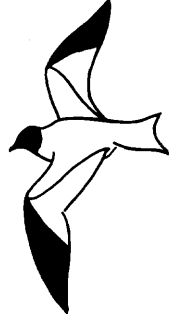


# WESTERN BIRDS



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## SEABIRDS IN THE NORTHWESTERN PACIFIC OCEAN AND SOUTH CENTRAL BERING SEA IN JUNE 1975

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Between 6 June and 8 July 1975 I was a seabird observer on a cruise from Hakodate, Hokkaido, Japan to Kodiak, Alaska, via the south central Bering Sea, aboard the Hokkaido University Faculty of Fisheries training/research vessel, *TV Osboro Maru*. This paper reports the distribution and relative abundance of species observed within the regions visited.

### AREA COVERED

The cruise track, with noon positions, count locations and local sea surface temperatures, is shown in Figures 1a and 1b. The track was north of that sailed by Hamilton (1958) and south and east of that covered by Kuroda (1955, 1960), both of whom report on seabird distributions in June cruises in the northwestern Pacific region. Our track was west of the Bristol Bay areas censused in late summer by Bartonek and Gibson (1972) and farther offshore for the most part than the areas reported on by Murie (1959) and Trapp (1975). Transect counts were tabulated by sea areas (Figure 2), which correspond with the Domains used by Sanger (1972), as adapted from Dodimead et al. (1963). The Oyashio/Kuroshio Confluence forms the southern boundary of the Transition Domain, the Northwestern Pacific and Pelagic Bering Sea areas are within the Western Subarctic Domain, the Offshore Aleutians within the Coastal Domain, and Bering Sea Continental Shelf area within the Bering Sea Coastal Domain.

### ENVIRONMENTAL CONDITIONS

Weather and observation conditions in the area were fairly typical for the season (see Kuroda 1955), although visibility was perhaps more restricted than normal (T. Fujii pers. comm.). General sea surface temperatures (Figure 2) were below long-term means in one area east of Japan

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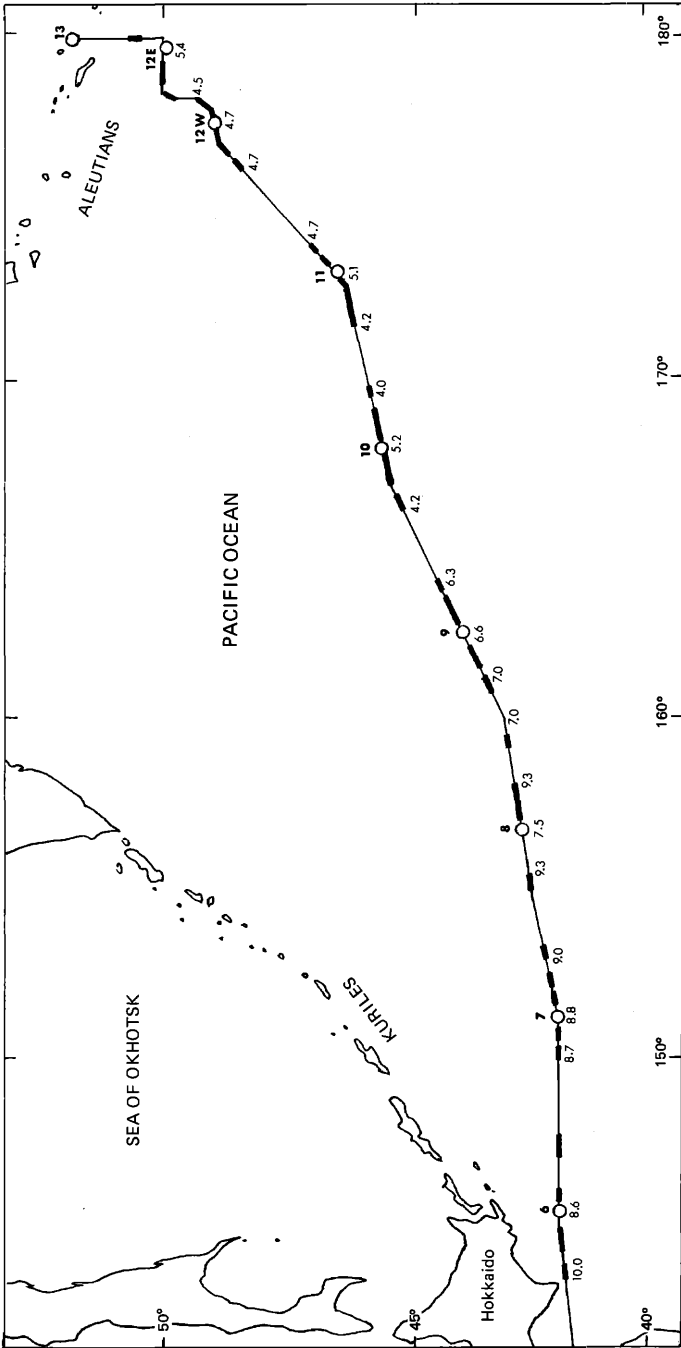


Figure 1a. Cruise track from Hokkaido to the Aleutians, locations of counts (heavy lines), noon positions 6-13 June 1975 (circles) and sea surface temperatures (°C).

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and in the Aleutians and Bering Sea areas (Clark and Miller 1975, Evans and Miller 1975). Wind speeds (Figure 2) were generally moderate. Sea conditions were relatively uniform, usually with swells of 1-3 m and seas of 0-3 m. Cloud cover of 90%-100% and an effective horizon of 2000-5000 m were normal observation conditions, although periods of fog restricting visibility to 100-250 m and occasional brief sunny periods also occurred. Precipitation was infrequent and relatively light.

## METHODS

Systematic observations were conducted during 112.2 hours from 6 June through 5 July while the ship was travelling a straight course at an average speed of about 11 knots. Observations were made from bridge wings approximately 6 m above the sea surface, from the side of the ship offering minimum effects of wind, precipitation, spray and (rarely) glare. Count periods usually lasted 30 to 60 minutes. Notes on all birds seen within a 300 m, 90° arc from bow to one side of the ship were tape recorded, with plumage, behavior and direction of movement noted when possible, along with conditions of observation. Flocks or unusual

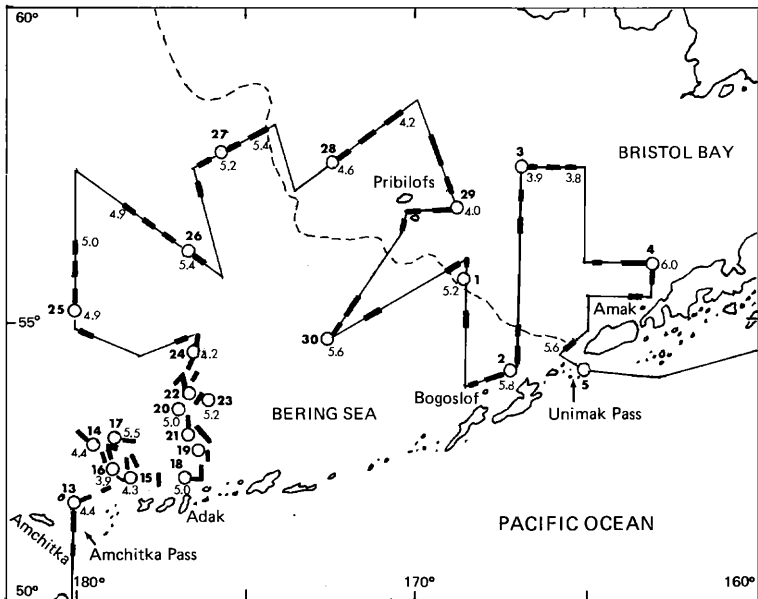


Figure 1b. Cruise track in the Bering Sea, location of counts (heavy lines), noon positions 13 June-5 July 1975 (circles), and sea surface temperatures (°C). Routes between gill-net drift stations 13-24 June not shown.



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Table 1 (cont.)

Species	June												July												Total								
	6	7	8	9	10	11	12W	12E	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28		29	30	1	2	3	4	5	
Black-legged Kittiwake	-	-	-	-	-	2	7	19	20	16	+	7	4	7	1	1	7	4	+	3	1	1	14	28	19	1	16	8	37	3	-	226	
Red-legged Kittiwake	-	-	-	-	-	-	-	-	6	3	+	6	+	-	-	-	1	-	-	-	-	17	22	2	17	54	8	5	-	-	-	141	
Sabine's Gull	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	
Arctic Tern	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	1	
Common Murre	-	-	+	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	79	86	3	1	+	12	13	-	196
Thick-billed Murre	-	-	-	-	-	-	-	-	-	-	-	-	3	2	2	-	2	-	1	1	-	1	1	178	76	1	2	165	4	-	-	442	
Murre (sp.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	59	-	-	34	2	3	-	115	
Pigeon Guillemot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2
Ancient Murrelet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	6	-	-	-	-	-	-	-	-	-	4	4	-	2	37
Least Auklet	-	-	-	-	-	-	-	-	-	-	-	-	1	7	4	-	+	-	2	+	-	-	1	-	-	-	-	-	-	-	-	31	
Crested Auklet	-	-	-	-	-	2	-	-	88	-	-	2	-	1	-	+	3	-	-	-	-	-	-	3	-	2	-	+	-	-	-	101	
Whiskered Auklet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
Parakeet Auklet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	2	-	-	-	-	3	-	-	87
Cassin's Auklet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Auklet (sp.)	-	-	-	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46
Horned Puffin	-	-	2	-	1	4	-	1	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	5	-	-	-	-	-	6	19
Tufted Puffin	-	1	24	5	1	5	2	5	6	2	-	-	1	3	+	1	2	1	+	5	-	2	-	+	4	+	2	53	39	16	20	200	
Total	600	100	97	22	23	87	149	3145	353	74	12	111	82	120	8	73	52	52	11	77	48	60	70	338	371	204	146	398	148	521	130	7682	
Hours of systematic observation	3.5	6.1	5.1	7.0	6.8	6.6	6.9	3.5	3.8	3.5	1.1	3.3	2.0	1.8	0.3	3.0	2.0	2.8	1.0	3.7	4.7	4.0	3.8	2.8	4.7	3.5	1.8	3.2	4.8	5.0	0.5		

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Table 2. Birds observed per 10 hours within 300 m transects, in each sea area.

Species/species groups	Oyashio/ Kuroshio Confluence	North- western Pacific	Offshore Aleutians	Pelagic Bering Sea	Bering Sea Continental Shelf
Albatrosses	24.5	9.6	+	—	—
Northern Fulmar	30.6	18.9	98.9	52.3	51.2
Shearwaters	46.3	52.6	1722.4	39.7	306.4
Gadfly petrels	39.5	6.3	—	1.4	—
Storm-petrels	374.1	29.1	87.4	73.9	39.2
Jaegers, skua	6.8	1.3	2.7	3.1	7.9
Glaucous-winged Gull	—	—	18.0	+	10.3
Kittiwakes	—	8.3	46.4	44.3	64.0
Murres	0.7	—	115.3	3.5	261.6
Small alcids	—	1.7	137.8	5.6	8.9
Puffins	18.4	6.3	38.3	3.8	45.3
Total birds/10 hours	540.8	134.1	2275.4 <sup>1</sup>	227.9	814.8
Total area censused (km <sup>2</sup> )	82.7	162.5	115.2	116.3	110.3
Birds/km <sup>2</sup>	9.6	2.5	36.1 <sup>2</sup>	5.6	15.0
Hours of systematic observation	14.7	30.2	18.3	28.7	20.3

1 Without shearwaters = 553.0 birds/10 hours

2 Without shearwaters = 8.8 birds/km<sup>2</sup>

occurrences of birds noted beyond the 300 m transect width were recorded also. In addition, general data on environmental conditions, ship speed, course and position were obtained from the ship's log or officers on watch. Several transect counts were aborted when fog closed in to limit visibility, and observations were sometimes limited by wind-chill resulting from ship motion and air temperatures as low as 2.9°C. Identifications were aided by 10x50 binoculars.

The numbers of birds following the vessel were adjusted to represent minimum daily numbers (maximum numbers noted at any one time during a count period or series of consecutive count periods). However, no further allowances were made for effects of ship-attraction or repulsion on some species (which may cause overstatement of numbers of albatrosses, fulmars, storm-petrels, gulls or flying puffins) or for varying observability of alcids on the water (which can understate abundance relative to flying alcids or larger, more visible species). Manikowski (1971) reports that kittiwakes apparently accumulated at fishing vessels during the day, with maximum numbers present before dark. Similar possible variations in the Bering Sea are not taken into account here. Thus, calculations of "densities" are not attempted (see King 1970 and Wiens et al. 1977 for pertinent discussions of many factors involved). Physical oceanography sampling (including sea temperature and salinity bottle

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casts), plankton sampling, and other experiments were made frequently beginning 12W June (12 June west of the 180° longitude date line), and these were the principal functions of the ship from 24 June through 4 July. Nine experimental salmon gill-net sets were made between 12E June and 24 June. The drift net (about 5 m deep and 5000 m long) was released just before dark and retrieved at first light.

## RESULTS

Table 1 gives daily totals of birds observed within the 300 m transects and additional occurrences outside transects. Specimens salvaged from gill-net sets are given in Appendix 1. Relative abundances of species/species groups noted within sea areas are shown in Table 2 and Figures 3-16.

Table 3. Relative abundance of color phases of Northern Fulmars observed within transects, by sea area. Dark phase includes "black," dark and medium gray; light phase includes white bodied birds with gray or white wings.

Color Phase	Oyashio/ Kuroshio Confluence	North- western Pacific	Offshore Aleutians	Pelagic Bering Sea	Bering Sea Continental Shelf
Dark	100%	98%	98%	97%	80%
Light	—	2%	2%	3%	20%
Total birds (n)	45	57	168	151	142

Table 4. Relative abundance of kittiwakes observed within transects by sea area.

	Oyashio/ Kuroshio Confluence	North- western Pacific	Offshore Aleutians	Pelagic Bering Sea	Bering Sea Continental Shelf
Black-legged					
Adult	—	50%	58%	20%	66%
Immature	—	50%	21%	6%	13%
Red-legged					
Adult	—	—	11%	22%	18%
Immature	—	—	9%	52%	2%
Total birds (n)	—	28	75	127	130

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### SPECIES SEEN AT SEA

**BLACK-FOOTED ALBATROSS** (*Diomedea nigripes*). Very few were seen (Table 1). Sea surface temperature range was 6.0-10.2°C, with one seen at 4.3-4.9°C.

**LAYSAN ALBATROSS** (*Diomedea immutabilis*). Birds followed the ship almost continually in the Confluence area and Northwestern Pacific, and were attracted to gill-net hauls on several occasions. Ten at 50°03'N, 178°08'E on 12E June were the most seen at once, and two at 52°50'N, 176°10'W on 20 June were the most northerly recorded. Birds attempted to pull fish from the gill-net (to about 0.5 m below the surface) with little apparent success.

**NORTHERN FULMAR** (*Fulmarus glacialis*). The absence of birds in mid-Pacific (Figure 4) suggests that we had passed beyond the range of the northwestern Pacific breeding population. Kuroda (1960) saw fulmars offshore from the Kuriles and Kamchatka. Numbers increased on 12W June, and the species was common on almost all days thereafter. Dark-phase birds predominated, although most were noticeably lighter than birds seen on 6-8 June in the Confluence area, which were extremely dark ("black") birds. A generalized dark/light phase breakdown by sea areas is given in Table 3.

Shuntov (1972) indicates very few dark fulmars are found in the area of the Pribilofs at any time of the year. My sample was small and the Pribilofs themselves were fog-bound, but counts over the Bering Sea continental shelf within 140 km radius of the Pribilofs showed dark birds outnumbered light by about 2.6:1 (n=79), with light birds generally concentrated north of the islands. On nine counts over the pelagic Bering Sea waters, between 185-370 km northwest and southwest of the Pribilofs, dark birds outnumbered light by 16:1 (n=50). This distribution generally agrees with the findings of G. Hunt (pers. comm.). The presence of dark birds in the offshore areas could represent distribution of birds from "dark" colonies in the Aleutians.

Fulmars did not follow the ship in the Confluence or Northwestern Pacific areas and, while they were attracted to the stopped ship and were usually seen over the ship's wake in the Offshore Aleutians and Bering Sea areas, most appeared evenly distributed over the sea surface to the limit of vision. Census numbers were adjusted to maximum numbers seen in a count period or series of consecutive counts. During our nine early-morning net hauls, numbers present ranged from 5-77 birds. Stopped-ship counts later at oceanographic stations ranged from 0-200, with an average of about 10.

**SOOTY SHEARWATER** (*Puffinus griseus*). This species was recorded in the Confluence area and very small numbers were noted in flocks of the next species thereafter (see Table 1). The combined distribution of Sooty and Short-tailed shearwaters is shown in Figure 5.

**SHORT-TAILED SHEARWATER** (*Puffinus tenuirostris*). Large flocks were seen resting on the water near Amchitka Pass on 12E June, and concentrations were evident near Unimak Pass on 4-5 July, although visibility was greatly restricted. Small numbers were noted in the Pelagic Bering Sea, but numbers increased substantially over the Bering Sea Continental Shelf, after 28 June. Wiens et al. (1977) report no shearwaters over the Bering Sea Continental Shelf area near the Pribilofs in mid-June 1976; the species' arrival time in the area is evidently quite variable (see Shuntov 1972).

**MOTTLED PETREL** (*Pterodroma inexpectata*). Two birds moving north in the Confluence area on 8 June were the first noted, and some were seen in the Northwestern Pacific area (Figure 6). This agrees with general distribution given by Nakamura and Tanaka (1977). Several birds were seen in the Pelagic Bering Sea area, the most northerly being one at 55°54'N, 179°58'E on 25 June. These records accord with Shuntov (1972), Kuroda (1955), and Kenyon and Phillips



(1965). It now appears the species is quite widely distributed over the cooler North Pacific during its non-breeding season (Wahl 1975, Nakamura and Tanaka 1977, W. Hoffman unpubl. records) and also in the Sea of Okhotsk (Shuntov 1972).

**SOLANDER'S PETREL** (*Pterodroma solandri*). This large gadfly petrel was seen in loose flocks on 7-8 June in the "warm" waters of the Confluence area (6.0-10.8°C occurrence range), usually foraging in rather slow circles, often high above the sea surface. (See Kuroda 1955, 1960 and Nakamura and Tanaka 1977).

**KERMADEC PETREL** (*Pterodroma neglecta*)? A bird seen briefly within 100 m at 42°01'N, 150°45'E in the Confluence area on 7 June showed head, body and underwing pattern described for the light phase of this species (see Slater 1970). Sea surface temperature was 5.7-6.2°C.

**COOK'S PETREL** (*Pterodroma cookii*). One was closely seen at 45°57'N, 169°10'E on 10 June, over sea surface temperature of 4.0°C. Another bird, possibly *cookii*, was seen at 45°59'N, 168°19'E, also on 10 June, over sea surface temperature of 4.9-5.3°C.

**HARCOURT'S STORM-PETREL** (*Oceanodroma castro*). Twenty-two of the white-rumped storm-petrels in the Confluence were identified as this species. Almost all storm-petrels there were flying to the east (see Kuroda 1960) into the wind, many failed to show species-characteristic flight styles, and hence were unidentifiable.

**LEACH'S STORM-PETREL** (*Oceanodroma leucorhoa*). Large numbers were seen in the Confluence area on 6 June (Table 1, Figure 7). Numbers were then seen in the Northwestern Pacific area approaching the Aleutians, and several were seen over the deep waters of the Pelagic Bering Sea and southeast of the Pribilofs at the continental slope.

**SWINHOE'S STORM-PETREL** (*Oceanodroma monorhis*)? I saw one small all-dark storm-petrel at 42°12'N, 152°20'E on 7 June over sea surface temperature of 9.0°C. This species is the only small, dark-rumped storm-petrel described for the region (Alexander 1954).

**TRISTRAM'S STORM-PETREL** (*Oceanodroma tristrami*)? Seven large, all-dark birds seen in the Confluence on 7-8 June had a languid flight style reminiscent of the Black Storm-Petrel (*O. melania*) of the Eastern Pacific. Field marks distinguishing this from Matsudaira's Storm-Petrel (*O. matsudairae*) could not be seen due to distance and light conditions, but distributional range suggests *tristrami* (Palmer 1962, Slater 1970).

**FORK-TAILED STORM-PETREL** (*Oceanodroma furcata*). This species first appeared in the Northwestern Pacific. Figure 8 shows the greatest concentrations near Amchitka Pass, over Petrel Bank north of the Aleutians, and southwest of the Pribilofs over the continental slope. This was the most abundant species in the Pelagic Bering Sea (Table 2) and was also quite consistently observed, along with fulmars and Black-legged Kittiwakes, in the Bering Sea Continental Shelf area. Along with those species, it was usually present (though often in small numbers) when fish were cleaned after gill-net hauls.

**RED-FACED CORMORANT** (*Phalacrocorax urile*). Four were north of Bogoslof Island on 2 July and one was east-northeast of St. Paul Island in the Pribilofs on 3 July.

**HARLEQUIN DUCK** (*Histrionicus histrionicus*). An immature male was observed swimming about the gill-net at 52°16'N, 178°40'W for about an hour on 17 June.

**TATTLER** (*Heteroscelus sp.*). One bird passed the ship on 22 June, at 58°32'N, 176°43'W, headed northeast toward the Pribilofs. This was almost certainly the Wandering Tattler (*H. incanus*).

**POMARINE JAEGER** (*Stercorarius pomarinus*). Birds were seen in the Confluence, near the Aleutians, and especially near the Pribilofs and over the Bering

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Sea Continental Shelf (Figure 9). Most were clearly attracted to kittiwakes attending our ship.

**PARASITIC JAEGER** (*Stercorarius parasiticus*). Very few were seen (Table 1). One immature at 45°55'N, 168°13'E on 10 June was farthest west.

**LONG-TAILED JAEGER** (*Stercorarius longicaudus*). Three adults were seen: one in the Confluence, one near Amchitka Pass, and one north of the Aleutians (Table 1).

**SOUTH POLAR SKUA** (*Catbaracta maccornicki*). A typical light phase bird with pale, straw-colored head was seen heading east at 42°06'N, 151°40'E on 7 June in the Confluence area.

**GLAUCOUS-WINGED GULL** (*Larus glaucescens*). The low number of sightings was due to the generally inshore distribution during the season (see Shuntov 1972). The species is attracted to ships and often ranges far offshore during non-breeding seasons (Sanger 1973 and pers. obs.).

**BLACK-HEADED GULL** (*Larus ridibundus*). A bird in breeding plumage was seen on 13 June at 51°45'N, 180°00', headed northwest toward Semisopochnoi Island.

**BLACK-LEGGED KITTIWAKE** (*Rissa tridactyla*). The species was seen daily after 11 June. Numbers followed the ship, checking the wake, scavenged fish offal, and gathered at oceanographic stations. Because both species of kittiwakes regularly followed the ship, transect counts were corrected to represent minimum numbers. However, relative abundances (Table 2) in the Pelagic Bering Sea and Bering Sea Continental Shelf areas were much greater than those given by Shuntov (1972). This could be due to proximity to colonies, seasonality, ship attraction behavior, inadequacies of census methods or sample size. Table 4 gives relative abundances of the two kittiwakes in the sea areas. Black-legs predominated in all areas except the Pelagic Bering Sea. Numbers at oceanographic stations in late June-early July were greater than numbers seen earlier at fishing stations north of the Aleutians. On 1 July about 120 Black-legs and 60 Red-legs, predominately adults of both species, flocked at one stop. No kittiwakes were noted on 4 transect counts east of 163°56'W (north of Amak Island) on 4 July.

**RED-LEGGED KITTIWAKE** (*Rissa brevirostris*). Small numbers were seen in the Amchitka Pass area, and a few were noted when we passed within a few miles of Bogoslof Island. The largest numbers were present west and south of Pribilofs over the deep waters of the Bering Sea (Figure 11), where this species outnumbered *tridactyla* on 26, 27 and 30 June. Immature birds predominated over Pelagic Bering Sea waters (Table 4), which suggests a seasonal distribution of non-breeders.

**SABINE'S GULL** (*Xema sabini*). An immature was seen with a flock of kittiwakes resting near the ship on oceanographic station at 57°00'N, 168°30'W on 29 June.

**ARCTIC TERN** (*Sterna paradisaea*). One was in the mid-Northwestern Pacific area on 10 June, and single birds were seen near the Pribilofs on 28 and 29 June.

**COMMON MURRE** (*Uria aalge*). Total numbers of murrees were low, likely reflecting inshore distribution near nesting colonies. Virtually all Common Murrees were seen relatively near the Pribilofs (Figure 12). While some murrees were unidentifiable as to species (Table 1), the blacker head and neck and generally heavier, shorter-necked appearance of the Thick-billed Murrees made most birds within 300 m transects identifiable.

**THICK-BILLED MURRE** (*Uria lomvia*). This species was more widely distributed than *aalge*. Almost all of the relatively few murrees seen in the Pelagic Bering Sea were *lomvia*. However, the only large concentrations were noted near the Pribilofs and just north of Bogoslof (Figure 13). Murrees noted outside the transect width and hours also followed these patterns. On several occasions near Bo-

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goslof, long lines of flying Thick-billed Murres were seen following the lead of one or two Tufted Puffins.

PIGEON GUILLEMOT (*Cepphus columba*). Three birds were noted (Table 1), all in breeding plumage. One inspected the gill-net for a few minutes on 17 June.

ANCIENT MURRELET (*Synthliboramphus antiquus*). This easily identifiable species was seen primarily north of the central Aleutians (most were north of Adak Island), near Unalaska Island, and east of the Pribilofs.

LEAST AUKLET (*Aethia pusilla*). Poor viewing conditions and unfamiliarity with the *Aethia* and *Cyclorhynchus* auklets resulted in my recording a number of unidentified "small dark alcids" both within and outside transects. The only noticeable concentrations of small alcids were near Amchitka Pass (Figure 14). The offshore cruise track and poor observation conditions near the Pribilofs and Unimak Pass probably reduced counts of small alcids more than other groups. Specimens of Least Auklets and other species salvaged from the gill-net are listed in Appendix 1.

CRESTED AUKLET (*Aethia cristatella*). Two birds at 46°20'N, 171°36'E (about 685 km south of Attu Island) on 11 June were the first seen. Flocks were seen flying south near Amchitka Pass on 13 June.

WHISKERED AUKLET (*Aethia pygmaea*). Only one bird was certainly identified, north of Adak on 18 June.

PARAKEET AUKLET (*Cyclorhynchus psittacula*). As with other alcids, the only concentrations noted were in the Amchitka Pass area on 13 June.

CASSIN'S AUKLET (*Ptychoramphus aleuticus*). Although quite familiar with this species at sea, I did not identify it alive. Two specimens were taken from the gill-net (Appendix 1).

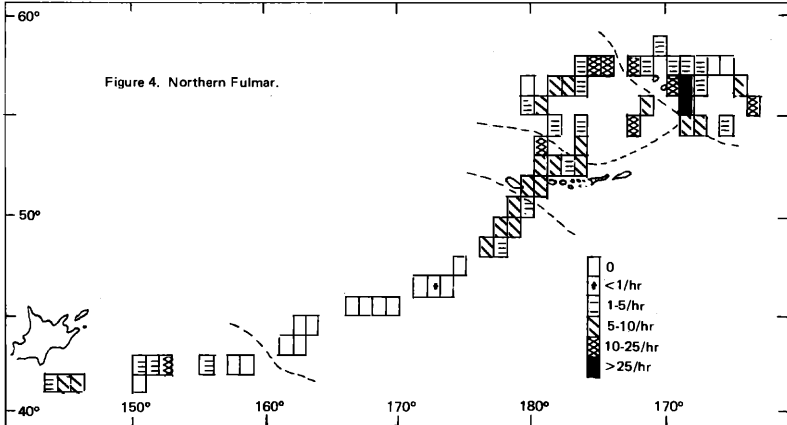
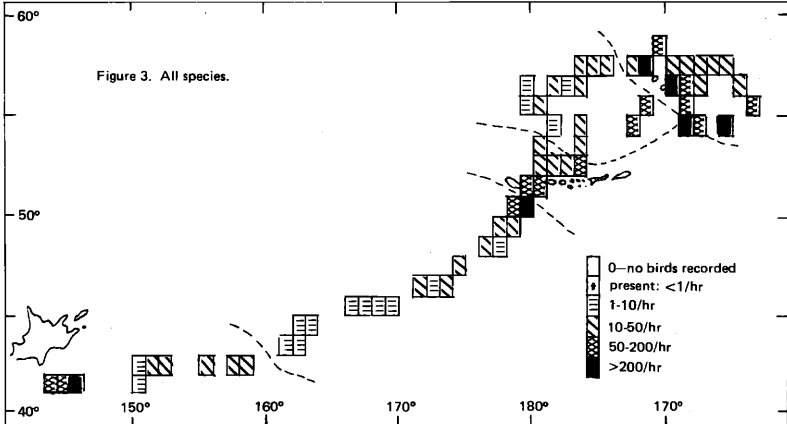
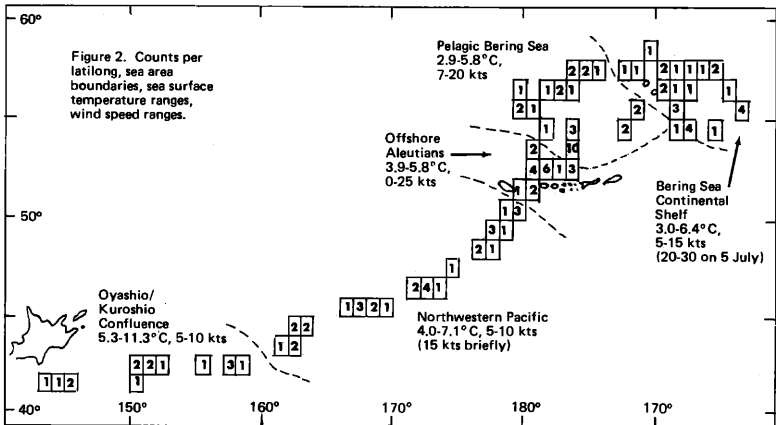
HORNED PUFFIN (*Fratercula corniculata*). Two sub-adults were seen in the Confluence area, and flying birds in adult plumage were seen in the Northwestern Pacific area. The few other birds noted were in the Bering Sea Continental Shelf area (see Figure 15). In addition, five birds were seen in a transect count south-east of the Shumagin Islands on 6 July.

TUFTED PUFFIN (*Lunda cirrbata*). A number of apparently flightless sub-adults were seen in the Confluence area. None of these birds were seen more than 100 m from the ship, and numbers shown for 7-8 June (Table 1) represent perhaps only 33-50% of their abundance relative to other species. Adult birds were seen almost every day from 9 June on, when the first two were seen at about 43°48'N, 161°53'E, 635 km from the nearest land in the Kuriles. Concentrations were seen near Bogoslof, east of St. George Island, northwest of Unimak Island, and at the northern entrance to Unimak Pass (Figure 16). Large numbers were seen also near the Shumagins and Kodiak. The species is attracted to vessels (see Kuroda 1955), and any calculation of absolute density must allow for this and its habit of flying higher above the sea surface than other alcids. The only sub-adult seen outside of the Confluence area was one at 54°26'N, 177°00'W on 24 June.

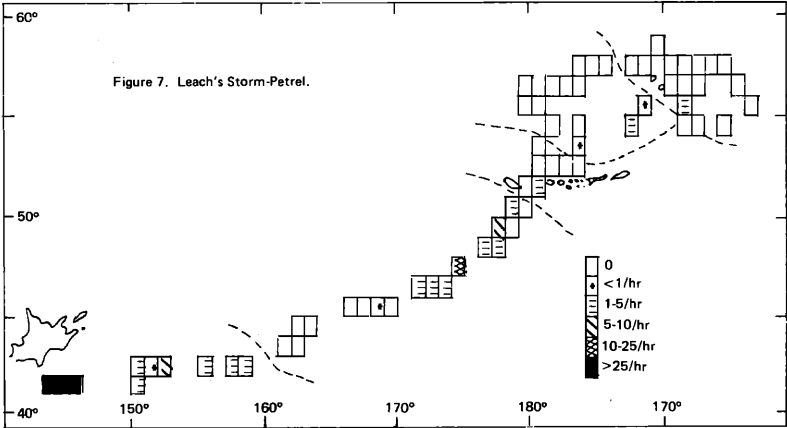
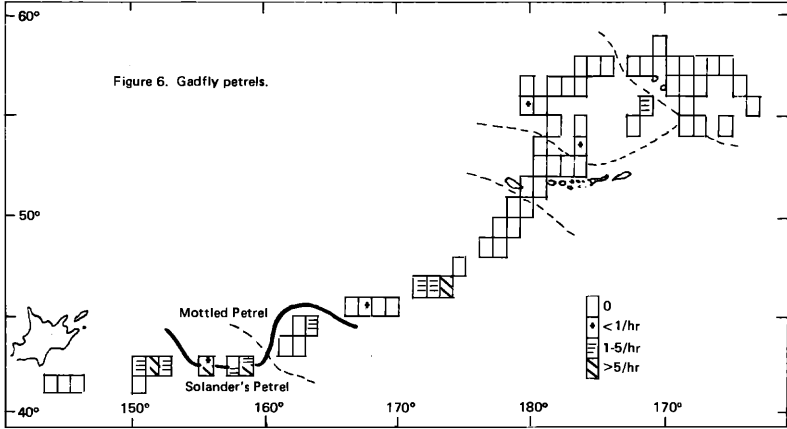
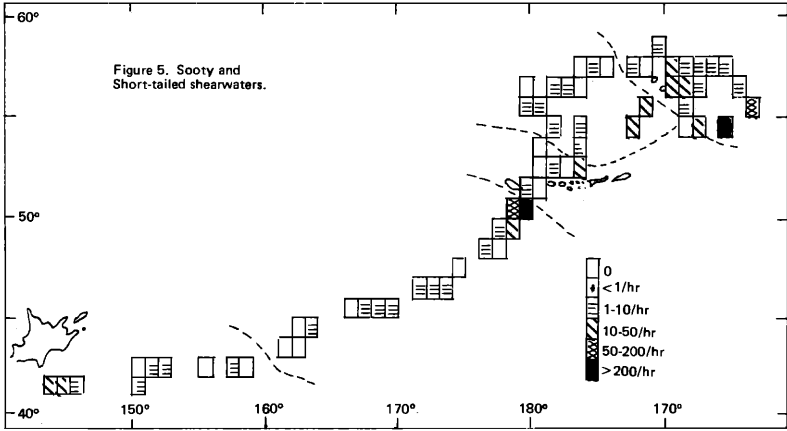
## OTHER SPECIES

Several additional seabird species were seen on 5 July in inshore Hokkaido waters: Streaked Shearwater (*Calonectris leucomelas*), Flesh-footed Shearwater (*Puffinus carneipes*), Japanese Cormorant (*Phalacrocorax capillatus*), Slaty-backed Gull (*Larus schistisagus*), Black-tailed Gull (*L. crassirostris*) and Rhinoceros Auklet (*Cerorhinca monocerata*). Additional species noted between Unimak Pass and Kodiak on 5-8 July included Pelagic Cormorant (*Phalacrocorax pelagicus*), Common Eider (*Somateria mollissima*), Herring Gull (*Larus argentatus*), Mew Gull (*L. canus*), Aleutian Tern (*Sterna aleutica*), Marbled Murrelet (*Brachyramphus marmoratus*) and Kittlitz' Murrelet (*B. brevirostris*).

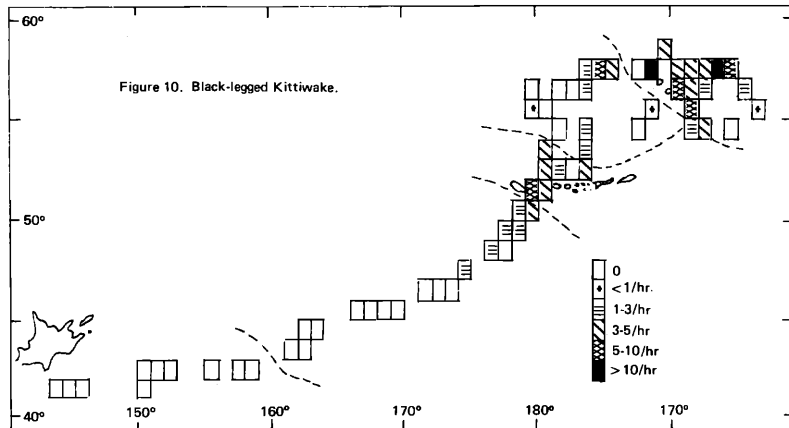
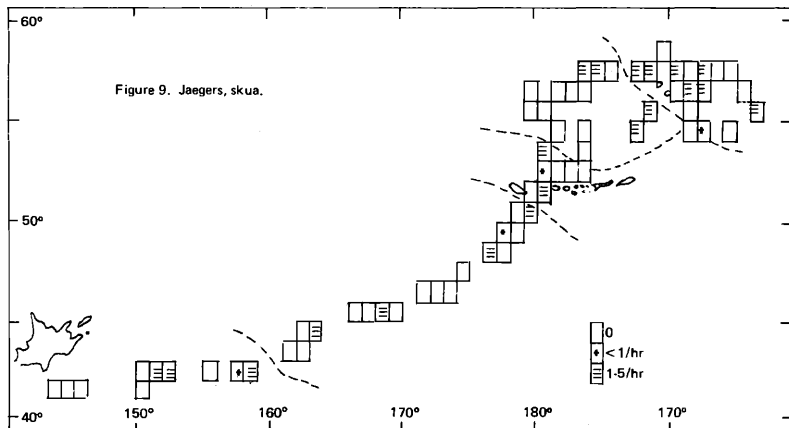
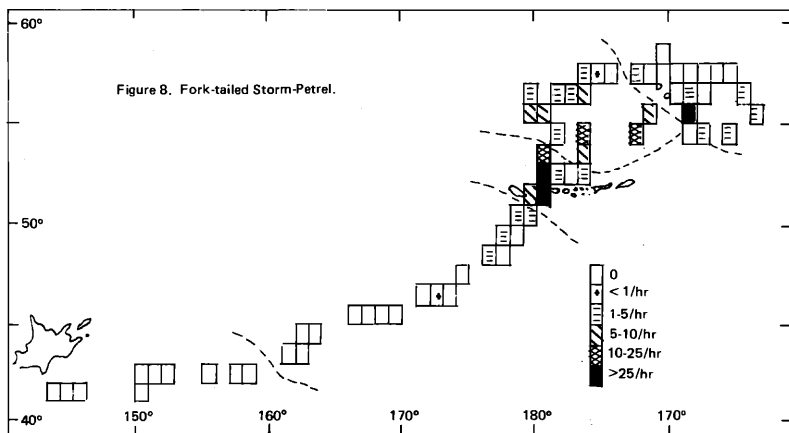
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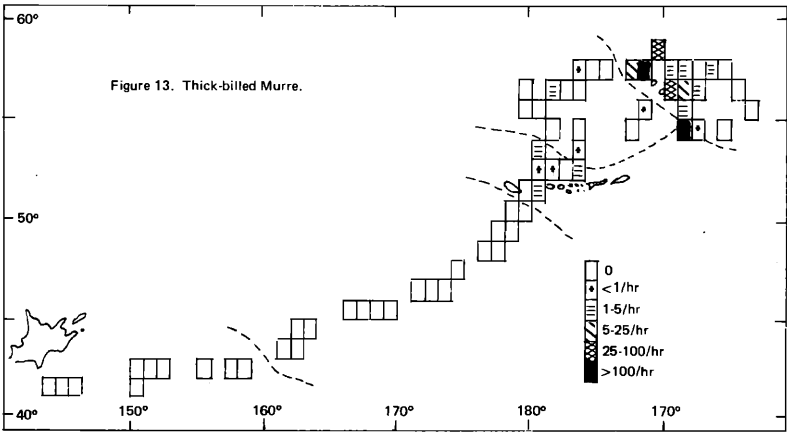
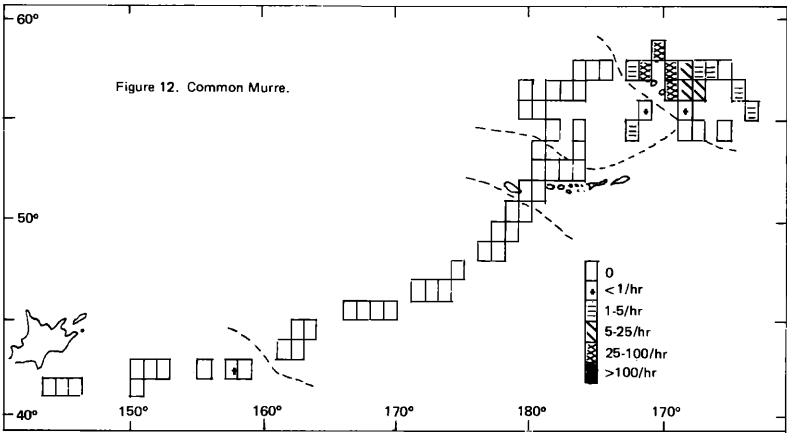
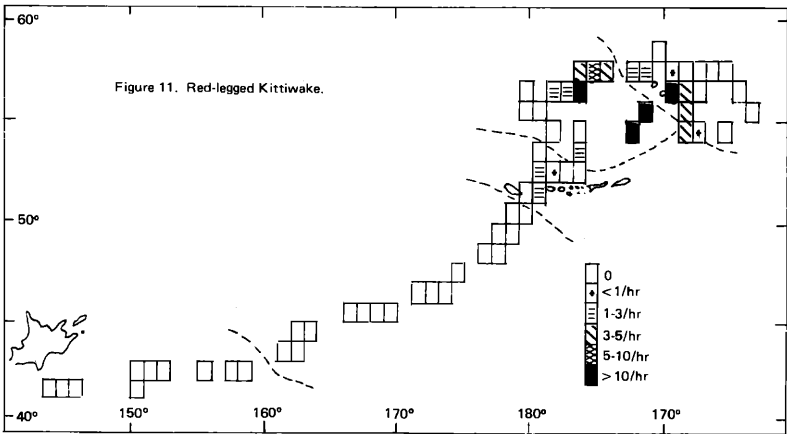
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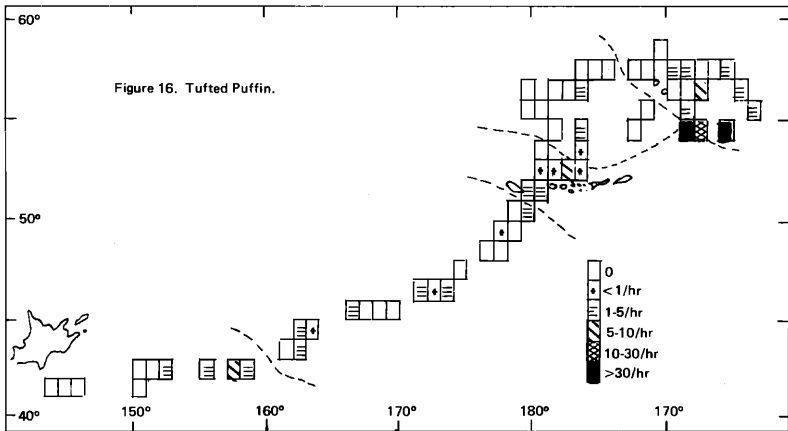
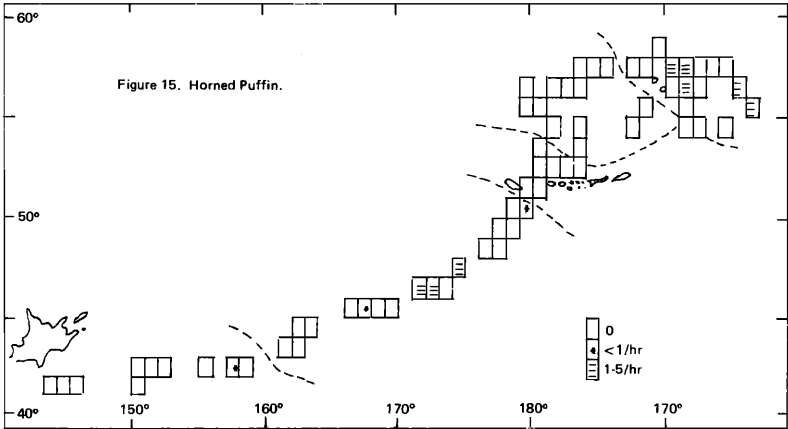
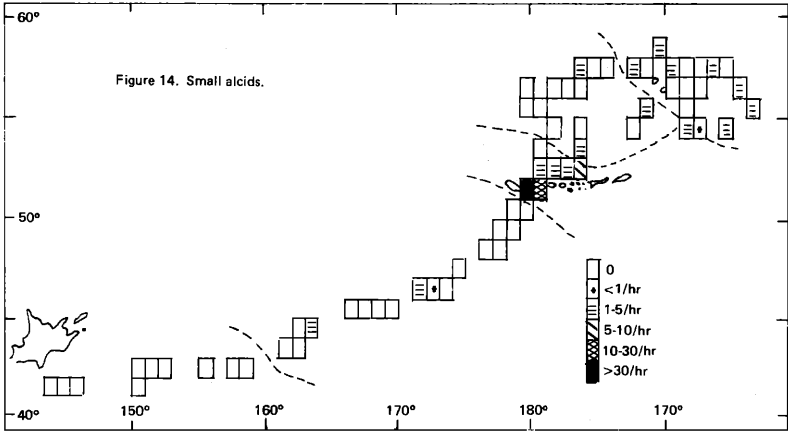
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The only passerine seen on the cruise was one female Common Redpoll (*Acanthis flammea*) which came on board in dense fog between St. Paul and St. George islands on 29 June and stayed at least until dark.

Marine mammals identified during the cruise were Northern Sea Lion (*Eumetopias jubata*), Northern Fur Seal (*Callorhinus ursinus*), 15-20 Killer Whales (*Orcinus orca*) near Kodiak Harbor on 8 July, Dall Porpoise (*Phocoenoides dalli*) which was widely distributed over the cruise route, and 3 Fin Whales (*Balaenoptera physalus*) southwest of Kodiak Island on 6 July.

## DISCUSSION

Ideally, replicate data are desirable to describe bird distribution in sizable areas of the oceans. However, data from a single cruise are useful when they add some specifics where broad generalizations had to serve previously. Since the present cruise track was at least several miles offshore, even in Amchitka Pass, transect counts were little influenced by large numbers of birds close to colonies. No large concentrations of birds at fishing fleets were encountered and, although one large flock was observed within a transect, data are felt to be fairly representative of "open water" abundance in June. Relatively little migration of species nesting in the northern hemisphere was noted.

## OYASHIO/KUROSHIO CONFLUENCE

The cruise track crossed the northern edge of the area where the cold Oyashio current and the warm Kuroshio current meet in the western Pacific. Sea surface temperatures (which were 12.8-13.6°C on 5 June leaving Japan) ranged from 5.3-11.3°C on 6-8 June (Figure 2), with changes of as much as 1.2°C within one hour. Frequent periods of dense fog greatly restricted hours of systematic observation, but counts and extra-transect observations indicated that birds were abundant in the area (Figure 3), particularly gadfly petrels and storm-petrels. Laysan Albatrosses, fulmars and shearwaters were also numerous, as were sub-adult Tufted Puffins (Table 2). Albatrosses were the only birds attracted to the ship, as we crossed this area without stopping. Sea surface temperatures along our track were below the temperatures (up to 16°C) in the part of the Confluence area visited by Kuroda (1955, 1960), and the main populations of "warm water" species were undoubtedly farther south.

I have found no ornithological descriptions of this interesting area, other than reports by Kuroda (1955, 1960), Hamilton (1958) and Nakamura and Tanaka (1977). Hamilton's (1958) brief sightings suggest that noticeable concentrations of birds occur east to at least 180° longitude in June. Personal observations (unpubl.) along 158° W in late October-early November suggest similar if less dramatic conditions there. Sanger (1972) does not estimate seabird abundance for the Confluence area. He estimates 4.5 birds/km<sup>2</sup> for the Transition Domain. My figure of 9.6/km<sup>2</sup> (Table 2) for the Confluence area is considerably higher and

does not seem unrealistic, although biomass is likely low because of the large numbers of small-bodied storm-petrels. Shuntov (1972) mentions the area but gives no data on abundance.

Kuroda (1955) saw both Buller's Shearwaters (*Puffinus bulleri*) and Japanese Murrelets (*Synthliboramphus wumizusume*) in waters east of Japan, and their absence on this cruise was probably a reflection of the cool surface waters along our northerly track over the Confluence (Kuroda reported *bulleri* over sea surface temperatures of 14.5-16.0°C; our maximum was 11.3°C in the Confluence). A number of authors have demonstrated a distribution of species relative to surface temperatures, salinity and associated food sources (e.g., Murphy 1936, Kuroda 1955, 1960, Szijj 1967, Gould 1971, Jehl 1973). The most common species encountered on this cruise were widely distributed over the entire range of sea surface temperatures, and species preferring warm waters were obvious only in the Confluence area (e.g. Solander's Petrel, Harcourt's Storm-Petrel). This area has been described oceanographically (see Favorite et al. 1976), and Ashmole (1971) and Gould (1971) describe the concentration of planktivores along boundaries of converging water masses. An intensive study of birds vs. oceanographic conditions here might provide interesting insights.

#### NORTHWESTERN PACIFIC

Sea surface temperatures decreased fairly steadily as the *Oshoro Maru* cruised northeastward toward the Aleutians. The numbers of birds observed per km<sup>2</sup> dropped to about 25% of the number observed in the Confluence area. My figure of 2.5/km<sup>2</sup> is in general agreement with the figure of 3.1/km<sup>2</sup> given by Sanger (1972) for this area. Shuntov's figure for the "open ocean" area of the "northwest part of the Pacific Ocean" south to 30°N is 1.6/km<sup>2</sup>. My personal observation (unpubl.) is that abundances decrease greatly south of the Subarctic Boundary at about 40°N. Relatively low populations of birds between 30° and 40°N could explain Shuntov's lower figure. Kuroda (1955, 1960) indicated higher densities near the Kuriles and Kamchatka compared to my count numbers from farther south and east. Shearwater numbers increased, and kittiwakes and small alcids appeared as we approached the Aleutians. Laysan Albatrosses were the only ship followers within this area, as they had been in the Confluence. Other species ignored our non-stop passage.

#### OFFSHORE ALEUTIANS

Trapp (1975) presents data pertinent to this area, and Gabrielson and Lincoln (1959) and Murie (1959) give information from inshore observations. Sanger (1972) gives a summer figure of 7.8 birds/km<sup>2</sup> for the Coastal Domain, and Shuntov (1972) gives a figure of 11/km<sup>2</sup> for

the Offshore Aleutians area for June-August. My figure of  $36.1/\text{km}^2$  (Table 2) includes a flock of 3000 Short-tailed Shearwaters which greatly affects both relative abundance and bird/ $\text{km}^2$ . Disregarding shearwaters, my figure would be  $8.8/\text{km}^2$ , which agrees well with Sanger and Shuntov. Compared to the Northwestern Pacific area, my actual numbers of all species except albatrosses and gadfly petrels increased substantially within this area. Birds/hour for all species combined (Figure 3) are influenced primarily by numbers of shearwaters and Fork-tailed Storm-Petrels and numerous small alcid in the area near Amchitka Pass (Figures 5, 8, 14).

#### PELAGIC BERING SEA

Fork-tailed Storm-Petrels, Northern Fulmars, kittiwakes and Short-tailed Shearwaters accounted for over 90% of the birds recorded. As in the Offshore Aleutians area, fulmars, Fork-tails and kittiwakes were attracted to gill-net operations. Sanger (1972) includes this area within the Western Subarctic Domain and estimates a summer abundance of  $3.1 \text{ birds}/\text{km}^2$ , and Shuntov (1972) gives  $2.7/\text{km}^2$  for June-August. My figure is  $5.6/\text{km}^2$ ; the variation may be due in part to differences in geographic designations, methodology and allowances for ship-attraction. Variation in species composition, seasonal distribution, air and water temperatures probably justify study of this ornithologically-neglected area as an entity separate from other deep-water areas of the North Pacific.

#### BERING SEA CONTINENTAL SHELF

Data were gathered in this area (Table 2, Figure 3), but periods of dense fog on 29 June and 20-30 knot winds and blowing spray combined with fog on 5 July near Unimak Pass reduced both the number of near-shore transects and birds recorded. Compared to the Pelagic Bering Sea, the numbers of Short-tailed Shearwaters and murre increased over the shelf, and storm-petrels showed a relative decrease. Birds/ $\text{km}^2$  were probably equal to those of the Offshore Aleutians area. Large numbers of Short-tailed Shearwaters and Tufted Puffins occurred near Unimak Pass during a brief count on 5 July. However, abundances over the continental shelf, as in other areas, were not uniform: two counts about 330 km east-northeast of the Pribilofs on 3 July indicated relatively low numbers of birds there.

Sanger (1972) estimates  $7.8 \text{ birds}/\text{km}^2$  for all species for the Coastal Domain, in which he includes the Bering Sea Continental Shelf. Shuntov (1972) gives  $18 \text{ birds}/\text{km}^2$  for June-August. Wiens et al. (1977) noted no shearwaters in June counts, but tentatively estimate about 12 birds of all species/ $\text{km}^2$ . Their counts probably included many more breed-

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ing birds around the Pribilofs than my counts did, however. My figure of 15/km<sup>2</sup> (Table 2) is given for comparison.

As noted above, we did not encounter working commercial fishing vessels on this cruise. The effects of very large concentrations of birds found at fishing vessels on calculated densities of birds for a large area are unknown. However, overall numbers of birds/km<sup>2</sup> in areas where extensive trawling and processing operations have been conducted for years could be both greater over the area as a whole and more locally variable when compared to areas where fishing effort has been less intensive (see Shuntov 1972). The lack of replicate data prevents allowance for effects of weather systems on bird distribution. Manikowski (1971) reports considerable variation in seabird distribution and behavior under different meteorological conditions and these could influence data given here, especially for the Pelagic Bering Sea and Bering Sea Continental Shelf areas.

### SUMMARY

Censuses of seabirds seen on a cruise from Hokkaido to Kodiak in June 1975 provided data on relative abundance, particularly for three areas of the North Pacific Ocean which have had little prior study: the Confluence, the Northwestern Pacific, and the Pelagic Bering Sea. Birds were numerous in the Confluence, with abundances of Solander's Petrel, Leach's Storm-Petrel and sub-adult Tufted Puffins being particularly noteworthy. Abundances were relatively low in the Northwestern Pacific area, with Short-tailed Shearwaters and Leach's Storm-Petrels the most numerous species noted. Northern Fulmars, Short-tailed Shearwaters, Fork-tailed Storm-Petrels and kittiwakes predominated over the deep waters of the Pelagic Bering Sea. The numbers of immature Red-legged Kittiwakes noted over the deep waters southwest of the Pribilofs may be representative of the distribution of non-breeders in June. Dark-phase Northern Fulmars substantially outnumbered light-phase birds in all areas, including sample counts near the Pribilofs. The large numbers of birds close to nesting colonies were not censused due to the offshore cruise track. The greatest concentrations of offshore birds were noted in the Confluence, near Amchitka Pass, near the Pribilof Islands, and in waters over the continental shelf north of Unimak Pass.

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### APPENDIX 1

Specimens retrieved from gill-net operations. Approximate locations: 13 June—50°44'N, 179°59'E; 14 June—52°19'N, 178°54'W; 17 June—52°16'N, 178°40'W; 18 June—52°32'N, 177°40'W; 20 June—52°50'N, 176°10'W; 23 June—53°50'N, 176°43'W; 24 June—53°30'N, 176°42'W. Specimens noted HU to Hokkaido University, Faculty of Fisheries; specimens destroyed for heavy metals analysis. Specimens noted UW to University of Washington, Burke Memorial Washington State Museum; specimen numbers follow.

Short-tailed Shearwater: 13 June, HU-1; 20 June, UW CEC 06, 07, 13; 24 June, HU-1. Thick-billed Murre: 13 June, HU-1; 14 June, HU-2; 17 June, HU-3; UW JR 211-214; 20 June, HU-1. Ancient Murrelet: 14 June UW JR 215; 18 June, UW CEC 03. Least Auklet: 20 June, UW CEC 08; 23 June, UW CEC 05, 10. Crested Auklet: 13 June, HU-2; UW CEC 01; 02, 11; 20 June, UW CEC 12. Cassin's Auklet: 20 June, UW CEC 09; 24 June, UW CEC 04. Horned Puffin: 20 June, HU-1. Tufted Puffin: 13 June, HU-1; 14 June, HU-1; 18 June, UW CEC 14.

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