

THE DISTRIBUTION OF MARINE BIRDS IN CHILEAN WATERS IN WINTER

JOSEPH R. JEHL, JR.

GENERAL aspects of the biology and distribution of seabirds along the coasts of South America are well-known through the classic studies of Murphy (1936). Yet detailed information for many species remains sparse and, with few exceptions (e.g. Szijj, 1967; Brown, Cooke, and Mills, MS; Watson and Angle, MS), quantitative distributional data are lacking. Knowledge of pelagic species near the southern end of the continent during the austral winter is particularly incomplete because environmental conditions at that season have inhibited or precluded offshore studies.

From mid-May to early July 1970, in conjunction with a study of marine mammals, I studied seabird distribution along the coast of Chile, in coastal and offshore waters, from Punta Arenas (55° S) northward to Isla Chañaral (29° S) and including visits to Islas Juan Fernandez and Islas Desventuradas (San Félix and San Ambrosio). These studies were made during cruise 70-3 of the R/V Hero. Our route transected the subantarctic, Humboldt Current, and subtropical zones of surface water, each with its own characteristic avifauna (Murphy, 1936; Watson et al., 1971; see also Gordon, 1967). Observations in the same general area between 26 January and 4 April 1970 by Brown et al. (MS), and in April 1965 by Watson and Angle (MS) provide comparative data for documenting important seasonal changes in distribution of several species.

For additional information on the breeding phenology and distribution of seabirds in this area see Murphy (1936), Johnson (1965, 1967), and Watson et al. (1971).

METHODS

The itinerary (Figure 1) is summarized below; locality names are from standard Chilean Navy charts. Table 1 lists the ship's noon positions and surface-water temperatures.

Leg 1.—Left Punta Arenas 15 May; passed briefly into Bahía Inútil, Isla Grande, thence westward through Straits of Magellan, arriving at mouth 19 May. Due to heavy seas continued northward through inland passages—Canal Smythe, Estrecho Collingwood, Canal Pitt, Canal Concepcion—to Golfo de Trinidad. At sea to approximately 15 miles west of Golfo de Trinidad on 22 May, but driven back by heavy seas. Proceeded northward through Canal Wide, Paso del Indio, and Canal Messier, reaching south shore of Golfo de Penas on 25 May; crossed Golfo on 26th. On 27th continued northward 10-30 miles off the Taitao Peninsula, arriving in Bahía Anna Pink on 28 May. Thence northward through channels along Isla Clemente, through Canal Darwin and Canal Morelada, to Boca del Guafo. Reached Isla Guafo midday 30 May; left afternoon of 31 May. Cruised 3-10 miles off

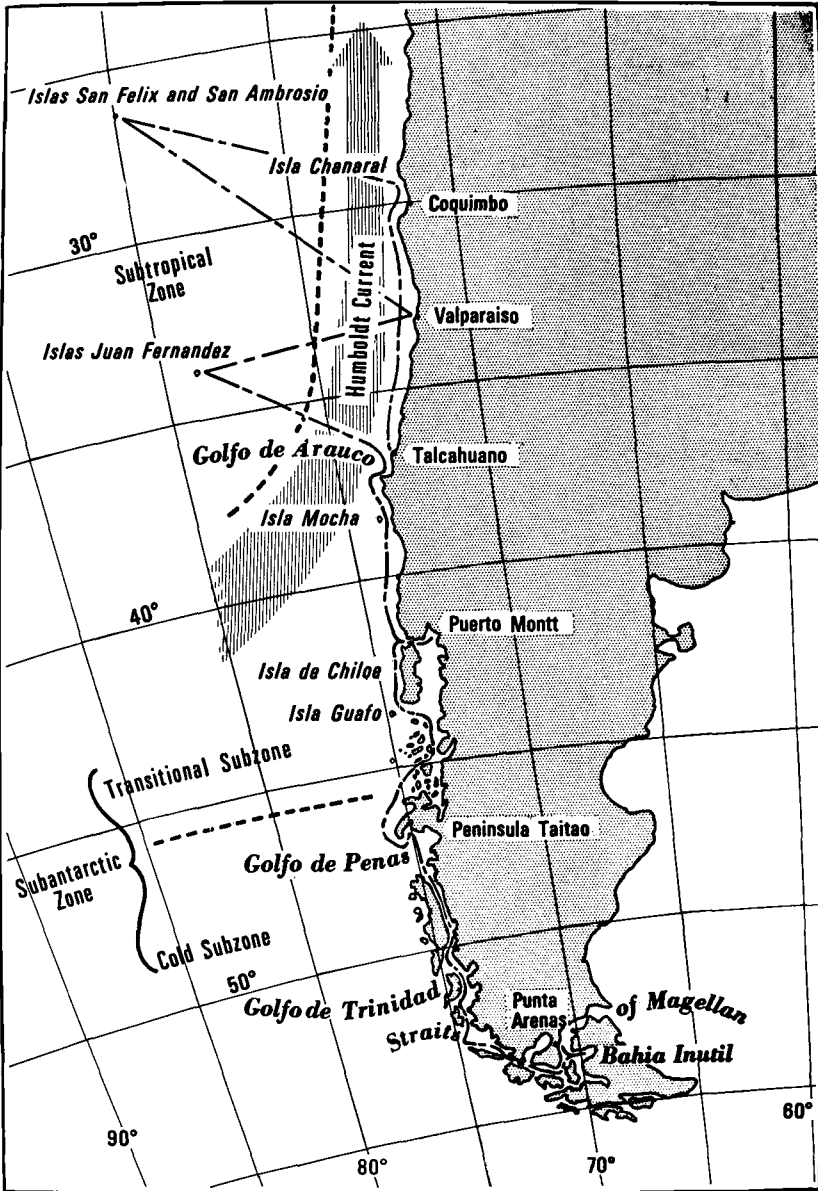


Figure 1. Itinerary of the R/V Hero between Punta Arenas and Talcahuano, Chile, mid-May to early July 1970, showing important localities mentioned in the text and major zones of surface water.

TABLE 1
SHIP'S POSITION AT NOON LOCAL TIME AND SEA TEMPERATURES FOR EACH
DAY OF OBSERVATION

Date	Latitude	Longitude	Sea temp. °C
Leg 1:			
15 May 1970	53° 20' S	71° 40' W	6.9
16	53° 20'	70° 58'	6.0
17	53° 54'	71° 20'	8.0
18	53° 24'	73° 19'	7.0
19	52° 33'	73° 39'	7.1
20	51° 50'	73° 48'	7.0
21	50° 36'	74° 59'	7.5
22	49° 59'	75° 10'	9.1
23	50° 05'	74° 47'	9.3
24	48° 41'	74° 27'	8.5
25	47° 44'	74° 55'	10.8
26	47° 15'	75° 05'	10.8
27	46° 58'	75° 35'	10.8
28	46° 19'	75° 30'	11.0
29	45° 47'	74° 40'	11.0
30	43° 35'	74° 45'	11.5
31	43° 35'	74° 45'	11.0
1 June	42° 51'	74° 18'	11.5
2	42° 13'	74° 09'	12.0
Leg 2:			
7	41° 56'	73° 10'	12.2
8	41° 48'	73° 50'	12.0
9	41° 18'	73° 58'	12.0
10	38° 18'	74° 00'	12.7
11	37° 28'	74° 04'	13.3
12	37° 00'	73° 30'	12.5
13	36° 40'	74° 00'	12.7
14	36° 46'	77° 10'	15.0
15	33° 40'	78° 53'	17.0
16	33° 40'	78° 53'	17.0
17	33° 25'	76° 10'	15.0
18	33° 39'	72° 02'	14.5
Leg 3:			
23	32° 49'	71° 55'	13.2
24	30° 12'	75° 20'	17.0
25	27° 40'	77° 53'	18.0
26	26° 20'	79° 52'	18.0
27	26° 20'	79° 52'	18.0
28	27° 15'	77° 30'	17.5
29	27° 50'	74° 02'	16.2
30	29° 05'	71° 32'	12.0
1 July	29° 32'	71° 32'	12.2
2	30° 35'	71° 46'	12.0
3	31° 55'	71° 33'	12.0
4	33° 06'	71° 36'	11.5
5	35° 40'	72° 42'	11.5

entire west coast of Isla Chiloé 31 May–1 June. Most of 2 June at Isote Metalqui, west coast of Isla Chiloé; arrived Puerto Montt 3 June.

Leg 2.—Left Puerto Montt 7 June, anchoring in Bahía de Ancud. Unable to pass seaward until 9 June; then 20–30 miles offshore toward Isla Mocha, arriving

on 10th. Headed toward Juan Fernandez Islands, reaching 80 miles offshore but retreated before rough seas into Golfo de Arauco. Left Golfo 13 June, reached Mas Atierra of Juan Fernandez Islands 15 June. In vicinity of Mas Atierra and Santa Clara islands 15-16 June. Departed late on 16th, arriving Valparaiso on 18th.

Leg 3.—Departed Valparaiso 23 June for Islas Desventuradas arriving 26 June. Explored waters around San Ambrosio on morning of 26th; landed on San Félix on 26th and on San Ambrosio on 27th. At sea 27-30 June, heading toward Isla Chañaral (29° S). Thence southward 1-3 miles offshore, entering all bays and harbors, reaching Talcahuano on 5 July.

Quantitative data were obtained through 1-hour censuses. The time varied with activities aboard ship, but usually at least two counts were made daily, from 10:00-11:00 and from 14:00-15:00. No counts were made when the ship was anchored or drifting. R. M. Gilmore and S. Bowen assisted in making the observations. The results are given in Table 2. Other observations were made throughout the day, mostly from a flying bridge 20 feet above the waterline, which provided good visibility in all directions. All birds were counted, but for ship-following species I estimated the number present each hour. Despite many sources of bias, offshore censuses seem reasonably representative. Observations of shore-inhabiting species are fragmentary, because the ship usually kept a mile or more from shore.

Sea water temperatures were taken daily at noon in inshore waters, and more frequently offshore. Specimens collected are deposited in the San Diego Natural History Museum and the United States National Museum of Natural History.

Field identifications were based on criteria presented by Alexander (1927), Falla et al. (1967), Humphrey et al. (1970), and especially Murphy (1936). In the following account the generic classification of Procellariiformes follows Alexander et al. (1965); nomenclature largely follows Meyer de Schauensee (1966).

ANNOTATED LIST OF SPECIES

ROCKHOPPER PENGUIN (*Eudyptes crestatus*).—Fairly common in ones or twos in sheltered areas of Bahía Inútil; rare in Straits of Magellan near Puerto del Hambre; not seen elsewhere. All birds lacked conspicuous supraorbital stripes and were probably immature.

HUMBOLDT PENGUIN (*Spheniscus humboldti*), **MAGELLANIC PENGUIN** (*S. magellanicus*).—Magellanic Penguins were abundant in the Straits of Magellan, in Bahía Inútil, and at Puerto Montt. They were less common in western regions of the straits and inland passages, but were seen daily, sometimes in good numbers. We did not find this species at Mas Atierra where it is reported to be resident.

The breeding ranges of Magellanic and Humboldt penguins overlap between 38° S and 32° S (Johnson, 1965: 37). Magellanic Penguins occurred as far north as the Bahía de Ancud (42° S), but except for two unidentified birds at Isla Mocha (38° S) penguins were not seen again until we reached the Golfo de Arauco (37° S). There we encountered large flocks of Humboldt Penguins and I considered all penguins seen there and northward as *humboldti*. They were widely distributed along the coast between Isla Chañaral and Talcahuano, but except for a flock of 150 seen near Coquimbo, they were nowhere common. Nearly all our penguin sightings were made within a mile or two of shore. One Humboldt Penguin was seen 75 miles west of Talcahuano.

WANDERING ALBATROSS (*Diomedea exulans*).—Identification problems with large albatrosses are well-known. Immature Wanderers are easily identified, but some

TABLE 2
RESULT OF DAILY CENSUSES¹

Species	Straits of Magellan					Inland passages: Canal Smythe to Golfo de Penas					Outer coast and channels: Taito Peninsula to Puerto Montt							
	May 15	16	17	18	19	20	21	22	23	24	26	27	28	29	30	31	June 1	2
<i>Spheniscus magellanicus</i>	60	36	4	—	0.3	34	—	—	—	1	—	2	—	—	—	—	—	—
<i>Spheniscus humboldti</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Diomedea exulans</i>	—	—	—	—	—	—	—	—	—	—	0.6	9	4.9	—	0.5	1	—	—
<i>Diomedea epomophora</i>	—	—	—	—	—	—	—	0.3	—	—	—	—	—	—	—	—	—	—
<i>Diomedea exulans/epomophora</i>	—	—	—	—	—	—	—	0.6	—	—	—	0.5	1.9	—	0.5	—	—	—
<i>Diomedea chrysostoma</i>	—	—	—	—	—	—	—	1.3	—	—	0.6	1.5	1.1	—	0.5	—	—	1
<i>Diomedea melanophris</i>	16	26	4	1	0.3	—	—	2.7	5	—	16	3.5	5.2	2	16	10	23	34
<i>Diomedea cauta</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Macronectes giganteus</i>	4	8	3.5	1.5	1.3	3	—	5.3	1	0.5	6.6	11	15	2	0.9	6	1	1
<i>Fulmarus glacialisoides</i>	44	239	24	5	1.3	12	3	82	258	1.5	116	3	10	2	7.7	3	33	17
<i>Daption capense</i>	0.4	—	—	—	0.7	—	30	77	17	—	1.2	28	6.4	2	7.3	1	0.5	—
<i>Pachyptila</i> sp.	—	—	—	—	—	—	—	10	4	—	3	1.5	0.4	—	3.6	—	—	—
<i>Procellaria aequinoctialis</i>	—	1	—	—	—	—	—	8.3	—	—	23	7.5	14	—	3.6	—	—	—
<i>Puffinus griseus</i>	2	1	0.5	—	—	—	—	0.7	—	—	4.8	1	37	—	10	1	1.3	—
<i>Pterodroma cooki</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Oceanites oceanicus</i>	—	—	—	—	—	—	—	1	—	—	36	1	0.8	—	5	—	—	1
<i>Pelecanoides magellani</i>	0.8	3	0.5	—	1.7	15	11	0.3	2	0.5	1.8	—	0.4	—	0.5	—	—	—
<i>Pelecanoides garnotii</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Pelecanus thagus</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Phalacrocorax atriceps</i>	2	—	—	—	—	—	—	0.7	—	4	—	—	—	—	—	—	—	0.3
<i>Phalacrocorax albiventer</i>	6.4	2	5	29	2.7	12	—	—	—	1.5	—	—	—	—	—	—	—	—
<i>Catharacta skua</i>	0.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Larus dominicanus</i>	4.4	1	9.5	10	3	15	2	0.3	3	16	1.2	—	0.4	—	—	—	—	—
<i>Larus modestus</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Sterna hirsudinacea</i>	13	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

¹ Abundance indicated is number of birds per hour of observation. Includes species seen on five or more days.

TABLE 2 Continued

Species	Outer coast: Puerto Montt to Golfo de Arauco					Offshore waters: de Arauco to Islas Juan Fernandez to Valparaiso					Offshore waters: Valparaiso to Islas Desventuradas to Chantarel					Outer coast: Chañaral to Tachahuano						
	7	9	10	11	12	13	14	15	17	18	23	24	25	27	28	29	30	July	2	3	4	5
																		1				
<i>Spheniscus magellanicus</i>			0.8																			
<i>Spheniscus humboldti</i>					22	0.2																
<i>Diomedeia exulans</i>	0.5	2.8	3.7			2	0.2	1	2.4	0.3	3	1		1	1							
<i>Diomedeia epomophora</i>	1	0.4	0.7																1	1		
<i>Diomedeia exulans/epomophora</i>	0.5	0.4	1								1.5							0.3				
<i>Diomedeia chrysostoma</i>	1											0.2								0.5		
<i>Diomedeia melanophris</i>	17	108	10	11	4	4	3.1	6	2.4	1.2	6.9	1.3	1			1.3	4.3	2.5	2.5	3	4.5	1.6
<i>Diomedeia cauta</i>			0.8	1	2.5	2			0.2	1.3	4.6					0.3	3.3	6	3		1.5	6
<i>Macronectes giganteus</i>	0.5	10	3.6	3		2	0.2	1	0.5	0.3	6.2				0.3	0.3		0.5		3	0.5	2
<i>Fulmarus glacialis</i>	9	22				0.5																
<i>Fulmarus glacialis</i>	28	32	42	20	32	1.4	1	1	1.2	3.7	4.1	2.7	0.5	1	2.3	0.3	8.3	5	1.5	3	7	2.5
<i>Daption capense</i>		12	6.8	170	64	28	0.3		3	5.1	3.9				0.3	1	5.2	37	99		26	20
<i>Pachyptila</i> sp.																						
<i>Procellaria aequinoctialis</i>	1.3	0.5	1.6	3.7	1.5	2.8	3.7		2.8	19	2.5	1.8			1	0.7	1	1	6.5	5	1.5	4
<i>Puffinus griseus</i>		8.5	398	167	250		0.9		2.4	0.6	1.5	3.6					34	12.5	5	6	238	650
<i>Pterodroma cooki</i>						0.3	1.5	8	0.2			0.7	4	10	1.7	0.3						
<i>Oceanites oceanicus</i>	5	0.5	1.6	0.3	3	2.2	1.4	1	3	8	1.2	1.7					1.3	24	2.5	9	5	5
<i>Pelecanoides magellani</i>	2.5	3	0.8	1																		
<i>Pelecanoides garnotii</i>					18	1												5.3	1	1.5	6	7
<i>Pelecanus thagus</i>	2.5	0.5		2.7	12	4.3				13	20						2	36	9	15.5		29
<i>Phalacrocorax atriceps</i>	5				1.5																	
<i>Phalacrocorax albiventris</i>																						
<i>Catharacta skua</i>	0.5	0.5		0.3	1		0.2				1.7								0.3		0.5	1
<i>Larus dominicanus</i>	4	4.5	16	4.7	15	1.8				11	4.6							2.3	24	11	3	20
<i>Larus modestus</i>																		0.3	14	1.5		0.5
<i>Sterna hirsutiacea</i>	2.5			9.2		12											1	0.5				4

adults are not. In birds closely following the ship, as well as in the three specimens collected, we noted that the bill color of white-winged birds that lacked brown smudges on the tail (presumably Royals) seemed to differ from that of undoubted Wanderers of all ages. In Wandering Albatrosses the bill was deep pink and contrasted with the cream-colored nail, whereas in presumed Royal Albatrosses the bill was paler and contrasted less strongly with the whitish nail.

As Johnson (1965: 65) noted, Wanderers "may be seen anywhere in Chilean waters, but especially from 40° S southwards." They were uncommon to rare north of Isla Mocha (38° S), whereas south of that island a few birds were almost always in our wake. Off the Golfo de Penas 25 were present on 27 May. Nearly all sightings were made from 5 to 50 miles off the coast, but two immatures were found well inside the Golfo de Penas after a storm.

Only six Wanderers were seen north of Valparaiso, none within 200 miles of the continent; an immature was present at Mas Atierra. On our return from San Ambrosio, we encountered no Wanderers within 360 miles of the continent. Two females collected near the Taitao Peninsula are referable to *D. e. exulans*. One had been feeding on squid (family Gonatidae) approximately 100–150 mm in length (J. H. Wormuth) and on garbage; the stomach of the other was empty.

ROYAL ALBATROSS (*Diomedea epomophora*).—Royal Albatrosses were encountered sparingly between the Golfo de Trinidad and Isla Chañaral, almost all within 10 miles (usually much less) of the coast. They were common only at the mouth of the Golfo de Trinidad on 22 May, where 8 of 12 large albatrosses were identified as Royals (1 specimen), and a few miles offshore north of Chiloé Island, where 6 Royal and 1 Wandering Albatrosses were noted on 9 June. North of 42° S, as the numbers of Wanderers decreased, Royals began to predominate in waters close inshore, although they were no commoner there than farther south. Along the coast between Isla Chañaral and Talcahuano one to three were seen each day. A specimen of *D. e. epomophora* collected at the Golfo de Trinidad had fed on squid 50–150 mm in length (Wormuth, pers. comm.).

BLACK-BROWED ALBATROSS (*Diomedea melanophris*).—This is by far the commonest albatross in Chilean waters, occurring in sheltered canals as well as far offshore. We found it common or abundant within 40 miles of the continent between 47° S and 40° S, and at the Golfo de Trinidad (50° S). Farther north it was less common, though still numerous as far as Isla Chañaral. Immatures predominated sharply northward and westward from Valparaiso. At least half of the 40 birds seen at Mas Atierra were immature, and the only two at San Ambrosio were young.

Black-brows occurred in greatest abundance at the Golfo de Penas, where hundreds were feeding on a huge emergence of pelagic crabs, and at 41° S, where a swarm of 600 to 800 feeding birds extended from the surfline seaward for about 3 miles. Near Valparaiso a flock of 150 settled on the water near our ship.

WHITE-CAPPED ALBATROSS (*Diomedea cauta*).—Common in coastal waters from the Golfo de Arauco to Isla Chañaral, occasionally outnumbering Black-brows close inshore; not seen south of 40° S, except for four at Chiloé Island on 2 June. Virtually all observations were made within 5–10 miles of the coast and in large bays. Offshore records included one 260 miles west of Valparaiso and another 140 miles off Isla Chañaral. Sixty were present in a flock of over 200 albatrosses 15 miles west of Valparaiso on 18 June. This species did not follow the ship (cf. Bierman and Voous, 1950). A specimen and all birds observed closely are referable to *D. c. salvini*.

GRAY-HEADED ALBATROSS (*Diomedea chrysostoma*).—Johnson (1965: 69) considered the ranges of this species and the Black-browed Albatross to be “virtually identical,” but the Gray-head prefers colder, southern waters (Bierman and Voous, 1950; Szijj, 1967; Watson et al., 1971). We observed about 25 at the mouth of the Golfo de Trinidad, where they outnumbered Black-brows by about 3:2. But northward they became progressively rarer: at the mouth of the Golfo de Penas the ratio was 1:4, and at 41° S, where we encountered vast numbers of Black-brows, it was no greater than 1:90. These were our northernmost sightings, except for a straggler at 30° 35' S on 2 July and two near Valparaíso (33° S) on 4 July. Several Gray-heads were seen well inside the Golfo de Penas and others occurred up to 40 miles offshore, but nearly all of our observations were made between 2 and 15 miles from land. This species did not follow our ship.

LIGHT-MANTLED SOOTY ALBATROSS (*Phoebastria palpebrata*).—Several 10–15 miles off the Golfo de Trinidad on 22 May and off the Golfo de Penas on 27 May. This species is largely restricted to antarctic waters (Bierman and Voous, 1950).

GIANT PETRELS (*Macronectes giganteus/halli*).—We did not distinguish between these highly similar species in the field (see Bourne and Warham, 1966). All birds collected (Isla Grande, 15 May; Newton Island (2), 20 May; Golfo de Penas, 25 May) or photographed at various places along the coast are referable to *M. giganteus*. Giant Petrels are tolerant of a wide range of surface temperatures, but are commonest in waters colder than 11° C. They were common to abundant in the Straits of Magellan and in coastal waters to 41° S, but much less common northward; between Isla Chañaral and Valparaíso only 1–3 birds were recorded each day. More than 30 miles offshore they were uncommon, but a few occurred near Mas Atierra and two were present at San Ambrosio.

White-phased birds were most abundant in the colder waters of the Straits of Magellan. Near Bahía Inútil the ratio of dark (including black juveniles and gray-phased adults) to white birds was approximately 5:1, at the mouth of the Straits 30:1, and at the Golfo de Penas 50:1. Except for a single individual inside the Golfo de Penas during a severe storm, white birds were absent from the channels, and our northernmost sighting was of a bird near Valparaíso.

A high percentage of birds seen north of 40° S and in the offshore waters, as well as all birds seen in the vicinity of the offshore islands, were immature. Brown et al. (MS) reported that all the birds they encountered were dark-phased and that most were immatures. They found the species relatively scarce in the Straits of Magellan in January but apparently more common in March. Watson and Angle (MS) encountered very few *Macronectes* offshore in April 1965. It thus appears that summer and early fall populations off southern Chile consist largely of immatures and that an influx of wintering adults begins by mid-May.

SOUTHERN FULMAR (*Fulmarus glacialisoides*).—Common to abundant in the Straits of Magellan, in the wider inland passages, and along the coast to 40° S, at which point they abruptly disappeared. Only a few isolated birds were seen later, the northernmost at Valparaíso. They were commonest in the Golfo de Trinidad and especially in the Golfo de Penas, where thousands fed on the swarms of pelagic crabs that darkened the water. Brown et al. (MS) found Southern Fulmars rare or absent in the Straits of Magellan and in the fiordlands in March. Their abundance there in late May presumably indicates a strong northward movement in winter. Two females collected in Bahía Inútil (weights 697, 707 g) had fed heavily on anomuran crustaceans (family Galatheidæ, probably *Pleuroncodes monodon*; A. Ross, pers. comm.).

CAPE PIGEON (*Daption capense*).—As with most other seabirds this species was commonest within 15 miles of shore (cf. Szijj, 1967). They were found near the coast to 29° S, and at sea to Mas Atierra (50 birds) and San Félix (1). Primarily birds of the open sea, they sometimes enter large bays but avoid narrow inland waterways. Our only observations in the Straits of Magellan were of a few in broad stretches near Punta Arenas.

Cape Pigeons were commonest in the colder waters south of Isla Chiloé but northward they were much less common, though scattered large flocks were noted in a few places; and from Valparaiso to Isla Chañaral they were generally scarce. There were hundreds off the Taitao Peninsula and in the mouth of the Golfo de Trinidad, but few among the thousands of Southern Fulmars in the Golfo de Penas.

Brown et al. (MS) did not report Cape Pigeons in March 1970. Most of their observations were made in sheltered waters, where this species is rare, but they also made observations as far offshore as Mas Atierra. Presumably the difference between our findings reflects a strong northward movement of Cape Pigeons in the austral autumn. Two males weighed 344 and 362 g.

KERMADEC PETREL (*Pterodroma neglecta*).—Johnson (1965: 93) considered this species "the most abundant petrel on or around the two landward Juan Fernandez islands." We saw only two at Mas Atierra and one at San Ambrosio, where they also nest, and one 130 miles southeast of San Ambrosio; all were dark-phased.

WHITE-NECKED OR JUAN FERNANDEZ Petrel (*Pterodroma externa*).—Abundant at Mas Atierra in early April 1970 (Brown et al., MS) and common at sea between 10°–44° S in April 1965 (Watson and Angle, MS). In Mid-June we saw only four at Mas Atierra. Johnson (1965: 94) considered it "a fairly abundant bird around the Juan Fernandez islands at any time of the year," but neither Johnson or Murphy (1936) specifically indicate its occurrence there in winter, when at least part of the population moves to the northern hemisphere (King, 1970). Torres N. (1970) reported high mortality on Mas Afuera from predation by feral cats.

COOK'S PETREL (*Pterodroma cooki*).—Cook's Petrels were fairly common more than 200 miles offshore where the surface-water temperatures exceeded 15° C. We saw scattered individuals at Mas Atierra but we obtained no evidence of birds coming to the island at night. This petrel was not particularly common at sea near San Ambrosio Island, but the cliffs of that island teemed with ten thousand or more chasing, calling birds that appeared to be courting and establishing territories. On 27 June we found scrapes in virtually every potential nest site—small caves, under boulders or small plants, or even in the open—from 50 feet above the sea to the island-top (1,500 feet). Single birds were present at most sites (Figure 2), but pairs were present at about 10 percent; there were no fresh eggs. Many scrapes contained mummified young or addled eggs of past years. Quite different conditions were noted at San Félix Island, only 10 miles distant. The waters near this island were almost birdless and on the island itself only a dozen or so petrels were engaged in courtship or territorial displays. We found two single birds in burrows beneath piles of volcanic cinders and heard several more calling.

The breeding seasons of this and other subtropical seabirds require additional documentation. Murphy (1936) noted that Cook's Petrels had been found nesting at San Ambrosio in July, but Millie (*in* Johnson, 1965) found only 150–200 pairs there, most with young birds, in October. Four males we collected in late June had testes 10 to 13 mm in length; the largest ova of two females measured 2 mm.



Figure 2. *Pterodroma cooki* at nest site, San Ambrosio Island, Chile, 27 June 1970.

These data suggest that the breeding season commences in early July in some years. On San Félix young have been reported as late as February (Murphy, 1936). Bajamonde N. (1966) reported that cats introduced on San Félix by transient fishermen prior to 1960 had caused extensive mortality, particularly among Sooty Terns (*Sterna fuscata*). We saw no cats but found the remains of many dead petrels. How these predators survive on this small waterless rock is unknown.

Nesting at Mas Atierra apparently commences in August or September, 4–8 weeks later than at San Ambrosio (Murphy, 1936; Johnson, 1965). This is supported by our failure to find more than a few birds near Mas Atierra (Brown et al. saw none in early April) and by gonad conditions of two specimens; the testis length of a male collected in mid-June was 6 mm, or half that of the San Ambrosio males we measured; the largest ovum of one female measured 2 mm.

We collected 9 specimens, 3 at Mas Atierra, 6 at San Félix and San Ambrosio; all are referable to *P. c. defilippiana*, as defined by Murphy (1936: 718). Weights, 3 ♀: 152, 169, 190 g; 5 ♂: 162, 182, 185, 190, 195 g; 1 unsexed: 220 g.

BLUE PETREL (*Halobaena caerulea*).—Johnson (1965: 100) stated that “small flocks of Blue Petrels may be observed as far north as Valparaiso in winter,” presumably on the basis of Paessler’s (1913) reports off Valparaiso and Isla Mocha in July 1910, and off Valparaiso and Isla Chiloé in August and May, respectively, 1911. Paessler gave no quantitative data or basis for identification and I find his reports unconvincing. Szijj (1967) also mentioned seeing Blue Petrels “almost

daily" across the South Pacific and included Chilean observations from as far north as Valparaiso.

I identified this species only at the mouth of the Golfo de Trinidad (50° S) on 22 May where 15 to 25 were scattered among the whale-birds. Watson and Angle (MS) reported three farther offshore between 52° S and 60° S in April 1965. The species may be commoner in cold water regions than is currently acknowledged.

WHALE-BIRDS or PRIONS (*Pachyptila* spp.).—Although Johnson (1965) considered *P. belcheri* and *P. desolata* "irregular visitors" to Chilean waters and Beck failed to record either species anywhere on the west coast of South America (Murphy, 1936), both almost certainly winter regularly along the entire coast of Chile. Szijj (1967) reported whale-birds in moderate numbers fairly near the continent in September; Post and Brown found several *belcheri* "wrecked" at Antofagasta, Chile, on 7 July 1968 (specimens in American Museum of Natural History); and Hughes (1970) recorded *desolata* and *belcheri* in southern Peru, "occasionally in some numbers," in July and August.

Brown et al. (MS) did not definitely record whale-birds in January–April 1970, but Watson and Angle (MS) encountered them in April 1965 between 60° S and 47° S. In May–July 1970, whale-birds were rare between 50° S and 41° S, occurring in fair numbers only near the Golfo de Trinidad; northward they were common and occasionally abundant within 10 miles of shore. Evidently whale-birds arrive in Chilean waters in early autumn and become widespread in the Humboldt Current region by mid-winter.

Seven hundred whale-birds (one *belcheri* collected) were present at the Golfo de Arauco, and maximum numbers were observed at Bahía Quebrada Honda (29° S), where for 5 miles the ship passed through thousands of feeding birds; both species could be identified among birds sitting quietly on the water but it was impossible to determine their relative abundance. At sea we saw scattered individuals, and occasionally small flocks, up to 250 miles offshore while en route to Mas Atierra; our last sighting en route to San Ambrosio was made 90 miles west of the continent, except for a single bird 420 miles west of Coquimbo. Only one bird was found in waters warmer than 15° C.

The distribution of whale-bird species can only be resolved through intensive collecting. Single specimens of *P. belcheri* were taken at Isla Guafo on 30 May and at Golfo de Arauco on 12 June; on 17 June we collected two *desolata* from a flock of 40 whale-birds (sp. ?) and found another dead 180 miles west of Valparaiso; on 18 June we shot two *desolata* and two *belcheri* from a single flock 25 miles off Valparaiso. The *belcheri* taken at Isla Guafo had fed on hyperiidean amphipods, the *desolata* taken off Valparaiso on small euphausids (A. Ross, pers. comm.). Weights, *P. belcheri* 3 ♀: 99, 104, 122 g. *P. desolata* 3 ♀: 88 (found dead), 100, 130 g; 2 ♂: 148, 155 g.

SHOEMAKER OR WHITE-CHINNED PETREL (*Procellaria aequinoctalis*).—Shoemakers were seen regularly from 5 to 200 miles offshore between Golfo de Trinidad and Valparaiso, but were less common northward. Unlike many species they did not show a sharp increase in abundance nearer the coast, although they were commonest within 40 miles of shore. They seemed to avoid waters close inshore, where Sooty Shearwaters were common. One was seen at Mas Atierra and a small group associated with pilot whales (*Globicephala* sp.) 400 miles west of Coquimbo. Only one was seen in sheltered waters, in the Straits of Magellan near Bahía Inútil. Most observations were of single birds, and flocks of 10 or more were rare. The inter-individual distance of birds sitting on the water is greater than in

Sooty Shearwaters; as a result resting flocks take on a characteristic appearance and can be identified at some distance.

SOOTY SHEARWATER (*Puffinus griseus*).—Except for a few birds near Punta Arenas, Sooty Shearwaters were absent from inland waters. They were generally uncommon between the Golfo de Trinidad and Chiloe Island and between Valparaiso and Isla Chafaral, but in the intervening area feeding flocks of several hundred to several thousand (Golfo de Arauco, Valparaiso harbor) were regular. Nothing indicated that these birds were migrating. Most of our sightings were made within 5 miles of the coast, and often in the mouths of large bays and near jutting coastal headlands. The only large flock away from the coast was 90 birds 180 miles off Coquimbo. Five males were collected at the Golfo de Arauco. Testis lengths ranged 5–7 mm. Weights, 5 ♂: 498, 678, 710, 746, 769 g.

LITTLE SHEARWATER (*Puffinus assimilis*).—On 1 June we saw 25 to 30 Little Shearwaters and collected three males 2 miles off Chiloé Island, between 40° 32' S and 42° 25' S. The birds were feeding in groups of twos or threes in waters where large, white, amorphous objects (medusae?) were floating. Their stomachs contained remains of juvenile or small (25–40 mm) stomiatoid fishes (family Stomiatoidea); these fishes are pelagic and largely bathypelagic (Wisner, Hubbs, pers. comm.). Virtually no other seabirds were in that area. On 9 June we saw at least 13 individuals 4 miles offshore at 41° 20' S, and later that day a single bird at 40° 52' S. These were our only observations of a species that has not been reported previously from the west coast of South America (Meyer de Schauensee, 1966).

On the basis of a specimen taken at 48° 27' S, 93° W, Bourne (1959) surmised the existence of an undiscovered breeding population in the southeast Pacific, possibly in the Juan Fernandez Islands. *Puffinus assimilis* is a winter breeder. The enlarged testes of our specimens (7 to 9 mm in length) suggest that the birds were not far from a nesting colony. Islands such as Chiloé or Guafo would seem likely sites.

Relationships and nomenclature in *Puffinus assimilis* are extremely complicated (cf. Murphy, 1927; Fleming and Serventy, 1948; Bourne, 1959), and no two authors concur on the validity of certain races. I compared the Chiloé specimens with the extensive material at the American Museum of Natural History. Chiloé birds are large and heavy-billed and are most similar to birds from near the Antipodes Islands (49° S, 179° W) that Murphy (1927) designated as *P. a. munda*, and to birds from the Chatham Islands of New Zealand that Bourne (1959) referred to *P. a. kempi*. Fleming and Serventy (1948) lumped both these populations, and others, under *P. a. munda*, a name the International Commission on Zoological

TABLE 3
DIMENSIONS OF *PUFFINUS ASSIMILIS* IN MM

Locality	No.	Culmen	Wing	Tarsus	Tail
Chiloé Is., Chile	3	25.5–26.2 (25.7)	193–197 (195.7)	40.2–41.5 (40.8)	72–74 (73)
Near Antipodes Is., N.Z. ¹	6	24 –27.5 (25.8)	182–200 (190.5)	39 –41.5 (40.3)	64–69 (66.8)
Chatham Is., N.Z.	3	23.7–26.4 (24.9)	178–183 (179.6)	41.0–41.8 (41.3)	68–69 (68.3)
Rapa Is. ²	1	25	196	40	81

¹ Data from Murphy, 1927.

² Data from Bourne, 1959.

Nomenclature has since declared a *nomen rejectum*. To avoid further confusion I refer to the various samples by their area of origin.

Chiloé, Antipodes Islands, and Chatham Islands birds differ from other populations of *P. assimilis* in having a strong bluish-gray cast to the dorsum. In all three populations the tips of the back feathers and wing coverts are edged with white, this character being developed most strongly in Chatham Islands birds. Axillars in all three populations are tipped with gray but seem to be darkest in Chiloé birds. Chiloé birds are longer-winged and longer-tailed (Table 3), but show no important differences in culmen or tarsus dimensions. They are much shorter-tailed than the bird from Rapa Island (28° S, 144° W) that Bourne (1959) described as *P. a. myrtae*.

Several bill characters seem to characterize the Chiloé birds. The culmen is slightly curved, apparently a result of a slightly inflated culminicorn; it is nearly straight in the other two populations. The plates on the mandibular rami are short and broad, comprise about 71 percent of the total length of the bill, and fuse only at the anterior end; in Antipodes Islands and Chatham Islands birds the plates are slender, comprise 75 percent of the total bill length, and are fused for approximately one-third of their length. The nostrils of the Chiloé birds open dorsally, whereas those of the other two populations tend to open more anteriorly. These differences are marked, but comments on their possible taxonomic significance are best postponed until larger samples comprising birds of all ages are obtained and until the breeding areas of all populations are determined. A thorough review of geographic variation in this species is needed.

PINK-FOOTED SHEARWATER (*Puffinus carneipes creatopus*).—Apparently the majority of Pink-footed Shearwaters depart for the northern hemisphere by early April. Brown et al. (MS) saw a few near the coast and at the Juan Fernandez Islands in March and early April. Our only sightings were of two at Mas Atierra on 15–16 June. We saw no Pale-footed Shearwaters (*P. c. carneipes*), although Szijj (1967) reported a few well offshore in early September. His are the only Chilean reports of this species with the exception of a specimen taken in 1914. Presumably his records pertain to migrants returning to New Zealand, as dark-phased birds have not yet been found breeding in South America. Additional observations are needed to confirm whether this race occurs regularly in September and October. As dark shearwaters are notoriously difficult to identify, the possibility of confusion with other species is high. Records of Pale-footed Shearwaters not backed by specimen evidence should be considered hypothetical.

WILSON'S STORM PETREL (*Oceanites oceanicus*).—Widely distributed along the coast and up to 400 miles offshore from 50° S to 29° S. Generally uncommon to rare, but common in a few localities (Valparaiso, Golfo de Penas, Golfo de Arauco, Coquimbo) near shore; several flew aboard at night at the Golfo de Penas. The largest flocks, up to 80 per hour, were seen 20 miles northwest of the Golfo de Arauco. Although we noted a few scattered individuals up to 200 miles off the coast, where the surface water temperatures reached 17.1° C, nearly all our sightings were in the cooler (11.5–13.5° C) waters of the Humboldt Current. Szijj (1967) suggested that "the bulk of the population departs from waters below 12° C in the winter."

Four birds that came aboard ship were referable to *O. o. oceanicus* on the basis of wing length. Their weights ranged from 27 to 29.5 (mean 27.9) g; their gonads were small.

WHITE-BELLIED STORM PETREL (*Fregetta grallaria*).—These petrels are alleged

to be common at the Juan Fernandez Islands as well as at San Félix and San Ambrosio "at any time of year" (Johnson, 1965: 109), but their occurrence at those islands is probably seasonal. Brown et al. (MS) reported only three or four near Mas Atierra in April, and we saw only one bird there in June. During the day in the channel between San Félix and San Ambrosio no more than five birds were observed. At San Félix an hour after dark many circled in the lights of our ship, and two we captured showed no evidence of reproductive activity. Other sightings included 10 birds within 15 miles of San Ambrosio in late afternoon, and several 110–130 miles southeast of San Ambrosio on 25 and 28 June.

PERUVIAN DIVING PETREL (*Pelecanoides garnotii*).—The southern boundary of this species' range is near Isla Mocha (38° S; Johnson, 1965). The identity of three diving petrels seen at that island is uncertain, but at the Golfo de Arauco (37° S) hundreds of *P. garnotii* were encountered (one collected) and all sightings to the north were referred to that species. Peruvian Diving Petrels were widely scattered along the coast, but were abundant only at the Golfo de Arauco and near Isla Chañaral, where flocks of up to 200 were feeding in the bays. Virtually all were within a mile of the beach, but we found one bird 18 miles offshore. Weight, 1 ♀: 225 g.

MAGELLANIC DIVING PETREL (*Pelecanoides magellani*).—Fairly common in Bahía Inutil, at the mouth of the Straits of Magellan, and in fiords and in large bays between Estrecho Nelson and Canal Trinidad. Absent from the western part of the straits, and uncommon to rare between 50° S and 40° S, except at the mouth of Golfo Coronados. Weights, 2 ♀: 145, 174 g; 2 ♂: 158, 163 g.

RED-BILLED TROPIC-BIRD (*Phaethon aethereus*).—We encountered this warm-water species twice between the mainland and San Ambrosio Island. On 24 June, at 30° 00' S, 75° 30' W, I saw two pass directly over the ship; 10 minutes later one bird (possibly a third individual) circled it for a few moments. On 29 June Bowen and Hunsacker saw a single tropic-bird (sp.) at 27° 50' S, 74° 02' W. Watson and Angle observed *P. rubricauda* 200 miles north of this area in April 1965. Johnson (1965: 117) lists four Chilean records of *P. aethereus*, but some of these are questionable (Watson and Angle, MS).

PERUVIAN PELICAN (*Pelecanus thagus*).—Common at the Golfo de Arauco and increasingly abundant northward, but almost always within 15 miles of the continent. A single bird halfway down the coast of Chiloé Island, our southernmost sighting, was at the limit of the species' range (Johnson, 1965).

PERUVIAN BOOBY (*Sula variegata*).—Fairly common in large bays between the Golfo de Arauco and Valparaíso; uncommon, though widely distributed, northward to 29° S. All were seen within a mile of the beach.

MASKED BOOBY (*Sula dactylatra*).—Rare and widely scattered 20–130 miles southeast of San Ambrosio Island. Nearer the island small groups began to appear, and on San Ambrosio hundreds—perhaps several thousand—were roosting. We saw no indication of nesting, but we were unable to climb to the roosting areas. At San Félix 400 pairs were nesting on the flat, ash-covered, northeast side of the island. On 26 June most nest sites were being guarded by a single bird, pairs being present at about 20 percent of the sites. Nests were spaced at intervals of 100–300 feet. Only 15 percent of the nests contained eggs, one- and two-egg clutches being equally common. One nest held a single chick that was less than a week old.

At the Galapagos, the nearest other breeding station, the Masked Booby has "a fairly well-defined annual breeding cycle running from September to June or July" (Nelson, 1967:198). The breeding season on San Félix may be more protracted, for at

least one pair must have begun nesting in May; other nesting reports have been obtained between August and November (Johnson, 1965).

GUANAY (*Phalacrocorax bougainvillii*).—Fairly common to abundant from Golfo de Arauco to Isla Chañaral. Forages up to several miles offshore.

OLIVACEOUS CORMORANT (*Phalacrocorax olivaceus*).—This species occurs nearly everywhere in Chile and is a resident in the extreme south (Johnson, 1965: 128). Humphrey et al. (1970: 90) considered it "probably a year-round resident of [Isla Grande] but nothing is known of local or seasonal movements." We saw very few at Punta Arenas, in the Straits of Magellan, or in the canals north to 48° S. Near the Golfo de Penas they became fairly common and were equally abundant with *P. atriceps* and *P. magellanicus* in the sheltered waters at Isla Guafo. The apparent increased abundance there suggests a northward movement of a southern population in winter.

RED-FOOTED CORMORANT (*Phalacrocorax gaimardi*).—Johnson (1965: 131) indicated that this distinctive cormorant is fairly common "along the entire coasts of Chile including the Magellanic region," but as Brown et al. (MS) found it only as far south as 46° S in March 1970 and our southernmost record was at northern Chiloé Island (42° S) on 2 June, there appears to be a pronounced northward shift in winter. North of Chiloé it was fairly common along the headlands and in the larger bays. This species is far less pelagic than the Guanay, with which it often associates, and rarely ventures seaward more than a mile.

BLUE-EYED CORMORANT (*Phalacrocorax atriceps*).—The similarity between this species and *P. albiventer* has resulted in confusion regarding its status in the Fuegian region. Humphrey et al. (1970) concluded that *P. albiventer* is the dominant species on Isla Grande and were skeptical of most reports of *P. atriceps*. I found *P. atriceps* very uncommon near Punta Arenas on 12–14 May, although at least 10 were present among the thousands of *P. albiventer* that roosted there. Two were seen in mid-straits between Punta Arenas and Bahía Inútil on 15 May.

In the western part of the straits we failed to observe *atriceps* anywhere, even though Johnson (1965) considered it the dominant cormorant in areas of heavy rainfall westward of 70° W. Our next records were made near Isla Lobos (50° 36' S) in the inland passages, where it was the only species seen. From there northward to Golfo de Penas, where it reached maximum abundance, to Puerto Montt it was by far the most abundant cormorant in the canals and the only cormorant in coastal waters. At Isla Guafo it occurred in equal numbers with *P. magellanicus* and *P. olivaceus*. A few were present at the Golfo de Arauco, which is slightly beyond the northern limit of the range recorded by Johnson (1965).

A bird collected at the Golfo de Penas contained otoliths of at least seven species of bottom-dwelling fishes, probably nototheniids (Fitch, pers. comm.), and one anomuran crustacean; it also contained many ostracodes, minute gastropods, chiton valves, and several isopods, which presumably had been ingested by the fish.

ROCK CORMORANT (*Phalacrocorax magellanicus*).—Uncommon in inland waters and well-sheltered coastal bays from Punta Arenas to Isla Chiloé. Johnson (1965: 133) stated that "from its northern limit in Chilean waters to about Lat. 50° S this species and the Blue-eyed Shag are present in about equal numbers with the Red-footed Cormorant a poor third." At all localities in the inland passages *atriceps* was seen far more commonly than *magellanicus*, but as our observations were made from a moving ship, they may not reflect the true abundance of this inshore species. At Isla Guafo *magellanicus* and *atriceps* occurred in equal numbers. Nowhere did we find *magellanicus* and *gaimardi* sympatric.

KING CORMORANT (*Phalacrocorax albiventer*).—Abundant at Punta Arenas where several thousand roosted, and common westward to the mouth of the straits; much less common in the inland passages and virtually absent north of 51° S. Our only sightings north of Golfo de Trinidad were two birds at English Narrows and one in a small bay at the Golfo de Penas.

KELP GOOSE (*Chloephaga hybrida*).—Abundant along rock shores as far north as Golfo de Penas; extremely common on Isla Guafo. Almost all observations were of mated pairs.

FLIGHTLESS STEAMER DUCK (*Tachyeres pteneres*).—Abundant in straits, canals, and fiords from Punta Arenas to Golfo de Penas; a pair on Isla Guafo. Stomachs of two specimens were crammed with gastropods, sea urchins, starfish, and a few barnacles.

FLYING STEAMER DUCK (*Tachyeres patachonicus*).—Encountered only at the south side of the Golfo de Penas, where the female of a pair was taken.

FUEGIAN OYSTERCATCHER (*Haematopus leucopodus*), BLACK OYSTERCATCHER (*H. ater*).—In a small cove at Isla Guafo we observed approximately 50 oystercatchers, *leucopodus* being four to five times as common as *ater*. Nearly all birds of each species were paired; intraspecific territorial displays were seen in *leucopodus*. *H. ater* appeared to be commoner than *leucopodus* in the inland passages but our records are too few to be meaningful.

SHEATHBILL (*Chionis alba*).—Three Sheathbills scavenged at the large cormorant roost in Punta Arenas on 13–14 May. A single bird in the harbor at Puerto Montt on 3 June was far north of this species' normal range.

SKUA (*Catharacta skua*).—Brown et al. (MS) found Skuas fairly common in the Straits of Magellan and inland waters in March, but our only observation in that area was of a single bird near Punta Arenas on 15 May. Skuas were rare but regular in large bays and within 5 miles of the coast from Golfo de Penas to Coquimbo. Only in the Golfo de Arauco were they common; 8 to 10 birds were present on 11–12 June. Offshore sightings included: one 90 miles west of Concepcion 14 June, one at Mas Atierra 16 June, five (including a flock of three) 200 miles west of Coquimbo 24 June. All observations refer to *C. s. chilensis*.

PARASITIC JAEGER (*Stercorarius parasiticus*).—Three or four Parasitic Jaegers in immature or subadult plumage harried terns in the Golfo de Arauco on 11–12 June.

DOLPHIN GULL (*Leucophaeus scoresbii*).—We saw Dolphin Gulls in only a few places, and always in the vicinity of large mammals. A few occurred near a herd of southern fur seals in Canal Concepcion; several were seen in Golfo de Penas where sei whales were present, 7 were seen at Isla Guafo near several blue whales, and 50 attended a herd of southern sea lions at Isla Chiloé. The affinity between this gull and large mammals reflects its coprophagous feeding habits. At Islote Metalqui the birds fought over fresh fecal material, even to pecking at the anal region of defecating seals (see also Humphrey et al., 1970: 221). They were also common at the sewer outlets of Punta Arenas, probably attracted by the availability of human wastes.

GRAY GULL (*Larus modestus*).—A single immature was seen at the north end of Chiloé Island. The species was not seen again until Valparaiso, where it was fairly common. Along the desert coast it was plentiful within a mile or so of land.

BAND-TAILED GULL (*Larus belcheri*).—An immature followed our ship for 15 minutes at Isla Mocha on 10 June. We were unable to collect it because of heavy seas. Johnson (1967: 32) gives Coquimbo, some 500 miles to the north, as the southern edge of the range, but this species has been noted as far south as Corral

(Olrog, 1967) and even Tierra del Fuego (Olrog, 1972), though the latter record may refer to the Atlantic population.

KELP GULL (*Larus dominicanus*).—Abundant in the straits of Magellan and everywhere along the coast; less common and occasionally absent from parts of the inland passages. Two birds had large white carpal patches similar to those described for *Larus occidentalis* (Hubbs, 1954), and a gray-mantled adult was collected in the Straits of Magellan (specimen in USNM).

BROWN-HOODED GULL (*Larus maculipennis*).—Fairly common in large harbors from Punta Arenas to Valparaiso; rare or absent away from large centers of human habitation.

SWALLOW-TAILED GULL (*Creagrus furcatus*).—On 13 June Cummings shot an immature male at 36° 12' S, 74° 46' W, 92 miles west of the Chilean coast; the surface water temperature was 14.0°C. On 25 June I shot a single bird and one from a group of three. These specimens, adult females, were taken 110 and 160 miles, respectively, southeast of San Ambrosio in surface waters of 18.5°C and 18.0°C. All three birds had little subcutaneous fat and their stomachs were empty. The only other Chilean records are by Watson and Angle (MS). The species may be a regular visitor in warm waters far offshore. Weights, 2 ♀: 622, 655 g.

INCA TERN (*Larosterna inca*).—Seen only at the mouth of Río Maule on 5 July, when 10 were feeding in a mixed flock of seabirds.

SOUTH AMERICAN TERN (*Sterna hirundinacea*).—This tern is abundant in southern Chile in summer (Murphy, 1936) but most birds leave the area in the winter. Thirty terns, presumably of this species, in Bahía Inútil on 15–16 May accounted for our only observations until we reached northern Chiloé Island, where 100 were present on 7 June; an equal number occurred in the Golfo de Arauco on 11–12 June. Along the coast between Coquimbo and Talcahuano small numbers were found in only a few sheltered bays, and we did not see this species daily.

DISCUSSION

Temperature preferences.—The distribution of certain seabirds is strongly correlated with water surface temperatures. Murphy (1936) outlined bird associations characterizing the major zones of surface water along the west coast of South America, and Szijj (1967) provided important information on winter assemblages in offshore waters. In my study several groupings of species could be established on the basis of temperature distribution (Figure 3).

The subantarctic zone of surface water is characterized by winter temperatures of 3–11.5° C and summer temperatures of 5.5–14.5° C (Murphy, 1936: 72). Within this zone Watson et al. (1971: Figure 1) recognized a cold subzone and a transitional subzone, with mean surface temperatures greater than 10° C. The following species were encountered largely or entirely in coastal waters south of 40° S, where surface temperatures ranged from about 8° C to 12° C: *Spheniscus magellanicus*, *Diomedea chrysstoma*, *Phoebetria palpebrata*, *Macronectes giganteus*, *Fulmarus glacialisoides*, *Puffinus assimilis*, *Halobaena caerulea*, *Pelecanoides magellani*, *Phalacrocorax atriceps*, *P. magellanicus*, *P. olivaceus*,

SEA SURFACE TEMPERATURE °C

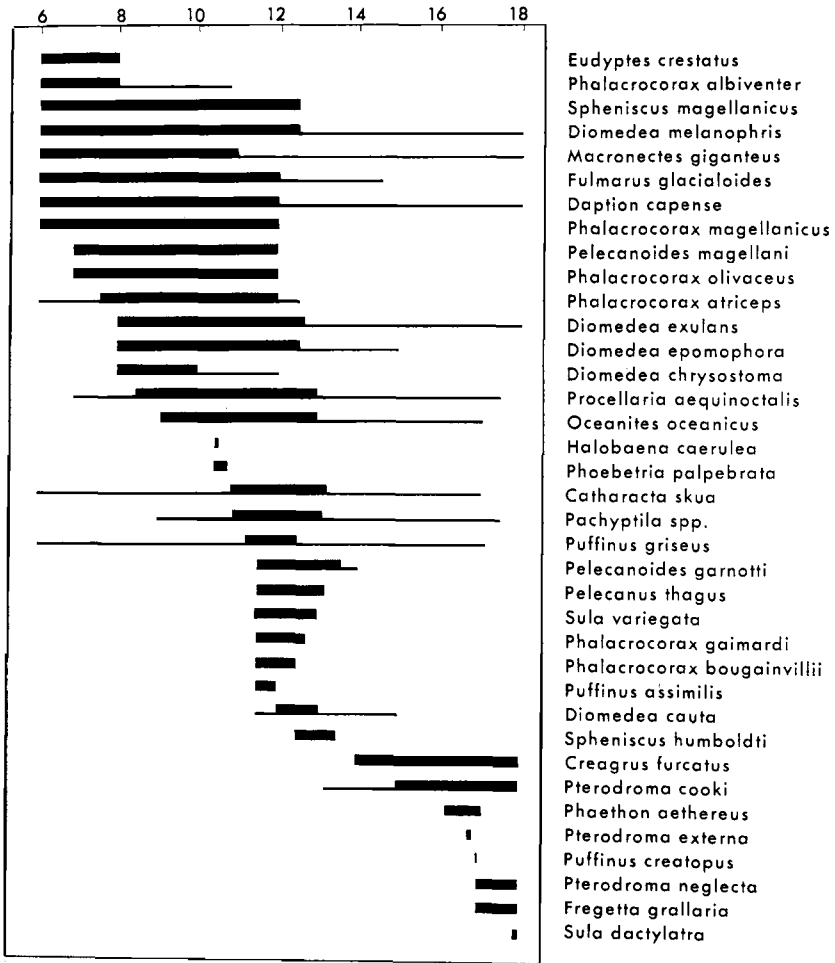


Figure 3. Temperature distribution of marine species encountered in this study. The major distribution is indicated by a solid bar, scattered records by a thin line.

and *Leucophaeus scoresbii*. The preference of *D. chrysostoma* for the cold subzone was particularly evident. We recorded colder temperatures (6-8° C) only in the straits and fiords. The occurrence there of *Eudyptes crestatus* may reflect surface temperature, but the local distribution of *Phalacrocorax albiventer* more likely indicates other environmental differences associated with sheltered areas.

The Humboldt Current first reaches the coast at about 38° S. Surface temperatures are warmer (11.5–13.5° C) and a distinct and well-known avifauna occurs: *Spheniscus humboldti*, *Diomedea cauta*, *Pelecanoides garnotti*, *Pelecanus thagus*, *Sula variegata*, *Phalacrocorax gaimardi*, *P. bougainvillii*, and *Larus modestus*.

Species occurring in the cooler portion (15–18° C) of the subtropical zone included *Puffinus carneipes creatopus*, *Pterodroma externa*, *P. neglecta*, *P. cooki*, *Fregetta grallaria*, *Phaethon aethereus*, *Sula dactylatra*, and *Creagrus furcatus*.

The temperature preferences of some widespread species were not easily delimited. The distribution of *Diomedea exulans*, *D. epomophora*, *D. melanophris*, *Daption capense*, and *Larus dominicanus* centered in the colder southern waters. *Pachyptila desolata*, *P. belcheri*, *Puffinus griseus*, and *Oceanites oceanicus* were most plentiful in the Humboldt Current. *Procellaria aequinoctalis* and *Catharacta skua* showed no obvious pattern, but appeared to be more regular in the Humboldt Current. These assignments largely agree with those proposed by Murphy (1936), except that *Pterodroma cooki* and *Fregetta grallaria*, which he considered subantarctic, were found only in subtropical waters. *Pachyptila desolata*, characteristic of antarctic waters in the breeding season (Murphy, 1936) is present in good numbers in the Humboldt Current in winter. Szijj (1967) found *Puffinus griseus* mainly in waters cooler than 6.5° C, whereas we found it commonest in the Humboldt Current, but our few observations in waters colder than 8° C were restricted to sheltered areas where this species would not be expected.

Seasonal movements.—Although the distribution of some pelagic birds in the southern hemisphere shifts northward in the southern winter (Szijj, 1967), there is little information on the timing of the movements. My data taken in conjunction with those of Brown et al. (MS) and Watson and Angle (MS) indicate that major northward movements of the following species probably occur in April and May; *Macronectes giganteus*, *Fulmarus glacialisoides*, *Daption capense*, *Pachyptila desolata*, *P. belcheri*, *Phalacrocorax gaimardi*, *Catharacta skua*, and possibly *Phalacrocorax atriceps* and *P. olivaceus*.

Seasonal northward movements were also suggested by our failure to find certain warm-water species. Sooty Terns (*Sterna fuscata*), Gray Ternlets (*Procelsterna albivitta*), and Brown Noddies (*Anous stolidus*) were absent from San Félix and San Ambrosio, though the latter has nested there as early as August (Johnson, 1967). We failed to observe three storm petrels—*Oceanodroma markhami*, *O. hornbyi*, and *Oceanites gracilis*—that range south to Valparaiso. The first two species are distinctive and not easily overlooked; careful observation did not reveal

Oceanites gracilis among the many Wilson's Petrels between Isla Chañaral and Talcahuano.

At Mas Atierra we did not identify *Pterodroma longirostris* (*Pt. leucoptera masafuerae* of earlier authors; Falla, 1942), which Brown et al. reported in April 1970, and which Watson and Angle collected nearer the mainland in April 1965. And we saw only small numbers of the other species of *Pterodroma* (*cooki*, *externa*, *neglecta*) that nest on the Juan Fernandez Islands. Presumably all these had departed for more northern wintering areas (see King, 1967, 1970). Seasonal dispersal probably also accounts for the rarity of *Fregetta grallaria*, an allegedly resident species.

The absence of the Pediunker (*Procellaria cinerea*), a highly pelagic shearwater whose range on the west coast of South America is said to parallel that of the Shoemaker (Johnson, 1965), was unexpected. Johnson gave no specific data on its occurrence in Chilean waters, but Murphy (1936) indicated that it was fairly common near Cape Horn, at least in summer, and cited records for the Golfo de Penas. Szijj (1967) reported a few well offshore from Talcahuano in September 1964. If Pediunkers nest in the austral winter as limited data hint (see Murphy, 1936: 65) our failure to find them is less surprising, although a few nonbreeders would have been expected. I suspect that this species is much less common off Chile than the literature implies, and that some records result from confusion with *Puffinus carneipes creatopus*.

ACKNOWLEDGMENTS

This study was partially supported by a National Science Foundation Grant (NSF AO-19306) to Raymond M. Gilmore. The field assistance of R. M. Gilmore, S. L. Bowen, W. C. Cummings, P. Thompson, A. Aguayo L., D. Torres N., and the crew of the R/V 'Hero' is gratefully acknowledged. W. R. P. Bourne, R. G. B. Brown, P. Devillers, P. S. Humphrey, and G. E. Watson commented on an earlier draft of the paper. C. L. Hubbs, R. Wisner, J. E. Fitch, A. Ross, and J. E. Wormuth kindly assisted in the determination of stomach contents.

SUMMARY

The distribution and ecology of seabirds in the southern winter was studied in southern Chile between mid-May and early July 1970. Areas surveyed included coastal and offshore waters from the Straits of Magellan (55° S) to Isla Chañaral (29° S) and the offshore islands of Mas Atierra, San Félix, and San Ambrosio. New information was obtained on northward movements of several species, including *Pachyptila belcheri*, *P. desolata*, *Fulmarus glacialisoides*, *Macronectes giganteus*, *Catharacta skua*, *Daption capense*, and several species of cormorants. Warm-water species that occur regularly in Chilean waters were virtually un-

recorded. Nesting data were obtained for *Pterodroma cooki* and *Sula dactylatra*. *Creagrurus furcatus* was encountered on three occasions and may wander regularly to Chilean waters. *Puffinus assimilis*, previously unrecorded on the west coast of South America, was found near Isla Chiloé; a breeding population in that area seems probable. The temperature distribution is tabulated for the major species encountered.

LITERATURE CITED

- ALEXANDER, W. B. 1927. Birds of the ocean. New York, G. P. Putnam's Sons.
- ALEXANDER, W. B., ET AL. 1965. The families and genera of the petrels and their names. *Ibis*, 107: 401-405.
- BAJAMONDE N., N. 1966. Islas Desventuradas. Seire Educativa No. 6, Museo Nacional de Historia Natural. Santiago, Chile.
- BIERMAN, W. H., AND K. H. VOOUS. 1950. Birds observed and collected during the whaling expeditions of the "Willem Barendsz" in the Antarctic, 1946-1947 and 1947-1948. Leiden, E. J. Brill.
- BOURNE, W. R. P. 1959. A new Little Shearwater from the Tubau Islands: *Puffinus assimilis myrtae* subsp. nov. *Emu*, 59: 212-214.
- BOURNE, W. R. P., AND J. WARHAM. 1966. Geographical variation in the Giant Petrels of the genus *Macronectes*. *Ardea*, 54: 45-67.
- FALLA, R. A. 1942. Review of the smaller Pacific forms of *Pterodroma* and *Cookilaria*. *Emu*, 42: 111-118.
- FALLA, R. A., R. B. SIBSON, AND E. G. TURBOTT. 1967. A field guide to the birds of New Zealand. Boston, Houghton Mifflin Co.
- FLEMING, C. A., AND D. L. SERVENTY. 1948. The races of *Puffinus assimilis* in Australia and New Zealand. *Emu*, 43: 113-125.
- GORDON, A. L. 1967. Structure of antarctic waters between 20° W and 170° W. Antarctic Map Folio Ser., Folio 6. New York, Amer. Geogr. Soc.
- HUBBS, C. L. 1954. Western Gull, with symmetrical wing patches, resembling aberrant Heermann Gulls. *Condor*, 56: 228.
- HUGHES, R. A. 1970. Notes on the birds of the Mollendo District, southwest Peru. *Ibis*, 112: 229-241.
- HUMPHREY, P. S., D. BRIDGE, P. W. REYNOLDS, AND R. T. PETERSON. 1970. Birds of Isla Grande (Tierra del Fuego). Preliminary Smithsonian Manual. Washington, D. C., Smithsonian Inst.
- JOHNSON, A. W. 1965. The birds of Chile and adjacent regions of Argentina, Bolivia and Peru, vol. 1. Buenos Aires, Platt Establicimientos Graficos S. A.
- JOHNSON, A. W. 1967. The birds of Chile and adjacent regions of Argentina, Bolivia and Peru, vol. 2. Buenos Aires, Platt Establicimientos Graficos S. A.
- KING, W. B. 1967. Seabirds of the tropical Pacific Ocean. Preliminary Smithsonian Identification Manual. Washington, D. C., Smithsonian Inst.
- KING, W. B. 1970. The trade wind zone oceanography pilot study. Part 7: Observations of seabirds March 1964 to June 1965. U. S. Fish Wildl. Serv., Spec. Sci. Rept. Fish. No. 586.
- MEYER DE SCHAUENSEE, R. 1966. The species of birds of South America. Narberth, Pennsylvania, Livingston Publ. Co.
- MURPHY, R. C. 1927. On certain forms of *Puffinus assimilis* and its allies. *Amer. Mus. Novitates*, No. 276.

- MURPHY, R. C. 1936. Oceanic birds of South America, 2 vols. New York, Amer. Mus. Nat. Hist.
- NELSON, J. B. 1967. The breeding behavior of the White Booby *Sula dactylatra*. Ibis, 109: 194-231.
- OLROG, C. C. 1967. Breeding of the Band-tailed Gull (*Larus belcheri*) on the Atlantic coast of Argentina. Condor, 69: 42-48.
- OLROG, C. C. 1972. Review of "Birds of Isla Grande (Tierra del Fuego)." Wilson Bull., 84: 107-109.
- PAESSLER, R. 1913. Beiträge zur Verbreitung der Seevögel. J. Ornithol., 61: 41-51.
- SZIJJ, L. J. 1967. Notes on the winter distribution of birds in the Western Antarctic and adjacent Pacific waters. Auk, 84: 366-378.
- TORRES N., D. 1970. Algunos datos sobre aves observadas en la Isla Alejandro Selkirk (Mas Afuera) del Archipelago de Juan Fernandez. Bol. Ornithol., 2: 5-7.
- WATSON, G. E., J. P. ANGLE, P. C. HARPER, M. A. BRIDGE, R. P. SCHLATTER, W. L. N. TICKELL, J. C. BOYD, AND M. M. BOYD. 1971. Birds of the Antarctic and Subantarctic. Antarctic Map Folio Ser. Folio 14. New York, Amer. Geogr. Soc.

Natural History Museum, P. O. Box 1390, San Diego, California 92112. Accepted 1 March 1972.