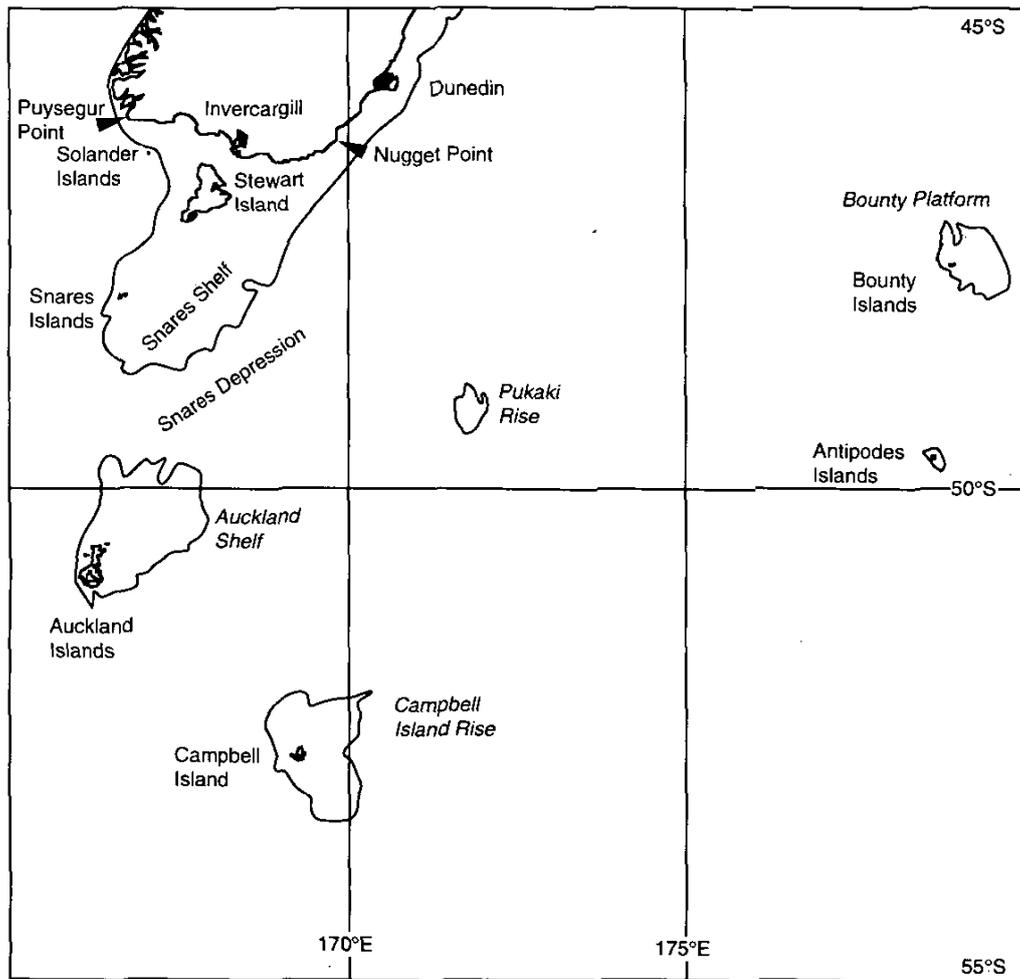


FIGURE 1 – Map of the study area on subantarctic waters of new Zealand, including the 200 m depth contours.

processing, there may be only a few birds about, but once the winches start turning to bring the net to the surface, birds start congregating. By the time the net reaches the surface, hundreds of birds will be behind and around the vessel.

During the squid season there might be more than 30 trawlers fishing in one area, each surrounded by hundreds of birds, which move about between vessels. At other times only one-two trawlers might be on a particular fishing ground, therefore birds might be more concentrated. Some species may gather very quickly. For example, on 20 Mar 1994 I thought only five Royal Albatrosses (*Diomedea epomorpha*) were around, but about 25 congregated within a minute after two settled on the water, attracted by floating offal. Therefore, the numbers quoted are estimates only, and are really only relative, but show interesting variations through the year.

Some seabirds are not usually attracted to trawlers or other vessels, some inspect them briefly and pass on, whilst others actively avoid them. Spotting these species amongst the hundreds of ship-followers can be difficult, but easier in certain sea and weather conditions.

TABLE 1 – Details of the observation effort, 1987-1995

Year	Period	Area
1987	12-15 Oct, 13-14 Nov	Nugget Point
	15-21 Nov	Solander I - Puysegur
1989	19-24 Oct	Nugget Point - Snares Is
1990	29 Jan - 25 Feb	Auckland Shelf
1991	27 Jan - 4 Apr	Snares Shelf, N Auckland Shelf
1992	16 Jun - 15 Aug	Puysegur, Snares Depression, W Auckland Shelf, Campbell I Rise, Pukaki Rise, Bounty Platform
	9 - 31 Oct	Puysegur, Snares Depression
1993	1 Feb - 18 Mar	Snares Shelf
1994	4 Mar - 3 Apr	Snares Shelf, N Auckland Shelf
1995	29 Jan - 13 Feb	Dunedin S, Snares Shelf, Auckland Shelf

### OBSERVATION METHODS

Because of the large numbers of birds involved, and their constant movement, accurate counts or estimates were impossible. Other observers have argued the merits of 5-, 10-, or 20-minute counts for recording seabird numbers from boats, but I think that for fishing vessels, a different approach is required. I usually estimated the numbers visible around the vessel at a peak time, and then spent 10-20 minutes identifying the different species. Any other species or peak numbers noticed during the day were added to the list. Robertson & Jenkins (1981), when studying birds of southern New Zealand waters, abandoned their usual 10-minute counts when confronted by the large numbers of birds concentrated around the fishing fleet on the Auckland Shelf, and instead “estimated the relative proportions of one species to another”.

Observations were made using 8x40 binoculars. The most common observation points were the bridge, the adjacent deck, and the stern, especially at haulback. My main identification guide was Harrison (1983).

## RESULTS

Seasonal variations in average daily numbers of the common species are presented in Table 2.

SNARES ISLAND PENGUIN *Eudyptes robustus*

A crested penguin, seen briefly on 10 Feb 1995 at 48°47' S 167°24' E, c.55 NM from the Snares Is, was most likely of this species.

WANDERING ALBATROSS *Diomedea exulans*

Although the Wandering Albatross breeds locally in large numbers, I have few records of it during the late summer squid season. 1991: three seen during 10 weeks on the Snares and Auckland Shelves. 1992: two singles on the Auckland Shelf and three with thousands of other birds settled near while stationary SE of Stewart I. on 25 Apr. 1993: two seen briefly while fishing; one-five often seen while steaming to and from grounds. 1994: four while fishing, two during a storm, and four while steaming.

Winter 1992: only two seen in over a month of fishing off Puysegur Pt and one-two on five days to the E and S; four on 11 Aug on the Pukaki Rise. While steaming: three behind our vessel approaching Bounty Is on 12 Aug, eight at 47°S, 177°E on 15 Aug.

October 1992: c.15 behind vessel nearing Puysegur Pt on 9 Oct; c.10 on 12 Oct, five while steaming on 11 Oct; otherwise only odd birds while fishing.

SOUTHERN ROYAL ALBATROSS *Diomedea e.epomophora*

During February-April (squid season), usually 5-20 birds around the trawler; with > 30 trawlers in the vicinity, this could represent 300 or more in total. On 25 Apr 1992, while stationary SE of Stewart I., c.60 eventually settled nearby. On 11 Feb 1993, a very calm day on the Snares Shelf, > 60 birds, mainly sitting on the water in small groups. In 1994, usually 10-30 on Snares Shelf with c.55 behind a passing trawler on 10 Mar; on the Auckland Shelf only one-two seen most days.

Winter 1992: usually about five while fishing near Puysegur Point, with 10-15 birds on four days. In July, fishing over the Snares Depression, usually > 20, occasionally 40-50. On the Campbell Rise, Pukaki Rise, and Bounty area: usually five-ten birds. October-November: usually one-four birds.

Royal Albatrosses made greater use of trawlers in this area than Wandering Albatrosses, joining the smaller mollymawks for the easy food behind the vessels, but probably because of their lesser manoeuvrability, not coming as close to the stern as them. The greater numbers recorded during the winter were perhaps because more birds congregated around the few vessels fishing.

NORTHERN ROYAL ALBATROSS *Diomedea epomorpha sanfordi*

Only seen off the Otago coast from Dunedin to Nugget Pt; up to about eight birds, and one E of Stewart I. in 1995.

TABLE 2 - Seasonal variation in average daily numbers of the most common species around a single trawler.

Species	Months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Royal Albatross	-	10	10	10	-	10	20	20	-	2	2	-
Shy Mollymawk	-	400	400	400	-	300	50	(1)	-	400	400	-
Salvin's Mollymawk	-	2	1	0	-	1	1	(300)	-	20	20	-
Black-browed Mollymawk	-	2	2	2	-	2	2	1	-	300	10	-
Buller's Mollymawk	-	30	30	50	-	150	300	(1)	-	1	1	-
Gian Petrel	-	1	1	1	-	45	45	45	-	4	4	-
Cape Pigeon	-	30	40	50	-	1000	1000	1000	-	150	150	-
White-chinned Petrel	-	50	20	5	-	0	0	0	-	80	80	-
Grey Petrel	-	0	0	0	-	80	80	80	-	0	0	-
Sooty Shearwater	-	500	500	500	-	1	1	0	-	500	500	-
Prion spp.	-	20	20	20	-	30	30	30	-	20	20	-
Black-backed Storm Petrel	-	30	30	30	-	1	0	0	-	25	25	-
Total no. of weeks of observation	1	11	14	5	0	2	4	2	0	5	1	0

Notes: (1) During February-April, >30 trawlers working in the area; 1-5 during the rest of the year.

(2) Observations in August were made further south and east than usual, so figures not always comparable.

**BLACK-BROWED MOLLYMAWK** *Diomedea melanophrys*

Though about 24,000 pairs breed on Campbell I (Gales 1993), this mollymawk is uncommon during the late summer squid season, with generally only one-two birds, rarely up to ten. However, in 1994, usually 5-20, occasionally up to c.40, on the Snares Shelf, (where fewer Shy Mollymawks were observed than usual). Only the occasional one-two birds on the Auckland Shelf where most of the Shy Mollymawks were congregated. Other observers of its summer distribution in this area (Hicks 1973, Robertson & Jenkins 1981) found it most abundant around and S of Campbell I, where most feeding in summer may occur.

Winter 1992: uncommon, only one-two most days off Puysegur Pt, one-three on the Pukaki Rise and Bounty Platform, but none near Campbell I., and only scattered records between the Snares and Auckland Is.

In spring, the situation is very different. 1987: off Nugget Pt, the commonest mollymawk on 11-12 Oct, but only small numbers by 13 Nov, and similar small numbers near Puysegur Pt between 16-20 Nov. 1992: one-five off Puysegur Pt between 11-14 Oct, but at the Snares Depression from 15-18 Oct it was the commonest mollymawk with 300-400 birds, up to 75% of the total mollymawks. By 18 Oct c.300 each of Shy and Black-browed Mollymawk, changing to 400 Black-browed and 600 Shy on 20 Oct. Between 21-30 Oct, usually only c.40 Black-browed Mollymawks. Nearly all these birds were adults of the subspecies *impavida*.

These high numbers during October were presumably birds gaining condition before laying, during the so-called honeymoon period, when birds leave the colony for a period after re-establishing pair bonds and nest sites. Large numbers of Black-browed Mollymawks seem to make significant use of trawlers as a food source in the area only during this short period.

**SHY OR WHITE-CAPPED MOLLYMAWK** *Diomedea cauta steadi*

This species is greatly attracted to trawlers. About 65,000 pairs of Shy Mollymawk breed on the Auckland Is (Turbott 1990) and throughout most of this area it is the commonest subspecies of *D. cauta* to be seen.

February to April: usually 200-500 around a trawler, with sometimes > 1000 on the Auckland Shelf, a total of several thousand around the whole fleet. 1993: c.20 behind the vessel as we approached the fishing grounds on 1 Feb, c.50 congregated as we shot the first trawl, and c.200 gathered by the time we hauled. Even during the night > 50 could be behind the vessel at haulback. 1994 was unusual: 300-500 on the Auckland Shelf, where most of the fleet were fishing, but on the Snares Shelf usually under 100, outnumbered by Buller's Mollymawks (*Diomedea bulleri*) during the first half of March.

Winter 1992: 200-300 in June off Puysegur Pt and S of the Snares Is, with a maximum at Snares Depression of c.600 on 19-20 Jun. Still c.300 on 16 Jun off Puysegur Pt, but when we returned there on 27 Jun only 50-80 for the next month, outnumbered greatly by Buller's Mollymawks. Similarly, at Snares Depression, c.500 on 21 Jun, but when we returned on 26 Jul

none for three days, then only one-three for the next few days. In early August only odd birds around Campbell and Pukaki Rises (and no other mollymawks), and none on the Bounty Platform where Salvin's Mollymawk (*D. cauta salvini*) were numerous. This sudden drop-off in numbers coincides with the start of the hoki (*Macruronus novaezelandiae*) fishery on the West Coast, South Island, and it seems likely that most birds had migrated N to the richer food source that >40 trawlers provide.

October 1992: 50-300 off Puysegur Pt during 11-13 Oct and 100-600 on the Snares Shelf for the rest of the month, though it was outnumbered there by Black-browed Mollymawk until 18 Oct. Bartle (1974) found this species to be the boldest and commonest mollymawk in Cook Strait in 1966 and Oliver (1955) mentions it following fishing boats at Stewart I, so its use of trawlers as a food source is an old habit.

#### SALVIN'S MOLLYMAWK *Diomedea cauta salvini*

This race breeds mainly on the Bounty Is, with a few hundred on the Snares (Turbott 1990). During the squid season, usually few seen between the Snares and Auckland Is. In some years none, or only one-two, occasionally up to five, but 10-20 observed in February 1995.

Winter 1992: usually one-two off Puysegur Pt, but only two singles in the Snares Depression area, and none seen on Campbell and Pukaki Rises. As we neared Bounty Is on 12 Aug, one appeared at 48°08' S, 177°50' E and c.40 gathered when we shot our first trawl in the area, with up to c.500 thereafter. It seems that this race spreads mainly N from its breeding grounds, leaving the waters to the W to the Shy Mollymawk.

October 1992: 15-25 off Puysegur Pt, up to c.50 as we fished S of the Snares Is. These were presumably breeders from the Snares, which usually make little use of trawlers in this area.

#### CHATHAM ISLAND MOLLYMAWK *Diomedea cauta eremita*

This subspecies breeds only on Pyramid Rock of the Chatham Is and remains mainly in the adjacent waters (Turbott 1990). Only records in my study area: one off Nugget Pt on 14 Nov 1987; one on the Snares Shelf on 27 Oct 1992.

#### GREY-HEADED MOLLYMAWK *Diomedea chrysostoma*

Although this species breeds in large numbers on Campbell I. (Turbott 1990) I have seen it infrequently. During the squid season: one on the Auckland Shelf on 31 Jan 1991 and a juvenile on 4 Feb 1993 on the Snares Shelf. Robertson & Jenkins (1981) recorded c.20 around the fishing fleet on the Auckland Shelf in May.

Winter 1992: single birds on three days between the Snares and Auckland Is and on most days off Campbell I. in early August. Three on the Pukaki Rise on 10 Aug 1992.

One juvenile on the Snares Shelf on 15 Oct 1992. It seems that this species generally ranges S from its breeding grounds in summer, and in this area makes little use of trawlers.

### BULLER'S MOLLYMAWK *Diomedea bulleri*

While *D. bulleri platei* breeds at the Chatham Is, laying about November, the nominate race breeds on the Snares and Solander Is two-three months later (Marchant & Higgins 1990).

October trips: few birds seen, none in 1987 and 1989, but one-two on most days from Puysegur Pt to the Snares Depression in October 1992.

February to April: usually 20-40 (c.10% of the mollymawks) on the Snares Shelf, with rather more in April, e.g. c.200 on 3 Apr 1991 (60% of mollymawks), c.100 on 1 Apr 1992 (33% of mollymawks), and c.50 on 25 Apr 1992 whilst stationary SE of Stewart I. On the Auckland Shelf, usually less than five, occasionally ten. In March 1994, most of the squid fleet were on the Auckland Shelf with only about five Buller's Mollymawks behind our trawler. On the Snares Shelf, however, with only one-two trawlers, it was the commonest mollymawk, up to 250 birds. It seems that in that year most of the Shy Mollymawks concentrated around the main fleet and were replaced by Buller's Mollymawks on the Snares Shelf.

Winter 1992: birds were much more common. On 16 Jun c.150 off Puysegur Pt (with c.300 Shy Mollymawks) and W and S of the Snares Is 60-200 birds during June (25-50% of the mollymawks). When we returned to Puysegur Pt on 27 Jun it was the commonest mollymawk, and remained so during July with 300-500 (80-90% of the mollymawks). After leaving Puysegur Pt, we moved back to the Snares Depression on 26 Jul 1992 and saw no Buller's Mollymawks for three days (150-200 a month earlier). From 29 Jul-1 Aug one-two birds, but none further S and E. Robertson & Jenkins (1981) also found it the commonest mollymawk S of New Zealand in May and June, especially close to the breeding grounds on the Snares and Solander Is. At that time Buller's Mollymawks are feeding young, and numbers of competing Shy Mollymawks are lower as they are mainly concentrated around vessels fishing for hoki.

### LIGHT-MANTLED SOOTY ALBATROSS *Phoebastria palpebrata*

This species breeds on the Auckland and Campbell Is and generally shows little interest in fishing boats. I have seen individuals on four occasions on the Auckland Shelf in February/March, and once at the Snares Depression on 15 Oct 1992. Generally, it seems to range S from its breeding grounds (Hicks 1973, Weimerskirch & Robertson 1994). However, Robertson & Jenkins (1981) estimated ten birds around the squid fishing fleet on the Auckland Shelf in May 1981.

### SOOTY SHEARWATER *Puffinus griseus*

The Sooty Shearwater is a summer breeder on most of the islands (Turbott 1990), and is one of the commonest species attending trawlers. Numbers about a trawler in summer were usually in the hundreds, on some days >2000. This species is the best underwater swimmer, and after wheeling round the boat, birds will, with a slight stall, dive straight under the water close to the stern or discard-chute. At other times one will sit on the surface,

continually putting its head under water until food is spotted and then diving after it. Birds will often congregate in flocks on the water, and on 25 Apr 1992, stationary SE of Stewart I., numbers resting around the vessel increased from c.200 to 2500.

The species was common from October to April, so I can give no indication of arrival or departure dates in the area. During the winter of 1992, a single bird at the Snares Depression on 17 Jun. On most days off Puysegur Pt from 10 Jul-24 Jul, one-two overwintering birds seen.

#### HUTTON'S SHEARWATER *Puffinus huttoni*

On 26 Feb 1990 near Bluff, six shearwaters, black above and with white underparts, were thought to have been this species.

#### LITTLE SHEARWATER *Puffinus assimilis*

Not closely attracted to fishing vessels, but Robertson & Jenkins (1981) recorded one on 1 Mar and c.200 in May 1981 around the Auckland Shelf squid fleet. One on 23 Mar 1994 26 NM north of the Auckland Is, and five on 2 Feb 1995 12 NM farther east.

#### DIVING PETREL *Pelecanoides urinatrix*

Although breeding at Auckland and Snares Is, this species is not attracted to fishing vessels and I have seen it infrequently, usually only two-three times on each trip, most records being one-three birds flying into a strong wind. On 3 Feb 1991 N of the Auckland Is, c.50 birds were battling against a 50 knot northerly gale. From observations in other parts of New Zealand, I have found that this species generally feeds fairly close to the shore, which may explain my few records offshore in the subantarctic.

#### GREY PETREL *Procellaria cinerea*

Although small numbers of Grey Petrel breed in winter on Campbell I. with more on the Antipodes Is, returning in February/March, and laying in March/April, I have seen few during the February-April squid season. 1990: none. 1991: one on 28 Mar E of Stewart I. 1992: singles on the Snares Shelf on 31 Mar and 23 Apr and one when stationary SE of Stewart I. on 25 Apr. 1993: one on 6 Feb. 1994: one on 5 Mar and 6 Mar. Robertson & Jenkins (1981) saw about ten around the Auckland Shelf fishing fleet in May 1981.

Winter 1992: the situation was very different. In the Puysegur area one on 9 Jul, and one-four from 19-23 Jul. However, in the Snares Depression area there were 20-80 from 17-26 Jun and 26 Jul - 2 Aug. Near the Auckland Is usually 50-80 with peaks of c.300 on 19 Jul and c.120 on 31 Jul. Near Campbell I, 40-100 in early August, and on Pukaki Rise usually 30-50 from 9-11 Aug, with c.200 at one haulback on 11 Aug and c.20 still following the vessel as we crossed 46°S on 15 Aug.

No birds seen in October or November, though at that time young and adults are leaving the colonies.

This is rather puzzling. If birds return to the colonies from February onwards, why are they not attracted to the trawlers at that time, when some obviously use them as a food source during the winter? Two explanations seem plausible: a) they have a more attractive food source during the summer months; b) they are deterred from following trawlers by the mass of competing Sooty Shearwaters and White-chinned Petrels (*Procellaria aequinoctialis*), and will use trawlers as food providers in winter when those species are absent.

#### WHITE-CHINNED PETREL *Procellaria aequinoctialis*

A summer breeder on the Auckland and Campbell Is, this species is habitually attracted to fishing vessels.

October/November: always present, numbers ranging from five to a more usual 50-100, occasionally 250.

Squid season: numbers are similar. 1990: 50-100 or more on the Auckland Shelf. 1991: usually 20-50, sometimes >200. In 1992 and 1993, numbers dropped off during March and April, so birds may start to leave the area fairly early some years.

Winter 1992: no birds seen although it is suggested by Harrison (1983) that adults probably remain in seas adjacent to the breeding islands.

#### WESTLAND BLACK PETREL *Procellaria westlandica*

One off Puysegur Pt. on 12 Jul 1992, and a probable sighting S of the Snares on 30 Jul 1992 when no other dark petrels were around. None seen during the squid season.

#### CAPE PIGEON *Daption capense*

The Cape Pigeon habitually follows ships and trawlers, and is seen in the area throughout the year. Squid season: usually c.30-50 but sometimes up to c.200. About 500 gathered nearby while stationary SE of Stewart I. on 25 Apr 1992.

Winter 1992: numbers much higher, 1000-3000 in the Puysegur Pt and the Snares areas, up to 800 near Campbell I. and up to 400 on the Pukaki and Bounty Rises.

October 1992: 50-200 birds near Puysegur Pt, and 200-400 on the Snares Shelf.

#### ANTARCTIC FULMAR *Fulmarus glacialisoides*

Seen singly, off Nugget Pt on 13 Oct 87 and 14 Nov 87; near Solander I. on 18 Nov 87; off Puysegur on 30 Jun 1992, 5 Jul 1992 and 10 Jul 1992; near Campbell I. on 7 Aug 1992 and 8 Aug 1992 (four together); S of the Snares Is on 25 Oct 1992.

#### GIANT PETREL *Macronectes halli* and *M. giganteus*

The two species of Giant Petrel are not always readily distinguishable at sea, so are dealt with together here, with indications of the species where this was determined.

During the squid season, not commonly seen, and not every day; e.g. in 1993 on the Snares Shelf, birds were seen on about two-thirds of the days but often only briefly; usually singly, occasionally two-three, with five on 11 Feb and 20 Feb. Of those identified, 16 were Northern (*M. halli*) and four Southern (*M. giganteus*). 1994: more records, with 12 on 27 Mar and 12 while stationary on 11 Mar; 16 Northern and eight Southern Giant Petrels were identified. Other peaks: eight attracted to a dead mollymawk on 29 Mar 91, and ten when stationary SE of Stewart I. on 25 Apr 92. A white phase *M. giganteus* was seen off Nugget Pt on 26 Apr 92. The sparsity of birds feeding around trawlers during summer suggests that Giant Petrels find most of their food closer to the breeding colonies. Robertson & Jenkins (1981) saw them mainly near the islands.

Winter 1992: much more numerous, usually 40-50 near Puysegur, with maxima of c.70 on 28 Jun and 14 Jul, of both species, and always one- two white phase *M. giganteus* with a maximum of five on 4 Jul. At the Snares Depression in June, usually 20-70 with a maximum of c.150 on 19 Jun with one white phase each day. In August around Campbell I., Pukaki Rise and Bounty Is, usually 5-20.

In October 1992, up to six in the Puysegur area (one white) and usually one south of the Snares, with sometimes 5-10. Nearer the Auckland Is usually 10-15 each day, with c.80 on the sea together on 15 Oct.

Giant Petrels make use of trawlers here much more during the winter than the summer.

#### PRIONS *Pachyptila* spp.

Prions were often seen flying past singly or in flocks, and sometimes feeding far back in the wake. Numbers were usually not high and did not seem to vary much seasonally. Squid season: not seen every day, often only one-two, usually less than ten, with very occasionally up to 50. On 5 Mar 1993, >1500, feeding and resting all around with Sooty Shearwaters and storm petrels. On 8 Mar 1993 c.300 feeding around the vessel.

Winter 1992: usually a few, occasionally up to c.50. Near the Bounty Is on 13 Aug and 14 Aug, 1500-2000 birds feeding around the vessel.

October 1992: usually only a few birds, but >200 on 23 Oct and >50 on 24 Oct feeding far back in the wake with storm petrels.

Prions are not always attracted to trawlers, but occasionally make use of the turbulence, probably to feed on disturbed plankton, far back in the wake. Large feeding flocks may be encountered at any time of the year. Most identified birds were Fairy Prions (*Pachyptila turtur*), but single Antarctic Prions (*Pachyptila desolata*) were identified S of the Snares and off Nugget Pt in October 1992. Also, about ten on Snares Shelf on 15 Mar 1994 and at least three near Stewart I. on 5 Apr 1994.

#### MOTTLED PETREL *Pterodroma inexpectata*

This species is not attracted to fishing boats and was seen only occasionally. November 1987: one- five on three days near Solander Is. 1991: two on 10 Feb, singles on 12 Feb and 20 Feb. 1992: none in the squid season, c. eight

off Nugget Pt on 31 Oct. 1993: one-two on five days with four on 10 Feb, and one off Nugget Pt on 3 Mar. 1994: total of six seen. 1995: five just S of Dunedin on 29 Jan, and one on the Snares Shelf on 31 Jan.

#### WHITE-HEADED PETREL *Pterodroma lessonii*

Not usually attracted to trawlers. During the squid season: 1990: singles on 30 Jan and 23 Feb, two on 12 Feb. 1992: singles on 14 Mar, 19 Mar and 26 Apr with four heading into a storm S of the Snares on 15 Mar. March 1994: total of four seen.

#### SOFT-PLUMAGED PETREL *Pterodroma mollis*

This species is not attracted to fishing vessels. Single birds seen on 22 Mar 1992 at 48°42' S, 167°40' E; on 3 Mar 1993 at 45°30' S, 171°40' E; and on 19 Mar 1993 at 45°09' S, 172°00' E.

#### COOK'S PETREL *Pterodroma cooki*

One on 4 Apr 1994 at 47°40' S, 166°31' E.

#### WILSON'S STORM PETREL *Oceanites oceanicus*

Scarce on the Pukaki Rise but common on the Bounty Platform in December 1970 (Vooren 1973). One at 45°30' S, 171°40' E on the Snares Shelf on 3 Mar 1993, and on 6 Mar 1993.

#### GREY-BACKED STORM PETREL *Oceanites nereis*

During the squid season generally only occasional birds, but a scattered flock of c.50 feeding on the Auckland Shelf on 6 Feb 1990 with birds around all afternoon, and c.50 there on 30 Jan 1991. 1993: one- three on only five days. None in 1992 or 1994. 1995: c. ten near Auckland Is on 2 Feb and two on the Snares Shelf on 3 Feb.

Winter 1992: Snares Depression, one on 19 Jun and a scattered flock of c.60, on 1 Aug which later fed in the wake with some prions. 1987: c. ten off Nugget Pt on 13 Nov and up to 20 off Puysegur in late November. October 1992: occasionally one- five with c.50 S of the Snares Is on 23 Oct and 24 Oct, and >60 far back in the wake on 22 Oct. Thus this species is seen in small numbers throughout the year in this area, sometimes in small flocks and occasionally taking advantage of the turbulence in the wake of the vessel to feed.

#### WHITE-FACED STORM PETREL *Pelagodroma marina*

Two off Puysegur Pt on 17 Nov 87.

#### BLACK-BELLIED STORM PETREL *Fregetta tropica*

This is by far the most abundant storm petrel in the area.

October/November: from Nugget Pt to Puysegur Pt and S of the Snares, up to ten birds usually every day, but c.50 S of the Snares Is on 24 Oct 1992.

February to April: nearly every day, either individually or in flocks, often far back in the wake. Usually 30-60 birds per day, but occasionally 100-250, with peaks up to > 500, the larger numbers usually taking advantage of the turbulence 100- 400 metres back in the wake. It was noticeable on 1 Feb 1993 that more birds were around as soon as we reached the fishing grounds, showing that birds congregate around the fishing fleet.

Winter 1992: in nine weeks only c.20 at the Snares Depression on 17 Jun, and one on 18 Jun, so most birds leave the area in winter.

#### CORMORANTS *Phalacrocorax* sp.

Apart from Stewart Island Shags (*Leucocarbo chalconotus*) 3 NM off Stewart I. and near Bluff, no cormorants were seen.

#### BROWN (SUBANTARCTIC) SKUA *Catharacta skua lonnbergi*

Although this bird breeds on many islands in the area, I have few records. Spring 1987: one off Nugget Pt on 13 Nov and 14 Nov, one near Solander I. on 15 Nov. Spring 1992: one near Puysegur on 14 Oct, one off Nugget Pt on 31 Oct.

Squid season: none in 1990, 1991 or 1993. 1992: singles on three days in March on the Auckland Shelf, and one on the Snares Shelf on 29 Mar, hassling mollymawks. 1994: singles on 7 Mar and 25 Mar c.25 NM from Auckland Is.

Winter 1992: singles off Puysegur Pt on three days in July, with two on 15 Jul. One was seen to chase a Cape Pigeon until it dropped food, but was then beaten to it by three mollymawks.

This species does not depend on trawlers for its food supply. It is more likely that the voracious feeding and robbing behaviour of mollymawks behind trawlers provides too much competition for the skuas, which are usually seen cruising about 20-30 m above the boat.

#### SOUTHERN BLACK-BACKED GULL *Larus dominicanus*

Gulls are not usually seen far offshore. Winter 1992: up to five off Puysegur Pt between 13 Jul and 22 Jul, the furthest from land at 46°38' S, 166°06' E, c.38 NM off-shore. On 4 Mar 1993 a juvenile seen at 47°45' S, 168°33' E, c.41 NM off Stewart I., and an adult about the same place on 30 Jan 1995.

#### RED-BILLED GULL *Larus novaehollandiae*

Generally keeps closer to land than the previous species. One on 5 Nov 87 12 NM N of Solander I. Winter 1992: up to eight from 13-15 Jul in Puysegur area, the furthest being at 46°33' S, 166°16' E, 27 NM offshore.

#### WHITE-FRONTED TERN *Sterna striata*

Single birds were seen on 30 Jan 1990 and 31 Jan 1990 c.30 NM off Auckland Is, and one on 31 Mar 1991 c.60 NM south-east of the Snares Is. A juvenile was off Nugget Pt on 4 Apr 1991, and two unidentified terns were heading N on 18 Mar 1992 on the north Auckland Shelf. On 9 Mar 1993, two unidentified terns flew over at 48°30' S, 167°58' E.

**ANTARCTIC TERN** *Sterna vittata*

Breeding on all island groups in the area (Turbott 1990), this species must feed fairly close inshore, and my only record is of two on 2 Feb 1995 14 NM east of Auckland Is.

**LANDBIRDS****SKYLARK** *Alauda arvensis*

One flying about the vessel for about an hour 20 NM off Nugget Pt on 12 Oct 87.

**WELCOME SWALLOW** *Hirundo tahitica*

Two juveniles, found exhausted on board on 2 Apr 1991 at 48°32' S, 167°54' E (c.70 NM south of Stewart Is.), died the next morning. On 25 Apr 1992 four juveniles were on board when we were stationary at 47°35' S, 169°31' E, c.66 NM from coast. Two were still present the next day as we steamed N towards Dunedin.

**SONG THRUSH** *Turdus philomelos*

1991: one on board on 12 Mar 20 NM north of the Auckland Is, was last seen heading in that direction. On 29 Mar another one was on board for 2 days 23 NM north of the Auckland Is.

**DISCUSSION**

Large numbers of seabirds are attracted to fishing vessels to scavenge around the net and discard-chutes, and these can be observed at closer quarters and for longer periods than would be possible under more natural conditions. The attraction of a trawler as a food-source might be considered atypical and the numbers seen, the behaviour and distribution of the birds may bear little relationship to the natural pattern. However, scavenging occurs worldwide and such behaviour is important to record. For some species and age groups it may form an important proportion of their food, at least at certain times of the year.

Most scavengers in New Zealand waters are Procellariiformes, but in the North Atlantic the main species are gulls, skuas, gannets and Fulmars (*Fulmarus glacialis*) (Nelson 1980). The spectacular increase and spread of the Fulmar from the Arctic south round the coasts of Britain and north-west Europe coincided with the huge development of fisheries and was thought by James Fisher (quoted in Nelson 1980) to have probably started with the whaling industry over 200 years ago. It has been suggested that some kind of genetic change may have occurred to enable this to happen (Wynne-Edwards, quoted in Nelson 1980), but learning of some kind must be involved.

It was probably during the whaling period in New Zealand, too, that scavenging by seabirds became common, and they later moved their attention to fishing boats. There are few early scientific records and the major study of birds associated with trawlers in New Zealand waters was by Bartle (1974) from observations in the Cook Strait area in 1966. Changes are apparent

since 1966. For example, Sooty Shearwaters were not normally attracted to fishing boats but during autumn migration up to six birds at a time came in to gutting (Bartle 1974). However, today hundreds gather around trawlers and during summer in the subantarctic it is the commonest small petrel attracted. Similarly, Bartle (1974) found that Buller's Shearwaters were only occasionally attracted whereas in May 1993 I had up to 500 birds behind a trawler in the Cook Strait area, and Freeman (1992) found them regular followers on the Chatham Rise. Bartle (1974) also found that Buller's and Black-browed Mollymawks were both rather shy and did not approach the trawler closely, but nowadays both species are bold scavengers. Therefore, in several species, scavenging in New Zealand waters has increased in the last 25 years, which coincides with a great increase in fishing activity (Annala 1994, Sissenwine & Mace 1994).

Different colonies of the same species may behave differently towards trawlers. Off Taranaki (western coast of the North Island), in spring 1991, we often attracted 20-50 Gannets (*Morus serrator*), diving around the net at haulback from 20 to 35 NM offshore. In contrast, off Cape Kidnappers (East Coast, North Island) in May and September, 1993, no Gannets were seen although the colony was only 18 NM distant. Here it seems birds from one colony have learnt to make use of trawlers whereas those from another ignore them. Hawkins (1982) noted that although up to 100 Gannets might be seen while trawling in Tasman Bay, they usually ignored the boat. In June 1981, one- two scavenged as the net was hauled, the only time in several years she had seen or heard of Gannets feeding in this way.

Seabirds distinguish between trawlers and other vessels, and could even differentiate between the bow and stern of a stationary trawler (Bartle 1974). They can also tell when the winches start turning to bring the net to the surface. Procellariiformes have a well-developed sense of smell (Warham 1990) and can probably detect a fishing-boat from a considerable distance. Most species that are attracted to fishing-boats are probably gregarious feeders, in the habit of watching the behaviour of other birds, and gathering quickly around food sources. Even when a trawler is stationary, not fishing or processing, after a few hours hundreds of birds of many species may be settled on the sea around the vessel.

Scavenging methods behind a vessel differ among species. Mollymawks and larger petrels land close to the stern of the vessel, taking large scraps or whole fish and squid mainly from the surface, but some with surface-diving of short duration. Sooty Shearwaters are the best underwater feeders, diving well and covering long distances underwater. The large albatrosses do not usually come very close to the stern, probably because their larger size makes them less manoeuvrable, but they swoop on discards drifting astern and displace smaller species. There is considerable squabbling and piracy often occurs as larger species grab food away from smaller birds, or chase them until they drop it. However, because of the large numbers of birds around, the bird that chases is often beaten to the food by another individual. Further back in the wake, Cape Pigeons feed with storm petrels and prions on smaller scraps and/or plankton churned up by the vessel and the net.

Exploitation of this food resource by different species varies through the year. The Shy Mollymawk is the commonest scavenging albatross in the Subantarctic during most of the year, except in winter, when this species concentrates on the hoki fleet. It seems that the presence of large numbers of the larger mollymawks may deter the smaller species, and it is when they are in low numbers in winter that the most Buller's Mollymawks occur. Similarly, during the 1994 squid season, when most of the Shy Mollymawks were concentrated around the main fleet on the Auckland Shelf, Buller's Mollymawks were more common than usual around the few boats on the Snares Shelf. The Black-browed Mollymawk makes surprisingly little use of fishing boats in the subantarctic throughout most of the year, but during October large numbers attend. Sooty Shearwaters and White-chinned Petrels are common scavengers in summer, but migrate north in the winter when the Grey Petrel is able to scavenge with less competition from similar-sized species.

It is interesting to speculate on the importance of scavenging in the diet of different species, but it is difficult to know what percentage of a population takes part in scavenging. Although thousands of Sooty Shearwaters attend trawlers on the Snares Shelf, several million birds breed in that area (Turbott 1990), and it could be that only a small proportion is attracted to trawlers. Sometimes large flocks of Sooty Shearwaters feed independently from the fishing boats. It is possible that most of the Shy Mollymawk population makes use of fishing boats as a food source. Bartle (1974) thought that the relatively constant supply of fish refuse could explain the rarity with which certain offal-feeding species are cast ashore on beaches as compared with more pelagic-feeding shearwaters and prions. He thought scavenging might be especially important for young birds amongst which mortality is generally highest, and it seems likely that it could also be important for adults accumulating fat reserves prior to breeding or migrating, or when feeding rapidly growing young. There are drawbacks, of course, as feeding near nets and boats can be dangerous. Some birds get caught in the net or on the net cables and drown. There was considerable mortality caused by birds hitting the net-monitor cables on Soviet trawlers until their use was made illegal in 1992 (Bartle 1991, pers.obs.). Many birds are still caught and drowned on the hooks of tuna long-liners. More and more large trawlers have fish-meal processing capability which reduces the amount of offal disposed of overboard, and might result in a reduction of scavenging.

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