



## THE DISTRIBUTION OF WATERFOWL TO ST. LAWRENCE ISLAND, ALASKA

Francis H. Fay

*(Arctic Health Research Center, Public Health Service, U.S. Department  
of Health, Education, and Welfare, Anchorage, Alaska)*

### Summary

TWENTY-TWO species of waterfowl are represented on St. Lawrence Island. Twelve of these breed on the island, and the rest occur irregularly or as migrants. The surrounding waters constitute a major wintering area for Long-tailed Ducks (*Clangula hyemalis*) and King Eiders (*Somateria spectabilis*), while in summer the island is an important breeding and moulting area for Emperor Geese (*Anser canagicus*), Pacific Eiders (*Somateria mollissima v-nigra*), Northern Pintails (*Anas acuta acuta*), and Long-tailed Ducks. Seasonal occurrence and some features of natural history of the more common species have been described.

The avifauna of St. Lawrence Island is more closely affiliated with that of North America than Asia. This may be a result of the island's relationship to the Bering Land Bridge, which probably had a strong influence on the intercontinental distribution of waterfowl. With gradual inundation of the land bridge during the last part of the Wisconsin (Würm) glacial epoch, the island's faunal tie to North America probably was weakened. A decrease in abundance of North American forms is indicated by a comparison of the Eskimo's waterfowl harvests of 1-2000 years ago with those of the present.

### Introduction

St. Lawrence Island, a land mass of some two thousand square miles, is situated in the Bering Sea nearly midway between western Alaska and eastern Siberia (Fig. 1). The flora and fauna of this locality are typical of the low arctic and resemble those of the adjacent continents, to which the island evidently was connected quite recently in geologic time. Some ecologic and faunistic relationships of birds occurring on the island have been discussed

recently by Fay and Cade (1959), and material relating to the waterfowl is reviewed and enlarged upon in the present paper.

Some physical attributes of St. Lawrence Island that are of great importance to waterfowl are the 320-mile coastline and the extensive system of fresh and brackish water lagoons. The sand and gravel bars separating the lagoons from the sea comprise nearly one-third of the total coastline. About 60 per cent of the interior land area is low, rolling tundra dotted with lakes, while the remainder is mostly high, rocky upland. In summer, the shores and islands of the lakes and lagoons are nesting areas for about nine thousand ducks, geese, and swans, while the lagoons and coastal areas are resting, foraging, and moulting sites for these and more than twenty-five thousand non-breeding waterfowl. In winter, the surrounding ice-choked waters attract several hundred thousand sea ducks, which breed for the most part in higher arctic regions.

The vegetation of the island includes almost no arborescent forms; sedges, grasses, ericaceous shrubs, and cryptogams are abundant. The climate is low arctic maritime, with relatively milder winters and cooler summers than the adjacent continental areas. The average wind velocity is nearly 20 mph, and the prevailing wind direction is north-easterly (Weather Bureau, 1953). Storms with strong southerly winds are common from May through September, and precipitation occurs on approximately 300 days per year. Inclement weather predominates, and there are some indications that the climate is in large measure responsible for repelling some birds which might otherwise become established.

Ornithological investigations on the island have been intermittent and largely confined to the western half. Much of the information concerning the birds of the eastern half has come from the Eskimo, who formerly travelled widely over the island while herding reindeer. The earliest extensive account of the birds was published by E. W. Nelson (1883), and this was followed by a long series of notes and papers, especially by Herbert Friedmann and O. J. Murie. The earlier contributions were summarized by Friedmann (1932), and the more recent ones by Fay and Cade (1959). In the following description of the waterfowl, some information from previous accounts has been utilized, but I have drawn largely upon my own field notes made during 24 months of discontinuous observation from 1952 to 1960. The population figures included are approximations based upon casual observation and probably are accurate only within the limits of plus or minus 50 per cent.

The nomenclature and geographic ranges of the waterfowl considered in this paper are according to Delacour (1954-59).

### **The Seasonal Occurrence of Waterfowl**

#### *Winter*

From December to May the island is surrounded by the ice pack, which extends from the polar sea to approximately the latitude 60°N. During the period 1st December to 30th April, the monthly mean temperatures range from 3° to 17°F, and snow squalls and blizzards are frequent. Prevailing winds pack the ice tightly against the northern coast and, at the same time, blow it away from the southern coast. Occasional contrary winds reverse this

pattern, and strong tidal currents along the shore modify it, especially at either end of the island, by alternatively dispersing and concentrating the ice about certain points and headlands. The result is an enormously complex, dynamic system of ice-free areas being created and obliterated continuously. Since openings are present somewhere around the island at all times, and since marine invertebrates abound, conditions are suitable for the overwintering of a very large population of Long-tailed Ducks (*Clangula hyemalis*) and considerable numbers of King and Pacific Eiders (*Somateria spectabilis* and *S. mollissima v-nigra*).

The population of Long-tailed Ducks which winters annually about the island is conservatively estimated as five hundred thousand on the basis of aerial observations. These birds are constantly on the move, flying from one area of open water to another. With a reversal of wind and consequent packing of the ice on one coast, the entire population flies around and across to the opposite side of the island and alights again in the newly formed openings. During these flights in late winter and early spring, large numbers of Long-tailed Ducks are killed by the Eskimo for food.

The wintering Eiders may number upwards of fifty thousand but are much less evident than the Long-tailed Ducks because they tend to remain well offshore. In February, 1953, R. A. Ryder (*in litt.*) sighted one flock of King Eiders which he estimated contained fifteen thousand. He observed that the Pacific Eiders were present in much smaller numbers and were mixed with the large flocks of King Eiders. Both the Eiders and the Long-tailed Ducks are subject to predation by Snowy Owls (*Nyctea scandiaca*) and Gyrfalcons (*Falco rusticolus*) throughout the winter. The number of Gyrfalcons is small (certainly less than fifty), whereas several hundred Snowy Owls may be present in some years. Considering the large number of waterfowl present, it seems improbable that the predators have much effect on the populations, but I suppose that it may be as great as the mortality at the hands of the Eskimo. The latter usually take more than a thousand Long-tailed Ducks and less than two hundred Eiders during the winter months.

In most years, immigration of Long-tailed Ducks to the St. Lawrence Island region takes place in December when the first chunks of polar ice arrive from the north. They remain concentrated there at least until the middle or end of April, when milder weather and shifting winds begin to dissipate the ice pack. By 1st May, emigration is evident from the decrease in abundance, and toward the middle of the month, the Long-tailed Ducks that are present probably are those that will summer locally. The latter are nearly absent from the coast by the fourth week of May or first week of June, having moved inland to lakes and rivers from which the ice has begun to melt. The first courtship displays were noted on 25th April, and nesting probably commences in early June. Two nests found on 15th and 17th July contained four and six eggs, respectively, none of which had been incubated more than a week. Non-breeding birds seem to be about as numerous as the breeders, and flocks of from less than ten to more than a hundred are frequently seen along the lagoons and interior lakes from June to August. One flock sighted on 23rd August was flightless, and another flightless bird was seen on 2nd September. During September, these ducks disperse from the island and are rare or absent throughout October and November.

### Spring

It is generally agreed by the St. Lawrence Islanders that winter ends in April with the arrival of the first whales and small groups of walrus. From this beginning until its end in early June, spring is a spectacular event in terms of vertebrate activity. The flight of birds to and from the island is continuous in the 24-hour daylight, and waterfowl comprise a large proportion of the total transient population.

The mean temperature during this period is about 30°F. Warm southerly winds are more frequent, and by the end of the season, most of the snow and ice is gone. Aside from the great population of Long-tailed Ducks, King Eiders are the earliest and most numerous migrants seen along the western coast<sup>1</sup>. These appear in abundance about 25th April and intermittently pass northward over the ice for about one month. Judging from the direction of flight, north of Northwest Cape, these birds are bound for both the Siberian and Alaskan coasts. Very few adults are present on the island in summer, but at least two thousand non-breeding birds remain in large flocks offshore and along the southern lagoons.

Pacific Eiders and Steller's Eiders (*Polysticta stelleri*) appear in force about 15th May, and a few Spectacled Eiders (*Somateria fischeri*) are also present at that time. Whistling Swans (*Cygnus columbianus columbianus*), Pacific Brent Goose (*Branta bernicla orientalis*), Emperor Geese (*Anser canagicus*), Lesser Snow Geese (*Anser caerulescens caerulescens*), and Northern Pintails (*Anas acuta acuta*) arrive somewhat later, usually between 20th and 29th May. The adult Steller's and Spectacled Eiders, like the King Eiders, mostly pass northward to their continental breeding grounds. Both of these species occasionally nest on the island, but for the most part their local summering populations consist of immature birds. The Swans, Geese, and Pintails pass in small numbers, and all proceed in a northwesterly direction, toward the Chukchi Peninsula. Breeding populations of each of these, except the Snow Geese, also remain on the island throughout the summer.

Of the Eiders seen on the western coast, the Pacific Eider is the most common throughout the spring and summer. A breeding population of, perhaps, thirty-five hundred occurs on the island in summer, and there is a smaller non-breeding group as well. The breeding birds move inland as the fresh water becomes ice-free in late May and early June, and incubation is under way by 15th June. In general, the nests are widely distributed over the island on nearly every type of terrain, but none has been found more than 500 yards from water. On several small islands in the southern lagoons, these ducks nest colonially, the maximum density being about a hundred pairs per acre. The average clutch size is approximately five eggs. Nests with fresh or slightly incubated eggs have been found frequently in the first two weeks of July, and females with downy young are a common sight after 15th July.

The Pacific Eider is taken by the Eskimo principally during the spring months, and eggs are collected from certain of the colonial nesting sites

<sup>1</sup>My observations of birds from mid-April to early June have been limited to a 20-mile segment of the western coast from Northwest Cape to the Moghoweyik River. Contrasting results of observations at Southeast Cape by a biologist (R. A. Ryder) and by the Eskimo indicate that avian activity on the western coast is by no means representative for the island as a whole. See "Delay in Migration." below.

nearly every year about the middle of June. The number of Pacific Eiders used annually by these people is less than five hundred, and the harvest of eggs may average more than a thousand.

During the height of the spring migration, several species of irregular or accidental occurrence have been recorded. These are the Thick-billed Bean Goose (*Anser fabalis serrirostris*), Pacific White-fronted Goose (*Anser albifrons frontalis*), Cackling Canada Goose (*Branta canadensis minima*), American Green-winged Teal (*Anas crecca carolinensis*), Baikal Teal (*Anas formosa*), European Wigeon (*Anas penelope*), and the Northern Shoveler (*Anas clypeata*).

### Summer

In the long, cool days of summer, the skies are overcast more than 90 per cent of the time, and precipitation is frequent. The mean temperature during this period, mid-June to early September, is about 44°F, and winds are mostly from the south-west. Flocks of immature King and Steller's Eiders (up to two hundred per flock) are seen frequently offshore and along the lagoons, while Pacific Harlequins (*Histrionicus histrionicus pacificus*) occur along the southwestern cliffs and some other rocky points in aggregations of five to ten.

The nesting population of Whistling Swans on the western half of the island is less than ten pairs, and an approximately equal number of juvenile birds occupies this area. One pair of adults in courtship and defence of territory was seen on 24th and 25th May, and one empty nest was found on 29th July. Broods of two, three, four, and five downy young have been seen between 13th and 25th August. A group of seven flightless immatures was seen on 29th July, and the Eskimo report that the fledglings are incapable of flight until late September. Fledglings formerly were taken by the Eskimo for food, but this practice was discontinued at least fifteen years ago.

The density of the Northern Pintail population is highly variable, but in an average summer it may comprise more than a thousand breeders and about half as many non-breeders. The earliest nesting record is 15th June, and the latest 13th July. One hen with a brood was seen by P. E. Tovey (*in litt.*) on 15th August. The scarcity of brood records and the fluctuations in population density indicate that nesting is relatively unsuccessful in this locality.

Other ducks which occur irregularly but probably breed occasionally are the Pacific Scaup (*Aythya marila mariloides*) and the Red-breasted Merganser (*Mergus serrator serrator*). Both the White-winged and Black Scoters (*Melanitta fusca deglandi* and *M. nigra americana*) also have been recorded on several occasions, but none has been seen away from the littoral waters.

By far the most abundant and characteristic summering waterfowl on the island are the Emperor Geese. Between ten and twenty thousand non-breeding birds spend the summer along the southern coast and on some of the larger lagoons on the northern coast, congregating in large "herds" during the molt. I have seen the Eskimo capture flightless birds many times between 17th June and August 7th, and some apparently incapable of flight

were seen as late as 15th August. In an aggregation of approximately five thousand Emperor Geese along one of the southern lagoons on 21st July, 1960, not more than ten were capable of sustained flight.

It is difficult to estimate the size of the breeding population of Emperor Geese, but it is certainly no more than one-tenth as large as that of the immature birds. Clearly, the population of immatures is not entirely the product of local breeding. It seems probable, as Cade has suggested (Fay and Cade, 1959), that St. Lawrence Island is the principal summering area for the entire population of immatures produced in Alaska and Siberia.

According to the Eskimo, Emperor Geese nest extensively in the wet tundra of the central and eastern parts of the island. One nest with four partly incubated eggs was found by P. E. Tovey on 23rd June on the shore of a small lake in the central district (Fay and Cade, 1959, pl. 14, *b*). I have seen broods of two and three downy young on 15th and 29th July respectively, and one fledgling, fully feathered except for the head and neck, was taken on 22nd August. The latter was still unable to fly.

From about 10th to 22nd August there is a strong tendency for northward migration by the Emperor Geese and Eiders, both on the coasts and across the interior tundra and mountain ranges. The trend is reversed toward the end of August, and by 1st September nearly the entire population of immature Emperor Geese has departed from the western half of the island. Some Emperor Geese remain through September and early October, but these probably are all adults and young of the year. The Eskimo familiar with conditions on the eastern end of the island report that the southbound Emperor Geese congregate in the vicinity of Southeast Cape, and some remain there as late as December.

### Fall

The interval between wet summer and icebound winter is long (September to December), severe storms are frequent, and birds are few. Winds are variable, though mostly from the north, and the temperature averages about 30°F. There is a strong, eastward migration of waterfowl along the coasts in September. Among the migrants are an estimated five thousand Lesser Snow Geese, which begin to arrive from Siberia about August 20 and pass intermittently for about a month. Most are in small flocks (ten to forty each), and the Eskimo state that these Geese depart directly from the eastern end of the island toward the Alaskan mainland. They are very shy, and no more than fifty are taken annually by the Eskimo.

Toward the end of September, waterfowl are relatively scarce on and near the island, and few are seen until the truly arctic species, *Clangula hyemalis* and *Somateria spectabilis*, return with the ice in December.

### Delay in Migration

Whereas Ryder (*in litt.*) observed that Brent Geese were approaching the Southeast Cape of St. Lawrence Island on 1st May, 1954, none was seen at Northwest Cape until 28th May, that year. This discrepancy led to an examination of the arrival dates for other migrants and a comparison with arrivals on the Yukon Delta, a possible departure point for waterfowl flying to Siberia by way of the island. The comparison is shown in Table 1, in which the earliest dates for arrivals on the Delta have been drawn from the

compilation by Gabrielson and Lincoln (1959). Since the earliest arrival of Brent Geese on the Delta (5th May) corresponds closely to Ryder's record, it is assumed that the dates for other species are equally comparable. Waterfowl which occur around the island in winter and those for which comparative dates are not available have not been included in the table.

On the basis of the number of days between arrival dates for each species, the birds of Table 1 are divisible into two groups, *viz.* those which reach both localities within plus or minus ten days of the same date and those which reach Northwest Cape twenty to thirty days after their arrival

**Table 1.** Some comparative arrival dates of migrant waterfowl in spring on the Yukon Delta and at Northwest Cape, St. Lawrence Island.

Species	Date of earliest arrival		
	Yukon	Delta*	Northwest Cape
<i>Cygnus columbianus columbianus</i> .. .. .	"mid-April" (SM)		May 24
<i>Anser caerulescens caerulescens</i> .. .. .	April 29 (MV)		May 21
<i>Anser canagicus</i> .. .. .	May 15 (HB)		May 9
<i>Branta bernicla orientalis</i> .. .. .	May 5 (SM)		May 28
<i>Anas acuta acuta</i> .. .. .	April 28 (SM)		May 19
<i>Aythya marila mariloides</i> .. .. .	May 18 (HB)		May 27
<i>Polysticta stelleri</i> .. .. .	May 18 (HB)		May 16
<i>Somateria fischeri</i> .. .. .	May 5 (HB)		May 13

\*Localities: HB—Hooper Bay; MV—Mountain Village; SM—St. Michael

on the Delta. With one exception (*Aythya marila mariloides*), the birds of the first group winter primarily in the vicinity of the Aleutian Islands, while the second group winters mostly far to the south, in the western United States. The latter, having already completed the major portion of their migration, evidently tarry along the final segment of their route. On the other hand, the northern species have a relatively short distance to go and proceed more directly to their destination. The Brents, and possibly the others as well, evidently linger along the southern coast of the island.

In fall, the trend seems to be reversed, the northern species remaining longest and the southern group departing directly toward the mainland.

### Recent History and Faunal Relationships

During the last part of the Wisconsin (=Würm) glacial epoch, St. Lawrence Island evidently remained connected to North America as a part of the Bering Land Bridge for more than a thousand years after the connection with Siberia had been severed (Hopkins, 1959). In consideration of this point and the position of the island relative to the probable form of the "bridge" (Hopkins, 1959, Fig. 5), one might expect the fauna to show slightly stronger affinity to North America than to Eurasia. For the birds, in general, this affinity has been demonstrated (Fay and Cade, 1959), and for the waterfowl, in particular, it is clearly shown by the status of species or races in the modern fauna (Table 2). Five of these are of North American origin, three are Asiatic, and the remainder are Circumpolar or Amphipacific in distribution. Of the North American representatives, one breeds on the island, one occurs in large numbers as a migrant, and the others occur irregularly. Each of the Asiatic representatives, on the other hand, is known only from a single, extra-limital record.

The fourteen species and races of Circumpolar and Amphi-Pacific distribution comprise nearly 99 per cent of the total number of waterfowl utilizing the island and more than 99 per cent of the breeding population. For an island so near and so recently connected to Asia and North America, the representation of birds peculiar to these continents seems disproportionately small. It would seem, anyway, that the continental forms must have been more numerous during the periods when the land bridge was extant. Of course, there are no paleontological records available to compare with the present fauna in order to test this hypothesis, i.e., to determine what changes, if any, have taken place in, say, the last ten thousand years. Fortunately, there are some archeological records for the final quarter of that period, and these, cautiously interpreted, do suggest possible changes.

Table 2. Status of the recent waterfowl of St. Lawrence Island.

Faunal affinity	Species	Present status
NORTH AMERICAN		
	<i>Cygnus columbianus columbianus</i>	common; breeds
	<i>Anser caerulescens caerulescens</i>	abundant; migrant
	<i>Branta canadensis minima</i>	irregular
	<i>Anas crecca carolinensis</i>	irregular
	<i>Melanitta fusca deglandi</i>	irregular
ASIATIC		
	<i>Anser fabalis serrirostris</i>	accidental
	<i>Anas formosa</i>	accidental
	<i>Anas penelope</i>	accidental
AMPHI-PACIFIC		
	<i>Anser albifrons frontalis</i>	irregular
	<i>Anser canagicus</i>	abundant; breeds
	<i>Branta bernicla orientalis</i>	uncommon; breeds
	<i>Polysticta stelleri</i>	common; breeds
	<i>Somateria mollissima v-nigra</i>	abundant; breeds
	<i>Somateria fischeri</i>	uncommon; breeds
	<i>Aythya marila mariloides</i>	uncommon; breeds (?)
	<i>Melanitta nigra americana</i>	irregular
	<i>Histrionicus histrionicus pacificus</i>	common; breeds (?)
CIRCUMPOLAR		
	<i>Anas acuta acuta</i>	common; breeds
	<i>Anas clypeata</i>	accidental
	<i>Somateria spectabilis</i>	common; breeds (?)
	<i>Clangula hyemalis</i>	abundant; breeds
	<i>Mergus serrator serrator</i>	irregular; breeds (?)

In 1934, Friedmann published a note on the identification and distribution of several thousand bird bones from archeological sites on St. Lawrence Island. Much of the waterfowl material in this collection was excavated on the southeastern tip of the island from the lower levels of a large kitchen midden at Kialegak. This site was occupied intermittently from about two thousand to one thousand years ago and again in a more recent period (see Collins, 1937). The rest was obtained on the northwestern tip of the island, principally from three sites ranging in age from about a thousand to more than twenty-five hundred years old. Taken at face value, the proportion of these collections comprised by each species is not representative of the status



of the populations extant at the time, but relative abundance is certainly reflected in a general way. In order to interpret this, however, one must take into account the effects of preferential selection on the part of the Eskimo and the efficiency of their hunting methods. For example, today the Pacific Eider is taken in preference to any other duck because of its large size and the fine quality of its flesh. About half as many Pacific Eiders as Long-tailed Ducks are taken annually, although more than ten times as many of the latter are available during the year. The Long-tailed Ducks are among the least desired for food and are taken only when no other birds are available. On the other hand, Snow Geese are at present the most desired of the Anserinae, but they make up a very small proportion of the total harvest. Though abundant in migration, they are very shy and difficult to obtain, even with firearms. In the past, when the hunting equipment used for waterfowl consisted of spears, snares, and the bolas, Snow Geese would have been very rarely taken.

Having a rather complete understanding of the preferences and techniques utilized today and the sampling error introduced by them in the modern waterfowl harvest, it is possible to interpret the harvests of the past if one assumes that the preferences were similar but the equipment and techniques were less efficacious. With their primitive equipment, "it is obviously unlikely that the Eskimos would have been able to get numbers of birds that were rare at the time" (Friedmann, 1934, p. 84); hence, those species represented in the collections must have been relatively common.

In Tables 3 and 4 the waterfowl harvests of the past have been compared with those of the present, and to each species has been assigned a symbol indicating the direction of change of status. Only those species that were represented in the middens or are taken annually in the modern harvest have been included. The archeological data summarized in Table 3 are from the three oldest sites (2500-1000 B.P.) near Northwest Cape; Table 4 contains a summary of the Kialegak collection (mostly 2000-1000 B.P.). The difference in number and kind of species represented at Northwest Cape as compared to Southeast Cape is merely a reflection of the distribution of waterfowl on the island. Those present in Table 4 but not in Table 3 ordinarily do not occur in the northwestern district.

**Table 3.** Ancient and modern waterfowl harvests by Eskimo at Northwest Cape, St. Lawrence Island.

Species	Relative quantity (a)		Change in status (b)	Faunal affinity
	Past	Present		
<i>A. a. frontalis</i> .. ..	x	—	—	Amphi-Pacific
<i>A. c. cerulsecens</i> .. ..	—	x	0	North American
<i>A. canagicus</i> .. ..	—	xx	+	Amphi-Pacific
<i>B. b. orientalis</i> .. ..	—	x	0	Amphi-Pacific
<i>A. a. acuta</i> .. ..	—	x	0	Circumpolar
<i>P. stelleri</i> .. ..	x	x	0	Amphi-Pacific
<i>S. m. v-nigra</i> .. ..	xxx	xxx	0	Amphi-Pacific
<i>S. fischeri</i> .. ..	—	x	0	Amphi-Pacific
<i>S. spectabilis</i> .. ..	xx	xx	0	Circumpolar
<i>A. m. maritoides</i> .. ..	x	—	—	Amphi-Pacific
<i>H. h. pacificus</i> .. ..	xx	—	—	Amphi-Pacific
<i>C. hyemalis</i> .. ..	xx	xxx	0	Circumpolar

(a) xxx — common; xx — uncommon; x — rare; — — none.

(b) + — increased; 0 — no change; — — decreased.

Obviously, the result of weighting the harvest data is rather inexact, but the trend indicated is highly suggestive of a diminution in the North American and Amphi-Pacific elements during the last 2000 years. Of the North American species represented in the harvests, two have apparently remained unchanged while four have decreased in abundance. Of the Amphi-Pacific species, five are unchanged, three have decreased, and one evidently has increased. None of the Circumpolar species has undergone any changes detectable from this material.

Table 4. Ancient and modern waterfowl harvests by Eskimo on the southern coast, St. Lawrence Island.

Species	Relative quantity (a)		Change in status (b)	Faunal affinity
	Past	Present		
<i>C. c. columbianus</i> ..	x	—	0	North American
<i>A. a. frontalis</i> .. ..	x	—	—	Amphi-Pacific
<i>A. c. cærulsecens</i> ..	—	x	0	North American
<i>A. canagicus</i> .. ..	xx	xxx	+	Amphi-Pacific
<i>B. c. minima</i> .. ..	x	—	—	North American
<i>B. b. orientalis</i> .. ..	x	x	0	Amphi-Pacific
<i>A. a. acuta</i> .. ..	x	x	0	Circumpolar
<i>P. stelleri</i> .. ..	xx	x	0	Amphi-Pacific
<i>S. m. v-nigra</i> .. ..	xxx	xxx	0	Amphi-Pacific
<i>S. fischeri</i> .. ..	xx	x	—	Amphi-Pacific
<i>S. spectabilis</i> .. ..	xxx	xx	0	Circumpolar
<i>A. m. mariloides</i> ..	—	x	0	Amphi-Pacific
<i>M. f. deglandi</i> .. ..	xx	—	—	North American
<i>M. perspicillata</i> .. ..	x	—	—	North American
<i>M. n. americana</i> ..	xx	—	—	Amphi-Pacific
<i>H. h. pacificus</i> .. ..	xx	x	0	Amphi-Pacific
<i>C. hyemalis</i> .. ..	xx	xxx	0	Circumpolar
<i>M. s. serrator</i> .. ..	x	x	0	Circumpolar
<i>M. m. americanus</i> (?) ..	xx	—	—	North American(?)

(a) xxx — common; xx — uncommon; x — rare; — — none.  
 (b) + — increased; 0 — no change; — — decreased.

Discussion

The physiography of the Bering Land Bridge during several stages of inundation toward the end of the Wisconsin glacial epoch has been broadly described by D. M. Hopkins (1959). For several thousand years St. Lawrence Island evidently was a part of the southern shore of this intercontinental link, and as such was situated on what probably was a major coastal migration route for aquatic birds. The general alignment of this coastline seems to have been northwest-southeast, diagonally across the, now, Bering Sea from Bristol Bay to southeastern Chukotka. Any waterfowl using this coastal route probably would have been species which wintered in western North America and spread northward in summer to breed in the non-glaciated regions of Alaska, eastern Siberia, and on the land bridge itself. The present movement of waterfowl between western Alaska and eastern Siberia by way of St. Lawrence Island may be a relict of that migration.

Judging from the bathymetry of the Bering-Chukchi Platform, with gradual inundation, the land bridge was bisected by a broad channel extending from the Strait of Anadyr north to Bering Strait (Hopkins, 1959). With further inundation, the channel evidently became wider and the southern coast of the defunct "bridge" receded northward and eastward, leaving St.

Lawrence Island first as the end of a peninsula and later as an isolated island. As the coastline changed, so also must the migration routes have changed, though at a much slower rate. In my opinion, the increasing overwater distance between western Alaska and St. Lawrence Island in the last 10,000 years, together with modifications of climate, must have been a deterrent to trans-Beringian migration, resulting in a very gradual diminution of the island's avifaunal tie to the continent. A comparison of the Eskimo's waterfowl harvests of 1-2000 years ago with those of the present indicates the kind of changes that have taken place in the final quarter of that period and gives some inkling of the rate at which they have occurred.

It is significant that those species, the status of which seems to have changed the least in the last 2000 years, are the same species that still migrate via the island to Siberia to breed. Those which evidently were abundant in the past but do not breed in Siberia at present, have decreased or are now absent from the insular fauna. It appears that the strength of the present avifaunal tie to North America is derived more from the use of the trans-Beringian migration route than from the suitability of the island, itself, as a habitat for continental birds.

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