

NOTES ON THE WINTER DISTRIBUTION OF BIRDS IN THE WESTERN ANTARCTIC AND ADJACENT PACIFIC WATERS

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WHILE serving as cruise leader of the University of Southern California Marine Biology Program in the summer of 1964, I had the opportunity to conduct systematic observations on pelagic birds of the extreme South Pacific and adjacent Antarctic waters. The total time of these observations was 52 consecutive days, starting on 29 July at Wellington, New Zealand, and ending on 17 September at Valparaiso, Chile. The cruise pattern of the ship, the USNS "Eltanin" is shown in Figure 1.

Shipboard observations on oceanic birds are frequently published in the literature for other parts of the Pacific Ocean (for a recent summary see D. C. Wilhoft, *Condor*, 63: 257-262, 1961), but the above-mentioned sector is rarely traversed by surface vessels, especially in the southern winter. Correspondingly, information on the birds of these waters is relatively scarce. For this reason, I thought it best to present a more comprehensive account of each species observed, rather than follow the customary format of the so-called "bird logs" (C. A. Fleming, *Emu*, 49: 169-188, 1950; R. K. Dell, *Rec. Dominion Mus.*, New Zealand, 3: 293-305, 1960). Besides the annotated list, I have made a simple analysis of the broad distributional pattern of pelagic birds in the winter, especially as it might relate to the position of the Antarctic Convergence and of the floating sea ice at this time of the year. D. D. John (see pp. 69-71 in R. C. Murphy, *Oceanic birds of South America*, New York, Amer. Mus. Nat. Hist., 1936) has described the climatic and biotic characteristics of the Antarctic Convergence, or line where the Antarctic and sub-Antarctic waters meet.

Information on the ship's position for each day of the observations, as well as the corresponding sea-surface temperatures (Table 1) are given for 1200 hours, Greenwich Mean Time.

METHODS

The observations were conducted daily, in two one-hour periods. One of these was in the late morning hours, and the second was in mid-afternoon. Adjustment of the timing of the observation periods was often necessary because of the ship's schedule and the observer's duties. Between the scheduled observation periods, frequent watches and casual observations were also made, but the results of these are not included in the quantitative results in Table 2. In some cases these casual observations do appear in the annotated list of the species.

TABLE 1
SHIP'S GMT NOON POSITION AND SEA-SURFACE TEMPERATURE DATA FOR EACH DAY
OF OBSERVATION

Day	Date ¹	Latitude	Longitude	Sea-surface (°C)
1	29 July	42° 19.7' S	176° 24.3' E	12.87
2	30 July	44 49.0	178 20.9	9.08
3	31 July	46 41.0	172 17.3 W	9.90
4	1 August	48 28.3	166 06.7	9.10
5	2 August	50 01.0	159 52.5	7.60
6	3 August	50 44.9	159 33.2	7.70
7	4 August	52 01.0	159 36.7	7.10
8	5 August	53 58.8	159 58.2	4.30
9	6 August	54 44.6	159 55.6	4.15
10	7 August	54 59.2	159 38.1	3.97
11	8 August	56 12.9	160 46.4	3.40
12	9 August	57 01.0	160 06.8	2.52
13	10 August	55 58.0	159 03.9	3.79
14	11 August	58 03.1	160 03.8	1.90
15	12 August	58 50.9	159 51.0	1.16
16	13 August	59 18.0	159 48.1	0.80
17	14 August	59 41.1	160 36.8	0.85
18	15 August	60 47.7	160 12.5	0.48
19	16 August	62 00.2	159 58.2	-0.20
20	17 August	62 56.0	159 53.9	-1.76
21	18 August	62 25.6	159 39.3	ice
22	19 August	61 37.0	156 12.1	-1.02 + ice
23	20 August	60 26.0	153 29.4	ice
24	21 August	60 18.1	152 02.1	-1.80
25	22 August	59 52.3	147 08.2	-1.15
26	23 August	60 02.0	144 24.0	-0.82
27	24 August	60 06.9	141 03.9	-0.60
28	25 August	59 59.5	136 54.0	-0.50
29	26 August	59 59.1	132 41.2	0.15
30	27 August	59 53.6	128 53.4	0.30
31	28 August	60 10.2	126 30.9	2.20
32	29 August	60 25.8	124 29.2	1.30
33	30 August	58 59.3	125 06.8	3.22
34	31 August	57 58.8	125 04.7	3.18
35	1 September	57 38.3	124 58.0	4.78
36	2 September	57 18.9	125 21.7	4.98
37	3 September	56 01.1	124 53.0	6.18
38	4 September	56 22.6	124 32.0	5.70
39	5 September	54 53.1	124 58.7	6.02
40	6 September	55 39.3	125 17.1	5.39
41	7 September	55 13.6	126 47.4	6.12
42	8 September	54 28.7	124 35.0	5.58
43	9 September	51 54.3	117 56.3	4.75
44	10 September	49 20.0	111 48.7	6.42
45	11 September	47 01.1	106 28.0	7.38
46	12 September	44 46.9	101 02.9	7.90
47	13 September	43 13.2	97 42.7	8.60
48	14 September	41 38.1	94 30.8	9.30
49	15 September	39 59.2	88 26.8	11.20
50	16 September	38 35.7	82 18.2	11.80
51	17 September	37 12.4	76 45.1	12.00
52	18 September	35 38.9	73 11.0	11.90
53	19 September	33 00.4	71 50.1	12.40

¹ All in 1964.

All observations were carried out from a small platform at the stern of the ship, about 15 feet above the water level. Efforts were made to identify all birds seen and note their numbers. It was impossible to ascertain the exact numbers seen during any observation period, as the birds were constantly in motion, disappearing and reappearing from time to time. The figures in Table 2 represent the best estimates of the minimum numbers of birds under these conditions. Apart from the difficulties in accurate counting, problems of identification further reduced the numbers recorded. In this report, only those individuals which were positively identified are included. The maximum distance at which such an identification could be made from the observer's platform was as much as one mile in the case of large albatrosses, and for the smaller species proportionately less, depending on size, conspicuousness of pattern, and visibility. For identification, W. B. Alexander's *Birds of the ocean* (New York, G. P. Putnam's Sons. Second Edit., 1954) was used, but the nomenclature is that of Peters (*Check-list of the birds of the world*, vol. 1. Cambridge, Harvard Univ. Press, 1931). Two pairs of binoculars (7 × 30 and 12 × 50) aided in the identification. In at least one case, identification was made from a photograph taken with an Exacta VX camera, through a 400 mm lens.

NOTES ON THE SPECIES

Wandering Albatross (*Diomedea exulans*).—This species was seen in moderate numbers almost daily, north of the Convergence. It seems that it avoids the cold Antarctic waters, being a typical sub-Antarctic species in this respect, although three individuals were seen on the 15th day of the cruise at the southern edge of the Convergence. Alexander (*op. cit.*: 14) defines the range of the species on the high seas as falling between 30° and 60° S latitude, which certainly seems to be the case in the winter. The summer range might be extended farther south, as Dell (*op. cit.*) observed this albatross in the Ross Sea as far south as 66° S, in the summer of 1958.

Royal Albatross (*D. epomophora* subsp.).—Very little is known about the movements of this species on the high seas (Murphy, *op. cit.*: 576). It is normally sighted in the vicinity of New Zealand and adjacent islands, South Australia, and the coast of South America (Alexander, *op. cit.*: 8) and rarely over the vast expanse of ocean separating these localities. On this cruise, some individuals were seen close to New Zealand, but from the 44th through the 47th days a single individual was observed daily. The sighting of the Royal Albatross around 49° 20.0' S and 111° 48.7' W on 9 September puts the species well over 1,000 miles off the Chilean coast, over the open sea.

TABLE 2¹
NUMBERS OF INDIVIDUALS SEEN ON THE CRUISE

Species	Day of voyage ²																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Wandering Albatross	9	12	20	8	5	6	10	12	10	3	-	1	3	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Royal Albatross	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Black-browed Albatross	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gray-headed Albatross	-	-	6	-	1	-	1	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Light-mantled Sooty Albatross	-	-	8	6	1	1	1	5	1	-	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Giant Petrel	10	1	3	4	1	-	-	1	-	-	1	-	-	-	1	-	1	-	1	1	-	-	-	-	-	2	4	-
Cape Petrel	40	12	2	12	-	8	15	15	12	15	10	12	12	15	16	6	6	3	6	12	15	-	-	40	25	60	15	-
Antarctic Petrel	-	-	-	-	-	-	-	-	-	4	4	4	-	3	2	1	-	-	1	3	8	2	8	-	-	1	-	-
Black-tailed Shearwater	-	6	4	3	7	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White-chinned Petrel	-	-	1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White-headed Petrel	-	-	-	10	15	12	-	6	5	5	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Great-winged Petrel	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blue Petrel	-	-	-	-	1	3	2	6	4	6	3	4	3	4	4	5	1	-	1	-	-	-	-	-	4	-	8	-
Snow Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	4	35	-	-	-	-
Scaled Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shearwater spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flesh-footed Shearwater	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sooty Shearwater	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(3)	-	-	-
Silver-gray Petrel	-	-	-	-	-	-	-	-	-	-	-	-	1	4	2	-	1	-	3	2	5	-	-	-	2	4	1	-
Diving petrel, sp.?	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White-faced Petrel	-	1	3	15	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wilson's Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prion, sp.?	-	-	6	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Skua, Antarctic subsp.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Skua, Chilean subsp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chinstrap Penguin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2	5	-	4	-	5	-	-
Magellan Penguin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total species /day	5	5	12	9	10	6	7	7	6	4	4	5	8	8	6	4	4	1	6	5	6	2	3	3	3	6	2	1
Total individuals/day	68	32	69	65	42	31	38	46	33	28	18	22	33	33	28	13	9	3	16	20	49	6	47	47	29	82	16	3

¹ This table is concluded on the next page.

² Days 15 to 32 inclusive were spent south of the Antarctic Convergence.

Black-browed Albatross (*D. melanophris*).—This circumpolar species was seen in moderate numbers near both the New Zealand and the Chilean coasts, and a single individual was sighted around 56° 22.6' S, 124° 32.0' W, on 4 September. The species appears to frequent the warmer, sub-Antarctic waters, with temperatures over 6°C (see Figure 2). Palmer's remark (*Handbook of North American birds*, vol. 1. New Haven, Yale Univ. Press, 1962, p. 131) that it ranges "occasionally south far into the pack ice" may hold for the summer range only (see also Dell, *op. cit.*).

Gray-headed Albatross (*D. chrysostoma*).—This species appears to range farther south than the former. On 11 August, it was observed at the northern edge of the Convergence at 58° S, 160° W. Since it was seen over waters ranging from 10.1° to 1.9°C in temperature, the species would appear to be a bird of the colder, sub-Antarctic waters.

Light-mantled Sooty Albatross (*Phoebastria palpebrata*).—This species was frequently seen over the warm, subtropical waters, with numbers decreasing to the northern edge of the Convergence. The fact that it pene-

TABLE 2
(CONTINUED)

Species	Day of voyage ¹																				Average number/day				
	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48		49	50	51	52
Wandering Albatross	-	-	-	-	-	-	1	1	-	2	1	-	1	2	-	-	1	2	5	5	3	6	6	2.73	
Royal Albatross	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	0.13	
Black-browed Albatross	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	4	1	3	3	0.35	
Gray-headed Albatross	-	-	-	-	-	-	-	1	-	-	-	-	-	15	1	2	2	3	1	3	-	-	-	0.75	
Light-mantled Sooty Albatross	-	-	-	-	-	-	-	1	-	-	-	-	5	-	-	1	3	4	-	-	-	-	-	0.77	
Giant Petrel	3	1	3	2	-	1	-	1	2	-	-	3	-	1	2	-	-	-	3	-	-	-	-	1.04	
Cape Petrel	4	12	30	25	10	15	25	20	15	25	15	15	6	25	20	15	20	30	12	25	25	10	15	15.63	
Antarctic Petrel	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.85	
Black-tailed Shearwater	-	-	-	-	-	-	-	-	-	-	-	-	-	10	3	-	1	-	-	4	-	1	10	1.00	
White-chinned Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	4	12	0.50	
White-headed Petrel	-	-	-	-	-	-	1	-	-	1	-	1	-	3	3	3	1	3	-	-	-	-	-	0.04	
Great-winged Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.58	
Blue Petrel	-	44	5	7	4	4	6	4	4	4	4	4	-	8	3	8	8	4	2	3	3	10	8	3.10	
Snow Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.04	
Scaled Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0.08	
Shearwater spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0.13	
Flesh-footed Shearwater	-	-	1	2	3	2	1	-	-	2	1	-	-	4	-	4	2	3	-	-	-	-	3	0.83	
Sooty Shearwater	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Silver-gray Petrel	-	2	4	4	4	4	4	4	6	5	7	7	3	8	15	12	-	1	-	4	3	-	3	2.40	
Diving petrel, sp.?	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	
White-faced Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.50	
Wilson's Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	0.58	
Prion, sp.?	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6	4	12	15	50	2	2.04	
Skua, Antarctic subsp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	
Skua, Chilean subsp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.02	
Chinstrap Penguin	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.15	
Magellan Penguin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.02	
Total species/day	5	5	7	5	4	5	4	5	8	6	5	5	2	10	6	8	9	10	8	11	7	6	8	9	
Total individuals/day	49	20	45	40	21	26	36	29	30	39	29	28	9	80	44	46	43	53	26	72	55	77	51	80	37.52

¹ Days 15 to 32 inclusive were spent south of the Antarctic Convergence.

trates well into the cold, Antarctic waters was evidenced by the sighting of a single individual at approximately 59° 18' S, 159° 48' W, with the sea-surface temperature around 0.9°C. The distribution pattern of this species is quite similar to that of the former, although it ranges somewhat farther south (see Figure 2).

Giant Petrel (*Macronectes giganteus*).—This was an ubiquitous species which occurred in both sub-Antarctic and Antarctic waters. On 18 August it was seen over floating sea ice ("pancake ice") at the edge of the pack, around 62° 25' S, 159° 40' W.

Cape Petrel (*Daption capensis*).—This was by far the commonest sea bird seen on the trip. The numbers varied greatly from day to day, but at least a few were always visible at all times. Even in total darkness, this species was seen crossing the beam of the ship's searchlights, indicating that they are aloft at night as well. It was conspicuously missing over sea ice, near the edge of the pack. The distribution included the widest range of sea-surface temperatures of any species encountered, rang-

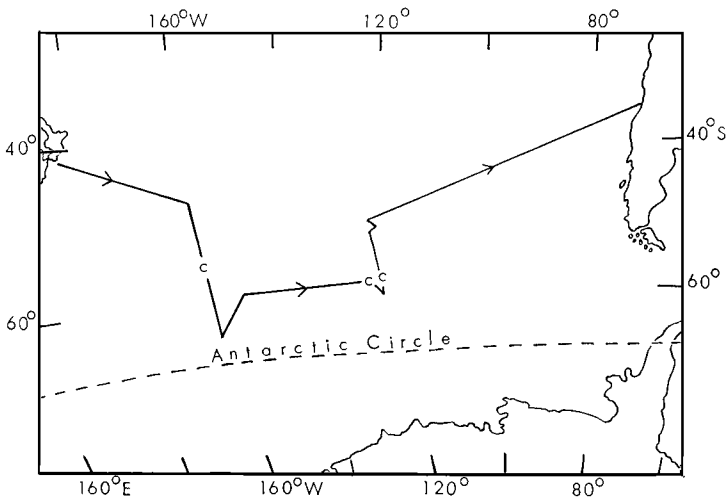


Figure 1. Approximate route of ship from Wellington, New Zealand, to Valparaiso, Chile, 29 July to 19 September 1964. Letter c = location of Antarctic Convergence.

ing from 13.0°C to -1.5°C . There was no evidence of the presence of two separate feeding populations, as suggested by Dell (*op. cit.*).

Antarctic Petrel (*Thalassoica antarctica*).—This is one of the truly Antarctic species, although it ranges well north of the Convergence, into surface waters of 3.8°C , as far north as 55°S (7 August). In the summer, the northern limit is apparently “a day north of the pack ice” (Dell, *op. cit.*), but Alexander (*op. cit.*: 43) does list it as occurring as far north as 50°S .

Black-tailed Shearwater (*Adamastor cinereus*).—This species appeared to be a bird of the warmer sub-Antarctic waters (12.2°C to 5.9°C), sometimes quite close to shore, as on the Chilean side (see Table 2). On 8 September ($54^{\circ} 29' \text{S}$, $129^{\circ} 35' \text{W}$) about 10 individuals were following several groups of pilot whales (*Globicephala* sp.), fluttering and gliding in the wake left by the whales. This was the southernmost occurrence of the species.

White-chinned Petrel (*Procellaria aequinoctialis*).—This petrel was observed in the vicinity of land only (see Table 2), in small numbers. It seems to prefer the warmer surface waters (12.2°C to 8.0°C) of the sub-Antarctic zone during the southern winter.

Great-winged Petrel (*Pterodroma macroptera*).—Only two individuals were seen, on two consecutive days (9 and 10 August), just north of the Convergence, in waters of 3.7°C to 2.4°C . The limited nature of the observations does not allow further conclusions to be made on the winter

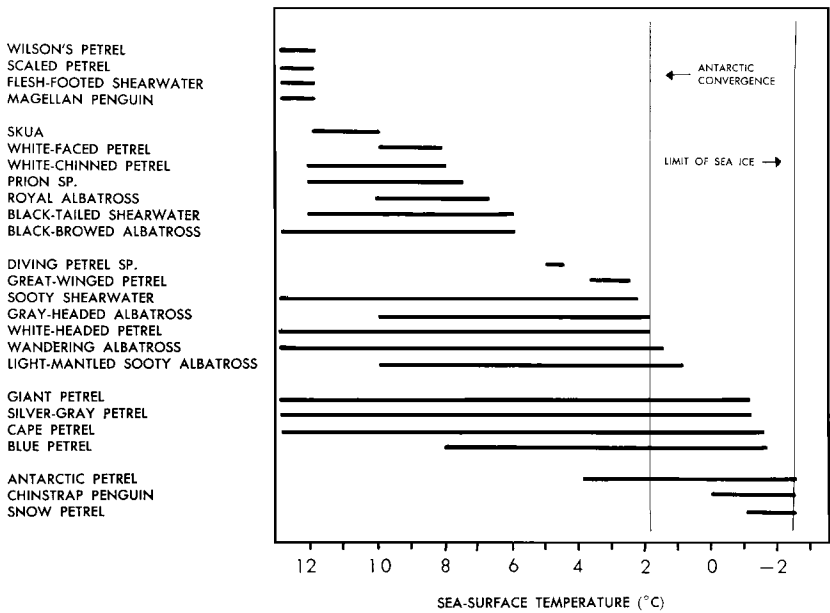


Figure 2. Distribution of various sea birds with respect to sea-surface temperature. The horizontal bars indicate the range of temperatures over which each species was recorded.

range of the species. Alexander (*op. cit.*: 51) remarks that the southern limits of the species' distribution is around 50° S. The individual sighted on 10 August was at 56° S and 159° W.

White-headed Petrel (*P. lessonii*).—This is a moderately common species which ranges all the way to the northern edge of the Convergence. It occurs over a wide range of surface temperatures (13.0°C to 1.9°C), but was never seen south of the Convergence in truly Antarctic waters. Dell (*op. cit.*) lists the summer range of the species in the Ross Sea as between 53° S and 65° S. It probably shifts its range to the north in the winter, as the northernmost sighting for the species was at 33° S, near the Chilean coast.

Scaled Petrel (*P. inexpectata*).—Several individuals of the petrel were seen on 19 September, almost in sight of the Chilean coast, which is interesting as Palmer (*op. cit.*: 210–211) describes its distribution as “far from land.” At no time was the species seen over the high sea during this trip.

Blue Petrel (*Halobaena caerulea*).—This little-known petrel was seen almost daily during the trip in moderate numbers. The species apparently occurs over a wide range of surface temperatures (8.1°C to -1.5°C) and

might be classified as a bird of the cooler sub-Antarctic as well as the Antarctic waters. It stays well clear of the ice at all times. The most southerly occurrence was noted on 16 August, at 62° S and 160° W. The birds are usually seen in small groups of two or three, flying very close to the surface and resembling the prions (*Pachyptila*) in this respect.

Snow Petrel (*Pagodroma nivea*).—This is the most truly Antarctic species of all the petrels, which was never seen out of sight of sea ice. The most northerly sighting occurred at 60° 26' S on 20 August. Small groups of 10 to 12 birds were often seen resting on floating fields of ice.

Flesh-footed Shearwater (*Puffinus carneipes*).—The only time this species was observed was well in sight of the Chilean coastline. At no time was it seen on the high seas. Presumably, the individuals seen belonged to the east Pacific race (*P. carneipes creatopus*), and all were of the dark phase. The subspecies nests on the Juan Fernandez group, and the sightings were made about 300 miles west of the islands.

Sooty Shearwater (*P. griseus*).—The observations on this species present a somewhat confusing picture. While birds were observed at almost all water temperatures between 12.4°C and 1.66°C, there appears to be a conspicuous gap in the geographic distribution of the species from the neighborhood of New Zealand to about midway between New Zealand and the South American coast, and just south of the Convergence (see Table 2). The sighting of three individuals in bad weather, just north of the pack ice could not be verified to satisfaction, but this record is nevertheless included in Table 2, in parentheses. The species appears to be a bird of sub-Antarctic waters, just barely crossing the Convergence in the winter.

Silver-gray Petrel (*Fulmarus glacialoides*).—With a temperature range of 13.0° to 1.1°C, this species ranges over both sub-Antarctic and Antarctic waters. It was not encountered, however, on the New Zealand side of the sub-Antarctic zone, but was seen almost daily on the Chilean side. The species belongs to the group of oceanic birds with a wide tolerance for sea-surface temperatures (see Figure 2). Five individuals were seen over sea ice on 18 August at 62° 25' S and 147° W, and Dell (*op. cit.*) remarks that the major concentrations are just north and south of the floating pack ice during the summer months. On this winter cruise the "Fulmar" was seen as far north as 33° S, in sight of the Chilean coast. The species was most numerous well north of the Convergence.

Diving petrel (*Pelecanoides* sp.).—On the night of 2 September a single diving petrel was seen fluttering around the searchlights of the ship in stormy weather. Specific identification was not possible. The position of the ship was approximately 56° S and 125° W. After arrival in Valpa-

raiso, a dead specimen of the Common Diving Petrel (*P. urinatrix*) was found on the foredeck, in partially mummified condition. It was not established how and when the bird got aboard the ship, and whether this was the same individual seen earlier.

White-faced Petrel (*Pelagodroma marina*).—This species was encountered on the first four days only, while the ship was near the New Zealand–Chatham Island area. It probably prefers the warmer sub-Antarctic waters and stays in the vicinity of the islands.

Wilson's Petrel (*Oceanites oceanicus*).—Only a half day's journey from the South American coast, this storm petrel began to flutter in the wake of the ship and at no time was the species observed on the high seas. In view of its extensive migrations, which take the species to or well past the equator (Palmer, *op. cit.*: 248–249), it seems that the bulk of the population departs from waters below 12°C in the winter.

Prions (*Pachyptila* spp.).—These small birds showed a curiously disjointed distribution, occurring in both the New Zealand and South American sectors in waters of 7°C or warmer, but twice they were encountered south of the Convergence as well (see Table 2). Since identification of the several species of the genus is rarely possible at sea, no attempt is made to comment on the distribution. Very likely, two or more species were included in the observations.

Skua (*Catharacta skua*).—About 80 miles southwest of Chatham Island, a single specimen of the dark race (*C. s. lombergi*) flew past the ship and continued in a northeasterly direction. The Chilean form (*C. s. chilensis*) was seen once, between Talcahuano and Valparaiso, only a few miles from the coast. This bird kept with the ship for almost a whole day.

Chinstrap Penguin (*Pygoscelis antarctica*).—These were the only penguins observed far from land during the voyage. As Figure 2 shows, the observations fall between 160° and 133° W and 62° and 60° S, approximately. Most sightings were made in the vicinity of floating sea ice, although the last observation, which included some 40 birds, was at least one and one-half day's journey from the ice floes. For some time it was thought that this species occurred in the eastern part of the Antarctic only (Murphy, *op. cit.*: 407), but more recently it extended its breeding range to the western sector, and became circumpolar (W. J. L. Sladen, *Biologie Antarctique*, Paris, 1964; p. 362 and map). It is remarkable, however, that these birds were spotted some 2,000 miles west of their nearest known breeding place, in the vicinity of the Antarctic Archipelago. It seems, therefore, that the species became circumpolar in its pelagic as well as in its breeding range.

Magellan Penguin (*Spheniscus magellanicus*).—A single individual was

seen in Valparaiso Harbor, Chile, in the company of pelicans, feeding mostly on scraps discarded by the fishermen.

DISCUSSION AND CONCLUSIONS

While it is quite well known that the distribution ranges of most oceanic birds (including those classified as truly Antarctic species) shift to the north to varying degrees during the southern winter, some of the records presented here represent extensions well beyond the range described in the literature for the given species. Good examples of this are the Chinstrap Penguin and the White-headed Petrel, discussed in detail in the annotated list. The occurrence of the Royal Albatross, far out at sea is also noteworthy in this respect, since most observations place this species either in the vicinity of the New Zealand or the South American coast (Murphy, *op. cit.*: 576). The species is known to breed on some of the islands in the vicinity of New Zealand only (Alexander, *op. cit.*: 8), and all South American records must therefore refer to individuals which have crossed the vast expanse of the southern ocean somewhere between the Australian and American sectors. The lack of sufficient data on the movements of this species could well be due to the difficulty of distinguishing the Royal from the Wandering Albatross at sea. Another, and possibly more important, factor might be the scarcity of ship tracks crossing the extreme South Pacific in the winter, around the latitude of 50° S, where the above-mentioned sighting occurred.

The distributions of some of the species observed on this trip are more difficult to explain, as shown by the case of the Sooty Shearwater. This species was consistently noted around (and just north of) the Convergence—and perhaps as far south as the pack ice (see comment in the annotated list). Palmer (*op. cit.*: 177) suggests that this bird undertakes vast circular migrations in the Pacific basin, returning from the northern hemisphere in the fall along the west coast of the Americas, and crossing the ocean along the trade winds region to reach the New Zealand breeding grounds. The observations presented here suggest that at least part of the population returns to the islands along the Convergence, and possibly even well south of it.

Aside from such additional information on the winter occurrence of individual species, these records also provide useful information on the winter distribution of oceanic birds in general, especially around the Antarctic Convergence. Without attempting a comprehensive analysis on such a limited set of data, the following simple conclusions seem pertinent.

When the daily observations are grouped according to the range of sea-surface temperatures recorded for the species, several more or less well-

defined distributional types become apparent (see Figure 2). The species making up each of the categories are as follows:

Group 1. These birds (Scaled and Wilson's petrels, Flesh-footed Shearwater, Magellan Penguin) are apparently "off-shore" birds, preferring warmer waters (not lower than 12°C) within a day's journey from the coast. None of the members of this group was seen on the high seas.

Group 2. The species in this group (Skua, White-faced Petrel, White-chinned Petrel, Black-tailed Shearwater, Royal and Black-browed albatrosses and prions) might be classified as the "warmer sub-Antarctic" group, ranging over waters from over 12 to 6.5°C. All members of this group are truly pelagic (with the possible exception of the Skua) and spend most of their time well off shore, over the open ocean.

Group 3. This group (diving petrels, Great-winged Petrel, Sooty Shearwater, Gray-headed Albatross, White-headed Petrel, Wandering Albatross, Light-mantled Sooty Albatross) is more a "cool sub-Antarctic" group, although several species range far into the warmer, northern waters, broadly overlapping with members of the former group. The best way to characterize this form of distribution is to say that the birds tend to frequent the cooler (below 6.5°C) part of the sub-Antarctic waters, ranging as far south as the Convergence.

Group 4. This (including the Giant Petrel, Silver-gray Petrel, Cape Petrel, and Blue Petrel) might be called the "ubiquitous" group, for its members range over both sub-Antarctic and Antarctic waters, with a total temperature range observed for all species falling between 7.1 and -1.5°C. These species usually stay well clear of ice in the winter (with the possible exception of the Silver-gray Petrel). They exhibit a considerable range of ecological tolerance, especially the Giant and Cape petrels.

Group 5. These birds (Antarctic Petrel, Snow Petrel, Chinstrap Penguin) are the "truly Antarctic" members of the assemblage observed during the trip. The bulk of the population seems to stay south of the Convergence during the winter, with only the Antarctic Petrel ranging just barely north of it. The narrowest ecological tolerance was undoubtedly seen in the Snow Petrel, which was only observed within sight of sea ice.

Figure 2 clearly indicates that there is much overlap between the various groups suggested, and at many temperature points members of two or even three different groups can occur together. The grouping, therefore, is not intended to show a geographic pattern, it is merely a reflection of the broad distribution types in the realm of water temperatures.

The Antarctic Convergence divides the bird faunas of the southern oceans into two more or less separate groups, although this division is not immediately apparent to a person making daily observations on the

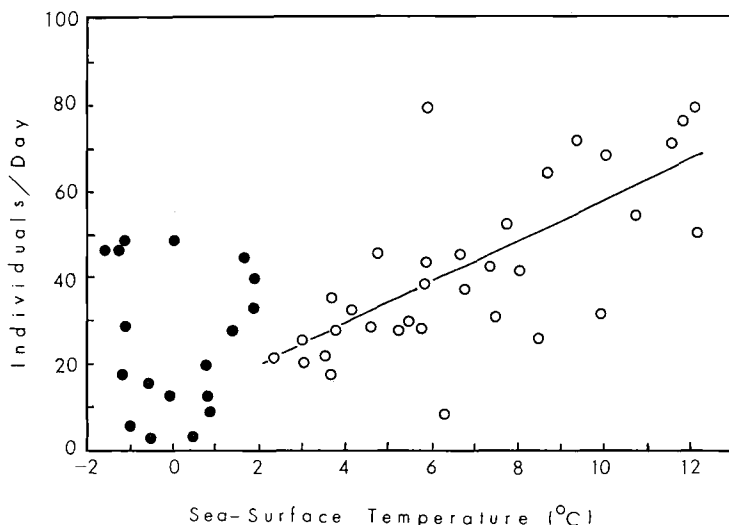


Figure 3. Total numbers of individuals seen daily as related to sea-surface temperature. Dark circles indicate records south of the Convergence; open circles, north of the Convergence. The latter were significantly correlated, as shown by the line.

high seas. There is much blending and mixing of the sub-Antarctic and Antarctic groups on both sides of the Convergence, which obscures the division. Of the groups suggested here, members of Groups 1, 2, and 3 are not likely to be found south of the Convergence, and members of Group 5 are rarely seen north of it. The ubiquitous Group 4 apparently contains species with wide ecological tolerances, and these birds are equally at home in both areas.

More important than differences in species composition is the pattern of distribution of the oceanic bird populations on the two sides of the Convergence (see Figure 3). North of this line the relationship of numbers of individuals to sea-surface temperature is very clear: as the temperatures decrease, so do the numbers, and this correlation shows statistical significance at the .01 level. South of the Convergence on the other hand, the pattern assumes a random distribution, and no correlation exists between numbers observed and water temperatures recorded for successive days. On this basis it might be suggested that the role of water temperatures in governing the dispersal of oceanic birds in the winter is negligible in the area between sea-ice and the Convergence. Any explanation of this phenomenon will have to wait until more quantitative data and a wider seasonal distribution of observations become available for analysis.

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SUMMARY

Two one-hour observation periods for 52 consecutive days in the summer of 1964 provided data on the distribution of oceanic birds between New Zealand and South America, both north and south of the Antarctic Convergence. The results of this brief survey are presented in the form of an annotated list for the species observed, and an attempt is made to group the various species on the basis of their apparent relationship to sea-surface temperatures. The five groups thus established broadly overlap at many temperature points. Both the species composition and the number of individuals seen per day show a marked change after crossing the Convergence. North of this line, a direct relationship exists between the numbers of birds seen and the temperature; the correlation is statistically significant. South of the Convergence this distribution is random.

New information for the (southern) winter distribution of several oceanic bird species is given, the most notable of these being the Chinstrap Penguin, White-headed Petrel, Silver-gray Petrel, Royal Albatross, and Sooty Shearwater. The need for more comprehensive faunistic studies in this rarely traveled portion of the world's oceans is emphasized.

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