

DISTRIBUTION AND ABUNDANCE OF MARINE BIRDS BREEDING BETWEEN AMBER AND KAMISHAK BAYS, ALASKA, WITH NOTES ON INTERACTIONS WITH BEARS

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In 1980 Congress established the 3.5 million-acre Alaska Maritime National Wildlife Refuge, the world's largest marine bird and mammal sanctuary. In a continuing effort to assess the seabird colonies on the some 2500 islands comprising this refuge, the mainland cliffs and islands along the eastern half of the Alaska Peninsula were surveyed in 1980 and 1981. Much of the survey area also lies within the Becharof National Wildlife Refuge and Katmai National Park. Recent offshore oil leasing in Shelikof Strait and lower Cook Inlet requires better documentation of the region's nesting seabirds.

General information on the Alaska Peninsula and some adjacent islands is provided by Murie (1959) and Gabrielson and Lincoln (1959). The first cursory reconnaissance of some of the seabird colonies between Amber and Kamishak bays was conducted in June 1973 (Sowls et al. 1978). In 1973 only a week was spent observing seabirds along this 1000-km stretch of the Alaska Peninsula from a boat. Bailey and others visited parts of this region opportunistically in 1976, and some colonies were more closely viewed from inflatable boats (Sowls et al. 1978), but generally no landings were made, and no time was spent on islands at night in search of nocturnal nesting seabirds.

The coastline to the southwest from Amber Bay to Mitrofanina Island was surveyed in 1979 (Bailey and Faust 1981), and Kamishak Bay to the north was surveyed in 1978 (Sowls et al. 1978). Breeding avifauna on Ugaiushak Island has recently been studied extensively (Wehle et al. 1977, Wehle 1978).

The purpose of surveying this segment of the Alaska Peninsula was to locate seabird colonies, determine species composition, and estimate numbers, or at least depict orders of magnitude of species or concentrations which are difficult and time consuming to enumerate. Only after preliminary surveys can key sites be identified for future long-term monitoring of population trends. Proper management of marine birds can then follow based on assessments of long-term population fluctuations of seabirds in relation to commercial fishing, offshore oil exploration, and changes in climatic and oceanographic factors.

STUDY AREA AND METHODS

The 150 islands and adjacent irregular coastline between Amber and Kamishak bays cover roughly an 8000 km² area, approximately 56°45'N, 157°20'W to 59°10'N, 154°05'W (Figures 1 and 2). The islands range from unnamed rocks and islets less than 1 ha in size to 300-ha Takli Island; elevations of islands range from a few meters above sea level at Douglas Reef to

160 m at David Island. Most islands are rugged like the adjacent coast of the Alaska Peninsula, but some, like Shaw and Jute islands and those in Wide Bay, are low and relatively flat.

Frequent cloud cover, wind and precipitation prevail in this area. Climatic data for the overall region are available only from Kodiak Island and sporadically from Chignik, the only village on the southeastern part of the Alaska Peninsula. The July mean temperature at Chignik is 11°C with a range of 24°C to 1°C. Chignik receives an annual average of 323 cm of precipitation.

Alpine and moist tundra characterize the islands and much of the adjacent coast. Insular vegetation is dominated by Beach Wildrye (*Elymus arenarius*) and other grasses, sedges and umbellifers. Inland portions of larger islands with few surface- and burrow-nesting seabirds, such as those in Wide Bay, are generally dominated by Crowberry (*Empetrum nigrum*), whereas those with large numbers of burrowing birds, such as Central Island, are covered by grasses and umbellifers, primarily Common Cowparsnip (*Heracleum lanatum*), Seawatch Angelica (*Angelica lucida*) and *Conioselinum chinense*. Scattered Sitka Spruce (*Picea sitchensis*) and Balsam Poplar (*Populus balsamifera*) occur on a few islands in Katmai National Park.

A 4-week reconnaissance involving roughly 500 km of coastline began at Jute Bay on 17 June 1980 and proceeded southwestward toward Amber Bay. On 1 July 1981 a 3-week survey began in Kanatak Lagoon in Portage Bay and proceeded northeastward to Nordyke Island in Kamishak Bay. Portage Bay was bypassed in 1980 because of bad weather. We surveyed all islands and nearly all of the adjacent Alaska Peninsula with a 5-m Avon inflatable boat and two 25-hp outboards. In addition to circumnavigating all islands, we went ashore on over 65 islands. It was not necessary to land on many of the smaller islands in the study area because of the absence of any evidence of breeding seabirds, and a few islets with birds were inaccessible or could not be landed on because of rough seas. Ugaishak Island was not visited in 1980 because of recent studies there (Wehle 1978).

No counts were conducted during periods of high winds, heavy rain, inadequate light, or markedly low ceilings and visibility. Colonies were indicated on 1:63,360 scale USGS maps. We noted nocturnal nesting species by their vocalizations after dark and by checking burrows.

Population estimates for kittiwakes and cormorants were derived from nest counts, and for murres were based on numbers seen on nesting cliffs and on the water below cliffs. Estimates of murre populations were made in good weather during the middle of the day between the end of egg-laying and the start of fledging, when numbers are most stable (Birkshead and Nettleship 1980). Our counts represent numbers present at a particular time and should be regarded as only approximations of actual breeding populations because of considerable variability in daily and hourly colony attendance and because of the presence of unknown numbers of nonbreeding murres. Accurate determination of the numbers of breeding murres at each colony requires establishment of study plots and repeated counts over a period of several days, efforts beyond the scope of this reconnaissance. From the inflatable, we counted the numbers of murres on cliffs and rafted on the water below them in groups of 10 and 100, using cracks and other features in the cliffs to

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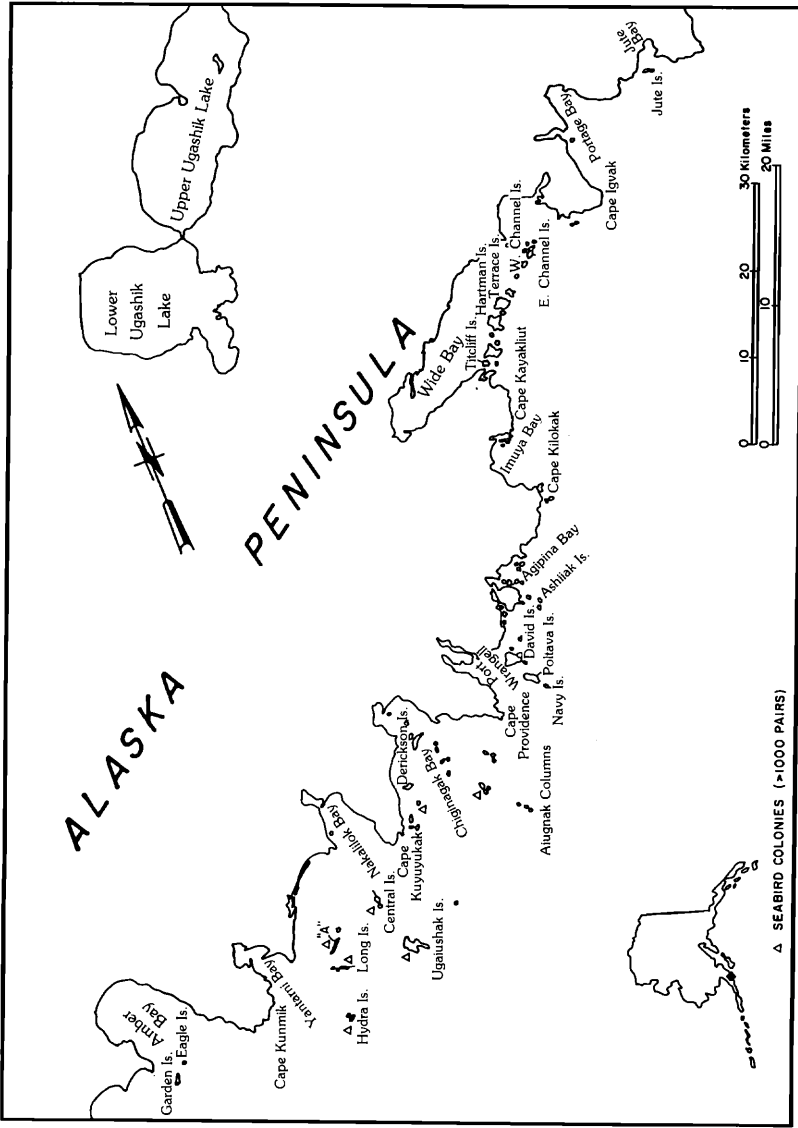


Figure 1. Islands south of the Alaska Peninsula between Jute Bay and Amber Bay, showing location of largest seabird colonies in 1980.

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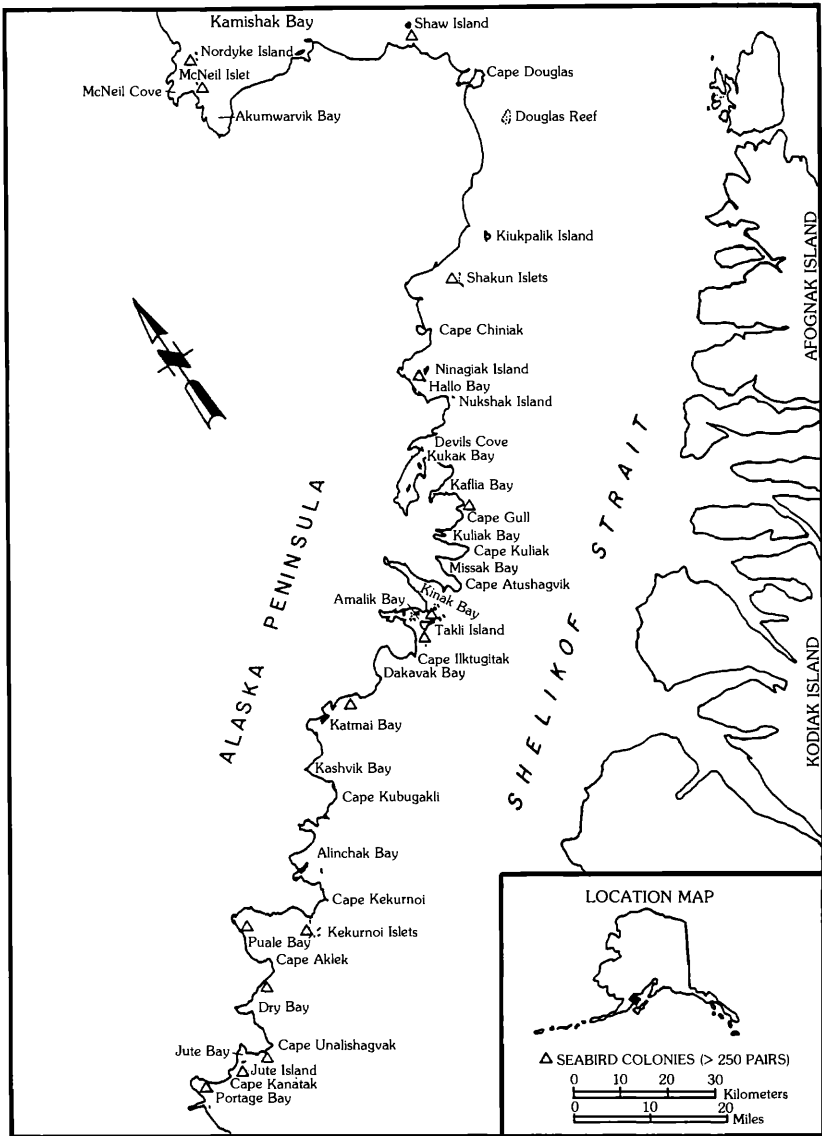


Figure 2. Islands south of the Alaska Peninsula between Jute Bay and Kamishak Bay, showing location of largest seabird colonies in 1981.

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partition big colonies. Except for a few colonies visited at the end of the 1981 survey, counts occurred during incubation.

Gull estimates were formulated from numbers of nests and pairs observed on given islands. On small islands we walked the entire area to locate nests; at large colonies, such as on Ninagiak and Shaw islands, we counted gull nests on a portion of the island and then made extrapolations for remaining gull habitat; counts of obviously paired birds in nesting areas were also used. Estimates of gulls nesting on cliff ledges and atop inaccessible stacks were based on counts of evidently territorial birds. Gulls were incubating at the first part of the survey; chicks were present on islands visited later in the survey.

Puffin numbers were derived from a combination of adults repeatedly seen at specific locales and from estimates of burrow numbers in dense colonies. Like most other colonial nesting seabirds, attendance at puffin colonies varies with season, time of day and weather. The large number of islands, extensive distances, foul weather and limited time to complete the reconnaissance precluded establishing any transects or quadrats to determine numbers of burrows and frequency of occupancy. Since insufficient time and personnel were available to establish adequate numbers of census plots on any island to determine statistically valid populations (Nettleship 1976), our estimates should be regarded as minimal indices of population size. Estimates are most useful for comparisons in orders of magnitude between different islands. Since we camped on all islands with large puffin colonies, repeated counts of numbers of birds observed were made at different times of day, or on successive days in some instances, and the highest estimates were used in each case. Puffin burrows were excavated periodically on various islands; birds were still incubating, except on some of the last islands examined, where some downy chicks were encountered. On some islands numbers of active burrows appeared more abundant than accounted for by puffins in the area. In such cases estimates were based more on burrow numbers than on numbers of puffins seen.

Populations of nocturnal hydrobatids and alcids were described as "present" (only a few present) or "abundant" (thousands), depending on the intensity of activity and vocalization and the extent of habitat used.

Estimates of Pigeon Guillemots (*Cephus columba*) and Parakeet Auklets (*Cyclorhynchus psittacula*), which utilize rock crevices, represent the number of birds sighted at various islands. No breeding estimates were made for Kittlitz's or Marbled murrelets (*Brachyramphus brevirostris* or *B. marmoratus*), both of which are solitary.

RESULTS AND DISCUSSION

Estimated numbers of breeding marine birds on various islands in 1980 and 1981 are indicated in Table 1 and 2, respectively. The 18 species recorded are discussed below in approximate descending order of abundance in the region. The data for Ugaiushak Island are taken from Wehle et al. (1977)

MURRES. Most of the 85,000 murres in the region nest on the cliffs in or west of Puale Bay, and the only other large colony is on Ugaiushak Island. Murre numbers reported along the cliffs in the Puale Bay area in 1976 (Sowls et al. 1978) were nearly 20%

Table 1. Estimated breeding seabird populations (pairs) between Jute Bay and Amber Bay on the south side of the Alaska Peninsula in 1980.

| Species | Jute | Portage Bay | Wide Bay group | Imuya Bay group | Kilokak Rocks | Ashiak | David | Pollava | Navy | Chiginagak Bay group | Aiugnak Columns | Ugaiushak | Central | Unnamed is. "A" | Long | Hydra | Garden-Eagle | SPECIES TOTALS |
|--------------------------|------|-------------|----------------|-----------------|---------------|--------|-------|---------|------|----------------------|-----------------|-----------|---------|-----------------|------|-------|--------------|----------------|
| Fork-tailed Storm-Petrel | | | | | | | | | | P | 1500* | P | A | | | | | 61 |
| Leach's Storm-Petrel | | | | | | 10 | | | | 15 | 34 | | P | | 1 | | | 644 |
| Double-crested Cormorant | 1 | | 15 | 80 | 20 | 20 | 60 | | | 105 | 2 | 57 | 5 | | 30 | | | 1954 |
| Pelagic Cormorant | | 250 | 145 | 5 | 60 | 1 | | | | 85 | | 173 | 175 | | 360 | | | 134 |
| Red-faced Cormorant | | 950 | | | | | 2 | 3 | 2 | 12 | | 26 | 3 | 10 | 4 | 3 | | |
| Black Oystercatcher | 4 | 4 | 45 | 10 | 1 | 2 | | | | | | 6 | | | | | | 6 |
| Parasitic Jaeger | | | | | | | | | | 60 | 45 | 800 | 160 | 100 | 75 | 35 | | 1730 |
| Glaucous-winged Gull | | | 80 | 130 | 40 | 70 | 20 | 35 | | 7025 | | 4500 | | | | | | 11,540 |
| Black-legged Kittiwake | 15 | | | | | | | | | 400 | | 4600 | | | | | | 5000 |
| Murre spp. | | | | | | | | | | 145 | 5 | 235 | 5 | 650 | 100 | 40 | 75 | 1510 |
| Pigeon Guillemot | 30 | 10 | 110 | 5 | 10 | 35 | 15 | 35 | 5 | | | P | P | 40 | 15 | 120 | | 450 |
| Ancient Murrelet | | | | | | | | P | | | P | | | | | | | |
| Parakeet Auklet | | | | | | | | | | | | P | | | | P | | |
| Rhinoceros Auklet | | | | | | | | | | | | | | | | | | |
| Horned Puffin | | | 10 | | 200 | 200 | 190 | 50 | 50 | 15 | | | 2500 | 400 | 100 | 200 | 80 | 12,945 |
| Tufted Puffin | 200 | 10 | 75 | 70 | 150 | 50 | 60 | 20 | 20 | 1500 | | 7000 | 2500 | 375 | 3000 | 1800 | 50 | 16,860 |
| ISLAND TOTALS | 314 | 1300 | 530 | 140 | 231 | 428 | 297 | 383 | 77 | 9362 | 52 | 26,481 | 5573 | 1575 | 3685 | 2198 | 208 | 52,834 |

P = Present A = Abundant *Not included in totals

Table 2. Estimated breeding seabird population (pairs) between Jute Bay and Kamishak Bay, Alaska Peninsula, in 1981.

| Species | Cape Unalishagvak and vicinity | SW Cape Akleik | Puale Bay | Kekurnoi Islets | Alinchak Bay area | Katmai Bay | Amalik-Kinak bays | Cape Gull area | Kukak Bay area | Ninaglak Island | Shakun Islets | Kiukpakik Island area | Shaw Island area | Nordkye Island area | SPECIES TOTALS |
|--------------------------|--------------------------------|----------------|-------------|-----------------|-------------------|------------|-------------------|----------------|----------------|-----------------|---------------|-----------------------|------------------|---------------------|----------------|
| Double-crested Cormorant | | | | | | | 10 | | | | | | 80 | 45 | 55 |
| Pelagic Cormorant | 15 | | 5 | 85 | | 20 | 330 | 5 | 30 | | | | 15 | | 570 |
| Red-faced Cormorant | 5 | | 1070 | 5 | | 100 | 200 | | 1 | | | | 20 | 10 | 1396 |
| Black Oystercatcher | | | | 15 | 5 | | P | 8 | 20 | 20 | 10 | 5 | | | 123 |
| Mew Gull | | | | | | | | | | | | | | | |
| Glaucous-winged Gull | 40 | | 115 | 50 | | 150 | 145 | 60 | 50 | 2000 | 100 | 15 | 1200 | 500 | 4425 |
| Black-legged Kittiwake | 600 | | 3250 | 30 | 135 | | | 265 | 10 | | 80 | | | | 1120 |
| Murre spp. | 19,000 | 15,000 | | | | | | | | | | | | | 37,250 |
| Pigeon Guillemot | 10 | | 10 | 40 | 30 | 5 | 170 | 50 | 75 | 10 | 100 | 50 | 10 | 10 | 570 |
| Parakeet Auklet | | | | | | | | | | | 10 | | | | 10 |
| Horned Puffin | 30 | | | 20 | | | 10 | | | 1000 | 300 | | 30 | | 1390 |
| Tufted Puffin | | | 50 | 50 | | | 280 | 50 | 10 | 2000 | 350 | 30 | 350 | 50 | 3220 |
| ISLAND TOTALS | 19,700 | 15,000 | 4500 | 295 | 170 | 275 | 1155 | 438 | 196 | 5030 | 950 | 100 | 1705 | 615 | 50,129 |

P = Present

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higher than our estimates 5 years later, although this difference may be due to counting discrepancies or vagaries in colony attendance. In 1977 Common Murres (*Uria aalge*) outnumbered Thick-billed Murres (*U. lomvia*) more than 10 to 1 on Ugaiushak (Wehle 1978). Seventy percent of the 800 individuals on an isle in Chiginagak Bay were Common Murres. No Thick-billed Murres were seen at the huge colonies at Cape Unalishagvak and west of Cape Aklek. We did not visit McNeil Islet in Kamishak Bay because of adverse tides; however, 2000 Common Murres nested there in 1978 (Sowls et al. 1978). Although murre colonies in the Puale Bay area are the largest on the Alaska Peninsula mainland, they are less than half the size of the nearby populations in the Semidi and Shumagin islands (Sowls et al. 1978). In 1978 the Puale Bay colonies ranked only 38th in size statewide (Anon. 1979).

TUFTED PUFFIN. Over 40,000 Tufted Puffins (*Fratercula cirrhata*) were estimated on 26 islands. Approximately 35% of the breeding puffins were on Ugaiushak Island, which accounts for over 25% of the total diurnal seabirds breeding in the region. Most of the remaining Tufted Puffins bred on Long, Central, Ninagiak and Hydra islands.

A sizeable Tufted Puffin colony on an unnamed island in the southeastern part of Chiginagak Bay was destroyed by a Brown Bear (*Ursus arctos*). When we visited this island on 2 July 1980, only about 100 puffins were milling about below the grassy, burrow-ridden headlands, and a bear was systematically excavating burrows around the island's perimeter. Entire slopes were dug up to the depths of nest chambers, and egg shells and feathers were common. Very few puffins remained in the small number of burrows overlooked by this bear. We noted similar destruction of other smaller colonies off the Katmai National Park coastline in 1981 and near Afognak Island in 1983.

Only about 200 puffins were recorded at David and Poltava islands in 1980, yet 17,000 were reported there in 1973 (Sowls et al. 1978). Furthermore, we found few burrows on these two islands, which are frequented by bears. It is possible that large feeding flocks off these islands were mistaken for local breeders. Wehle et al. (1977) estimated nearly three times more Tufted Puffins on Central Island in 1976 than we did in 1980; our puffin estimates on nearby Long and Hydra islands were considerably higher than those made in 1976 (Sowls et al. 1978). The only significant colony north of Jute Bay was of approximately 2000 pairs on Ninagiak Island. Compared to most other areas off the Alaska Peninsula, this section of coastline has few Tufted Puffins. The center of abundance of this species is in the eastern Aleutians, where over 1,000,000 or nearly 40% of the state's population breed (Nysewander et al. 1978).

HORNED PUFFIN. An estimated 29,000 Horned Puffins (*Fratercula corniculata*) nested on at least 25 islands or capes in the survey area, with the populations on Ugaiushak and Central islands accounting for 80% of the birds in the region. In 1976, 9000 Horned Puffins were estimated by Wehle et al. (1977) on Central Island, compared to only 5000 in 1980. Central Island is composed largely of colluvium and cliffs, which provide outstanding crevice habitat. Though only 7 km from the mainland, this was the only sizeable island where no significant evidence of bears was found. The only other significant colony east of Amber Bay is on Ninagiak Island. The total number of Horned Puffins breeding along this section of the Alaska Peninsula is small compared to populations in the Shumagins, Semidis and other islands south and west of the survey area (Sowls et al. 1978).

BLACK-LEGGED KITTIWAKE. Nearly 13,000 pairs of Black-legged Kittiwakes (*Rissa tridactyla*) nested on eight islands and two mainland cliffs. The largest colony was situated at a small island on the western side of Chiginagak Bay. We found 7000 pairs on this island compared to less than 2700 pairs in 1976 (Sowls et al. 1978). Four other small colonies reported in 1976 were not recorded on our reconnaissance. Except in the Sandman Reefs off the west end of the Alaska Peninsula, fewer kittiwakes nest along this stretch of the Peninsula than along any other segment (Sowls et al. 1978, Bailey and Faust 1981).

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STORM-PETRELS. Thousands of Fork-tailed Storm-Petrels (*Oceanodroma furcata*) nest in crevices on Central Island. This species was discovered only on two other islands besides Central. The previously mentioned unnamed island on the eastern side of Chiginagak Bay on which a bear had destroyed the Tufted Puffin colony was the only island utilized extensively by bears which also had nesting nocturnal seabirds. The population on this island is small and is scattered in rocky areas, judging from vocalization. Three thousand Fork-tails were estimated on Ugaiushak Bay (Wehle et al. 1977). No nocturnal nesters were found north of Chiginagak Bay, leaving a gap of over 300 km to the next known storm-petrel colonies in the Barren Islands (Bailey 1976). No colonies of nocturnals have been recorded across Shelikof Strait along the northwest side of Kodiak Island (Sowls et al. 1978).

Leach's Storm-Petrels (*O. leucorhoa*) occurred in small numbers only on Central and Ugaiushak islands. Enormous numbers of both species of storm-petrels nest in the Shumagin Islands and Sandman Reefs southwest of this survey area (Sowls et al. 1978).

GULLS. Over 70% of the 6150 pairs of Glaucous-winged Gulls (*Larus glaucescens*) recorded for this region were on Ninagiak, Shaw, Nordyke and Ugaiushak islands. A few small, scattered colonies, such as in Kashvik and Agripina bays and on Douglas Reef, are not included in Table 1 or 2. Although nests were located on 62 islands or headlands, breeding was markedly limited by bears, as destroyed or abandoned nests were frequently found. We estimated only approximately 200 gulls collectively on David and Poltava islands, yet 2000 were reported here in 1973 (Sowls et al. 1978). Also, 3000 were reported in 1973 on the islands off Cape Igvak, compared to 170 nests counted in 1980. Ninagiak, the island with the largest colonies in the region, has not been previously recorded (Sowls et al. 1978). Likewise, the colonies in the Shakun Islets to the north were previously unrecorded. Our estimate of 2400 gulls breeding on Shaw Island, the second largest colony along the upper Alaska Peninsula, compares with only 500 recorded there in 1978 (Sowls et al. 1978). We found no gulls nesting on Eagle Island, on which 500 were recorded in 1973. Immature Mew Gulls (*L. canus*) were noted at Port Wrangell, and they probably breed in Amalik Bay.

With the exception of the segment of the Alaska Peninsula between Sutwik and Mitrofanía islands, fewer gulls nested along this part of the Peninsula's coastline than elsewhere (Sowls et al. 1978, Bailey and Faust 1981).

PIGEON GUILLEMOT. Guillemots nested on almost all islands of significant size with suitable habitat as well as along some sections of the mainland. Sixty percent of the guillemots recorded west of Jute Bay were on Ugaiushak and on an unnamed island (designated "A") north of Long Island. The latter small island had at least 1300 guillemots, and 3000 were estimated here in 1973 (Sowls et al. 1978). This species was common in Chiginagak Bay, with the largest numbers on Derickson Island. Amalik and Kukak bays and the Shakun Islets had the largest numbers of guillemots in the eastern portion of the survey area.

CORMORANTS. Red-faced Cormorants (*Phalacrocorax urile*) significantly outnumbered Double-crested (*P. auritus*) and Pelagic (*P. pelagicus*) cormorants, but the last species was more widespread. The largest Red-faced Cormorant colonies were in Portage and Puale bays and at Takli Island in Amalik Bay, whereas the Kekurnoi Islets had the largest Pelagic Cormorant populations. Double-crested Cormorants occurred on only eight islands. Although 1500 breeding cormorants were reported on David and Poltava islands in 1973 (Sowls et al. 1978), we saw only 70 nests. Adverse weather prevented our visiting a reported colony of about 600 cormorants nesting on mainland cliffs inside Wide Bay (Sowls et al. 1978). All cormorants nesting on the islands in Wide Bay were on an unnamed island east of Titcliff. We found over 2200 cormorants nesting in the Puale Bay area, but only about 240 were recorded here previously (Sowls et al. 1978). In 1980 we found almost 800 cormorants on Long

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Island, where none were reported in 1976, and large population increases were documented at Central Island, Chiginagak Bay, Shaw Island and along the Katmai Coast. The only area off the Alaska Peninsula with larger cormorant colonies than between Amber and Kamishak bays is the Shumagin Islands (Sowls et al. 1978).

PARAKEET AUKLET. Although we observed Parakeet Auklets on eight islands, 75% nested on Central and Hydra islands. Since a few auklets were spotted around Poltava Island and the Aiugnak Columns, small breeding populations are presumed. In 1973 Parakeet Auklets were noted on only three islands in the region (Sowls et al. 1978). We found only one small colony east of Amber Bay. The overwhelming majority of Parakeet Auklets nesting along the Alaska Peninsula is found in the Shumagin and Semidi islands (Sowls et al. 1978).

MARbled and KITTLITZ'S MURRELETS. We often observed these two species feeding in certain bays along the Alaska Peninsula, especially Portage, Kinak, Agripina, Nakalilok and Amber bays and in Port Wrangell. Pairs or small flocks of murrelets sometimes were associated with Pigeon Guillemots. Kittlitz's Murrelets generally outnumbered their congener.

ANCIENT MURRELET. We recorded Ancient Murrelets (*Synthliboramphus antiquus*) only on Central and Ugaiushak islands. Breeding on the latter island was confirmed by discovery of an abandoned egg in 1976 and 1977 (Wehle 1978); on Central Island we periodically heard Ancient Murrelets in the incessant din of Fork-tailed Storm-Petrel calls. The only Ancient Murrelet noted in 1981 was a single bird outside of Alinchak Bay. Fewer Ancient Murrelets are found along this stretch of the Peninsula than in any other section (Sowls et al. 1978, Bailey and Faust 1981).

RHINOCEROS AUKLET. *Cerorhinca monocerata* nested on Hydra Island and probably on Ugaiushak. Since a few birds were seen flying to and from shore on Ugaiushak in 1976 and 1977, a small breeding population was presumed (Wehle 1978). We heard Rhinoceros Auklets fluttering about after dark and occasionally vocalizing on a headland on the north side of Hydra Island, and a newly hatched chick was excavated from a burrow on 4 July 1980. Auklets nested in small colonies of about 20 pairs on promontories. A storm forced us off the island before we were able to enumerate burrows in daylight. Two individuals were spotted off the Shakun Islets, but no evidence of nesting existed. Only five small colonies have been located south of the Alaska Peninsula; numbers appear highest in the Semidi Islands (Sowls et al. 1978).

AMERICAN BLACK OYSTERCATCHER. Oystercatchers (*Haematopus bachmani*) were noted on at least 60 islands. The greatest concentration of oystercatchers was recorded on the 21 islands in Wide Bay, especially East Channel Island and surrounding islets. Oystercatchers also were especially common on Ninagiak, Shaw, Ugaiushak and unnamed island "A". They were comparatively scarce on the islands in Chiginagak Bay.

PARASITIC JAEGER. Jaegers (*Stercorarius parasiticus*) nested only on Ugaiushak Island, where Wehle (1978) found six pairs in 1977. The only Parasitic Jaeger spotted in 1980 was on Eagle Island, and two were sighted at Cape Douglas in 1981. Elsewhere in the region jaegers nest only in the Shumagins, Semidis and on Sutwik Island (Bailey and Faust 1981, pers. obs.).

OTHER SHOREBIRDS. Shorebirds were generally scarce on the islands in this region, perhaps as a result of the frequent disturbance by bears and the lack of ponds and marshy areas on most islands, except for in Wide Bay and on David, Kiukpalik and Shaw islands. Least Sandpipers (*Calidris minutilla*) probably bred on Garden, Jute and East Channel islands, and Semipalmated Plovers (*Charadrius semipalmatus*) evidently nested on the latter two islands. Red-necked Phalaropes (*Phalaropus lobatus*) may breed on some of the islands in Wide Bay and on Kiukpalik and Shaw

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islands. Nonbreeding Whimbrels (*Numenius phaeopus*) were observed on five islands. Rock Sandpipers (*Calidris ptilocnemis*) are likely breeders on Hydra and Jute islands. Small flocks of Black Turnstones (*Arenaria melanocephala*) frequented islands east of Alinchak Bay, particularly the Shakun Islets.

WATERFOWL. We encountered over 2200 Harlequin Ducks (*Histrionicus histrionicus*) on the survey; largest numbers were noted around the unnamed islands near Cape Igvak and Amalik, Puale and Kukak bays. Common Eiders (*Somateria mollissima*) were seen at 14 islands, and nests or broods were found on Ugaiushak, Long, Shakun, Douglas and Shaw islands. Most of the over 200 eiders recorded were on Ugaiushak and Shaw islands; 10 broods were noted on the latter island. A brood of Tundra Swans (*Olor columbianus*) was on Hartman Island. Single Red-breasted Merganser (*Mergus serrator*) and Northern Pintail (*Anas acuta*) nests were discovered on islands in Chiginagak and Wide bays, respectively. Several hundred mainly moulting Common Mergansers (*M. merganser*) occurred in fjords near Port Wrangell, and mergansers also abounded at Nordyke and Kiukpalik islands and at Sukoi, Kuliak, Amalik and Alinchak bays. Most of the 2500 White-winged and Surf scoters (*Melanitta fusca* and *M. perspicillata*) were in Kinak, Amalik, Kuliak and Jute bays and at the Shakun Islets and Kiukpalik Island. Mallards (*A. platyrhynchos*) and Northern Shovelers (*A. clypeata*) breed on Shaw Island, and Green-winged Teal (*A. crecca*) also are likely breeders on Shaw, an exceptionally productive island for waterfowl and shorebirds.

RAPTORS. We recorded a total of 145 Bald Eagles (*Haliaeetus leucocephalus*) and 29 nests west of Jute Bay, and 123 birds and 26 nests eastward to Kamishak Bay. The largest numbers of nests were on the islands in Wide Bay and in Kukak Bay. We found more eagles along the Amber-Kamishak Bay stretch of coastline than along similar segments of the Alaska Peninsula to the southwest. Brown Bears prey on accessible eagle nests, as four destroyed nests were encountered.

Peregrine Falcons (*Falco peregrinus*) nested on one island in 1977 (Wehle 1978) and were suspected breeders at two other locations. A Gyrfalcon (*F. rusticolus*) nest with a chick was found on Terrace Island in Wide Bay. This nest represents the second furthest south known record for this species in Alaska (C. White pers. comm.). Rough-legged Hawks (*Buteo lagopus*) nested on Terrace, Kiukpalik and Nukshak islands. Short-eared Owls (*Asio flammeus*) used Kiukpalik Island.

OTHER BIRDS. Twelve adult Red-throated Loons (*Gavia stellata*) and several chicks were noted on Shaw Island. Unlike along other segments of the Alaska Peninsula, no ptarmigan (*Lagopus* spp.) were found on any of these islands. Sixteen passerine species were recorded; David Island had the greatest diversity. Snow Buntings (*Plectrophenax nivalis*), which we have encountered occasionally on mountain tops of a few of the larger islands elsewhere off the Alaska Peninsula, were extremely abundant on the low-lying islands in Wide Bay.

Approximately 206,000 seabirds of 18 species nested in the region. No estimate was made for nocturnal nesting species or Kittlitz's and Marbled murrelets. Compared to numbers found in most other areas along the Alaska Peninsula and in the northwestern portion of the Gulf of Alaska, the number of seabirds nesting between Amber and Kamishak bays is low. Much larger populations are found in the Barren Islands and around Kodiak to the east, in the Semidi Islands to the south, and in the Shumagins to the southwest (Sowls et al. 1978). Nevertheless, certain colonies in the survey area, such as those on the cliffs near Puale Bay and on the islands around Chiginagak Bay, are of major regional importance. The gross discrepancies in population estimates between our 1980-81 survey and those made on some islands

visited briefly in 1973, 1976 and 1978 can only be partially explained by different observers and methods. No introduced foxes remain on any islands, and only three (David, Ugaiushak and unnamed island "A") evidently were used for fox farming (Bower and Aller 1917). Brown Bears supplant foxes on these islands as the primary limiting factor on nesting of most species of seabirds.

The ubiquitous bears probably are largely responsible for the fact that fewer seabirds nest between Kamishak and Amber bays than along any similar lengths of coastline on the Alaska Peninsula (Bailey 1978; Bailey and Faust 1980, 1981). Over 80% of the estimated 100,000 breeding seabirds between Jute and Kamishak bays are cliff-nesters. Certain island groups, such as those in Wide, Amalik and Kukak bays, are almost devoid of burrowing seabirds because of frequenting bears. We saw over 40 bears on or swimming between islands in the survey area, and trails, scat and diggings were encountered on nearly all islands. Sows with cubs were especially common. Unlike along the western half of the south side of the Alaska Peninsula, there are no villages along the eastern portion of the Peninsula; this lack of human habitation probably accounts for the widespread use of islands by bears in this region. Ten villages are located in the western part of the Peninsula, and local residents generally shoot any bears observed. Bears evidently were eliminated from the Shumagins and other islands off the lower Peninsula. The abundance of bears on islands off the upper Alaska Peninsula has probably greatly increased since 1912, when Katmai volcano buried several villages in ash. Subsequently, part of the coastline was designated a national park, and the area was never resettled. Hence, many seabird colonies undoubtedly disappeared after bears reinvaded islands off the upper Peninsula. Changes in seabird species composition and numbers caused by human influence on insular bear populations may have been as significant as those caused by insular fox farms in other regions.

No Arctic Ground Squirrels (*Citellus parryi*) or other rodents were found on any of the islands surveyed, probably reflecting the general lack of past fox farming, which was most likely due to the abundance of bears. Ground squirrels, voles and other rodents were introduced to the Semidis, Shumagins and many islands off the lower part of the Peninsula to supplement birds as a source of food for foxes.

Over 90% of the region's seabirds nested on seven islands and two mainland capes. The largest populations occurred in the vicinity of Cape Unalishagvak, on Ugaiushak, Central, Ninagiak and Long islands and on an unnamed island in Chiginagak Bay; the greatest species diversity (17) was found on Ugaiushak Island. A majority of the islands in the region had few or no nesting birds because of heavy use by bears. Pigeon Guillemots and American Black Oystercatchers were the most widely distributed species. Four nocturnal species nested in the western half of the region surveyed and were restricted to four islands. Thousands of Fork-tailed Storm-Petrels and some Leach's Storm-Petrels and Ancient Murrelets bred on Central Island. The Rhinoceros Auklet colony discovered on Hydra Island is only the fifth one known along the Alaska Peninsula.

Common Murres were the most abundant birds but were concentrated on two islands and three mainland cliffs. Tufted Puffins nested on 26 islands,

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and Black-legged Kittiwakes nested at 13 sites. Glaucous-winged Gulls nested on 62 islands or headlands, but most were recorded on 4 islands. Although Red-faced Cormorants were the most abundant of the three cormorant species present, Pelagic Cormorants nested on more islands; Double-crested Cormorants bred on only eight islands. Parakeet Auklets also inhabited eight islands, and half of the estimated 900 birds used Central Island. Parasitic Jaegers nested only on Ugaiushak.

This survey of seabird colonies along the Alaska Peninsula between Amber and Kamishak bays completes the systematic examination of the entire length of the Alaska Peninsula, except for a few small areas. This work complements similar incremental surveys conducted in the Aleutians, Kodiak, the Barren Islands, Kenai Peninsula, and other islands and segments of coastline along Alaska's mainland (Sowls et al. 1978, Nysewander et al. 1982, Bailey and Faust 1981, and others). With initial information on breeding seabird distribution largely complete, attention must now be devoted to long-term monitoring of population trends on key, representative colonies throughout Alaska.

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ADDENDUM

After this paper was in press a sole written reference to predation of seabirds by Brown Bears was inadvertently found. Bear predation has occurred on St. Lazaria, a 26-ha island in southeast Alaska used by huge numbers of nesting seabirds, mainly storm-petrels (pers. obs.). Willet (*Bird-lore* 14:419-426, 1912) indicated that Brown Bears are strong swimmers, and he reported that in June 1912 Indians encountered a bear destroying nesting birds on St. Lazaria. He later "searched the island thoroughly in hope of finding the marauder at work." Although the bear was no longer there, he noted that all over the top of the island there were excavations of the bear among storm-petrel nests. He estimated that at least 500 nests had been dug up, and "the incubating birds had been eaten feathers and all." Other species of seabirds had not been disturbed.

In 1977 A.M. Springer and D.G. Roseneau (pers. comm.) repeatedly watched a Brown Bear skillfully remove hundreds of murre eggs and chicks during July and August along narrow ledges on the high cliffs at Cape Lisburne, which is on Alaska's mainland between the Chukchi Sea and Arctic Ocean. A few other bears frequented these cliffs, and at least one bear took eggs and chicks at Cape Thompson, 80 km to the south.—EPB