

Annual Report

NOAA-OCSEAP Contract: 01-022-2538

Research Unit: RU-341/342

Study Task: A3

Reporting Period: October 1, 1976 to
March 31, 1977

Pages: i-vi + 55

FIELD STUDIES AT CAPE PEIRCE, ALASKA -- 1976

by

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Part XIII

of

POPULATION DYNAMICS AND TROPHIC RELATIONSHIPS OF MARINE BIRDS IN

THE GULF OF ALASKA AND SOUTHERN BERING SEA

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April 1, 1977

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ABSTRACT

Breeding biology of seabirds.

Colonies of Double-crested Cormorants (Phalacrocorax auritus), Pelagic Cormorants (P. pelagicus), Glaucous-winged Gulls (Larus glaucescens), Black-legged Kittiwakes (Rissa tridactyla), Common Murres (Uria aalge), and Tufted Puffins (Lunda cirrhata) were studied from 28 April to 9 September 1976. Abundance, distribution, breeding status, reproductive success, and factors influencing that success was determined for each species. General distribution of colonies in 1976 was the same as found by previous observers for all species except Pelagic Cormorants which shifted breeding areas. All suitable nesting areas were occupied by species for which the habitat appeared most appropriate. Although data from previous studies was not adequate to permit direct comparison of nesting densities, populations seemed to be similar to other years.

Breeding success of some species of seabirds nesting at Cape Peirce during 1976 differed from that observed in 1970 and 1973. Unusually low numbers of pairs of Common Eiders (Somateria mollissima), Glaucous-winged Gulls, and Double-crested Cormorants raised young, normal numbers of pairs of Black-legged Kittiwakes and Common Murres probably fledged fewer young, normal numbers of pairs of Pelagic Cormorants raised significantly more young, and fewer pairs of Tufted Puffins probably fledged young in 1976. Loss of eggs was attributed to red foxes (Vulpes fulva), Common Ravens (Corvus corax), or Eskimo eggng activities. Reasons for varied brood success are obscure, but may reflect available food resources.

Predation on seabirds.

Bird and mammal predators were observed on the Cape Peirce peninsula and on Shaiak Island from 28 April to 9 September. The Common Raven was the primary avian predator, and the red fox was the primary mammalian predator. Rough-legged Hawks (Buteo lagopus), Bald Eagles (Haliaeetus leucocephalus), Gyrfalcons (Falco rusticolus), and Peregrine Falcons (F. peregrinus) were not observed taking seabirds, or their eggs and young, and had minor impact on nesting seabirds. Glaucous-winged Gulls (Larus glaucescens) opportunistically took eggs and young of seabirds, and normally have a minor impact on nesting seabirds.

Avian and mammalian predators take accessible nests, thus selection of nest sites by seabirds occurs in part due to selection pressure by those predators. Common Murres minimized losses to avian predators by crowding together to preclude predators from landing among them. Black-legged Kittiwakes nested on parts of the cliffs where avian predators could not land. All seabirds nested on sheer cliffs or on the offshore island which were normally inaccessible to mammalian predators.

Spring migration, molt, and foraging areas of loons and waterfowl.

Loons and waterfowl were censused regularly from 28 April to 9 September to determine the pattern of spring migration, the location and

importance of feeding areas, and the chronology of molt. Migration of Red-throated Loons (Gavia stellata) began 3 May, and migration of Arctic Loons (Gavia arctica) began 5 May. Peak migration of Red-throated Loons, however, preceded that of Arctic Loons by 14 days. Peak migration of most waterfowl past Cape Peirce was during May, except for Surf Scoters (Melanitta perspicillata) whose peak migration occurred 20 June. Most waterfowl migrated in flocks of nearly equal sex ratios. Exceptions were flocks of male Pintail (Anas acuta), male White-winged Scoters (Melanitta deglandi), and female Oldsquaw (Clangula hyemalis).

Pre-molt flocks of waterfowl arrived after the peak of northward migration. Molting flocks of scoters, eiders, Harlequin (Histrionicus histrionicus), and Red-breasted Mergansers (Mergus serrator) were flightless from mid-July through September. Flightless birds were either adult males, or non-breeding subadults. Throughout the field season, each species foraged in areas that were non-overlapping in time or space.

I. Introduction.

This study of the birds of Cape Peirce is one of several site specific studies of marine birds conducted as part of the BLM/NOAA Outer Continental Shelf Environmental Assessment Program (OSCEAP). The objectives of these studies include:

1. To determine the number and distribution of each species relative to other species, to periods of the breeding season, and the characteristics of available habitat within the colony or study area.
2. To provide estimates of production or nesting success of principal species.
3. To establish and describe sampling areas or units which may be utilized in subsequent years or by other persons for monitoring the status of populations.
4. To determine the amount and kinds of foods utilized by principal species, when possible to determine the relationship of food selected to that available, and to describe daily foraging patterns.
5. To describe the chronology and phenology of events in the biology of breeding birds including changes in population from the onset of site occupancy in the spring through departure in fall.
6. To provide a comparison of current data with recent historical data.

Colonies of seabirds at Cape Peirce and Shaiak Island are part of a large complex of colonies included in the Cape Newenham National Wildlife Range which collectively may form the largest population of seabirds in the eastern Bering Sea. Birds from these colonies would be vulnerable to any extensive pollution by oil in the southern Bering Sea such as may occur with the development of petroleum in Outer Bristol Bay of the St. George Basin. In addition to the large colonies of nesting birds, large numbers of migrants pass the Cape or use the adjacent Nanvak Bay as a foraging area during migration.

Selection of the Cape Peirce study area was based primarily on its importance to marine birds, but the availability of prior information and long term continuation of studies by refuge personnel were considered in the selection process.

Observations of birds at Cape Peirce and Nanvak Bay were made intermittently by the refuge staff and other Fish and Wildlife Service (FWS) personnel between 1963 and 1971 (King 1966, King and Monson 1968, Hout 1969 and 1971) and provided general knowledge of species occurring in the area and numbers of waterfowl using Nanvak Bay. The most important effort to the present study was that by Dick and Dick (1971) who conducted

a careful biological survey of the area during the summer of 1970. The Dick's report contains extensively annotated accounts of all species of plants, mammals, and birds observed during their study. Much of the data collected is adequate for comparison with that of the present study.

Field work in 1976 was conducted by Margaret R. Petersen and Marilyn J. Sigman. Petersen arrived at the Cape Peirce field camp 28 April, and Sigman arrive 2 June. Both left 9 September. Data on spring migration and colony establishment were collected by Petersen; that on plants was collected by Sigman. Data on all other aspects of the study were collected jointly by both observers.

The study depended primarily upon direct observations of birds from various vantage points. Procedures necessarily varied with species and the nature of the habitat in which they occurred. The report is divided into major topics including breeding biology (Section III), predators (Section IV), and migration, molt, and use of foraging areas (Section V). All birds and mammals are listed in Appendix I, and a possible aging technique for Common Murres is described in Appendix II. Procedures used to evaluate individual species and habitats are described in these sections as appropriate.

The Cape Newenham National Wildlife Range supplied use of the field camp at Cape Peirce, and communications and logistic support throughout the field season.

II. Study Area.

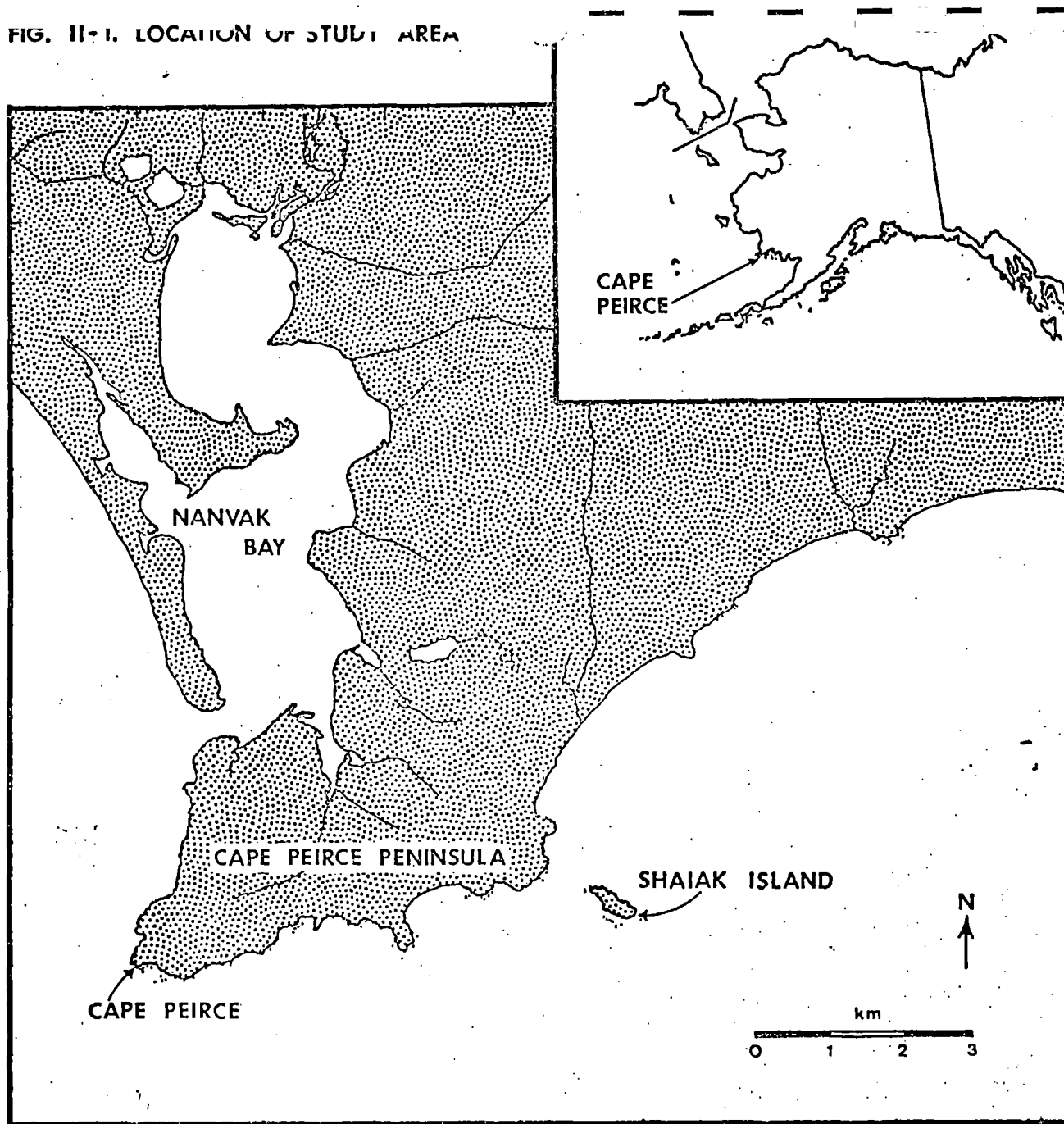
Cape Peirce (58°35'N, 161°45'W) is located on the base of Cape Newenham which forms the northern boundary of Bristol Bay (Figure II-1). The cliffs of the Cape Peirce peninsula and Shaiak Island range in height from 30 to 122 meters. The west facing cliffs of the peninsula are of schistose and phyllitic rocks, while the south facing cliffs and those of Shaiak Island are of volcanic rocks, siliceous siltstone, and chert (Hoare and Coonrad 1961). The cliffs have numerous ledges, cracks, and outcrops which provide nest sites for Pelagic Cormorants, Black-legged Kittiwakes, and Common Murres. Horned Puffins (Fratercula corniculata), Pigeon Guillemots (Cephus columba), and Parakeet Auklets (Cyclorhynchus psittacula) nest in the cracks and crevices of inaccessible rubble beaches.

Vegetation of the study area is described in Dick and Dick (1971). The area is generally treeless, with willows up to 1.5 meters in height found along streams. Heath tundra and fell-field tundra are the predominant vegetation types found on the Cape Peirce peninsula. Shaiak Island differs vegetatively from the peninsula, with Elymus arenarius, Artemisia arctica, and Calamagrostis canadensis being the predominant plants.

Waters near the Cape Peirce peninsula vary from 18 meters deep between the peninsula and Shaiak Island, to shallow soals 4 to 5 meters deep off the cape (Coast and Geodetic Survey 1954). Nanvak Bay is shallow with most of the sandy bottom exposed during minus tides. The bay supports extensive eelgrass beds used by migratory and resident waterfowl (King 1966, Dick and Dick 1971).

The climate of nearby Cape Newenham has been described by King (1966) as being generally inhospitable to man. Cape Peirce weather generally approximates that of Cape Newenham (Hout 1970). Most days in 1976 had either wind, fog, rain, snow, or combinations of those. The weather was generally milder in 1976 than that recorded by Dick and Dick (1971), with only one day of winds over 50 knots in the summer of 1976 (Appendex III). Nanvak Bay and offshore waters are normally ice covered in winter, although open leads caused by wind and tidal currents are common.

FIG. II-1. LOCATION OF STUDY AREA



III. Breeding Biology of Seabirds.

Previous studies of the breeding biology of seabirds at Cape Peirce are limited to the field seasons of 1970 (Dick and Dick 1971), and 1973 (M. H. Dick pers. comm.), and to general information on abundance and distribution of colonies (King 1966, Hout 1969 and 1971, J. C. Bartonek pers. comm.). Information on the abundance, distribution, breeding status, and reproductive success of all species is necessary for predicting the long term biological effect of losses that may occur as a result of the development of the petroleum resources of the outer continental shelf. These losses would have the most significant effect on those species having the lowest reproductive rate under normal conditions.

METHODS

Unless otherwise stated, data were obtained by observing birds from vantage points on the cliffs using a 20-power spotting scope and/or binoculars. Observation sites were marked with rock cairns and/or numbered wooden stakes, then were mapped and photographed as an aid to relocation of the site. Much of the nesting area on Shaiak Island was accessible and on such areas total coverage or sampling with quadrats or line transects was possible. Nesting areas were photographed from observation sites to facilitate observations throughout the field season, and to assist in comparison of data from 1976 with that from other years.

Double-crested Cormorant.

Nests of Double-crested Cormorants (Phalacrocorax auritus) were recorded as they were found on the slopes of Shaiak Island. All nests were re-examined weekly from 11 June to 22 August as weather allowed. Information on clutch sizes, numbers of young, and nest status was recorded. Six young were banded using USFWS bands with red streamers attached, and with numbered red leg bands to permit subsequent visual identification of individuals. General fledging dates of the colony were determined by observations of marked young away from nests, as well as from observations of nests.

Pelagic Cormorant.

General features of the Pelagic Cormorant (Phalacrocorax pelagicus) nesting habitat and the distances between nests were obtained from photographs of nests and nesting areas. As weather allowed, nesting areas and potential nesting areas were visited twice weekly from the date nests were found until fledging of young. At each visit the number of adults at each nest site, the number of incubating or brooding adults, the number of large young in each nest, and any unusual occurrences were noted.

Twenty-seven nests in a 805 meter long cliff area were observed three times daily from 28 April to 8 September to record fluctuations of numbers. Clutch sizes, dates of laying, dates of loss of eggs and young, and fledging dates were also recorded.

Common Eider.

The Common Eider (Somateria mollissima) nesting area on Shaiak Island was searched for eider nests weekly 6 June to 22 August when weather permitted. Nests on the peninsula were recorded when found, although no concerted effort was made to search for duck nests.

Glaucous-winged Gull.

Glaucous-winged Gulls (Larus glaucescens) were censused on Shaiak Island by using line transects, quadrat samples, and total counts of birds in large colonies as described by Nettleship (1976). One quadrat 30.5 by 30.5 meters was established during early incubation. Territorial birds were observed from a blind to determine the number of incubating birds and failed breeding birds.

Eggs were measured, weighed, and marked with indelible ink when found in nests. Nests in the line transect and quadrat samples containing eggs were marked with numbered tongue depressors pushed almost completely into the ground to facilitate re-finding nests. All marked nests were visited weekly.

Black-legged Kittiwake.

Twenty-four nesting areas of Black-legged Kittiwakes (Rissa tridactyla) were censused as soon as melting snow permitted observations from cliff tops. Areas were delineated and photographed as described by Nettleship (1976). Mainland nesting areas were visited twice weekly throughout the field season to determine the number of territories, the number of birds, the number of birds apparently incubating, the number of young, and any unusual occurrences. Similar observations were made of nesting birds on Shaiak Island weekly when weather permitted.

A 805-meter long cliff area containing four distinct nesting areas were visited three times daily from 29 April to 8 September to assess fluctuations in the number of birds using the colony area. More intensive observations of birds on 106 territories were made to determine egg laying dates, clutch sizes, loss of eggs and young, hatching dates, and fledging dates. No attempt was made to follow particular nests due to dense numbers and the apparent turnover of adults which occupied unsuccessful nests.

Common Murre.

Seventeen nesting areas of Common Murres (Uria aalge) were observed in the manner described for kittiwakes. Nesting areas on the peninsula were visited twice weekly; and those on Shaiak Island weekly or as weather permitted.

A 805-meter long portion of the cliffs containing three distinct nesting areas were visited three times daily to assess diurnal and seasonal variations in murre numbers. Two areas containing 50 and 75 breeding birds, respectively, were observed to determine egg laying dates, rate of loss of eggs and young, hatching dates, and dates young

left the cliff. As murres do not build nests, and brooding birds are difficult to identify, each adult was watched until it moved enough to permit establishing the presence or absence of eggs or young.

Tufted Puffin.

The density and reproductive status of the Tufted Puffin (Lunda cirrhata) on Shaiak Island was estimated from thirty 5 by 5 meter plots. Cairns were built at the beginning of each series of plots to facilitate their relocation. Plots were established weekly from incubation through two weeks into the brood rearing period. Burrows containing adults, eggs, or young as well as those with evidence of fresh digging, a worn entrance, egg shells, or fresh fecal material were considered to be occupied. Occupied burrows were marked near the entrance with numbered tongue depressors. Numbered burrows were visited weekly or as weather permitted to determine the status of eggs and young. Twenty-four eggs and eleven young were weighed and measured. Twelve adults and eight young were banded with USFWS leg bands. Seven of the young were also banded on the left leg with numbered red bands.

Other Alcids.

Pigeon Guillemots (Cepphus columba), Horned Puffins (Fratercula corniculata), Tufted Puffins, and Parakeet Auklets (Cyclorhynchus psittacula) were noted as pairs were seen on the cliffs, or if concentrations of birds were seen. All crevices where these species nested were inaccessible to observers, and the breeding status of each species was inferred from observations of displays, birds going into cracks, birds carrying food items, and the eventual disappearance of the species from the breeding area.

RESULTS

Double-crested Cormorant.

Double-crested Cormorants were first observed on the study area on 30 April. No eggs were found when Shaiak Island was visited on 6 June, but two nests found on 11 June, each with two eggs, indicated that laying began by 7 June. Eggs in five nests hatched between 2 and 10 July. Young in 13 nests fledged between 22 and 29 August. After 22 August, dates of fledging of young were estimated from observations of color-marked young. The average number of young fledging per successful nest was 1.62.

M. H. Dick (pers. comm.) estimated the nesting population of Double-crested Cormorants on Shaiak Island to be 125 pair in 1973. Areas with active nests 25 June 1973 (J. C. Bartonek photo) did not have active nests on 11 June 1976. The reduction in numbers of nests in 1976 is attributed to two red foxes (Vulpes fulva) who destroyed all nests located on the slopes of Shaiak Island.

Pelagic Cormorant.

Pelagic Cormorants were on the ledges when Petersen arrived 28 April. At most nest sites, 1 to 3 inches of snow still covered old nest platforms, although nests could be seen beneath the snow. Birds began gathering new nest material as soon as vegetation was exposed by melting snow.

A nest found 21 May with the first three eggs of a four egg clutch, indicated that nesting began 14 May. The peak of egg laying was 24 May, and last nests were not initiated until early July (Table III-1). The size of 28 clutches varied from 2 to 5 eggs (Table III-2). The average clutch size of 3.11 eggs was similar to that of clutches observed in 1970 (3.1) and 1973 (3.2) (M. H. Dick pers. comm.).

Fledging of young began 3 August. Most young fledged by 27 August, although some young remained in nests until September. One to four young fledged at each nest (Table III-2). Of 128 nests observed with eggs and/or young in 1976, young had fledged from 100 nests (73.1%), and 5 nests (3.9%) still had unfledged young on 3 September. Egg laying, hatching, and fledging dates are similar to those observed by M. H. Dick in 1970 and 1973 (pers. comm.).

Successful nests with eggs or small young were attended by at least one adult during all observation sessions. Adults without eggs or young, or with large young, were most prevalent on territories in late afternoon through late evening. Peak numbers of adults on the colonies occurred in the late evening when pairs were commonly found on territories and non-breeding birds were found roosting on cliff faces.

An estimated 350 pairs of Pelagic Cormorants nested on Cape Peirce in 1976. Changes in the total population of Pelagic Cormorants from 1970, 1973 and 1976 were not apparent, although use of nesting areas varied between years. Significantly more young fledged per successful nest in 1976 than in 1970 and 1973 (M. H. Dick pers. comm.).

Common Eider.

One nest scrape with one egg was found 6 June on Shaiak Island, and several nest scrapes with no eggs were found throughout the field season. One nest with abundant down but no eggs was found on the peninsula.

J. C. Bartonek (pers. comm.) estimated 100 eider nests on Shaiak Island 14 July 1973, but no nests with eggs were found in the primary nesting area in 1976. The lack of nests found with eggs was attributed to red foxes taking eggs as they were laid, but data are inconclusive. Possibly, the bulk of the population did not attempt to nest.

Black-legged Kittiwakes.

Black-legged Kittiwakes were first observed 29 April and occupied nesting territories the same day. All birds were intermittently absent from nesting areas until 30 May. Territories were occupied by both

successful and unsuccessful nesting birds until all young fledged. All laying was completed between 10 June and 10 July. The last young fledged on 2 September (Table III-3). Loss of eggs to Common Raven (Corvus corax) was continuous throughout the period of laying and incubation. Breeding birds were not marked, but observations of several birds with aberrant plumage and foot color patterns suggest that there was a continual change over of pairs on territories throughout the breeding season.

Of a sample of 1986 nests, eggs in 38.9% (772) hatched and young fledged from 24.6% (489). No pairs produced more than one fledged young. Loss of nests was reduced after hatching and 63.3% of the nests with young survived to fledging. Loss of eggs was not uniform throughout the Cape Peirce area; no eggs hatched in two areas, eggs in as many as 50% of the nests hatched in 16 areas, and 50 to 80% of nests in 6 areas had eggs hatch. Variation between nesting areas in loss of young was not apparent, although further analysis of the data is needed. Losses of eggs and young were due primarily to predation by Common Ravens.

Numbers of kittiwakes on territories varied both diurnally and seasonally. The maximum number of birds were on territories by sunset each evening; decreasing to minimum numbers in early afternoon. By late incubation, only those birds that were incubating eggs or which had recently lost their eggs were present on territories during early afternoon. Numbers of birds maintaining territories decreased during brood rearing, and were lowest after the young fledged.

Extrapolation of counts from sample areas of known density to other parts of the Cape Peirce area indicated that the total population numbered about 100,000 pairs.

Glaucous-winged Gulls.

Glaucous-winged gulls were present on 28 April. Most gulls nested in a dense colony on the slopes and plateau of Shaiak Island, but a few nested on the peninsula cliffs as scattered pairs. Laying on Shaiak Island had begun by 6 June when 84.8% (39 nests) of 46 nests contained one egg, 1.3% (2 nests) contained two eggs, and 2.2% (1 nest) contained 3 eggs. Egg loss to Eskimo egg gathering activities and to two red foxes occurred throughout the egg laying period. Red foxes continued taking eggs throughout incubation and eliminated all eggs prior to hatching.

A density of 1 nest per 12.9 sq. meters was found in a sample area of 930 sq. meters in apparent optimal habitat. Nests were empty and nest material blown away before other plots could be established. Renesting attempts were not observed. Counts of territorial pairs from the blind on 11 June indicated 508 birds and 60 nests were present. Comparative counts of birds from photographs taken 25 June 1973 (J. C. Bartonek photo) showed 668 birds in the same area. In that year, foxes were not present, and gulls successfully hatched eggs (J. C. Bartonek pers. comm., M. H. Dick pers. comm.). Thus, numbers of pairs attempting to nest probably were similar in both years. Our observations indicated that about 5,000 birds attempted to nest on Shaiak Island in 1976.

Common Murre.

Common Murres were observed on the cliffs when Petersen arrived 28 April. Murres irregularly occupied the cliff nesting areas until 12 June (Table III-4). Because it is difficult to identify eggs or young on ledges, our sample sizes are small, but data are believed to be representative of the population.

Losses of eggs to predation by Common Ravens were high. Ledges on which laying was synchronized and which were crowded with murres appeared to be more successful than when laying was not synchronized or when fewer than 20 birds were present.

Periodic influxes of breeding plumage birds were noted during July and August. A total population of 500,000 birds, and a breeding population of 200,000 birds was estimated from counts of 9,000 birds in sample areas. Our limited data indicated that about 20% of the pairs successfully raised young. Data are insufficient for more accurate estimates.

Tufted Puffin.

The first Tufted Puffin were observed in the study area on 17 May, and birds were regularly observed beginning 19 May. Tufted Puffins nested on Shaiak Island in crowded colonies, and on the Cape Peirce peninsula as scattered pairs. Egg laying was not observed. One egg pipped on 17 July, and the peak of hatching (16 eggs) was 4 August. Two eggs were still present on 22 August when the burrows were last visited. Fledging was not observed.

Of 59 nests, 35.6% were known to be unsuccessful. Five burrows were obviously destroyed by red foxes, eggs disappeared from 11 burrows, and 5 eggs were apparently deserted. Loss caused by investigators could not be estimated because of disturbance by Eskimo egging parties on the island 10, 11, and 12 June, and the continual disturbance by red foxes. There were no obvious differences in the timing of egg laying and breeding success among plots of different physical characteristics or nesting densities.

An average of 0.40 active burrows per sq. meter was found in thirty 5 by 5 meter plots. Plots with the highest densities contained 1.25 burrows per meter². Extrapolation of sample densities to the total area used for nesting indicated that the breeding population of Shaiak Island was about 39,600 pairs.

Other Alcids.

Approximately 150 pairs of Pigeon Guillemots, 450 pairs of Horned Puffins, and 50 pairs of Parakeet Auklets nested in the cliffs on the peninsula and Shaiak Island. The cracks and crevices birds used were inaccessible. One Horned Puffin egg was observed 7 July in a crack on the cliffs, but had disappeared by 12 July. Three adult Parakeet Auklets collected on 14 July had brood patches, indicating they were breeding birds. Parakeet Auklets were last observed 11 August, and Pigeon Guillemots on 3 September. Horned Puffins were still present on 9 September.

DISCUSSION

Factors influencing nest site establishment.

Although snow was present on nesting areas when birds arrived in 1976, it did not prevent birds from landing on nesting areas and establishing territories. On the peninsula, no birds attempted to nest on slopes with drifted snow. Birds on Shaiak Island were observed evenly dispersed on the snow covered slopes, and were apparently on nest sites. However, laying did not begin until nesting areas were free of ice and snow. In general, cliff ledges preceded slopes in becoming ice and snow free. Although the effect of snow was minor in 1976, it seems likely that deep snow or late melting may prevent some birds from nesting in some years.

In general, all species arrived before their species specific nesting areas were free of snow, but the sequence of arrival was correlated with the sequence of snow melt of their specific type of nesting site.

Factors influencing reproductive success.

Of those birds attempting to nest in 1976, success seemed to be most influenced by loss of clutches and broods to predation by Common Ravens and red foxes. Losses to Common Raven were apparently minimized by Common Murres by synchronization of laying on crowded ledges. Kittiwakes apparently minimized losses to Common Ravens by nesting on small inaccessible ledges. Losses to red foxes were apparently minimized by all species by nesting in inaccessible areas. Behavioral defensive reactions to predators resulted in no apparent reduction of egg or young losses, except by Pelagic Cormorants which could successfully defend their nests from ravens.

Because of continuous loss of eggs to predators, the actual number of eggs laid by Black-legged Kittiwakes could not be accurately determined. Only one young fledged in each successful nest; and those initially with two young losing one young within a week of hatching. Reasons for partial loss of broods could not be determined, but may reflect the availability of food as well as partial predation.

Pelagic Cormorants raised significantly more young per brood to fledging in 1976 than in 1970 or 1973 (M. H. Dick pers. comm.). Broods of four young fledged in 1976, whereas none were observed in 1970 or 1973 (M. H. Dick pers. comm.). Clutch sizes did not differ between years, and apparently more young per brood survived to fledging. Reasons for the higher survival in 1976 are obscure, but may reflect an increased food availability during the chick stage.

Population estimates.

Estimates of the number of Black-legged Kittiwakes and Common Murres nesting or seen in nesting areas during the field season are probably low. The total number of murres at Cape Peirce may be as many as 1,000,000, but no fewer than 500,000. There may be as many as 200,000 pairs of kittiwakes, but no less than 100,000 pairs. No observations were made from boats or airplanes to determine the percent of the nesting area used that was censused from cliff edges, thus, more accurate

estimates are not possible at this time. Numbers of Pelagic Cormorants are probably accurate to within a few pairs, since most of the known nesting areas could be observed. The size of the nesting population of Tufted Puffins and Glaucous-winged Gulls were estimated by using sampling techniques which are relatively free of biases affecting estimates for other species, thus, our estimates may be relatively accurate. Exact counts were obtained for nests of Double-crested Cormorants.

Table III-1

Breeding Chronology of Pelagic Cormorants.

Event	Date	Sample Size
Egg laying		110 nests
First egg laid	14 May	
Modal egg laying	24 May	
Last egg laid	3-7 July	
Hatching		25 nests
First hatched young	16 June	
Modal hatching	21 June	
Last hatched young	26 July	
Fledging		103 nests
First fledged young	3 August	
Modal fledging	10 August	
Last fledged young	? September	

Table III-2.

Size of Clutches and Broods of Pelagic Cormorants.

	No. of eggs or young per nest					Average
	1	2	3	4	5	
Clutches	0	4	18	5	1	3.11
	(0%)	(14.3%)	(64.3%)	(17.9%)	(3.6%)	
Broods	14	38	48	3	0	2.39
	(13.6%)	(36.9%)	(46.6%)	(2.9%)	(0%)	

Table III-3.

Breeding Chronology of Black-legged Kittiwakes.

Event	Date	Sample Size
Egg laying		48 nests
First egg laid	10 June	
Modal egg laying	20 June	
Last egg laid	2 July	
Hatching		45 nests
First hatched young	9 July	
Modal hatching	15 July	
Last hatched young	27 July	
Fledging		34 nests
First fledged young	18 August	
Modal fledging	28 August	
Last fledged young	2 September	

Table III-4.

Breeding Chronology of Common Murres

Event	Date	Sample Size
24 hour ledge occupancy		3 areas
First birds seen on nesting areas at 2200 hrs.	1 June	
50% of birds on nesting areas at 2200 hrs.	12 June	
Egg laying		12 eggs
First egg laying	7 June	
Modal egg laying	15 June	
Last egg laid	18 June	
Hatching		8 young
First hatched young	18 July	
Modal hatching	21 July	
Last hatched young	22 July	
Young jumping from ledges		15 young
First young in water	10 August	
Modal young disappearance	17 August	
Last young off cliffs	4 September	

IV. Predation on Seabirds.

Colonial nesting seabirds are believed to be in part restricted to island nesting areas by mammalian predators (Lack 1954 and 1968, Murie 1959). Furthermore, foxes are believed to determine nesting locations of seabirds (Fay and Cade 1959). Selection pressure by avian predators is believed to have selected for synchronization of egg laying within ledges (Belopol'skii 1957) and within colonies (Lack 1968). Further suggesting that birds have nested on cliffs over an extended period of time, are studies on adaptations of birds to cliff nesting (Cullen 1957, Tschanz and Hirsbrunner-Scharf 1975).

Norman (1971) documented the impact of an invasion of red foxes (Vulpes vulpes) on Short-tailed Shearwaters (Puffinus tenuirostris) nesting in Australia, but no studies prior to ours have been conducted where foxes had no other prey species available. A recent invasion of the mammal-free Shaiak Island by two red foxes (Vulpes fulva) provided an opportunity to evaluate predation by foxes on six species of seabirds including: Double-crested Cormorant (Phalacrocorax auritus), Pelagic Cormorant (P. pelagicus), Common Eider (Somateria mollissima), Glaucous-winged Gull (Larus glaucescens), Black-legged Kittiwake (Rissa tridactyla), Common Murre (Uria aalge), and Tufted Puffin (Lunda cirrhata). The nearby nesting colonies at Cape Peirce provide comparisons of nest sites selected in an area of historic red fox activity. Our observations of foraging techniques used by both avian and mammalian predators, means by which birds avoid predators, and our observations of nesting success provides further insight of the value of nest site selection in minimizing losses to predators.

METHODS

Birds and mammals potentially utilizing seabirds were recorded when encountered to determine their relative abundance. Den sites of four pair of red foxes, and nest areas of three pair of Common Ravens (Corvus corax), two pair of Rough-legged Hawks (Buteo lagopus), and one pair of Bald Eagles (Haliaeetus leucocephalus) were located. Incidental observations of foraging behavior of all species were made when they were encountered. Den sites of red foxes were examined for food remains when found; then checked intermittently throughout the field season. All prey items were removed from the den site at each visit to facilitate identification of new items and to permit evaluation of seasonal differences in prey.

The abundance and nesting phenology of passerines and shore birds which were alternate prey were determined by censuses of linear transects. Numbers of hoary marmots (Marmota caligata) and arctic ground squirrels (Citellus undulatus) seen daily were recorded. Abundance of small mammals was determined by trapping (2000 trap nights) between 2 May to 6 September. Traps were set in the dune area and near the cliffs where small mammals were thought to occur.

An 804-meter long area along the beach was searched for dead birds at 2 to 3 day intervals between 21 May to 5 September. Dead birds were removed from the beach after checking for the presence or absence of oil on the plumage, and determination of age and sex.

RESULTS

Buteoninae.

One Bald Eagle nest and two Rough-legged Hawk nesting areas were found (Fig. IV-1). One Bald Eagle fledged between 8 and 16 August, and one Rough-legged Hawk fledged 30 July.

Rough-legged Hawks and Bald Eagles were never observed attempting to capture sea birds. Each species was observed flying past nesting Black-legged Kittiwakes and Common Murres once. All birds immediately flew from the nests until the raptor was past the nesting area, but no eggs or young seabirds were present. M. H. Dick (pers. comm.) found kittiwake and Tufted Puffin remains at the nest of the Bald Eagle in 1973, indicating they may take seabirds.

Falconidae.

Gyrfalcons (Falco rusticolus) were observed 12 times between 2 May and 4 September. No nests or suspected nesting areas were found on Cape Peirce, although Gyrfalcons have been reported nesting at nearby Cape Newenham (Fyfe, et. al. 1976). All observations in 1976 were of a pair of gray-phase birds which suggests that they were nearby residents. One Gyrfalcons made three unsuccessful attempts to capture a Green-winged Teal (Anas crecca carolinensis) on a small pond. Interactions with nesting seabirds were not observed.

Peregrine Falcons (Falco peregrinus) were observed only twice (20 May and 16 August), and are not known to nest in the area (Fyfe, et. al. 1976). Peregrine falcons probably had no impact on the seabird colonies in the area.

Glaucous-winged Gull.

A few pair of Glaucous-winged Gulls nested on the cliffs of Cape Peirce, and an estimated 5,000 birds nested on Shaiak Island. Adult gulls frequently flew near the cliffs, and toward the primary foraging area, a nearby salmon stream. Sub-adult gulls primarily scavaged along the beach and in the harbor seal (Phoca vitulina) pupping area. Loss of nests to Glaucous-winged Gulls was apparently restricted to unattended nests, and no gulls were observed taking eggs or young from undisturbed seabird nests. However, opportunistic predation on eggs or young may be common when colonies are disturbed by other predators or human activity. Gulls took eggs of murres and kittiwakes when Eskimos disturbed nesting colonies during eggging activities, and loss of two Glaucous-winged Gull nests to gulls was attributed to observed activity.

Common Raven.

Three pairs of Common Ravens were found nesting on the cliffs (Fig. III-1), and four young fledged at each nest between 29 and 30 June. Adults and young ravens frequently harassed nesting kittiwakes and murres, and successfully took adult seabirds, eggs, and young from nests

(Table IV-1). Raven preceded the taking of eggs and young by flying close to adult birds on nest sites. Tufted Puffins, Common Murres, and Black-legged Kittiwakes that did not have eggs or young immediately flew from the area. A raven then landed on the cliff or ledge near an incubating bird. Most kittiwakes defended the nest by pecking at the raven, but of little avail, and ravens removed them by grasping a wing with the bill and pulling them from the nest, then seized and flew off with an egg or young. Common Murres were similarly removed from eggs after ravens landed on the ledge near the incubating adults. Sigman observed an immature raven killing an adult kittiwake in flight near a colony. Common Ravens were not observed harassing Pelagic Cormorants, and the cormorant egg (Table IV-1) was probably from an unattended nest. One Pelagic Cormorant young was scavenged near a cormorant colony, apparently after it had fallen from a nest.

Loss of eggs from Black-legged Kittiwake nests in discrete nesting areas was not uniform throughout the Cape Peirce area; no eggs hatched in two areas, eggs in as many as 50% of the nests hatched in 16 areas, and 50 to 80% of nests in 6 areas had eggs hatch. Nesting areas were noted to be desimated between twice weekly observations. Loss probably occurred during one day, but data are insufficient to support that conclusion. Common Raven families were observed foraging together and six Common Ravens could conceivably destroy 50 nests during one foraging effort.

Losses of nests to Common Ravens decreased in mid-July after eggs of kittiwakes hatched. However, this reduced predation on kittiwake chicks may have been a result of the increased availability of young passerines which were beginning to emerge from nests. Populations of small mammals were low, and during 2,000 trap nights, only 12 Sorex obscurus and two Microtus oeconomus were captured. Thus, rodents did not provide an important alternate food source, although they may in other years. Common Ravens collected by M. H. Dick (pers. comm.) in 1976 had eaten Empetrum and Vaccinium berries which would also provide an alternate food source in some seasons.

Red Fox.

Four territories of red foxes were found on the Cape Peirce peninsula, and two red foxes were present on Shaiak Island. Of six den sites found on the peninsula (Fig. IV-1), five were freshly excavated. Individual foxes were recognized by peltage and body conformation differences. At least one red fox was seen each day, and the individual could usually be determined. One pair successfully raised five pups, and all food items recorded were from that family.

Remains of avian food items at den sites occurred in the same proportions as birds found dead on the beach within the foxes' territory ($\chi^2 = 11.42$, $df = 9$, $p < 0.1$; Table IV-2), suggesting that scavaging may provide an important source of food. Foxes were observed taking an adult kittiwake from a colony on one occassion, and an egg of a murre on one occasion.

Remains of arctic ground squirrels, hoary marmots, and least weasels (*Mustela rixosa*) were also found at den sites (Table IV-2). Arctic ground squirrels and hoary marmots were eaten, but the least weasles were not. Adults and pups were observed hunting squirrels, and adults were observed capturing them. Small rodent remains were not found.

Two red foxes were observed on Shaiak Island 2 May, and were present throughout the field season. There were no small mammals on the island, and the foxes were apparently dependent on seabirds and their eggs and young for food, although invertebrates may have provided an alternate food source.

On Shaiak Island, Common Eiders, murres, Glaucous-winged Gulls, and Double-crested Cormorants nested on level or sloping terrain areas that were accessible to foxes. All nests initiated in such habitat by these species were destroyed by foxes or by gulls after disturbance by foxes. Nests of kittiwakes on accessible portions of cliffs were also destroyed and only nests in areas inaccessible to foxes survived (Table IV-3).

Burrow nesting provided some protection to Tufted Puffins. Of 59 Tufted Puffin nests observed, only 35.6% were destroyed by two weeks into brood rearing. Direct loss to foxes accounted for 76.2% of the unsuccessful nests. Five marked burrows were dug out by red foxes, but in most instances eggs or young were taken from short burrows. Adult puffins were also taken, as carcasses were commonly found. Our samples indicated that the total loss of adults was approximately 5,000 birds (4 metric tons).

Arctic Ground Squirrels.

Arctic ground squirrels were commonly found along cliff edges and ridges of the Cape Peirce peninsula. None were found on Shaiak Island. Squirrels were never observed at nests of kittiwakes, murres, or Pelagic Cormorants.

Hoary Marmots.

Hoary marmots were restricted to rocky cliff edges and were commonly seen in cracks on cliff faces. No seabird-marmot interactions were observed.

DISCUSSION

Tuck (1970) has observed Rough-legged Hawks and Gyrfalcons taking murres at colonies, but we did not observe raptors preying on any seabirds. Although Bald Eagles, Rough-legged Hawks, and Gyrfalcons resided in the area, they had minor impact on the nesting success of seabirds at Cape Peirce.

Glaucous-winged Gulls appeared to be effective as opportunistic predators when disturbance of colonies caused incubating or brooding birds to leave their nests, thus exposing eggs and young to predation. Although losses caused by gulls were of relatively minor importance at Cape Peirce, it could be significant in areas where colonies are subjected to additional disturbance as may be caused by increased human activity.

Common Ravens were clearly the most persistent and effective avian predator on both kittiwakes and murres, taking large numbers of eggs and young. Ravens were least effective when kittiwakes or murres nested on ledges that prevented ravens from landing near the nesting site. Synchronization of laying and crowding on ledges by murres also tended to exclude ravens and increased nesting success. The differences in nesting success on different ledges provides a strong selective pressure for use of a particular habitat and for synchronization of laying in crowded conditions. As murres are known to return to the same ledges to breed in successive years (Tuck 1960), crowding probably reflects an increased survival of chicks on particular ledges and the return of chicks and adults to the ledges they were born or nested successfully.

Red foxes were the primary mammalian predator within the study area. Foxes are historically abundant at the Cape Peirce peninsula, and with few exceptions, seabirds utilized only areas that were inaccessible to them. Thus, the effect of predation by foxes was negligible. At Shaiak Island, however, foxes have not been present in recent years, and seabirds traditionally nested in areas that included areas that were easily accessible to the two foxes that invaded the island in 1976. In those accessible areas, all nests of cormorants, eiders, murres, gulls, and kittiwakes were destroyed, and productivity of Tufted Puffins was reduced. In addition, foxes killed about 6% of the adult puffins.

The foxes' devastating effect on the seabirds of Shaiak Island indicates that nesting in vulnerable areas could not persist where foxes are present, and that the distribution of seabirds in mainland areas is limited by mammalian predators.

We consider it significant that seabirds attempted to nest in vulnerable areas on Shaiak Island in normal numbers despite the presence of foxes, although few attempted to nest in similarly vulnerable habitat in mainland colonies. Possible causes for this persistence include the imprinting of young to the area of their origin, an unusually strong tendency of adults to occupy sites they have used previously, or the inability of birds to recognize foxes as predators of eggs and young and immediately change nest sites to inaccessible areas.

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Table IV-1.

Numbers of seabird prey observed taken by Common Ravens.

Species	Adults	Eggs	Young
Pelagic Cormorant	0	1	0
Black-legged Kittiwake	1	6	1
Common Murre	0	7	0

Table IV-2.

Species potentially available and used by one red fox family.

Species	No. of individuals found:	
	Beached birds	Den site - Prey items -
Pelagic Cormorant (<u>Phalacrocorax pelagicus</u>)	1	0
American Wigeon (<u>Anas americana</u>)	0	1
Pintail (<u>Anas acuta</u>)	1	0
Harlequin (<u>Histrionicus histrionicus</u>)	3	1
Eider (<u>Somateria sp.</u>)	1	0
Black Scoter (<u>Melanitta nigra</u>)	1	0
Glaucous-winged Gull (<u>Larus glaucescens</u>)	2	1
Black-legged Kittiwake (<u>Rissa tridactyla</u>)	10	23
Common Murre (<u>Uria aalge</u>)	12	23
Horned Puffin (<u>Fratercula corniculata</u>)	0	2
Tufted Puffin (<u>Lunda cirrhata</u>)	0	2
Least weasel (<u>Mustela rixosa</u>)	-	4
Hoary marmot (<u>Marmota caligata</u>)	-	3
Arctic ground squirrel (<u>Citellus undulatus</u>)	-	3

Table IV-3.

Chronology of seabird nest loss on Shaiak Island.

Species	No. Pair	Egg Laying Dates	Fox Exploitation Dates	Nesting Habitat
Double-crested cormorant	300	1-11/6	1-19/6 2-10/7	Plateau Slopes
Pelagic Cormorant	50	14/5-1/7 ^{1/}	none	Cliff faces
Glaucous-winged Gull	2,500	4-17/6	4/6-2/7	Plateau
Black-legged Kittiwake	10,000	10/6-2/7	10/7-15/8 none	Rock faces Cliff faces
Common Murre	25,000	7-18/6	7/6-15/8 none	Slopes Cliff faces
Tufted Puffin	39,590	4/6-17/7	17/7-22/8	Sod slopes

^{1/} Estimated from size of young.

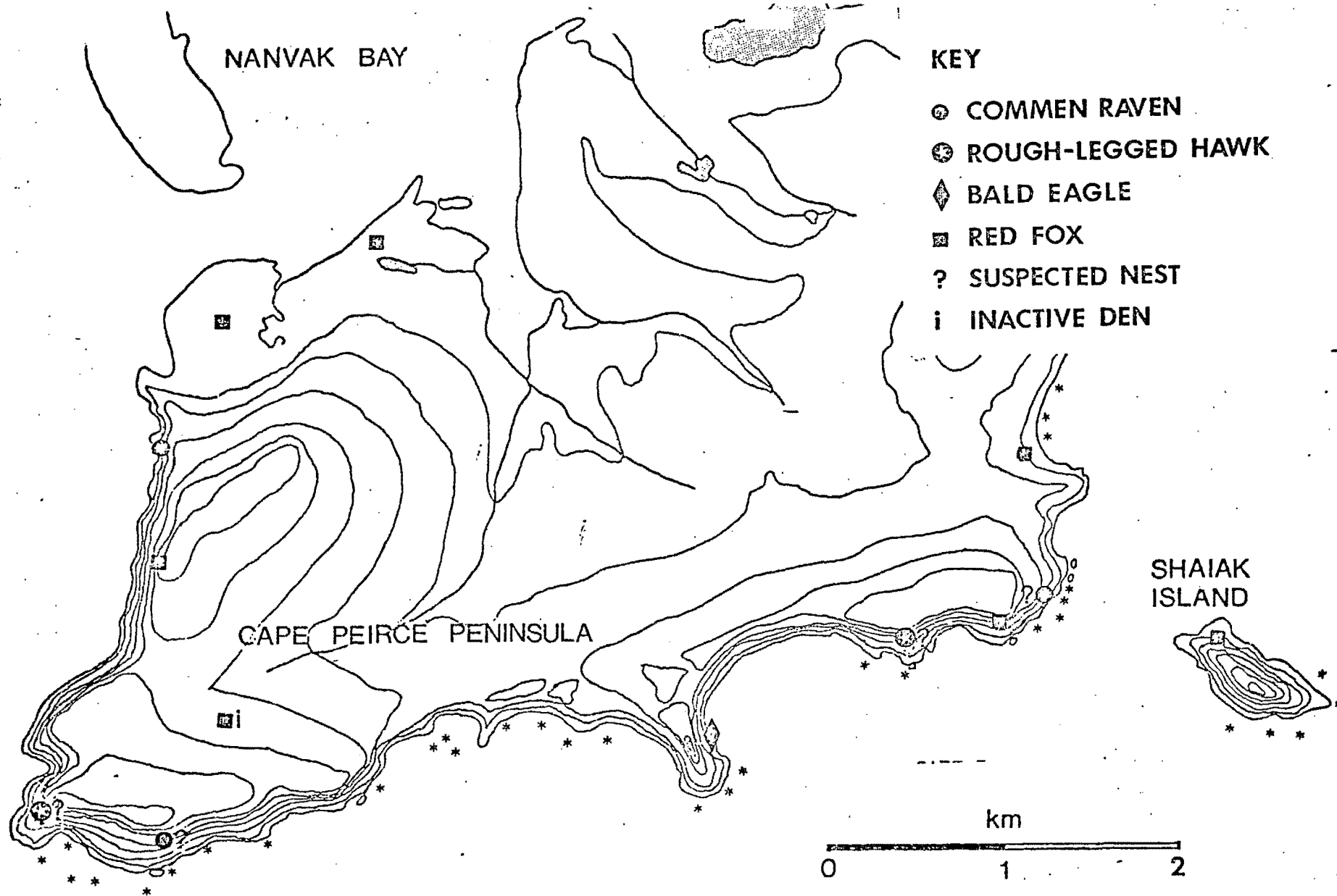


FIG. IV-1. LOCATION OF AVIAN PREDATOR NEST SITES AND RED FOX DEN SITES.

V. Spring migration, molt, and foraging areas of loons and waterfowl.

Migrant loons, waterfowl, and cormorants may be easily observed from the cliffs of Cape Peirce; some species proceeding northward and others stopping at Nanvak Bay (King 1966, M. H. Dick pers. comm.). Observations at Cape Peirce, thus permit evaluation of the timing of migration and the importance of the coastal route from Bristol Bay to more northern breeding, feeding, or molting areas. Additionally, large numbers of waterfowl are present in the Nanvak Bay-Cape Peirce area from early April to October (King and Monson 1968, Hout 1971). These include many seaducks (eiders, Harlequin, and scoters), none of which have been studied in the Bering Sea region and only limited information is available from other areas (Bellrose 1976). Habitat use of wintering seaducks have been conducted on the east coast of the U.S. (Stott and Olson 1973), and South Sweden (Nilsson 1972), and habitat use of molting birds have been conducted in Denmark (Joensen 1973).

Thus, our observations which document the chronology of spring migration, and characterize the populations in the Nanvak Bay-Cape Peirce area are of interest both for evaluation the importance of the study area and to the overall understanding of populations and ecology of the seaducks of the Bering Sea.

METHODS

Migration and general movements of loons, cormorants, waterfowl, and alcids were observed from three seawatch sites and 12 bay observation sites (Fig. V-1). The Nanvak Bay site was in the dunes overlooking the bay, Obs. II seawatch site was on a cliff 30 meters above the water, and the Cape Peirce VABM seawatch site was from a rock windbreak near the VABM marker 115 meters above the water. Bays and inlets below the cliffs were censused from marked observation sites on the cliffs.

Birds using Nanvak Bay and the water along the cliffs were censused by making sweeps with a 20 power spotting scope. Species, age, sex, plumage, molt stage, group size and composition, and activity data for each individual was recorded. Age and sex determination of waterfowl were based on plumage characteristics described in Palmer (1976). Counts of two hours in duration of all birds and mammals moving up or down the coast were made from the VABM seawatch site, with the same type of data collected as during the sweeps. In addition, birds flying with food in their bills were recorded. From 19 April to 1 June, seawatches were conducted as weather permitted three times daily from Nanvak Bay and Obs. II. Sweeps were conducted twice daily, and two hour watches once daily on alternate days from 29 April to 1 June from the VABM seawatch site. Seawatches were conducted at all sites weekly from 1 August to 1 August, then twice weekly from 1 August to 5 September. Bays and inlets were censused twice weekly throughout the field season as weather allowed.

Areas utilized by birds (Fig. V-2) were delineated by noting where birds foraged or roosted.

RESULTS

Spring Migration.

Gaviiformes - Red-throated Loons (Gavia stellata) and Arctic Loons (G. arctica) migrated past Cape Peirce 3 May until 1 June, with peak migration of Red-throated Loons occurring 14 days earlier than Arctic Loons (Table V-1). Both species were seen in numbers ranging from single individuals to flocks of 14. Flocks of Red-throated Loons (Table V-2) did not vary significantly in size throughout spring migration, with an average flock size of 1.93. Arctic Loons migrated predominantly as flocks until after peak migration when singles predominated ($\chi^2 = 43.88$, $df = 9$, $p > 0.005$; Table V-2). All migrating loons observed were in breeding plumage, and none stopped along the cliffs of Cape Peirce.

Anserinae - Black Brant (Branta bernicla nigricans) and Emperor Geese (Anser canagica) were observed flying overland across the Cape Peirce peninsula as well as around the Cape from May to June (Table V-1). On the one clear day during peak Black Brant migration, some flocks were observed landing at Nanvak Bay, and others continued up the coast. A sum of 4,400 Black Brant were observed from the Nanvak Bay seawatch site at one count. Some brant fed in the windrowed eelgrass on the shore, but most roosted on the ice. Emperor Geese were similarly observed, but in smaller numbers. Sex of individuals was not determined; all geese observed at close range during migration were in adult plumage.

Anatinae - Most ducks migrated as pairs or in flocks of nearly equal sex ratios (Table V-1). Exceptions were Pintail (Anas acuta), White-winged Scoters (Melanitta deglandi), and Oldsquaw (Clangula hyemalis). Pintail and White-winged Scoter flocks were all or nearly all male, with only the occasional female seen. Flocks of Oldsquaw were predominantly females with an occasional pair observed. Both male and female Oldsquaw were in either alternate plumage or in the prebasic molt early in migration, then during the latter part of migration birds in the basic plumage were observed.

Analysis of age-sex ratios, and flock composition as they changed through the season has not been completed.

Most yearling and some two-year old male, and some yearling female eiders and scoters could be identified. It was apparent that sub-adults migrated after the peak migration of adults, and stopped and fed more frequently than adults.

The King Eider (Somateria spectabilis) was the dominant species observed, with 10,798 birds observed during a 2.6 hour observation period at peak migration. Flocks of up to 650 birds were recorded, and flocks of 200-300 birds were common in early migration. Flocks of greater than 100 birds were not observed after 12 May when sub-adult birds predominated.

Alcidae - Local movements of Common Murres (Uria aalge) could not be separated from possible migration past Cape Peirce to other areas. Pigeon Guillemots (Cephus columba), Horned Puffins (Fratercula corniculata), Tufted Puffins (Lunda cirrhata), and Parakeet Auklets (Cyclorrhynchus psittacula) had no discernable migration past Cape Peirce, but "appeared" off the cliffs and apparently remained in the study area.

Phalacrocoracidae - Both Pelagic Cormorants (Phalacrocorax pelagicus) (and/or Red-faced Cormorants [P. urile]) and Double-crested Cormorants (P. auritus) were observed flying up and down the coast throughout the field season. There was no obvious migration as reported by M. H. Dick (pers. comm.) in 1973. Cormorants were generally flying in groups of one or two individuals and were occasionally seen landing on nearby cliffs, indicating that all birds we saw were a part of the local population.

Molting and foraging areas of seaducks.

Harlequin - Pairs of Harlequin (Histrionicus histrionicus) were observed daily during migration, until 31 May when unpaired birds predominated. Males were the predominant sex molting in the area, with females comprising only 12.4% of the total molting birds. Molting Harlequin were usually found in flocks of 3 to 15 individuals, with all individuals in a similar stage of molt. Birds began the pre-basic molt 8 to 15 July, became flightless 16 to 23 July, and had regained flight by 23 August (Table V-3).

The area immediately adjacent to the outer coast was the principle habitat utilized by Harlequin, and flocks commonly foraged close to shore (Fig. V-2), and roosted on rocks exposed at low tide.

Common Eider - Flocks of adult Common Eiders (Somateria mollissima) were observed during migration, and sub-adults were observed in small flocks (5 to 20 individuals) during the molt. Some adults were in the area throughout the field season, and we found them nesting on both the mainland and Shaiak Island. However, no broods were observed. Flightless birds were found beginning 28 July, and were still present on 9 September (Table V-3). Full winged birds were not encountered regularly in the fall.

Common eiders used Nanvak Bay during both the spring and summer seasons (Fig. V-2) and foraged in the shallow water where we observed them eating Mya arenaria.

King Eider - Although the King Eider was the predominant species observed on migration, few birds remained in the area to molt; molting birds being observed only as scattered individuals. Birds which remained on the study area were mostly sub-adults. They became flightless beginning 30 July (Table V-3); and flightless birds were still present 9 September when we left the study area. Birds in the pre-alternate molt were not observed.

Both migrant and resident King Eiders foraged primarily off the tip of Cape Peirce, and between Shaiak Island and the peninsula (Fig. V-2);

with migrating birds in flocks of several 1,000, and molting birds in flocks containing 1 to 21 birds. Molting birds occasionally roosted on the rocky shores near the foraging areas.

Steller' Eider - Flocks of adult Steller's Eiders (Polysticta stelleri) were observed while on migration until 8 July (Table V-3). Flocks observed in July, August, and September consisted of birds in basic plumage. It could not be determined if birds in this plumage were sub-adult males, adult females, or sub-adult females. Only a few adult males were identified in flocks, which contained from 9 to 350 individuals. All birds within individual flocks were in identical molt stages, although flocks differed. The first flightless birds were observed 27 August (Table V-3), and flocks were still moving into the area to become flightless when we left 9 September.

Both migrating and molting flocks foraged in areas adjacent to cliffs, along the peninsula (Fig. V-2). Flocks roosted near foraging areas on rocks exposed during low tide.

Black Scoter - Black Scoters (Melanitta nigra) were not common molting birds, and most observations were of migration birds. Molting birds were flightless by 15 August (Table V-3), and presumably were still flightless when we left the study area 9 September.

Migrant scoters foraged in Nanvak Bay (Fig. V-2), in flocks of mixed age and sex. Although Common Eiders foraged in Nanvak Bay at the same time, mixed species flocks were not observed.

White-winged Scoter - White-winged Scoters were observed only as scattered individuals along the cliffs. Flightless birds were first noted 20 July, and were still in the study area 9 September (Table V-3). Those we observed were predominantly males of undetermined age, and birds could be found in almost any stage of molt from July through September.

White-winged Scoters foraged up to 1 km or more from the cliff area (Fig. V-2), and were never observed near shore.

Surf Scoter - Surf Scoters (Melanitta perspicillata) were observed as scattered individuals along the cliffs. Migrants were not observed feeding in the study area. Molting birds were predominantly adult and sub-adult males. As with White-winged Scoters, birds in almost any plumage or molt stage could be found throughout the flightless period (Table V-3).

Surf Scoters foraged in the surf along the western portion of the Cape Peirce peninsula, and in one area along the southern portion of the peninsula (Fig. V-2).

Red-breasted Mergansers - A few pair of Red-breasted Mergansers (Mergus serrator) were observed on migration in early May. Most birds observed were in a single molting flock of 163 adult males. All individuals observed 8 July were in the prebasic molt, and were flightless by 30 July (Table V-3). Flightless birds were still observed 7 September.

DISCUSSION

Spring migration.

Probably most of the west coast populations of Arctic Loons, Red-throated Loons, Black Brant, Emperor Geese, King Eiders, and Stellers Eiders migrate through the Cape Peirce-Nanvak Bay area. Also migrating through the area were significant numbers of Common Eiders, Harlequin, and Black Scoters that breed further north, as well as smaller segments of the breeding populations of Common Goldeneye (Bucephala clangula), Greater Scaup (Aythya marila), American Green-winged Teal (Anas crecca carolinensis), American Wigeon (A. americana), Oldsquaw, Pintail, and Red-breasted Mergansers. During the later part of spring migration, sub-adults and non-breeding birds of many species were observed migrating to more northerly feeding areas, and some stayed in the Cape Peirce-Nanvak Bay area to molt.

Loons did not migrate as obvious pairs, although pairs could have migrated together in flocks. Similarly, Black Brant and Emperor Geese may have migrated as pairs. Ducks probably were paired, since flocks of adults invariably had a 50:50 sex ratio. Notable exceptions were flocks of male Pintail, and male White-winged Scoters, and female Oldsquaw. Possibly the male White-winged Scoters were non-breeding birds summering along the west coast of Alaska, unpaired adults going to breeding areas inland, or males that have abandoned nesting females and are on a molt migration. Pintail and Oldsquaw may have been migrating to more northern breeding areas, and only a small disproportionate segment of each population was observed.

The timing of migration for each species varied (Table V-1); with peak migration of Red-throated Loons, Anatinae, goldeneyes, King Eiders, and Oldsquaw occurring in early-May, and most other species migration by 18 May. Surf Scoter migration peaked 20 June. No information from Cape Peirce is available to compare peak migration dates of waterfowl from other years.

Foraging areas.

Nanvak Bay is obviously an important feeding area for migrant Black Brant, Emperor Geese, Common Eiders, Black Scoters, Greater Scaup, Common Goldeneye, Oldsquaw, and Red-breasted Mergansers. As much as 50% of the world's population of Black Brant foraged or roosted on Nanvak Bay during spring migration. Until the ice began to melt in the marsh areas, all puddle ducks foraged or roosted in Nanvak Bay. Harlequin, Steller's Eiders, and King Eiders migrating in the spring foraged along the cliffs, as well as throughout the rest of the field season. Arctic and Red-throated Loons were the only species not observed foraging during spring migration.

Seaducks found foraging in the Cape Peirce-Nanvak Bay areas showed spatial and temporal segregation of the use of feeding areas (Fig. V-2). White-winged Scoters were found furthest from the cliffs, and Surf Scoters were found in surf near the cliffs. Steller's Eiders and Harlequin

were found the closest to the cliffs, but at different times. King Eiders generally restricted activity to two areas off the cliffs not utilized by other species. Red-breasted Mergansers, Common Eiders, and Black Scoters foraged in Nanvak Bay, but not in the same area or in mixed species flocks.

Food items taken by seaducks at Cape Peirce were not determined. Information of food habits of Harlequin, scoters, eiders, and mergansers during May to September are fragmentary; but in general, scoters, Harlequin and eiders take similar types of benthic organisms, and Red-breasted Mergansers take fish (Preble and McAtee 1923, Cottam 1939, McGilvrey 1967, Pethon 1967, Bengtson 1971, Nelsson 1972, Stott and Olson 1973). More data on food preferences, substrate types, water depth, food availability, and foraging ability of each species is needed before conclusions regarding habitat separation by species at Cape Peirce can be made.

Molt chronology.

Common Eiders and Redbreasted Mergansers became flightless during the same time of year as individuals of the same age and sex classes in Denmark (Joensen 1973). Steller's Eiders are flightless during August and September both at Cape Peirce and Izembek Bay, Alaska (Jones 1965). Observations of subadult flightless King Eiders from areas other than Cape Peirce are lacking, but flightless dates are similar to Common Eiders. Male Harlequin were flightless 16 July to 23 August at Cape Peirce, but comparative information on flightless male Harlequin from other areas are lacking (Bellrose 1976). Flightless White-winged Scoters, Black Scoters, and Surf Scoters can be found at Cape Peirce late-July through September; however, information on the flightless period of these scoters from other areas is lacking. The general consensus is that scoters are flightless August and September, and molt at sea (Joensen 1973, Palmer 1976, Bellrose 1976). Observations beyond 1 km from shore at Cape Peirce should be made since flightless birds have been found 4 to 10 km from shore (Joensen 1973).

Table V-1

Spring migration dates of common species

Species	Peak Migration Date	Dates of Migration <u>1/</u>
Red-throated Loon	6 May	3 May - 1 June
Arctic Loon	20 May	5 May - 1 June
Pelagic Cormorant	12 May	5 May - 9 June
Black Brant	12 May	3 May - 1 June
Emperor Goose	16 May	2 May - 9 June
Pintail	2 May	28 April - 17 May
American Wigeon	1 May	29 April - 14 May
American Green-winged Teal	1 May	1 May - 19 May
Greater Scaup	10 May	30 April - 31 May
Common Goldeneye	7 May	30 April - 13 May
Harlequin	16 May	30 April - 7 June
Common Eider	18 May	5 May - 8 June
King Eider	5 May	30 April - 30 June
Steller's Eider	13 May	28 April - 14 June
Oldsquaw	3 May	28 April - 26 May
Black Scoter	12 May	30 April - 20 June
White-winged Scoter	12 May	30 April - 30 June
Surf Scoter	20 June	21 May - 13 July
Red-breasted Merganser	none	28 April - 31 May

1/ Observer present 28 April to 9 September.

Table V-2

Flock sizes of loons during spring migration.

		Flock Size										
		1	2	3	4	5	6	7	8	10	13	14
Red-throated loon												
	3 May - 1 June	46	21	9	5	1	0	1	0	1	1	0
Arctic loon												
	3 May - 20 May	46	24	16	10	6	6	2	4	2	0	1
	22 May - 1 June	80	14	4	1	1	0	0	0	0	0	0

Table V-3

Molting dates of non-breeding water fowl.

Species	Dates present ^{1/}	Dates flightless	Predominant age-sex class molting
Harlequin	31 May - 8 Sept.	16 July - 23 Aug.	male
Common Eider	6 May - 9 Sept.	28 July - 9 Sept.	subad. male & subad. female
King Eider	6 May - 9 Sept.	30 July - 9 Sept.	subad. male & subad. female
Steller's Eider	8 July - 9 Sept.	27 Aug. - 9 Sept.	subadult (?)
White-winged Scoter	1 May - 9 Sept.	20 July - 9 Sept.	male (adult?)
Surf Scoter	21 May - 9 Sept.	30 July - 9 Sept.	subad. male & ad. male
Red-breasted Merganser	29 June - 9 Sept.	30 July - 9 Sept.	adult male

^{1/} Observer present 28 April to 9 Sept.

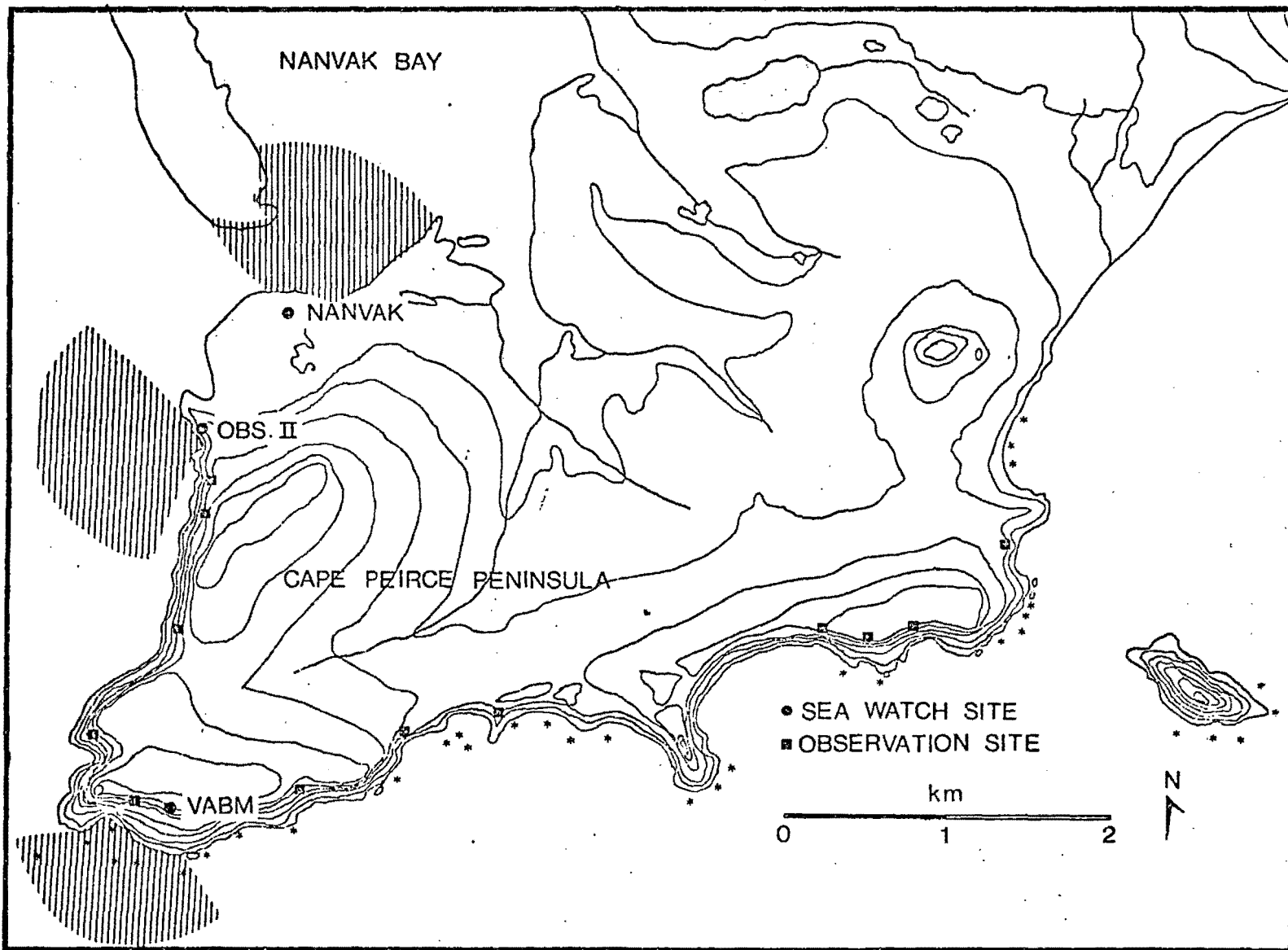
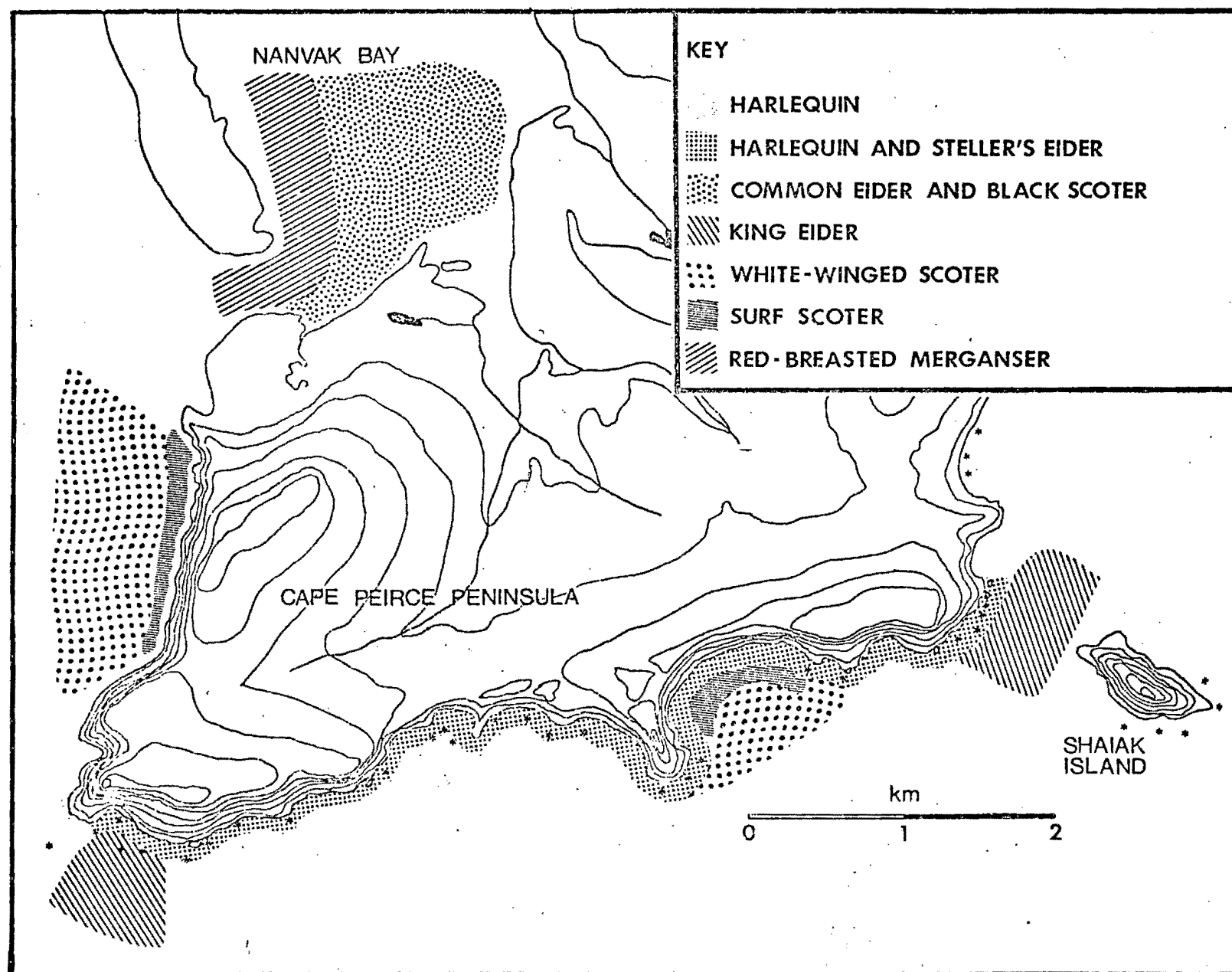


FIG. V-1. LOCATION OF SEAWATCH SITES
AND OBSERVATION SITES

FIG. V-2. FEEDING AREAS OF SEADUCKS



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APPENDEX I. Birds and Mammals Observed at Cape Peirce and Nanvak Bay.

Several lists of birds and mammals seen in the area have been compiled (King 1966, Hout 1969 & 1971, Dick and Dick 1971), and notes on each reported. Table 1 includes species recorded at Cape Peirce-Nanvak Bay from 1963 to 1976, and all observations were between 2 April and 1 October. Notes on species included in this report include species not observed previously to 1976, or those that changed status in 1976.

SPECIES NOTES

Birds

Yellow-billed Loon (Gavia adamsii). One adult in basic plumage was observed flying south across the Cape Peirce peninsula 3 September 1976.

Red-throated Loon (Gavia stellata). This species has been recorded previously (Table 1), but breeding was not recorded until 1976. A pair hatched one egg 23 June in a small pond, and the young fledged 13 to 19 August. Red-throated Loons were also common spring migrants.

Frigatebird (Fregata sp.). One bird in immature plumage was observed soaring and stalling 20 May 1976 above the dune area, then soared west out to sea. The individual had the typical immature plumage of white breast, neck, and head. The individual could have been a F. minor, F. ariel, or F. magnificens based on descriptions of subadults in King (1967) and Palmer (1962).

Red-faced Cormorant (Phalacrocorax urile). Red-faced Cormorants were previously observed nesting on the cliffs of Cape Peirce in 1970 and 1973 (Dick and Dick 1971, M. H. Dick pers. comm.). Birds were only observed on 12 occasions from 7 May to 21 August 1976, and no birds attempted to nest.

Snow Goose (Anser hyperborea). Flocks of an estimated 150, 75, and 100 Snow Geese were observed 1 May 1976 along the cliffs of Cape Peirce. Age rations could not be determined.

Baikal Teal (Anas formosa). A single alternate plumage male was observed 1 May 1976 in a small melt water pond. The bird flew from the pond and landed in Nanvak Bay as I approached within 10 meters. The bird had a black rump, scapulars, and head stripes similar to a male Pintail, but was teal size with a green speculum and green head patches. The cream colored patches before and behind the eye were obvious.

American Kestrel (Felco sparverius). A male was observed 27 August 1976 flying down the coast along the cliff edge.

Solitary Sandpiper (Tringa solitaria). An individual in alternate plumage fed along the edge of a fresh water pond with Western Sandpipers 19 May 1976.

Spotted Sandpiper (Actitus macularia). A group of two birds in alternate plumage were seen 26 and 30 May 1976 on the upland tundra.

Lesser Yellowlegs (Totanus flavipes). Lesser Yellowlegs foraged in the tidal marsh on six days between 10 June and 12 July. One male (MRP 194, OBS-CE No. FW 602339007) was collected 10 June 1976, and had the following measurements; culmen - 34.9mm, tarsus - 50.5mm, weight - 85 gms. In 1973, M. H. Dick (pers. comm.) tentatively identified a bird as a Lesser Yellowlegs.

Skua (Catharacta skua). A skua was observed in the marsh 29 July 1976 after a mild storm. The attempt to secure the specimen was unsuccessful. The individual was very dark, and the characteristic white "patches" at the base of the primaries were conspicuous. The skua was "mobbed" by an adult parasitic jaeger when leaving the marsh area.

Red-legged Kittiwake (Rissa brevirostris). Four adult Red-legged Kittiwakes in alternate plumage were observed roosting with two Black-legged Kittiwakes on fast ice in Nanvak Bay 30 April 1976. One immature Red-legged Kittiwake roosted on a rock beneath a Black-legged Kittiwake colony on 25 September 1976.

Sabine's Gull (Xema sabini). Sabine's Gulls were observed 5 July 1964 by King (1966) (Table 1), but none were observed again until 1976 when birds were observed on five days from 12 May to 31 May. All individuals were in alternate plumage and were either feeding in shallow water or roosting on the beach of Nanvak Bay.

Cliff Swallow (Petrochelidon pyrrhonota). One Cliff Swallow foraged over a small pond with eight Tree Swallows and six Bank Swallows 9 June 1976.

Arctic Warbler (Phylloscopus borealis). A group of eight Arctic Warblers foraged briefly in a snow-free area of the marsh 1 May 1976.

Myrtle Warbler (Dendroica coronata coronata). A single male Myrtle Warbler was observed along the cliff edge 19 May 1976.

Slate-colored Junco (Junco hyemalis hyemalis). Slate-colored Juncos were observed in the dune area and nearby cliffs 29 August (one individual), 2 September (one individual), and 4 September (one group of four). One individual was captured and banded.

Mammals

Dusky shrew (Sorex obscurus). Twelve specimens tentatively identified as Dusky shrews were trapped during 2,000 trap nights 1 May to 5 September. All specimens were captured in heath-grass areas.

Ribbon seal (Histiophoca fasciata). A single Ribbon seal was observed 22 May 1976 on the sand of Nanvak Bay with Harbor seals.

Harbor porpoise (Phocoena vomeria). One individual was observed 1/2 mile off shore 28 June 1976 apparently feeding.

Gray whale (Eschrichtius robustus). Gray whales have previously been observed (Dick and Dick 1971), and an attempt to monitor northward migration during sea watches (see part V for sea watch description) was made in 1976. Whales were observed moving up the coast 5 May to 21 July, with no feeding activity observed. The first apparent cow-calf group was observed 20 May and such groups were observed until 13 July. Observations of 141 groups of Gray whales averaged 1.73 individuals per group. The largest group observed contained six individuals, but most groups had three or less individuals. One marked Gray whale, later identified by the description as "Gigi" (J. Hall pers. comm.), was observed 30 June in a group of four whales.

Minke whale (Balaenoptera acutorostrata). One individual tentatively identified as a Minke whale was observed diving one mile off the cliff area 13 July 1976.

A Brown bear tracks ^{in snow} were observed by Bartonek and Sanger on Cape Peewee across from Shaiak Island on 3 June 1976.

Table 1.

Checklist of birds observed at Cape Peirce-Nanvak Bay - 1963 to 1976.

Species	1963-69 ^{1/}	1970 ^{2/}	1971 ^{3/}	1973 ^{4/}	1976 ^{5/}
Common Loon (<u>Gavia immer</u>)	x	x		x	x
Yellow-billed Loon (<u>Gavia adamsii</u>)					x
Arctic Loon (<u>Gavia arctica</u>)	x	x		x	x
Red-throated Loon (<u>Gavia stallata</u>)	x	x	x	x	x
Red-Necked Grebe (<u>Podiceps grisegena</u>)	x	x	x	x	x
Horned Grebe (<u>Podiceps auritus</u>)				x	x
Short-tailed Shearwater (<u>Puffinus tenuirostris</u>)				x	
Double-crested Cormorant (<u>Phalacrocorax auritus</u>)	x	x		x	x
Pelagic Cormorant (<u>Phalacrocorax pelagicus</u>)	x	x	x	x	x
Red-faced Cormorant (<u>Phalacrocorax urile</u>)		x		x	x
Whistling Swan (<u>Olor columbianus</u>)		x		x	x
Canada Goose (<u>Branta canadensis</u>)	x	x		x	-
(<u>B. c. minima</u>)					x
(<u>B. c. taverneri</u>)					x
Black Brant (<u>Branta bernicla nigricans</u>)	x	x	x	x	x
Emperor Goose (<u>Anser canagica</u>)	x	x	x	x	x

Table 1. Continued

Species	1963-69	1970	1971	1973	1976
White-fronted Goose (<u>Anser albifrons</u>)		x	x	x	x
Snow Goose (<u>Anser caerulescens</u>)					x
Mallard (<u>Anas platyrhynchos</u>)	x	x		x	x
Pintail (<u>Anas acuta</u>)	x	x	x	x	x
Shoveler (<u>Anas clypeata</u>)	x	x		x	x
Common teal (<u>Anas crecca crecca</u>)				x	x
(<u>A. c. carolinensis</u>)	x	x	x	x	x
Baikal Teal (<u>Anas formosa</u>)					x
American Widgeon (<u>Anas americana</u>)				x	x
Greater Scaup (<u>Aythya marila</u>)	x	x		x	x
Common Goldeneye (<u>Bucephala clangula</u>)	x	x		x	x
Barrow's Goldeneye (<u>Buchphala islandica</u>)	x				
Bufflehead (<u>Bucephala albeola</u>)				x	x
Oldsquaw (<u>Clangula hyemalis</u>)	x	x	x	x	x
Harlequin Duck (<u>Histrionicus histrionicus</u>)	x	x		x	x
Steller's Eider (<u>Polysticta stelleri</u>)	x	x		x	x

Table 1. Continued

Species	1963-69	1970	1971	1973	1976
Common Eider (<u>Somateria</u> <u>mollissima</u>)	x	x		x	x
King Eider (<u>Somateria</u> <u>spectabilis</u>)	x	x		x	x
White-winged Scoter (<u>Melanitta</u> <u>deglandi</u>)	x	x		x	x
Surf Scoter (<u>Melanitta</u> <u>perspicillata</u>)	x	x		x	x
Black Scoter (<u>Melanitta</u> <u>nigra</u>)	x	x		x	x
Red-breasted Merganser (<u>Mergus</u> <u>serrator</u>)	x	x		x	x
Bald Eagle (<u>Haliaeetus</u> <u>leucocephalus</u>)		x		x	x
Gyr Falcon (<u>Falco</u> <u>peregrinus</u>)	x	x		x	x
Peregrine Falcon (<u>Falco</u> <u>peregrinus</u>)		x	x	x	x
Goshawk (<u>Accipiter</u> <u>gentilis</u>)		x			x
Marsh Hawk (<u>Circus</u> <u>cyaneus</u>)				x	x
Rough-legged Hawk (<u>Buteo</u> <u>lagopus</u>)		x		x	x
Swainson's Hawk (<u>Buteo</u> <u>swainsoni</u>)		x		x	
Osprey (<u>Pandion</u> <u>haliaetus</u>)		x		x	x
Golden Eagle (<u>Aquila</u> <u>chrysaetos</u>)		x	x	x	

Table 1. Continued

Species	1963-69	1970	1971	1973	1976
American Kestrel (<u>Falco sparverius</u>)					x
Willow Ptarmigan (<u>Lagopus lagopus</u>)		x		x	x
Rock Ptarmigan (<u>Lagopus mutus</u>)		x		x	x
Lesser Sandhill Crane (<u>Grus canadensis</u>)	x	x		x	x
Golden Plover (<u>Pluvialis dominica</u>)		x		x	x
Black-bellied Plover (<u>Pluvialis squatarola</u>)		x		x	x
Semipalmated Plover (<u>Charadrius semipalmatus</u>)	x	x		x	x
Mongolian Plover (<u>Charadrius mongolus</u>)				x	
Whimbrel (<u>Numenius phaeopus</u>)		x		x	x
Bristle-thighed Curlew (<u>Numenius tahitiensis</u>)				x	
Hudsonian Godwit (<u>Limosa haemastica</u>)				x	x
Bar-tailed Godwit (<u>Limosa lapponica</u>)		x		x	
Solitary Sandpiper (<u>Tringa solitaria</u>)					x
Spotted Sandpiper (<u>Actitis macularia</u>)					x
Wandering Tattler (<u>Heteroscelus incanum</u>)	x	x		x	x
Greater Yellowlegs (<u>Tringa melanoleucus</u>)		x		x	x

Table 1. Continued

Species	1963-69	1970	1971	1973	1976
Lesser Yellowlegs (<u>Tringa flavipes</u>)				x	x
Short-billed Dowitcher (<u>Limnodromus griseus</u>)		x		x	
Long-billed Dowitcher (<u>Limnodromus scolopaceus</u>)				x	
Unknown Dowitcher (<u>Limnodromus</u> sp.)					x
Surfbird (<u>Aphriza virgata</u>)				x	x
Ruddy Turnstone (<u>Arenaria interpres</u>)		x		x	x
Black Turnstone (<u>Arenaria melanocephala</u>)		x		x	x
Rock Sandpiper (<u>Calidris</u> <u>ptilocnemis</u>)	x	x		x	x
Pectoral Sandpiper (<u>Calidris melantos</u>)				x	x
Sharp-tailed Sandpiper (<u>Calidris acuminata</u>)		x		x	
Dunlin (<u>Calidris alpina</u>)	x	x		x	x
Sanderling (<u>Calidris alba</u>)	x	x	x	x	x
Baird's Sandpiper (<u>Calidris bairdii</u>)		x		x	
Least Sandpiper (<u>Calidris minutilla</u>)	x	x		x	x
Western Sandpiper (<u>Calidris mauri</u>)	x	x	x	x	x
Terek Sandpiper (<u>Xenus cinereus</u>)				x	x

Table 1. Continued

Species	1963-69	1970	1971	1973	1976
Red Phalarope (<u>Phalaropus</u> <u>fulicarius</u>)	x	x		x	x
Northern Phalarope (<u>Phalaropus</u> <u>lobatus</u>)	x	x		x	x
Common Snipe (<u>Capella gallinago</u>)	x	x		x	x
Parasitic Jaeger (<u>Stercorarius</u> <u>parasiticus</u>)	x	x		x	x
Pomarine Jaeger (<u>Sterocorarius</u> <u>pomarinus</u>)				x	x
Long-tailed Jaeger (<u>Stercorarius</u> <u>longicaudus</u>)	x	x		x	x
Skua (<u>Catharacta skua</u>)					x
Glaucous Gull (<u>Larus hyperboreus</u>)				x	x
Glaucous-winged Gull (<u>Larus glaucescens</u>)	x	x	x	x	x
Mew Gull (<u>Larus canus</u>)	x	x		x	x
Bonaparte's Gull (<u>Larus philadelphia</u>)	x	x		x	x
Black-legged Kittiwake (<u>Rissa tridactyla</u>)	x	x	x	x	x
Red-legged Kittiwake (<u>Rissa brevirostris</u>)					x
Sabine's Gull (<u>Xema sabini</u>)	x				x

Table 1. Continued

Species	1963-69	1970	1971	1973	1976
Arctic Tern (<u>Sterna paradisaea</u>)	x	x		x	x
Aleutian Tern (<u>Sterna aleutia</u>)				x	x
Common Murre (<u>Uria aalge</u>)	x	x	x	x	x
Pigeon Guillemot (<u>Cepphus columba</u>)	x	x	x	x	x
Horned Puffin (<u>Fratercula corniculata</u>)	x	x		x	x
Tufted Puffin (<u>Lunda cirrhata</u>)	x	x		x	x
Marbled Murrelet (<u>Brachyramphus marmoratum</u>)		x	x		
Parakeet Auklet (<u>Cyclorhynchus psittacula</u>)	x	x		x	x
Short-eared Owl (<u>Asio flammeus</u>)	x	x		x	x
Say's Phoebe (<u>Sayornis saya</u>)		x			
Barn Swallow (<u>Hirundo rustica</u>)				x	
Cliff Swallow (<u>Petrochelidon pyrrhonota</u>)					x
Tree Swallow (<u>Iridoprocne bicolor</u>)	x	x		x	x
Bank Swallow (<u>Riparia riparia</u>)		x		x	x

Table 1. Continued

Species	1963-69	1970	1971	1973	1976
Black-billed Magpie (<u>Pica pica</u>)				x	
Common Raven (<u>Corvus corax</u>)	x	x	x	x	x
American Robin (<u>Turdus migratorius</u>)				x	
Varied Thrush (<u>Ixoreus naevius</u>)				x	
Hermit Thrush (<u>Catharus guttata</u>)		x		x	
Gray-cheeked Thrush (<u>Catharus minima</u>)	x	x		x	x
Arctic Warbler (<u>Phylloscopus borealis</u>)					x
Water Pipit (<u>Anthus spinoletta</u>)		x		x	x
White Wagtail (<u>Motacilla alaba</u>)				x	
Yellow Wagtail (<u>Motacilla flava</u>)	x	x		x	x
Orange-crowned Warbler (<u>Verminora celata</u>)		x		x	
Yellow Warbler (<u>Dendroica petechia</u>)	x	x		x	x
Myrtle Warbler (<u>Dendroica coronata</u>)					x
Blackpoll Warbler (<u>Dendroica triata</u>)				x	
Northern Waterthrush (<u>Seiurus noveboracensis</u>)				x	
Wilson's Warbler (<u>Wilsonia pusilla</u>)	x	x		x	x

Table 1. Continued

Species	1963-69	1970	1971	1973	1976
Red-winged Blackbird (<u>Agelaius phoeniceus</u>)				x	
Rusty Blackbird (<u>Euphagus carolinus</u>)				x	x
Gray-crowned Rosy Finch (<u>Leucosticte tephrocotis</u>)	x	x		x	x
Redpoll (<u>Carduelis</u> sp.)		x		x	x
Savannah Sparrow (<u>Passerculus sandwichensis</u>)	x	x		x	x
Slate-colored Junco (<u>Junco hyemalis</u>)					x
Tree Sparrow (<u>Spizella arborea</u>)		x		x	x
White-crowned Sparrow (<u>Zonotrichia leucophrys</u>)		x		x	x
Golden-crowned Sparrow (<u>Zonotrichia atricapilla</u>)	x	x		x	x
Fox Sparrow (<u>Passerella iliaca</u>)		x		x	x
Lapland Longspur (<u>Calcarius lapponicus</u>)	x	x	x	x	x
Snow Bunting (<u>Plectrophenax nivalis</u>)	x	x	x	x	x

1 King (1966) - 12 days April to September 1963 and 1964; Hout (1969) - 3 to 12 June, 21 to 29 July, and 18 September 1969.

2. Dick and Dick (1971) - 23 May to 28 August 1970.
3. Hout (1971) - 2 to 9 April, 18 September to 1 October 1971.
4. Dick (pers. comm.) - 27 April to 19 May, 26 May to 24 June, 14 August to 27 September 1973.
5. This study - 28 April to 9 September 1976.

Table 2.

Checklist of mammals observed at Cape Peirce-Nanvak Bay - 1963 to 1976.

Species	<u>1/</u> 1963-69	<u>2/</u> 1970	<u>3/</u> 1971	<u>4/</u> 1973	<u>5/</u> 1976
Dusky Shrew (<u>Sorex obscurus</u>)					?
Least Weasel (<u>Mustela rixosa</u>)				x	x
River Otter (<u>Lutra canadensis</u>)		x			(tracks)
Red Fox (<u>Vulpes fulva</u>)	x	x	x	x	x
Northern Sea Lion (<u>Eumetopias jubata</u>)	x				x
Walrus (<u>Odobenus rosmarus</u>)	x	x			x
Harbor Seal (<u>Phoca vitulina</u>)	x	x	x	x	x
Ribbon Seal (<u>Phoca fasciata</u>)					x
Hoary Marmot (<u>Marmota caligata</u>)	x	x		x	x
Arctic Ground Squirrel (<u>Citellus undulatus</u>)	x	x		x	x
Tundra Redback Vole (<u>Clethrionomys rutilus</u>)				?	?

Table 2. Continued

Species	1963-69	1970	1971	1973	1976
Tundra Vole (<u>Microtus oeconomus</u>)					?
Grizzly Bear (<u>Ursus horribilis</u>)	x	(tracks)		(tracks)	(tracks)
Muskrat (<u>Ondatra zibethica</u>)		x			
False Killer Whale (<u>Pseudorca crassidens</u>)		x			
Harbor Porpoise (<u>Phocoena phocoena</u>)					x
Gray Whale (<u>Eschrichtius robustus</u>)		x		x	x
Minke Whale (<u>Balaenoptera acutorostrata</u>)					?

1. King (1966) - 12 days April to September 1963 and 1964; Hout (1969) - 3 to 12 June, 21 to 29 July, and 18 September 1969.
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APPENDIX II. Possible Aging Technique for Common Murres in Breeding Plumage.

The age determination of a species by observations of a relatively conspicuous morphological characteristic can be a useful tool to help determine demographic information of a population. Common Murres (Uria aalga) in breeding plumage have been described with "feet and swimming webs black, but lighter (brownish or yellowish) on anterior side of tarsometatarsus and external surface of toes" (Dement'ev and Gladkov 1951).

Common Murres in breeding plumage were noted to have a variable shade of orange coloration on their toes and tarsus. Four distinct color variations were separated into bright orange, moderate orange, light orange, or dark (no observable orange) color categories. Associated with the variations in foot and tarsus color were differences in breeding success. Birds with young 11 August 1976 were predominantly birds with bright or moderate foot and tarsus colors, and those without young had dark or light orange feet and tarsus colors ($\chi^2 = 16.22$, $df = 3$, $p > 0.005$; Table 1). Data suggest that slight and dark foot-tarsus individuals were the last to have young jump from the cliffs.

Birds collected in the area for food habit studies were examined for a brood patch, foot and tarsus color, and bursa. All birds were in the alternate plumage, and no young of the year were collected. Data (Table 2) suggest a correlation with age and foot-tarsus color.

Further examination of a larger sample size of breeding plumage birds at colonies, and examination of known age individuals is needed to access the validity of the hypothesis that foot and tarsus color is age-related, and to more accurately describe the color variations.

Literature Cited

- Dement'ev, G. P. and N. A. Gladkov (eds.). 1951. Birds of the Soviet Union, Vol. 2. (Trans. from Russian). Israel Program for Sci. Transl., Jerusalem.
- Palmer, R. S. (ed.). 1962. Handbook of North American Birds, Vol. 1. Yale Univ. Press, New Haven.

Table 1.

Foot-tarsus colors of Common Murres on one ledge.

Date ^{1/}	Status of birds	Number of birds observed with:			
		dark foot- tarsus	slight orange foot- tarsus	moderate orange foot- tarsus	bright orange foot- tarsus
11 August	Without young	9	4	3	2
	With young	0	0	7	6
17 August	Without young	8	1	0	0
	With young	0	1	0	0
23 August	Without young	1	0	0	0
	With young	1	1	0	0
28 August	Without young	5	2	4	0
	With young	1	1	0	0

^{1/} First young jumped 10 August; model young disappearance 17 August;
all young jumped by 3 September.

Table 2.

Specimen data of Common Murres collected in 1976.

USFWS Acc. no.	Date coll.	Sex	Foot-tarsus color	Burse length (mm)	Brood patch	Plumage
522	19 June	F	bright	none	present	alternate
524	19 June	M	moderate	none	present	alternate
528	19 June	M	moderate	none	absent	alternate
523	19 June	F	light	15	absent	alternate
532	14 July	F	light	14	absent	alternate
533	14 July	F	light	19	absent	alternate

APPENDEK III. 1976 Weather Data from Cape Peirce.

	April ^{1/}	May	June	July	Aug.	Sept. ^{2/}	Total
Ave. daily max. (C)	3.0	5.1	10.6	14.4	13.8	11.5	
Ave. daily min. (C)	-3.0	-0.6	3.7	7.1	9.0	6.0	
Max. for mo. (C)	6.0	11.0	21.0	20.0	18.0	14.0	
Min. for mo. (C)	-3.0	-3.0	0.0	2.0	7.0	4.0	
Total ppt. (mm)	0	14.2	21.8	23.6	96.0	27.7	183.3
Days of < 5% cloud	1	1	4	2	2	0	10
No. days with snow	0	10	0	0	0	0	10
No. days with rain	0	10	11	11	20	3	55
No. days with fog	1	9	17	17	7	0	51
No. days w/winds ≤ 5 kts	0	11	14	18	15	5	63
No. days w/winds 6-25 kts	2	14	15	12	14	2	59
No. days w/winds 26-35 kts.	0	1	1	0	1	0	3
No. days ≥ 36 kts.	0	5	0	0	1	0	4

^{1/} April 29-30

^{2/} Sept. 1-7

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