

CORELLA

(formerly *The Australian Bird Bander*)

Journal of the Australian Bird Study Association

VOLUME 1 (New series)

MARCH, 1977

NUMBER 1

One Year's Observations of Seabirds in Continental Shelf Waters off Sydney, N.S.W.

DAVID MILLEDGE

The monthly occurrence and relative abundance of seabirds of inshore continental shelf waters off Sydney during one year's observations are recorded and discussed. An annotated list of the species with comments on their feeding behaviour and presence in relation to breeding colonies is given.

The seabird assemblage of inshore waters off Sydney is characterised by four main components based on seasonal movements. A peak in seabird abundance and biomass during spring may have reflected an increase in productivity and this was supported by the food utilisation of the species concerned.

Introduction

Between May, 1973 and April, 1974 I was engaged in a study of the benthic fish community of continental shelf waters off Sydney as part of an inshore benthic survey conducted by the Australian Museum. This work involved cruises by fishing trawler at least once a month to a set sampling area and I took the opportunity during these trips to attempt censuses of the seabirds present.

The main purpose of this paper is to describe the seasonal changes in seabird assemblages recorded in inshore continental shelf waters off Sydney during the course of a year. These seabirds have been studied over past years by a number of ornithologists, including a group associated with the N.S.W. Field Ornithologists Club and although there exists a good deal of local knowledge on relative abundance and seasonal movements, very little of this information has been documented. Exceptions are quantitative data for the Wedge-tailed Shearwater *Puffinus pacificus* for the years 1968-73 (Rogers, 1975)

and some general comments on seasonal occurrence for the Wandering Albatross *Diomedea exulans*, Black-browed Albatross *D. melananophrys*, giant-petrels *Macronectes* spp., Flesh-footed Shearwater *P. carneipes* and skuas *Stercorarius* spp. (Hindwood, 1955; Gibson and Sefton, 1958; Jones, 1973).

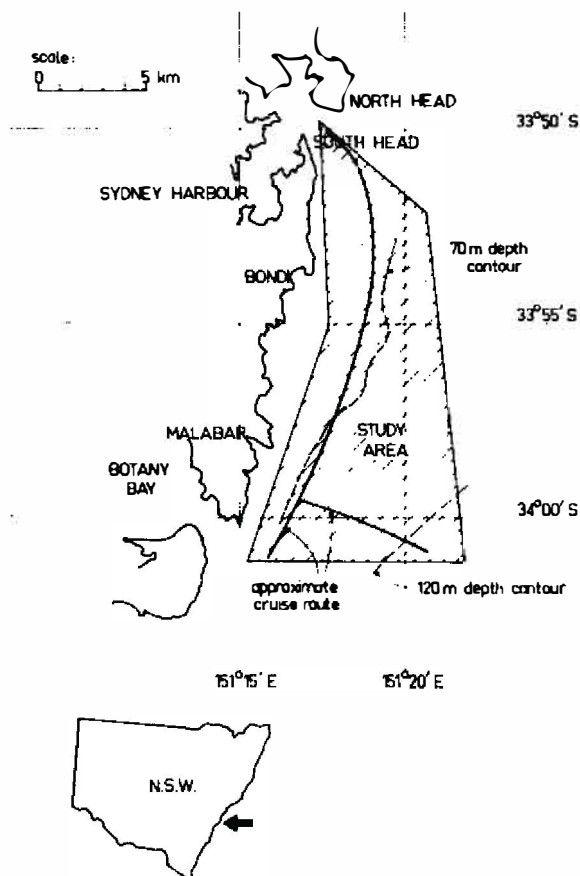
The continental shelf off Sydney extends approximately 25 km from the coast and the surface temperature, salinity and nutrient levels of its waters are a function of the East Australian current and upwellings of colder sub-surface water masses. The East Australian current transports Coral Sea water of low salinity and poor in nutrients in a complex series of eddies, up to 200 km in width, southwards towards Bass Strait at a rate of approximately 80 km a month (Hamon and Tranter 1971). During summer the current operates relatively close inshore along the central New South Wales coast but in winter and spring it moves offshore, allowing upwellings of cold waters (Newell, 1961). The resultant increase in nutrients from these richer waters probably pro-

motes the plankton blooms that are characteristic of inshore waters during spring months.

Although the plankton and intertidal plants and invertebrate animals along the central N.S.W. coast have been shown to be typically sub-tropical (Rochford, 1950; Womersley and Edmonds, 1958), characteristic seabird elements from both cold water and sub-tropical zones are equally well represented during the year. Serventy et al. (1971) have commented on this seabird richness which probably is due to the complexity of hydrological conditions and the proximity of the sub-tropical convergence to the south. Of local importance are the six sewer outfalls for metropolitan Sydney which discharge into the sea between Manly and Malabar. It has long been known that these outfalls attract seabirds, particularly at Malabar (Hindwood, 1955). However, it appears that their attractiveness is a measure of sewage particle size and constituency, as modification of the Malabar outfall has shown. Here the reduction of particle size and virtual elimination of untreated abattoir content has resulted in a great reduction during the last ten years in the numbers of albatrosses and giant-petrels that frequented the outfall in the 1950's and early 1960's (Gibson, 1973).

Methods

The sampling area trawled for the fish study was a section of seabed between 60 m and 120 m depth due east of Botany Bay. To reach this the outgoing route was a course approximately 5 km from the coast attained shortly after leaving Sydney Heads, with the return route along the same course. Thus the seabird censusing area lay between Lat. $33^{\circ}50'S$ and Lat. $34^{\circ}05'S$ (see map Figure 1). Cruise time between Sydney Heads and the trawling area for each leg was about two hours with trawling also taking two hours. This meant that a total of six hours or more were spent at sea for each cruise. During this time observations of seabirds were recorded continuously and with interruptions associated with fishing activities amounting to about an hour, observation time per trip totalled approximately five hours. At the end of each cruise the total numbers of each of the boat-following species seen during the five hour period were adjusted slightly (10% subtracted) to attempt to correct for repeat countings. This is a well-known problem of censusing seabirds from boats



● Figure 1. Map showing cruise route and study area.

(Bailey and Bourne, 1972) and the totals given (particularly with the more abundant birds) should be regarded more as a measure of relative abundance than as accurate counts of the birds present. Additional factors that made censusing difficult were weather conditions, varying conspicuousness of the species involved and patchiness of distribution.

Only birds first observed with the naked eye were counted, although this obviously favoured larger birds such as the albatrosses. Specific determinations were made using 8x40 binoculars. Weather conditions in the study area greatly influenced the composition of seabird assemblages as during days of strong winds and high seas,

many more individuals of albatrosses and petrels were present than on calmer days. These birds also tended to spend more time sitting on the surface during calm days and thus were less readily detected. Patchiness of distribution was not a great problem although occasionally flocks of seabirds following schools of pelagic fish and other fishing boats were encountered and some birds, particularly gulls, concentrated about the sewer outfalls. These were included in total counts but reference is made to them in the annotated list.

Cruises along the normal route to the trawling area were made at least once a month and twice or more for some months. The boat usually left Sydney Heads at 0700 hours returning at about 1300 hours. Occasionally excursions to 20 km from the coast were made and in May, 1974, one cruise extended to 40 km from the coast. The purpose of these trips was to determine any change in species composition of seabird assemblages with increasing distance from the coast.

Results

Twenty-two species of seabirds representing six families were recorded in the study area during the year's observations. These were one penguin, four albatrosses, ten petrels, one gannet, three skuas, one gull and two terns. The number of individuals of each species estimated for one five-hour observation period per month between May, 1973 and April, 1974 are given in Figures 2, 3 and 4. To facilitate the presentation of this data, birds have been divided into three categories: (a) usually less than 10 individuals per observation period; (b) between 10 and 50 individuals per period; and (c) more than 50 per period. When two or more cruises were made for a particular month the mean value for each species is given.

In May, 1974 a cruise to 40 km off the Sydney coast revealed three additional species of seabirds. During a four hour period between 1300 and 1700 hrs, 40 Great-winged Petrels *Pterodroma macroptera*, 15 Wilsons Storm-petrels *Oceanites oceanicus* and two White-faced Storm-petrels *Pelagodroma marina* were observed. Other cruises off Sydney to 20 km from the coast during the study year did not encounter any seabirds unrecorded in the study area.

An annotated list of the species follows:

Little Penguin *Eudyptula minor*

Only three seen in the study area during December. It may be present off Sydney throughout the year in small numbers but is difficult to detect unless the call is heard. Small groups of up to six Little Penguins were also recorded inside Sydney Harbour in December, January and February.

Breeding colonies closest to the study area are on Bird, Lion and the Five Islands, N.S.W.

Wandering Albatross *Diomedea exulans*

Very small numbers, between one and seven individuals, were recorded for all months except February. The observed ratio of adults to sub-adults and juveniles was two to one. These low figures illustrate the drastic effect that modification of the Malabar sewer outfall has had on the numbers of this albatross. For example, on one day in August, 1957, 548 birds were counted about the outfall (Gibson and Sefton, 1959) and hundreds (between 100 and 400) were continually present from May through to mid-November in the 1950's (Hindwood, 1955). This was the largest known aggregation of Wanders away from their breeding grounds and it would be interesting to know whether the same numbers now occur in a more dispersed distribution off the eastern Australian coastline during winter and spring. Albatrosses are opportunistic feeders taking a wide range of naturally available food as well as offal and would be expected to search widely over a large area in their non-breeding range. Nevertheless Tickell and Gibson (1968) have shown that individuals may become sedentary during this time at a regular food source.

Concentrations of Wandering Albatrosses are now absent from the study area because of the lack of large-sized effluent particles or other suitable food. The cuttlefish *Ampliseptia verreauxi* which is an important food further south off Wollongong (Gibson and Sefton, 1959) does not occur at the surface in any numbers off Sydney. The only material seen taken by Wandering Albatrosses in the study area was offal from fishing boats.

It was interesting to note that when sewage particles of up to 1 cc in size were being flushed

from the North Head outfall in July, 1973, 40 or more Wandering Albatrosses were present feeding voraciously — by far the largest concentration seen near Sydney during the study.

From recoveries of banded birds it has been shown that Wandering Albatrosses occurring off the N.S.W. coast originate from breeding colonies on South Georgia, Iles de Kerguelen, Marion Island, Iles Crozet, Macquarie and Auckland Islands. Thus several populations are represented (Ticknell and Gibson, 1968).

Black-browed Albatross *Diomedea melanophrys*

This was the most abundant albatross recorded in the study area with birds present during all months except February and March and a peak of 100 plus individuals in September. Obviously its numbers have not been as greatly affected by modification of the Malabar sewer outfall as those of the Wandering Albatross and its dependence on this sewage must have been much less. Certainly no Black-browed Albatrosses were observed taking sewage during the study and in July, 1973 off North Head when Wandering Albatrosses were feeding on a sewage discharge, numbers of Black-browed Albatrosses in the vicinity showed no interest in the effluent. The only feeding activity observed in the study area was on offal from fishing boats although the large number of individuals present for several months suggests that some natural food may have been available. Fishing boat activity on the continental shelf off Sydney was not great at that time.

The Campbell and Antipodes Islands breeding race of the Black-browed Albatross *Diomedea melanophrys impavida* was present in the study area from May to September when adults accounted for about half of the totals for those months. However it was not positively identified during the remainder of the study period although adults present may have been overlooked because close views were not obtained. A. Rogers (pers. comm.) has indicated this race is regular in winter and spring off Sydney. Banding recoveries show that birds of the nominate race *D. m. melanophrys* off the N.S.W. coast come from Heard and Macquarie Islands (Hindwood, 1955) but probably numbers from other colonies also occur.

The ratio of juveniles and sub-adults to adult Black-browed Albatrosses varied throughout the

year during the study. It was the lowest from May to July and from December to April with the ratio then about one to one. This increase of young birds corresponded with the total increase in numbers over this period.

Yellow-nosed Albatross

Diomedea chlorohynchus

Recorded in quite high numbers in the study area in April, June, July and September. Counts for these months were apparently abnormal (A. Rogers pers. comm.) as the bird is regular off Sydney but usually less than ten can be seen in a single day. Yellow-nosed Albatrosses are more abundant in continental shelf waters of north-eastern N.S.W. (G. Holmes pers. comm. and author's obs.) and birds observed during the study may have been attracted or displaced from this area. The ratio of juveniles to adults in the study area for all months was constant at one to four.

Of all the mollymawks (smaller albatrosses) seen off Sydney the Yellow-nosed Albatross was the most adept at exploiting offal discarded from fishing boats. It was bolder than Black-browed Albatrosses and its smaller size and wingspan allowed it to manoeuvre better with the result that it was usually first on the scene at a food source. However, due to its small size, this albatross was always last in the peck order when inter-specific disputes developed.

Breeding colonies of the Yellow-nosed Albatross closest to Australia are on St. Paul and Amsterdam Islands in the sub-Antarctic region off New Zealand, although it is not known where birds occurring off Australia originate.

White-capped Albatross *Diomedea cauta*

The only record for the study area was eight adult birds of the race *D. c. cauta* in September. The White-capped Albatross is the common mollyhawk of continental shelf waters of south-eastern N.S.W. (D. Barton pers. comm.). Off Sydney it appears to be regular only in small numbers in winter and spring (A. Rogers, pers. comm.).

No feeding activity was observed in September but off Eden the bird readily takes offal from

fishing boats (D. Barton, pers. comm.). The nominate race *D. c. cauta* breeding on Albatross Island in Bass Strait, the Mewstone in southern Tasmania and on the Auckland Islands in New Zealand, predominates in waters off Sydney. Banded individuals from Albatross Island have been recovered off the N.S.W. coast (Serventy *et al*, 1971). The race breeding on the Snares and Bountry Islands *D. c. salyini* has been seen near Wollongong (Gibson, 1973).

Southern Giant-petrel *Macronectes giganteus* and Northern Giant-petrel *Macronectes halli*

The two species of giant-petrels occurred in the study area in small numbers from July to November. The southern species was most numerous with a maximum of 25 individuals in September. As with the Wandering Albatross, giant-petrels were formerly attracted in large numbers to the Malabar sewer outfall before its modification and 150 were counted there in one day in July, 1954 (Hindwood, 1955). These numbers are now of course much reduced but giant-petrels are still attracted to the outfalls close to the study area in reasonable numbers as they are capable of dealing with smaller-sized effluent particles than Wandering Albatrosses (also noted by Jones, 1973). In July, 1973 a concentration of 50 or more mostly juvenile Southern Giant-petrels was feeding on sewage effluent of particle size about 0.25 cc at North Head, just outside study area. Three individuals collected from this group had been banded as nestlings on Signy Island in the South Orkneys in March, 1973.

Other banded *M. giganteus* recovered off Sydney have originated from South Georgia and the South Shetlands and banded *M. halli* have come from Macquarie Island. (Jones 1973).

Cape Petrel *Daption capense*

Recorded in small numbers during July, September and October in the study area. Birds were observed single, in pairs or small flocks but no feeding activity was noted. Cape Petrels appeared interested in albatrosses feeding on offal behind fishing trawlers but never settled and fed with them.

Off Sydney the Cape Petrel is quite sporadic in occurrence and numbers in inshore waters.

For example on 1 September, 1973 A. Rogers (pers. comm.) recorded 250-300 Cape Petrels whereas only 25 were present a week later on a census day. Probably their presence over the continental shelf is a function of the weather, concentrating inshore during adverse conditions. The closest breeding colonies to Australia are on sub-Antarctic islands off New Zealand.

Prions *Pachyptila* spp.

Prions occurred in the study area from July to September with a peak of 150 in July. Single birds, small groups and loose flocks of up to fifty were observed. Except in July all were of the Fairy/Fulmar type *P. turtur*/*P. crassirostris* and almost certainly were Fairy Prions. Several dead individuals of *P. turtur* were picked up on the surface in the study area in August. Prions with a narrow tail band were present in the ratio of about two to one Fairy-type Prion during July. These were most probably the Antarctic Prion *P. desolata* as this is a relatively common derelict on Sydney beaches, (from specimens in the Australian Museum collection).

Feeding during the daytime was observed in the study area whenever birds were present. The usual method was rapidly picking material off the surface whilst hovering into the wind with wings outstretched and feet lowered. Prions showed no interest in boats or the sewer outfalls.

Fairy Prion breeding colonies closest to the study area are on small islands in eastern Bass Strait.

Flesh-footed Shearwater *Puffinus carneipes*

Present from December to March with a maximum of about 250 in January. Birds occurred singly and in groups of up to 40 individuals and were adept at scavenging from fishing boats. They gathered closely behind the trawl as it was being raised from the water and quickly picked-up small fish that dropped out. Flesh-footed Shearwaters also readily took offal and were seen to dive up to two metres below the surface to recover scraps. They mixed freely with Wedge-tailed Shearwaters about a food source and no aggressive interactions were seen.

The Flesh-footed Shearwaters occurring in eastern Australian waters are of the race *P. c.*

hullianus (Hindwood, 1945; Gibson and Sefton, 1958) which breeds on Lord Howe Island and islands off New Zealand. If adults were present in the study area during summer then it is most likely they were foraging for chicks in burrows on Lord Howe Island.

Wedge-tailed Shearwater *Puffinus pacificus*

This shearwater was the most common species in spring and summer with approximately 900 recorded for October. Large rafts of several hundred birds were commonly encountered sitting on the water or feeding on surface concentrations of natural food. In October they were seen diving 2-3 metres to take euphausiids. Wedge-tailed Shearwaters also fed on offal from trawlers and took dead fish spilled from trawls. As with the preceding species they dived to recover scraps.

The low totals of 50 and 200 for November and December suggest a pre-egg laying exodus from the breeding area as occurs with the Short-tailed Shearwater *P. tenuirostris* (Serventy *et al.*, 1971). However, Rogers (1975) did not mention a reduction in numbers during these months and the lack of birds in 1973 may have been due to a food source outside the area. The general regime of occurrence agrees closely with Rogers' observations for 1968-73 with a complete absence in June, July and August and only a single individual present in May.

Breeding colonies closest to the study area are on Bird, Lion and the Five Islands, N.S.W.

Grey-backed Shearwater *Puffinus bulleri*

Three Grey-backed Shearwaters were observed feeding with Wedge-tailed and Short-tailed Shearwaters behind the boat in December. Close views were obtained as all three came up to take spill from the trawl.

Holmes (1975) summarised occurrences of this species off Eastern Australia and suggests that it may recently have become a regular visitor due to a population expansion of the only breeding colony, in the Poor Knights Group, New Zealand.

Sooty Shearwater *Puffinus griseus*

Eight and ten Sooty Shearwaters were recorded in November and December respectively. Sight-

ings were mostly of single birds which occurred with flocks of Wedge-tailed or Short-tailed Shearwaters. A few birds came up behind the boat but no feeding was observed.

Breeding stations closest to the study area are on Bird, Lion and Bowen Islands, N.S.W.

Short-tailed Shearwater *Puffinus tenuirostris*

Present from October through to March with a maximum of 200 in December. Short-tailed Shearwaters did not mix with Wedge-tailed Shearwaters and were mostly observed in discrete flocks. They were noted feeding on the surface in rafts of 50 or more on several occasions and did not show any interest in offal from fishing boats.

Breeding colonies closest to the study area are on Broughton Island, the Five Islands and Bowen Island, N.S.W.

Fluttering Shearwater *Puffinus gavia*

Small numbers of this New Zealand-breeding Shearwater were recorded for all months except May, June and August with a peak of 300 estimated for October. Almost certainly non-breeding birds occur in eastern Australian waters throughout the year.

In October large flocks of more than 100 were noted on the surface about the edges of the sewage fields and although feeding was not directly observed, many birds were diving as if pursuing live food underwater. Occasionally single birds came to take spill from the trawl but usually this species ignored boats.

Australian Gannet *Morus serrator*

Regular, recorded throughout the study period in small numbers each month with the highest total 15 in February. Fifty percent or slightly more of all counts consisted of immature-plumaged birds indicating that inshore waters off Sydney are frequented mostly by non-breeders. Birds banded as nestlings at New Zealand colonies have been recovered as immatures along the eastern Australian coast and young gannets from Bass Strait and southern Tasmanian colonies probably range north to Sydney.

Little fishing was observed in the study area which was to be expected, as Gannets generally feed close inshore along the N.S.W. coast. Individuals and small groups were noted diving on pelagic fish schools less than 100 metres off the rocks at South Head on several occasions.

Great Skua *Stercorarius skua*

Single birds and pairs of the race *S. s. lonnbergi* were recorded in July and August with four the highest count for one cruise. All skuas came in to inspect the boat and readily took off. One pair was seen to chase several Crested Terns *Sterna bergii* and recover the disgorged food.

The origin of the race *S. s. lonnbergi* visiting Australia is not known. Closest breeding stations are on Macquarie and sub-Antarctic islands off New Zealand.

Arctic Skua *Stercorarius parasiticus*

Observed singly in the study area in summer and one record for June. Serventy *et al* (1971) state that the Arctic Skua does not occur commonly over the open sea off Australia, tending to favour bays and harbours. This was found to hold for the waters off Sydney for twice as many birds were seen inside Sydney Harbour as were recorded in the study area during the summer months.

No feeding was observed at sea although Arctic Skuas were seen chasing Crested Terns and Silver Gulls in Sydney Harbour.

Pomarine Skua *Stercorarius pomarinus*

The most common skua in summer with a maximum number of about 100 recorded in January. Both light and dark "colour phase" birds occurred in equal numbers although dark Pomarine Skuas with elongated central tail feathers were never seen. Food was taken readily from trawl spills and Pomarine Skuas competed vigorously among themselves for offal from fishing boats. In December and January there were at least 10 birds following the boat at all times and it appears that the Pomarine Skua obtains more of its food in this way than from pursuing other seabirds in the traditional skua manner. Very

few pursuits of other species were noted apart from a few unsuccessful attacks on Crested Terns.

Silver Gull *Larus novaehollandiae*

Silver Gull numbers were fairly constant throughout the year in the study area with several hundred frequenting the sewer outfalls although fewer than in the 1950's (Hindwood, 1955). 20 or more were always present about the boat and flocks occurred up to 20 km from the coast, feeding over schools of pelagic fish. Movements of this species occur around the Australian coastline and one bird banded at Altona, Victoria was recovered at Malabar (Hindwood, 1955).

Breeding colonies closest to the study area are on Moon and the Five Islands, N.S.W.

Common Tern *Sterna hirundo*

Recorded in January, February and March with a flock of sixty in January the highest count. Both the European *S. h. hirundo* and Eastern *S. h. longipennis* races of the Common Tern occur in Australian waters although it appears that the more frequent is the Eastern (Hitchcock, 1965).

Common Terns came in to investigate the boat but did not take any of the trawl spill. The flock observed in January was fishing in tight formation, diving on schools of small pelagic fish. These birds may have come from a flock normally resident in Botany Bay during the summer.

Crested Tern *Sterna bergii*

Present throughout the year in varying numbers in the study area. The highest count was 100 or more in December. Crested Terns took trawl spill and offal from fishing boats as well as feeding on pelagic fish schools.

Considerable coastal movements of this tern occur as South Australian-banded individuals have been recovered on the N.S.W. coast (Serventy *et al*, 1971). Breeding colonies closest to the study area are on Moon and Five Islands, N.S.W.

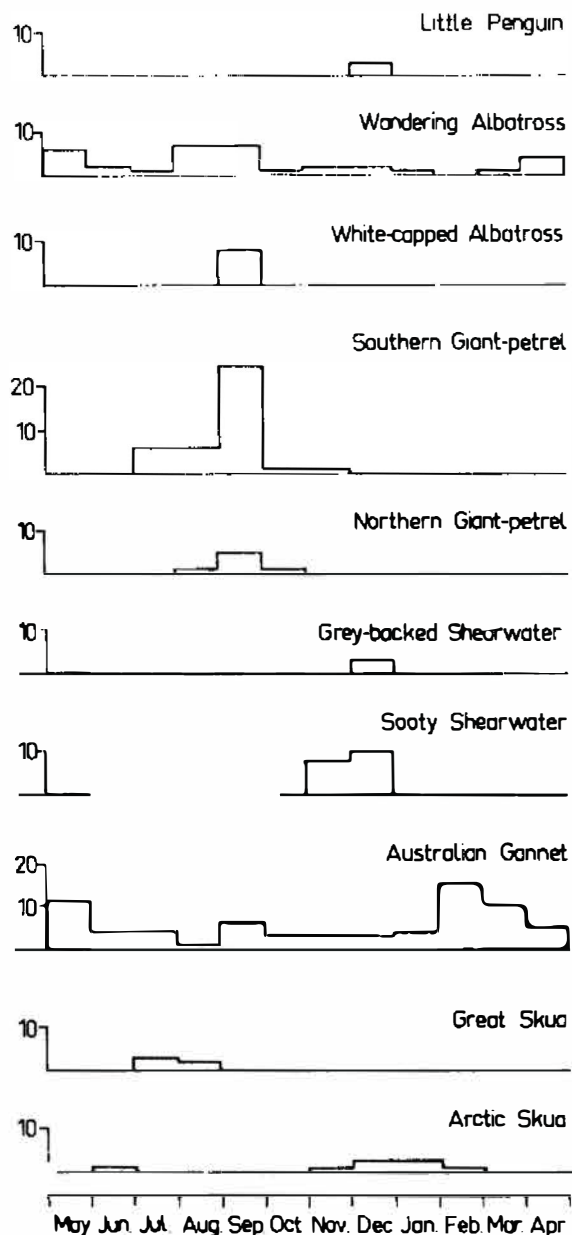
Discussion

From the data presented in Figures 2-4 it is apparent that four main components, based on seasonal movements, exist in the seabird assemblage of the study area. These comprise: (a) a southern cold-water breeding (mostly sub-Antarctic) component of albatrosses, petrels and one skua occurring through the winter and spring with a peak in early spring; (b) a small Palaearctic breeding group of two skuas and one tern occurring in summer; (c) a sub-tropical breeding component present throughout the year consisting of a penguin, shearwater (petrel), gannet, gull and tern; and (d) a sub-tropical breeding component of five shearwaters migrating into the North Pacific for the southern winter, present during spring and summer with two peaks, one in early spring and the other in mid summer. The presence per monthly observation period of each of these components in terms of biomass is depicted in Figure 5 (weights from Serventy *et al.*, 1971).

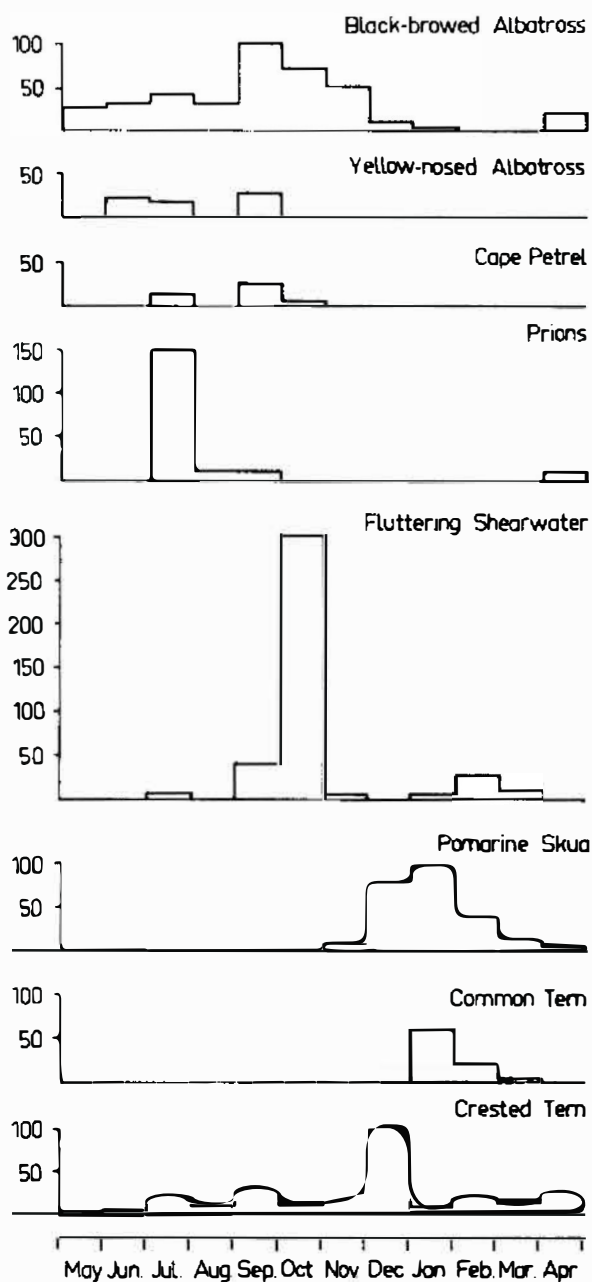
The food utilisation within the study area by seabirds can also be seen to vary during the year. Birds exploiting offal from fishing boats and sewage effluent were present throughout the year with an abundance peak in winter. Species which fed on zooplankton and the micronekton occurred in winter, spring and summer with a definite peak in spring. Seabirds feeding on the larger nekton were present throughout the year with the highest numbers in summer.

The seabird biomass peak in spring (Fig. 5) as it was also a high in numbers of zooplankton and micronekton-feeding seabirds suggested a spring increase in productivity for the area. This coincides broadly with the known occurrence of plankton blooms (Hamon and Tranter, 1971) although as Bartle (1974) has pointed out, it is unwise to make superficial judgements on productivity using seabird numbers as an index because often the planktonic organisms involved are unavailable as food for seabirds.

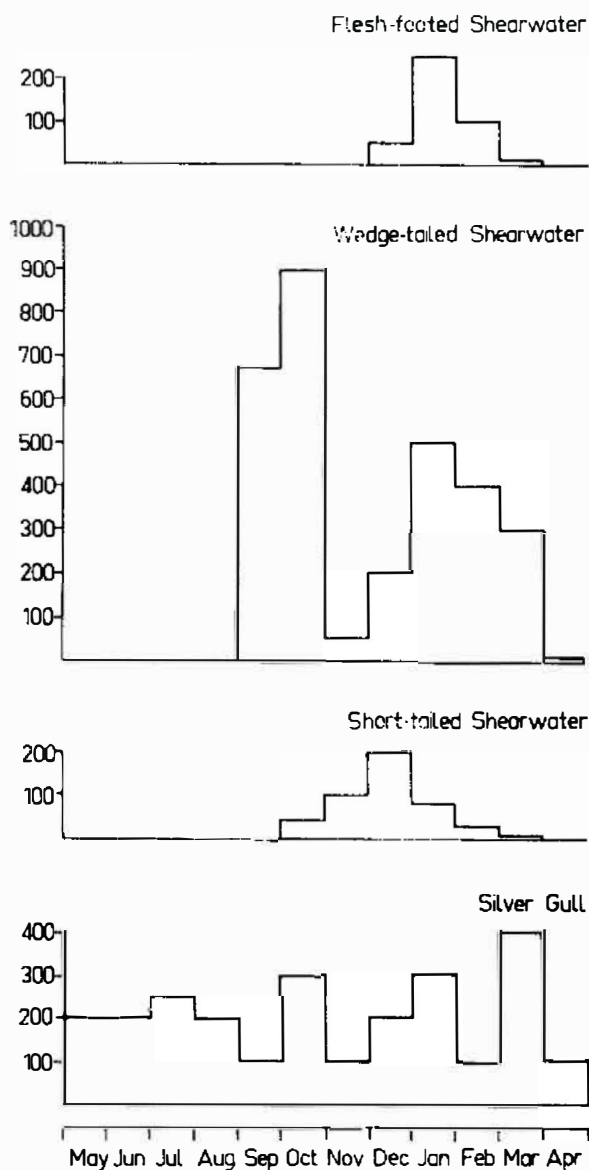
Sixty species of seabirds have been recorded for the waters off Sydney although many of these are known only from beach-washed specimens (Table 1). The 22 species recorded during this study and their relative abundance agree with previous years observations (A. Rogers, pers. comm.). Overall the pattern described can be



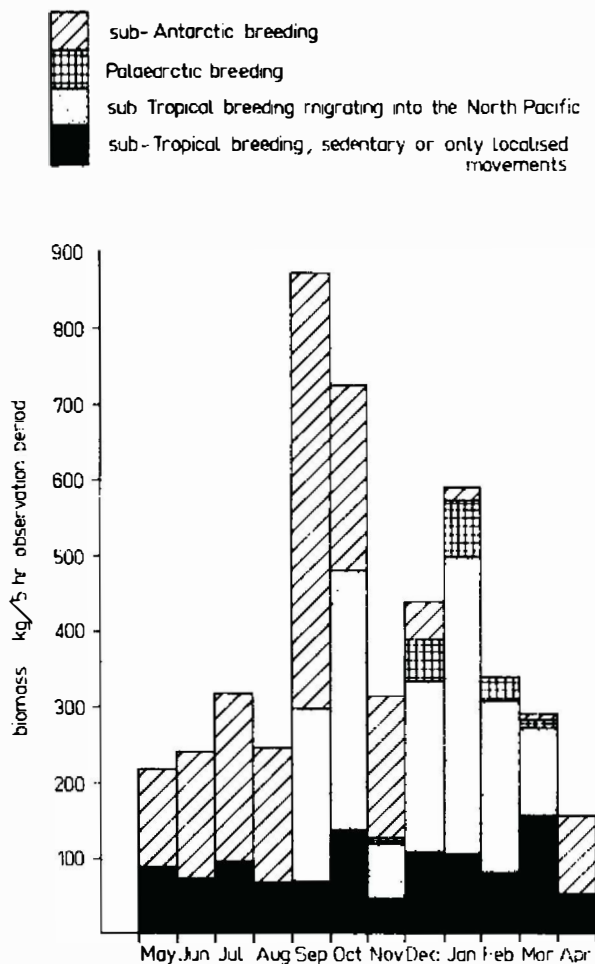
● Figure 2. Mean numbers of seabirds estimated for one five-hour observation period per month in the study area, May 1973 to April 1974—usually less than 10 individuals per period.



● Figure 3. Mean numbers of seabirds estimated for one five-hour observation period per month in the study area, May 1973 to April 1974—usually between 10 and 50 individuals per period.



● Figure 4. Mean numbers of seabirds estimated for one five-hour observation period per month in the study area, May 1973 to April 1974 — usually more than 50 individuals per period.



● Figure 5. Seabird biomass (kg per five-hour observation period) for each assemblage component in the study area, May 1973 to April 1974.

expected to hold, together with seasonal changes in assemblages, unless some substantial environmental change (such as modification of the sewer outfalls produced) takes place. However the abundance of certain species can be expected to fluctuate naturally — for example much larger numbers of prions have been encountered in some years prior to the study period (A. Rogers, pers. comm.).

The importance to some seabirds of existing sewer outfalls, particularly at Malabar and North

Head, has been shown to be related mainly to effluent particle size. The localised numbers of Wandering Albatrosses, Giant-petrels and Silver Gulls have decreased due to modifications to those outfalls and the abundance of species feeding on pelagic fish may also have been indirectly affected.

Observations during the May, 1974 cruise to 40 km from the coast indicate a different seabird species composition for the autumn-winter assemblage in these waters compared with that for continental shelf waters. The presence of two species of storm-petrels also suggests a different pattern in food utilisation. Future work could more clearly establish assemblages throughout the year in oceanic waters off Sydney and there is also a need to adopt censusing techniques which will give more accurate quantitative results. A detailed study of seabird and plankton fluctuations in the area associated with changes in the physical environment may establish whether seabird abundance can be used as an indicator of productivity in eastern Australian waters.



● Wandering Albatross (Immature) typical plumage during first year away from breeding areas.

TABLE I

A SYSTEMATIC LIST OF SEABIRDS RECORDED FROM THE SYDNEY REGION

For the purpose of this list the Sydney region is denoted as the waters between Lat. 33°40'S and Lat. 34°10'S and west of Long. 151°50'E to the coast. Seabirds known only from beach-washed specimens are marked with an asterisk.

family SPHENISCIDAE

Little Penguin *Eudyptula minor*

family DIOMEDEIDAE

Wandering Albatross *Diomedea exulans*
 Royal Albatross *Diomedea epomophora*
 Black-browed Albatross *Diomedea melanophrys*
 Buller's Albatross *Diomedea bulleri*
 Grey-headed Albatross *Diomedea chrysostoma*
 Yellow-nosed Albatross *Diomedea chlororhynchus*
 White-capped Albatross *Diomedea cauta*
 Sooty Albatross *Phoebastria fusca*
 *Light-mantled Albatross *Phoebastria palpebrata*

family PROCELLARIIDAE

Southern Giant-petrel *Macronectes giganteus*
 Northern Giant-petrel *Macronectes halli*
 Cape Petrel *Daption capense*
 Great-winged Petrel *Pterodroma macroptera*
 White-headed Petrel *Pterodroma lessonae*
 Providence Petrel *Pterodroma solandri*
 *Kerguelen Petrel *Pterodroma brevirostris*
 *Mottled Petrel *Pterodroma inexpectata*
 *Black-winged Petrel *Pterodroma nigripennis*
 *Cook's Petrel *Pterodroma cookii*
 *Blue Petrel *Halobaena caerulea*
 *Broad-billed Prion *Pachyptila vittata*
 *Medium-billed Prion *Pachyptila salvini*
 Antarctic Prion *Pachyptila desolata*
 *Slender-billed Prion *Pachyptila belcheri*
 Fairy Prion *Pachyptila turtur*
 *Black Petrel *Procellaria parkinsoni*
 *Westland Black Petrel *Procellaria westlandica*
 Flesh-footed Shearwater *Puffinus carneipes*
 Wedge-tailed Shearwater *Puffinus pacificus*
 Grey-backed Shearwater *Puffinus bulleri*
 Sooty Shearwater *Puffinus griseus*
 Short-tailed Shearwater *Puffinus tenuirostris*
 Fluttering Shearwater *Puffinus gavia*
 Hutton's Shearwater *Puffinus huttoni*
 *Little Shearwater *Puffinus assimilis*

family OCEANITIDAE

Wilson's Storm-petrel *Oceanites oceanicus*
 White-faced Storm-petrel *Pelagodroma marina*

family SULIDAE

Australian Gannet *Morus serrator*

family FREGATIDAE

Lesser Frigatebird *Fregata ariel*

family PHAETHONTIDAE

Red-tailed Tropicbird *Phaethon rubricauda*
 White-tailed Tropicbird *Phaethon lepturus*

family STERCORARIIDAE

Great Skua *Stercorarius skua*
 Arctic Skua *Stercorarius parasiticus*
 Pomarine Skua *Stercorarius pomarinus*
 Long-tailed Skua *Stercorarius longicauda*

family LARIDAE

Silver Gull *Larus novaehollandiae*
 Pacific Gull *Larus pacificus*
 Southern Black-backed Gull *Larus dominicanus*
 Caspian Tern *Hydroprogne caspia*
 Common Tern *Sterna hirundo*
 Arctic Tern *Sterna paradisaea*
 White-fronted Tern *Sterna striata*
 Sooty Tern *Sterna fuscata*
 Little Tern *Sterna albifrons*
 Crested Tern *Sterna bergii*
 Common Noddy *Anous stolidus*
 White-capped Noddy *Anous minutus*
 *Grey Ternlet *Procelsterna albivittata*

Acknowledgements

I wish particularly to thank Alan Rogers for much information freely given on seabirds off Sydney and also Glenn Holmes and David Barton for their observations on the occurrence of certain species off the north eastern and south eastern coasts of N.S.W. respectively. Glenn Holmes, Dr Harry Recher, and Alan Rogers kindly commented on the manuscript and Annette McKinley ably typed several drafts.

References

- Bartle, J. A. (1974), 'Seabirds of Eastern Cook Strait, New Zealand, in Autumn', *Notornis* 21: 136-166.
- Bailey, R. S. and W. R. P. Bourne (1972), 'Notes on Seabirds 36', *Ardea* 60: 124-127.
- Gibson, J. D. (1973), 'New South Wales Albatross Study Group 1972', *Aust. Bird Bander* 11: 5-7.
- Gibson, J. D. and A. R. Sefton, (1958), 'The Fleishy-footed Shearwater in N.S.W. Coastal Waters', *Emu* 58: 91-93.
- Gibson, J.D. and A. R. Sefton, (1959), 'First Report of the New South Wales Albatross Study Group', *Emu* 59: 73-82.
- Hamon, B.V. and D. J. Tranter, (1971), 'The East Australian Current', *Aust. Nat. Hist.* 17: 129-133.
- Hindwood, K. A. (1955), 'Seabirds and Sewage', *Emu* 55: 212-216.
- Hitchcock, W. B. (1965), 'Geography and Seasonal Movement of the Common Tern in Australia', *Emu* 64: 157-171.
- Holmes, G. (1975), 'The Australian Status of the Grey-backed Shearwater', *Aust. Birds* 9: 98-99.
- Jones, B. (1973), 'Studies of Giant Petrels at Malabar, N.S.W.', *Aust. Bird Bander* 11: 47-50.
- Newell, B. S. (1961), Hydrology of South-east Australian Waters: Bass Strait and N.S.W. Tuna Fishing Area. Tech. Pap. Div. Fish. and Oceanog. CSIRO, Aust. No 10, sect. B.
- Rochford, D. (1950), Oceanography, in Australian Fisheries. Indo-Pacific Fisheries Council, Sydney: 16-29.
- Rogers, A. E. F. (1975), 'Movements of Wedge-tailed Shearwaters off the Coast of New South Wales', *Emu* 75: 178-180.
- Serventy, D. L., V. Serventy and J. Warham, (1971), *The Handbook of Australian Seabirds*, Sydney.
- Ticknell, W. L. N. and J. D. Gibson, (1968), 'Movements of Wandering Albatrosses *Diomedea exulans*', *Emu* 68: 7-20.
- Womersley, H.B.S. and S. J. Edmonds, (1958), 'A General Account of the Intertidal Ecology of South Australian Coast', *Aust. Journ. Marine and Freshw. Res.* 9: 217-260.

D. R. Milledge
The Australian Museum,
Sydney.