AMCHITKA BIOENVIRONMENTAL PROGRAM
STUDIES OF THE AVIFAUNA ON AMCHITKA ISLAND, ALASKA
FINAL PROGRESS
AND
SUMMARY REPORT

August 14, 1967 - September 30, 1973

by

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ABSTRACT

This study, conducted between 1967 and 1973, concentrated on the distribution and composition of Amchitkan avifauna, breeding densities, and other ecological and biological considerations. As of September, 1973, 126 species had been recorded on Amchitka; of these 28 were known to have bred there.

The most numerous of the birds was the Lapland Longspur with about 10,000 breeding pairs which made up more than 65 percent of the birds breeding annually on the Island. This averages to about 37 pairs per 100 acres. Other important terrestrial breeders were Rock Sandpipers, 3 pairs per 100 acres, and Rock Ptarmigan, 1.3 pairs per 100 acres.

Waterfowl were abundant both in marine and freshwater habitats. In summer many freshwater lakes were used; in the fall most of the waterfowl observed in freshwater habitats were concentrated on less than 1 percent of the lakes. Cliffs that encircle much of Amchitka were used by nesting birds of which about 55 pairs of Bald Eagles, 18 pairs of Peregrine Falcons, and 500 pairs of cormorants nested annually. About 200 eagles and 50 falcons occurred on the Island during the summer. Both species derived most of their food from the marine environment. The discovery of breeding Aleutian Terns in 1968 was significant for there was no previous record of their breeding west of Umnak Island.

Of the fourteen ecological formations characterized during this study, only two marine and three terrestrial formations were the most significant to avifauna utilization.

Data on the feeding ecology of birds showed that, except for some vegetative matter eaten by finches, ptarmigans and some waterfowl species, the main food resources for all species was derived from the marine environment.

The immediate effects of Milrow were minimal; the more extensive Cannikin effects resulted in the known death of 17 birds, damage to 2 falcon eyries, and the destruction of 6 eagle nests. Other effects related to human activity as a result of the testing program are discussed.

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INTRODUCTION

Battelle's Columbus Laboratories' Amchitka Bioenvironmental Program was organized to predict, document, and evaluate the effects of the U. S. Atomic Energy Commission's activities on the Amchitka biota and environment; to recommend measures for minimizing adverse effects; and to predict radiological hazards to man that might result from radionuclide transport through food chains, should there be an inadvertent release of radioactivity. The birds of Amchitka were studied to provide data to accomplish these objectives. The studies are sponsored by the U. S. Atomic Energy Commission's Nevada Operations Office as a part of its Supplemental Test Site Program.

This report is in two parts: the first covers field and laboratory studies of the avifauna of Amchitka conducted between July 1, 1972, and September 30, 1973, the second part summarizes the objectives and results of studies begun in August 1967 and continued through FY 1973. The broad objectives of this program were to gather and interpret data for predicting and assessing effects of underground nuclear testing, specifically projects Milrow and Cannikin, on bird life and bird communities and to recommend actions to help minimize any potential deleterious effects to the avifauna. (For an assessment of data gathered previously, consult: Emison, Williamson, and White, 1971; White, Emison, and Williamson, 1971; Williamson, 1968; Williamson and Emison, 1969, 1971; Williamson, Emison, and White, 1971 and 1972.)

Much of the ability to interpret the data is a result of the extensive time spent on the Island and thus, familiarity with the problems.

To accomplish the objectives of the program, the following avian studies were conducted over the 6-year period:

- (1) A detailed accounting of the species composition of the avifauna at all seasons of the year.
- (2) Measurement of the population density of the birds present at all seasons of the year using direct counts and extrapolation from census plots.
- (3) Analyses of the ecological and geographical distribution of birds and their migrations.
- (4) Detailed analyses of the feeding ecology of selected species of birds, in particular the Emperor Goose and other waterfowl, used as food by man and those representative of the available spectrum of feeding niches.
- (5) Study of the breeding biology of selected species, in particular, those that are rare or endangered in other parts of their range, e.g., the Peregrine Falcon and Bald Eagle.
- (6) The collection of samples of selected species for analysis of stomach contents and subsequent determination of body burdens of radionuclides.

- (7) A general analysis of the disturbance of habitats caused by both short- and long-term effects of Milrow and Cannikin that might influence the population density and/or distribution of birds with some emphasis on cliff nesting habitat.
- (8) Based on the total data gathered, the outlining of future studies on birds to assess adequately the impact of testing and the intermittent presence of man on the Island, or total withdrawal of man after a period of use.

For the specific program of study in FY 1973, only some of the overall objectives could be undertaken because of support and time limitations, and the need to answer specific questions relative to the overall objectives of the program. These objectives may be stated as: (1) continued investigation of feeding and nesting habitats in the vicinity of Milrow and Cannikin SZ* to evaluate the effects of test-related disturbances on avian habitats; (2) surveys of avian populations in marine littoral waters, freshwaters, and those terrestrial habitats that experienced alterations produced by the testing program; (3) examinations of cliff and sea-stack nesting sites of Bald Eagles, Peregrine Falcons, and cormorants in the vicinity of Cannikin SZ; (4) continued surveys of the habitat in the vicinity of Long Shot, Milrow and Cannikin SZ for evidence of any long-term test-related effects on birds; (5) collection of selected avian species for radiological analyses; (6) gathering of data which might reflect any effects on avian species of withdrawing the food supply at the garbage-disposal area.

This report is in two sections presenting data gathered in FY 1973 and that gathered during the entire program.

THE 1973 STUDIES

Species Composition and Annotations

Between 1955 and 1971 a total of 113 avian species were observed on or near Amchitka (Kenyon, 1961, and this study). During FY 1973 nine additional species were recorded, and a review of earlier narrative reports prepared by the U. S. Fish and Wildlife Service revealed that four additional species have occurred on Amchitka. Thus, the total number of species positively known for the Island is 126. The nine additional species are: Sharp-tailed Sandpiper (Calidris acuminata), Far Eastern Curlew (Numenius madagascariensis), Barrow's Goldeneye (Bucephala islandica), Long-toed Stint (Calidris subminuta), Ringed Plover (Charadrius hiaticula), Semipalmated Plover (Charadrius semipalmatus), Cassin's Auklet (Ptychoramphus aleutica), Arctic Warbler (Phylloscopus borealis), and Arctic Loon (Gavia arctica). The four species reported in the narratives are: Steller's Sea Eagle (Haliaeetus pelagicus), Black-tailed Godwit (Limosa limosa), Gray Wagtail (Motacilla cinerea), and Wheatear (Oenanthe oenanthe). All species recorded are listed in Appendix A.

*Surface Zero: the point on the land at the top of the device-emplacement hole.

Population Studies and Nesting Ecology

Terrestrial Birds

No changes were detected in the densities of the Lapland Longspur, Rock Sandpiper, Rock Ptarmigan, or other species nesting on the tundra. For example, longspurs on the riparian meadow census plot numbered between 9 and 11 pairs (two males may have been recounts) which is similar to the earlier data (see Williamson and Emison, 1969) in terms of numbers per acre. One change that had taken place was an apparent increase in the number of Winter Wrens in the rock-fall areas created by Cannikin, i.e., between Petrel Point and Banjo Point. Some of this area, formerly high, grassy slopes rising from the beach, especially in the area directly north of Cannikin SZ, is now a rock-strewn slope. Figure 1 indicates locations of geographic features mentioned in this report.

A similar area NW of Crown Reefer Point surveyed for wrens revealed only one bird per mile in 1968 (Williamson, 1968). Wrens were especially abundant in October, 1972, and on surveying this area in May-June 1973 to derive actual counts, 15 wrens per mile were seen or heard; it appears that the newly created habitat will be important for wrens at least for feeding if not for nesting.

Waterfowl

In an effort to determine uses by birds of areas around the Cannikin and Milrow SZ, particularly lakes and other water sources where radionuclides might be detected should they occur, observations have been concentrated on lakes used for feeding, resting, or breeding by waterfowl. Only about 0.7 percent of the Amchitka lakes, including several around the test sites, are traditionally used by waterfowl.

A comparison of the utilization of lakes on the southeastern end of the Island, between October 1971 and October 1972, is given in Table 1. While the lake formed by Cannikin's subsidence ("Cannikin Lake") is frequently used, waterfowl have not been recorded there during the survey period. In time, however, this lake may be used more frequently.

Gulls and Terns

Number and locations of breeding colonies of the Glaucous-winged Gull changed little over that shown in earlier years.

In 1972 there was a reduction in the number of breeding Aleutian Terns. For example, one colony near Milrow SZ commenced nesting with the usual number of 12-20 pairs but later deserted the site. In 1973 the colony was again occupied and there was a minimum of 11 birds (5 pairs) present. The behavior of the terns is in no way associated with shot-related changes although human activity may be responsible in part.

FIGURE 1. FEATURES OF AMCHITKA ISLAND

Lakes frequented by waterfowl are indicated by circled numbers.

TABLE 1. 1971 AND 1972 NUMBERS OF WATERFOWL ON LAKES USED FOR LOAFING AND FEEDING IN THE FALL^(a)

	Mallard	Pintail	American Widgeon	Shoveler	Green-wing and Common Teal	Greater Scaup	Red-breasted Merganser	Bufflehead	Golden Eye	Unidentified
1 ^(b) South of D-Site (Deep Lake)	60/20	--	--	--	40/30	--	--	--	--	--
2 Near CI (Ultra Creek drainage)	4/0	--	--	--	2/30	9/0	--	1/0	--	--
3 Ultra Creek	15/0	--	--	--	75/0	2/0	--	--	--	--
4 "Tern Lake" (near Square Bay)	14/12	--	--	--	--	--	--	--	--	--
5 Silver Salmon	20/15	--	--	--	--	--	--	--	--	--
6 Rifle Range	10/14	--	--	--	10/40	1/0	--	--	--	--
7 Quonset Lake	0/0	--	--	--	0/5	3/0	--	--	--	--
8 Jones	20/8	0/2	2/0	--	20/2	70/40	4/0	20/0	2/0	0/2
9 Clevenger	50/40	--	--	--	250/20	10/20	0/5	--	--	--
10 Next to Sewer Pond	0/50	--	0/3	0/5	100/100	--	0/3	--	--	--
11 Pumphouse (Island Pond)	50/0	--	--	--	20/0	15/0	--	--	--	--
12 "Tin" Lake	20/15	--	--	--	40/30	--	--	--	--	--
13 Pillow Point	10/20	--	--	--	30/35	--	--	--	--	--
14 G. E. Lake	0/0	--	--	--	50/0	--	--	--	--	--
15 64 Lake (Whale Cove)	25/40	2/0	--	--	75/40	--	--	--	--	0/5
16 Omega Point	3/0	--	--	--	0/30	--	--	--	--	--
17 Adjacent to Silver Salmon	0/55	150/2	--	--	10/50	--	--	3/0	--	0/2
18 Galion Pits	0/2	--	--	--	--	--	--	--	--	--
19 Adjacent to South of Quonset	0/0	--	--	--	--	--	--	--	--	0/10
20 Fox Runway Lake	0/1	--	--	--	--	0/5	--	--	--	--
21 East of Sewer Pond	0/20	--	--	--	--	--	--	--	--	--
Total	301/312	152/4	2/3	0/5	722/412	110/65	4/8	24/0	2/0	0/19

(a) Values are represented as 1971/1972. The data for 1971 are from the most complete count, October 23, and the 1972 data are also from an October count.

(b) Numbers before the lake names indicate geographic placement in Figure 1.

Bald Eagles

Continued analysis of data has revealed a few mathematical errors in the Annual Progress Report for FY 1972 as concerns food and nesting of Bald Eagles. The corrected values are given herein.

Since the Amchitka program began, the numbers of territorial pairs of adult Bald Eagles appears to have increased: 1968, 40; 1969, 53; 1970, 56; 1971, 68; 1972, 72 (comparable data could not be obtained for 1973 because of the lack of a helicopter). Of 11 sites checked in 1973, two did not have eagles defending them. Cumulative data further suggest that, at least since 1970, greater numbers of nests are located at the southeastern end of the Island. In 1972, for example, 38 nests were along 44 miles of coastline (53 percent of the nests; 36 percent of the coastline). Northern and southern sectors of this coastline are distributed about equally, i.e., approximately 22 miles on both the Bering Sea and Pacific Ocean. We believe that this concentration of nests may be explained by the readily available food supply at the refuse dump, or other food-related factors rather than to availability of nesting sites. While about equal numbers of vacant sea stacks exist randomly around the Island, it cannot be demonstrated that stacks are used more frequently at one end of the Island than at the other.

Fledging success appeared to vary in relation to the types of structures on which the nests were placed. Nests closely connected to the mainland had greater success in fledging than those nests with restricted areas for the young, e.g., sea stacks (Table 2). Nest sites located where young could move to adjacent large areas (e.g., hillsides) appeared to promote greater nesting success than those sites with a nesting platform of limited size on which the young could move about (e.g., most sea stacks). Since fledging success varies in relation to the physical placement of a nest, nest site selection is important. Independent of size of the nesting area, however, a nest site may be selected in response to the proximity to an abundant food source, e.g., the refuse dump. Further, in the past, less favorable nest sites may have been selected (e.g., use of sea stacks even though the fledging success was less) because they were not accessible to terrestrial predators such as foxes.

TABLE 2. RELATIONSHIP OF BALD EAGLE NEST LOCATION TO FLEDGING SUCCESS

Nest Location	Nests	Percent of Total Nests	Percent Success of Nests
Man-Made Structure	1	1.4	0.0
Mainland Hillside	6	8.3	100.0
Offshore Islet	7	9.8	42.9
Ridge or Connected			
Sea Stack	26	36.1	69.2
Sea Stack	<u>32</u>	44.4	50.0
	72		

Nestling mortality increases as the season progresses up to the time of fledging. We have no data on the rate of mortality of young birds following fledging in late July. However, as shown in Figure 2 the percent of young lost increases faster than the percent of total nest failure. The nestling mortality was 20 percent between June 1 and

July 8 whereas only 14 percent of the nesting attempts failed completely in that same period. This is a result of density dependent, differential mortality of young in the nests.

FIGURE 2. BALD EAGLE NESTING MORTALITY

The range of observation dates in early June resulted from the fact that only certain parts of the island could be visited on different days, due to weather, whereas in late June when the weather improved, the entire island could be covered in one trip on one day.

Death of a young bird was most common in nests containing two or three young. Nests containing only two nestlings seldom lost both young although they sometimes lost one. Individuals in nests containing only one young had the best chance of survival.

Along with the increased number of nesting sites there was also an apparent increase in the survival of 4-year-old eagles. Alternatively, the increased numbers in this age class may simply reflect their being attracted to the Island because of available food. We saw eagles crossing Oglala Pass from Rat Island to Amchitka when dead whales were washed ashore. Apparently, eagles may be attracted to nearby islands by the sight of many eagles soaring over an abundant food source, such as a dead whale. In previous years a maximum of five to six 4-year-old eagles was observed. In 1972, during routine counts, six were counted in August, eight in October, and ten in January, 1973. More may have been present in January of 1973, however, since all ten were seen at the refuse dump at the same time.

Peregrine Falcons

There was extensive prehatching mortality of falcons in 1973. Counts of eggs or young in nests were begun on May 15. Between May 15 and June 10, visits to 18 eyries showed 22 eggs and 12 young. Adults were present at six vacant eyries (or had recently been present as indicated by freshly molted feathers). It is presumed that, at the latter eyries, adults did not lay because of some weather or food phenomena or, if eggs were laid, they were lost prior to our arrival.

The 22 eggs observed produced 14 young birds. Of these, 3 died (2 apparently from parental neglect; 1 from unknown causes) and 11 fledged. In previous years, an average of 32 fledged. The cause of this poor nesting performance is unknown, but the following explanation seems probable. First, because the young were dead in the eggs,

it appears that the eggs were not incubated faithfully. The lack of constant incubation may have been caused by (1) unseasonably inclement weather driving the adults from the nests, (2) lack of a readily exploitable food source due perhaps to some weather factor causing prey species to move farther offshore and consequently causing the adults to spend greater periods of time away from the nest to obtain food or, (3) some internally caused behavioral abnormality causing adults to reduce nest attentiveness. Possibility (1) is suggested because, in early April, several days of unseasonably cold subfreezing weather were accompanied by high winds and snow. The stage of development of the dead embryos was uniform, and suggests about 2 weeks of incubation; a fact that suggests death during April. Possibility (3) may be suggested by the fact that one female was known to "desert" her young shortly after they hatched. Such abnormal behavior may be related to some level of chemical contamination, although this is unlikely for the Amchitka population.

Whatever the cause of such reproductive failure, a follow-up study should determine if the population produces young in normal numbers in 1974. This is of special urgency because of the worldwide decline of Peregrine Falcon populations.

Feeding Ecology

The only noteworthy new data was finding* the remains of at least 56 sea otter pups (73.7 percent of the mammalian prey) in 28 of the 34 Bald Eagle nests that were regularly examined through August. When only otter hair was found, only one otter was counted although the hair may have come from several. Because of this uncertainty, and because the numbers of pups seen in the nests may not represent the total utilized, there is no precise estimate of the maximum number of otters taken. However, as many as nine pups were taken to one nest in a 4-week period.

Surveillance of Test-Induced Damage

Those ecological formations of primary concern to the avian ecologists were the tundra areas occupied by breeding passerines, waterfowl, terns, and ptarmigan, and the "rock" formations along the shoreline occupied by raptors and seabirds.

Although the tundra was "fluffed" (Kirkwood and Fuller, 1972) by Cannikin, this condition was apparently not extreme enough to affect the breeding birds. None were found dead on the tundra (although two were reported). The upland tundra plot was too far from Cannikin SZ for much "fluffing" to occur, and thus the data do not reveal the effects of this phenomenon on the local breeding birds. However, a qualitative, visual appraisal of areas that were "fluffed" suggest that normal densities of the species concerned were found in affected areas.

The extensively damaged cliffs between Petrel Point and Banjo Point were not used as extensively by Bald Eagles for breeding as in pretest years. Formerly, three and sometimes four nests were used, while in 1972 only one "area" was used and the nest involved was first moved about 200 yards from its former site (Williamson, White, Emison, 1973) and then abandoned before the eggs hatched. In 1973, sighting of a pair in the same area suggested that at least the territory was occupied, but without the aid of a helicopter no quantitative data could be collected. Throughout late summer, fall

*See Krog, 1953.

and winter of 1973, the use of this area by resting and loafing eagles was similar to that of pretest years. However, cormorants completely avoided these areas following the tests as they also did in 1973. Waterfowl feeding along the altered sections of intertidal zone were present in fall in near normal numbers although they appeared to forage further offshore than in pretest periods. In the fall and winter of 1973, Winter Wrens were apparently more common in the altered rock area to the north of Cannikin SZ than they had been in either the winter or spring of 1972.

If data gathered subsequently (i. e., in the spring of 1974) support the suggestion that wrens have increased in numbers, the area should be studied (when the slopes begin to revegetate) to determine trends. The utilization of this area by wrens may be confined to the nonbreeding season but this remains to be determined.

The Peregrine Falcon eyrie damaged at Stone Beach Cove was not used in 1972. A renesting attempt further east along the beach proved unsuccessful, and the falcons were not seen in the area of their territory throughout the fall and winter of 1972. However, the damaged eyrie was cleared of rubble in the late fall of 1972, a pair of falcons were at the nest in May, 1973, and they successfully raised two young.

Winter Populations in Relation to Roll-Up Operations

The species of birds which benefited by the presence of man included the Rosy Finch, Pigeon Guillemot, Glaucous-winged Gull, and Bald Eagle. The first two used man-made structures for nesting and the latter two used man's refuse as food. Since the roll-up operations will not remove all the man-made structures (primarily W. W. II remains), it is only the effects of removal of the food source (in the sense that it will be covered and no longer continuously supplied and thus not available) that can be adequately monitored. The effects of the lack of food at the refuse dump, especially the effects on eagles can be easily monitored. If we are correct in assuming that the additional food supplied by the dump helps to lower the mortality rate of 2- and 3-year-old eagles, then an age ratio count should reveal any numerical change in the size of the subadult population. There should be fewer in the total population once the food is unavailable. Further, if we are correct in assuming that eagles can nest in higher density on that part of the Island with access to readily available food at the refuse dump (a simple food/density dependent relationship), then there should be a decrease in nesting pairs on the southeastern part of the Island following the covering of the dump.

Data from January 1973 strongly indicate that the population of eagles was affected by the reduction of refuse available at the dump, a result of a reduction of the labor force, and a stricter regimen of refuse burial. In January 1973, less than a dozen eagles were commonly at the dump while in previous winters there were up to 100. Also, those that were at the dump were obviously under stress from food deprivation. On one occasion, when a pastry was thrown on the ground, three immature eagles immediately vied for it; the winner devoured it in flight. In January 1973, eagles also frequented the south hanger where they immediately devoured pieces of bread thrown to them by workmen. We know of no case where eagles in a normal state of nutrition have eaten bakery items. It will be at least a year before the effect of decreased refuse on the eagle population will be acute enough to be reasonably assessed. In the summer of 1973 it seemed that subadults were sighted less often than in previous years, but total population counts were not made.

Two each of Rock Ptarmigan, Common Goldeneyes, Emperor Geese, and Black Oystercatchers were collected during FY 1973 for radiological analysis by the University of Washington.

FINAL SUMMARY OF AMCHITKA AVIFAUNA STUDIES

Species Composition

Between 1967 and 1973, 120 species of birds were recorded on Amchitka Island and in surrounding waters. Of the 126 avian species recorded since 1955 (Kenyon, 1961; Gabrielson and Lincoln, 1959; Fish and Wildlife narrative Reports; Williamson, White, and Emison, 1973) 50 occur regularly on or near Amchitka Island, most in substantial numbers, and 76 species occur only as accidentals or casuals. The species and their status are listed in the Appendix.

Population Density

Estimates were made of the population size of each species during all seasons of the year (see the Appendix). Concerted investigations were carried out on populations of selected species of nesting terrestrial birds, nesting raptors, freshwater waterfowl, and nesting seabirds. Most population estimates of birds breeding on Amchitka were made in 1969 and were based on (1) actual counts of nests, (2) extrapolation from censuses made on selected plots, (3) censuses of lakes and beaches, and (4) population counts made just prior to nesting. Those 28 species known to breed on Amchitka are listed in the Appendix. In addition to the known breeders, it is probable that the Common Loon (Gavia immer) breeds there and possibly also Ancient Murrelets (Synthliboramphus antiquum) and Leach's and Forked-tailed Storm Petrel (Oceanodroma leucorhoa and O. furcata). There has been no detectable change in the numbers of breeding species from 1967 through 1973 except that one species, the Wood Sandpiper (Tringa glareola) does not breed on Amchitka every year. The erratic breeding of this sandpiper is not influenced by activities on the Island, but is a function of sufficient numbers arriving in any one year to breed.

Terrestrial Birds

To assess the size of terrestrial breeding populations, census plots were established in principal communities. Results of the censuses were extrapolated to the proportion of each plant community on the Island. The principal nesting species in the census plots were Lapland Longspur (Calcarius lapponicus), Rock Sandpiper (Calidris ptiloenemis) and Rock Ptarmigan (Lagopus mutus).

Census Plots. Extrapolating from the census data, in the Empetrum-Cladonia tundra, Lapland Longspur averaged 22 pairs per 100 acres in 1968 and 16 pairs per 100 acres in 1969. Rock Sandpipers averaged two pairs per 100 acres in both 1968 and

and 1969. In the riparian meadow, longspurs averaged 100 pairs per 100 acres in 1968 and 110 pairs per 100 acres in 1969. Rock Sandpipers were not present in 1968, but averaged 10 pairs per 100 acres in 1969. In the Carex meadow tundra census, the density of longspurs averaged 40 and 33 pairs per 100 acres in 1968 and 1969, respectively. During both nesting seasons, the density of Rock Sandpipers averaged eight pairs per 100 acres.

The lower elevations located on the eastern two-thirds of the Island are comprised primarily of Empetrum-Cladonia tundra, riparian meadow, and Carex meadow tundra. The higher elevations on the western one-third of the Island, characteristically wind-swept, contain either expanses of bare gravel largely devoid of vegetation or mosaics of vegetated and bare areas. Most of this part of the Island is not utilized by nesting birds, although the valleys and extreme western tip contain vegetation more conducive to nesting. In estimating total longspur and sandpiper populations on the Island, the western one-third was considered to have one-fourth the density of an area of corresponding size on the eastern two-thirds of the Island.

An estimate of the population density of Lapland Longspurs on Amchitka was derived by using the figure of 37 pairs per 100 acres. This was the average density for all vegetation types (plots) using census data from both 1968 and 1969. The population density of Rock Sandpipers, three pairs per 100 acres, was similarly derived.

On the basis of census data, the Lapland Longspur with 10,000 breeding pairs made up more than 65 percent of the total Amchitka breeding avifauna. By the early fall the population was considerably higher. In July 1972, the ratio of adults to fledged immatures present in the population was determined (Table 3). Under the assumption that fledging success is at least 1.22 young per starting pair of breeding longspurs (this is not a value reflecting fledging rate in successful nests only), the number of young would be about 12,200 for the 20,000 adults giving a total of 32,200 birds in early August.

TABLE 3. AGE RATIOS OF THE LAPLAND LONGSPUR

Miles in Count	Adult Males	Adult Females	Juvenile	Unidentifiable	Adult:Juvenile Ratio
3.0	20	10	21	10	1.42:1
3.1	10	3	12	7	1.08:1
2.0	10	7	16	6	1.06:1
Total 8.1	40	20	49	23	1.22:1

Rock Ptarmigan. During the 1969 nesting season, a census plot of 2,500 acres (which contained all vegetation types found on the eastern two-thirds of the Island plus numerous roads facilitating travel) was selected as a Rock Ptarmigan census plot.

In early May, the male ptarmigan established territories and vigorously defended them against other males. Usually several mounds were conspicuous on a territory, and the male used one of these for perching. The female remained within the territory of the male, and built a nest there.

During visits to these census plots, both by vehicle and on foot, males were easily found and locations of pairs were readily plotted. Almost all of the 32 pairs were located by systematically searching an area where a male was observed and locating the less conspicuous female. The breeding density of ptarmigan on the census plot was about 1.3 pairs per 100 acres. The ptarmigan population on the 43,500 acres of the eastern two-thirds of the Island was estimated to be 600 pairs. The ptarmigan population on the 31,500 acres of the western one-third of the Island would have been about 100 pairs, assuming the western part had one-fourth the population of an area of comparable size on the eastern part. Combining the estimates for the eastern and western parts of the Island, the total Rock Ptarmigan breeding population on Amchitka Island in 1969 was 1,400 individuals (700 pairs).

Waterfowl and Freshwater Aquatic Birds

In August and September 1967, it became apparent that certain lakes were important to aquatic birds for feeding and loafing. A sample of those lakes being used by the birds was regularly surveyed to assess the populations (Figure 3). The average numbers of aquatic birds per lake from 1967-1969 are shown in Table 4.

TABLE 4. AVERAGE NUMBER OF AQUATIC BIRDS OBSERVED
PER CENSUS ON NINE FRESHWATER LAKES,
1967-1969

Species	Feb	April	May	June	July	Aug	Sept	Oct
Common Loon	--	--	--	0 1	0 1	--	--	-
Red-throated Loon	--	--	0.2	0 3	0 7	1 4	--	-
Horned Grebe	--	--	--	--	--	--	--	0 1
Canada Goose	--	--	0 1	--	--	--	--	--
Brant	--	--	--	--	--		--	0 1
Mallard	--	0.5	0.7	0 5	0 5	1 0	8 6	8 4
Pintail	--	0.3	0.1	0 1	0 1	--	0 4	1 7
Common Teal	5.0	3.0	0 8	1.6	5.9	8 0	35 4	30 8
Green-winged Teal	--	--	--	0 1	--	--	--	--
European Widgeon	--	--	--	--	--	--	--	0 4
Shoveler	--	--	0 1	--	--	--	1.0	0 2
Common Pochard	--	--	0.1	0 1	--	--	--	--
Greater Scaup	4.0	0.3	5.8	6 1	5 2	1 7	16 0	9 8
Tufted Duck	--	--	0 6	0.2	--	--	--	--
Common Goldeneye	0.4	0 5	0 7	0.7	0 5	--	0 4	1 4
Bufflehead	5.3	4.8	4 5	0 2	--	--	-	1 4
Red-breasted Merganser	--	1.3	1.0	0 4	0 1	--	0 2	0 2
Smew	--	--	--	0 1	--	-	-

FIGURE 3. MAJOR LAKES USED IN THE CENSUSING OF BIRDS OF LACUSTRINE WATERS ON THE SOUTHEASTERN PORTION (SEE INSET) OF AMCHITKA

The numbered solid circles are the locations of the census plots. Environments of census plots: (1) Upland (*Empetrum*-*Cladonia*), (2) Beach Ridge, (3) Riparian Meadow, and (4) Wet Tundra (*Carex*-Meadow).

Those areas most heavily used by ducks, geese, and swans were located and the waterfowl in those areas was censused to determine relative numbers and species composition. The number of nesting species did not vary appreciably from year to year. Some lakes and ponds are used by waterfowl for loafing and feeding in autumn before they freeze for the winter. There are about 2,500 lakes and ponds on Amchitka, the largest is about 400 by 1,000 yards. Although 10 percent of these lakes appear suitable for waterfowl, repeated censuses have shown that only 16, about 0.7 percent, are used traditionally in autumn. Results of a survey of nearly all the lakes on Amchitka, partly by helicopter, are given in Table 1; the geographic locations of those lakes are shown in Figure 1.

Cliff Nesting Birds

Monitoring the status of cliff nesting birds was important for two reasons: (1) the bird habitat most affected by test activity was the cliff habitat and (2) the status of Bald Eagles and Peregrine Falcons, two cliff nesting raptor species on Amchitka, is of national concern.

Bald Eagle. Repeated censuses indicate that about 200 Bald Eagles (excluding nestlings) are present on Amchitka during the summer. Of these, about 75 percent are adults and 25 percent are subadults (excluding nestlings). During winter, the population is somewhat larger because of the addition of fledglings reared on Amchitka, and also probably because some interisland movement occurs in the western Aleutians (Murie, 1959). Counts made from helicopters show that the total winter population is approximately 300 eagles with 58 percent adults and 42 percent subadults.

Each year between 55 and 60 pairs of eagles nest around the perimeter of the Island. The greatest number of territories counted was 72 in 1972. The majority of nests are located in small grassy areas on top of isolated rocky pinnacles (sea stacks) just offshore. Other nests are situated on sea cliffs and on larger offshore islets. Only one nest was found inland on a tundra mound.

During the 1968, 1969, and 1970 nesting seasons, 88 different nest sites occupied by adults were located. Sixteen of these sites were used in all three breeding seasons, 30 were used twice, and 42 sites were used only once. Between 30 and 35 percent of the nests occupied in any one year were unoccupied the following year. As eagles show a lower nest site tenacity than Peregrine Falcons, the eagle is more likely to move if its nest site is destroyed. Data from 1971 indicate that the population of eagles increased even though human activity was at a maximum just prior to the Cannikin event.

Egg laying takes place during the last week of March and most hatching occurs during the first week of May. The average clutch size in 43 nests examined during this study was 1.91 eggs (7 one-egg, 33 two-egg, and 3 three-egg clutches). In 1969, young fledged per nesting attempt averaged 0.94.

Eighty-nine food items of eagles have been identified. Most of these were remains recovered from nests during the chick-rearing period. Of these, 28 percent were remains of mammals, with sea otter constituting about half, and rat and carrion of whales and seals making up the remainder; 57 percent were remains of birds with pelagic and marine littoral birds (fulmars, cormorants, eiders, oystercatchers, gulls, murres, murrelets, auklets and puffins) making up the majority. Some terrestrial and freshwater species (mallards, scaup, and ptarmigan) were also taken, particularly during the winter. Fishes (primarily rock greenling, but also a few lumpsuckers, snailfish, and Dolly Varden) comprise the other 15 percent of the food items.

Peregrine Falcon. During the spring and summer, the total nesting population of Peregrine Falcons on Amchitka averaged 15-20 pairs, but this population increased during the autumn and early winter with the addition of the fledged young. By early spring, however, few young of the previous year were found during surveys on the Island.

In 1968, seven eyries were tentatively located. Only two were determined to contain either eggs or young birds. Of the others, falcons were present at three in 1969 and 1970 and absent from two. In 1969, 17 eyries or faces of cliff with defending adults were located. The number of eyries located in subsequent years were: 19 in 1970, 22 in 1971, 19 in 1972, and only 16 in 1973.

Egg laying commenced about April 15, and fledging took place during the last week of June and the first week of July. In 1969 and 1970 clutch size averaged 3.32 eggs ($n = 15$) and fledging success was 1.36 young per nest ($n = 11$ nests).

Data on the foods of the falcons are presented in Table 5. Most notable is the significant percent of alcids that were taken and the minor role the migrants seemed to play. Details of the feeding ecology have been given by White, Emison, and Williamson (1973) and are discussed later.

Three falcon nest sites were unusable as a result of the testing program. The rubble was cleared from one of these in 1972, however, and it was used successfully in 1973. The other two sites had been used irregularly by a single pair in previous years, and that pair successfully occupied another site in 1972 and 1973. Thus, the Peregrine Falcon population was essentially unaffected by short term effects of AEC activities.

Colonial Seabirds

Colonial seabirds nesting on or near Amchitka include Pelagic and Red-faced Cormorants (Phalacrocorax pelagicus and P. urile), Glaucous-winged Gulls (Larus argentatus glaucescens), and the Arctic and Aleutian Terns (Sterna paradisaea and S. aleutica).

Cormorants. Twenty-three colonies of nesting cormorants were counted around the perimeter of Amchitka Island and on offshore islets during censuses made from a helicopter in June and July 1968. Most of these colonies contained 10 to 30 birds; the largest, by actual count, contained 60 birds.

Censuses from a helicopter in May and June, 1969, revealed 17 colonies (possibly three were missed in the Ivakin Point area and on Bat Island). Eleven contained between 10 and 30 nests. Of the remaining six colonies, one contained only two nests and one only one nest. The Mex Island colony was the largest, with about 85 nests. A colony in Chitka Cove contained 36 nests (all Pelagic Cormorant), and one at Kirilof Point contained 33 nests (18 Pelagic Cormorant and 15 Red-faced Cormorant). The location of colonies changed little through 1973.

Assuming that in 1969 colonies averaged 25 nests and that there were 20 colonies on the perimeter of the Island, the breeding population was estimated to be 1,000 birds (500 pairs). Some of these colonies were composed of Pelagic Cormorants only and other had both Pelagic and Red-faced Cormorants.

Some of the cormorant colonies apparently are not always at the same site in consecutive years. Only nine of the 23 colonies located in 1968 were in the same area in 1969. Three of the colonies active in 1968 were examined in 1969, and although nests were still visible, they were unoccupied. Between 1968 and 1969 species composition

TABLE 5. PREY ITEMS FOUND AT AMCHITKA ISLAND
PEREGRINE FALCON EYRIES OR PLUCKING
PERCHES, 1968-72

Species	Seasonal status on Amchitka	No	Approx weight class in grams	% of total	% of biomass
Scaled Petrel (<i>Pterodroma incpectata</i>)	M	1	100	0.18	0.08
Fork-tailed Petrel (<i>Occanodroma furcata</i>)	RU	19	15	3.46	0.76
Leach's Petrel (<i>Occanodroma leucorhoa</i>)	RU	20	10	3.64	0.70
Unidentified Petrel (<i>Occanodroma</i> sp.)	RU	2	10	0.36	0.07
Poocland subtotal	—	42	—	7.64	1.61
Mallard (<i>Anas platyrhynchos</i>)	RM	2	1100	0.36	1.93
Mallard duckling	RM	1	30	0.18	0.02
Pintail (<i>Anas acuta</i>)	RM	1	900	0.18	0.79
Common Teal (<i>Anas crecca</i>)	R	28	100	5.12	9.85
Common Goldeneye (<i>Bucephala clangula</i>)	RM	1	1000	0.18	0.87
Harlequin Duck (<i>Histrioncus histrioncus</i>)	RM	1	650	0.18	0.57
Red breasted Merganser (<i>Mergus serrator</i>)	RM	1	900	0.18	0.79
Water fowl subtotal	—	35	—	6.38	14.82
Rock Ptarmigan (<i>Lagopus mutus</i>)	R	22	600 ¹	4.01	11.59
Upland game bird subtotal	—	22	—	4.01	11.59
American Golden Plover (<i>Pluvialis dominica</i>)	M	2	150	0.36	0.27
Ruddy Turnstone (<i>Arenaria interpres</i>)	M	1	110	0.18	0.09
Wandering Tattler (<i>Heterosceclus mexicanus</i>)	M	1	100	0.18	0.08
Wood Sandpiper (<i>Limosa glaccola</i>)	M	1	55	0.18	0.05
Rock Sandpiper (<i>Calidris pilocnemis</i>)	R	8	80 ¹	1.45	0.57
Red Phalarope (<i>Phalaropus fulicarius</i>)	M	1	50	0.73	0.17
Black-headed Gull (<i>Larus ridibundus</i>)	M	1	290	0.18	0.26
Black legged Kittiwake (<i>Rissa tridactyla</i>)	RU	2	100	0.36	0.70
Arctic Tern (<i>Sterna paradisica</i>)	M	12	110	2.18	1.16
Alutian Tern (<i>Sterna alutica</i>)	M	7	130	1.27	0.80
Shorebird and gull subtotal	—	39	—	7.06	4.15
Pigeon Guillemot (<i>Cephus columba</i>)	R	2	160	0.36	0.80
Horned Puffin (<i>Fratercula corniculata</i>)	RU ¹	2	550	0.36	0.96
Tufted Puffin (<i>Lunda cirrhata</i>)	RU	2	800	0.36	1.40
Ancient Murrelet (<i>Synthliboramphus antiquus</i>)	RU ¹	85	230 ¹	15.51	17.18
Parakeet Auklet (<i>Cyclorhynchus psittacula</i>)	RU ¹	17	210	3.10	3.58
Crested Auklet (<i>Aethia cristatella</i>)	RU	131	230	23.90	26.48
Least Auklet (<i>Aethia pusilla</i>)	RU ¹	105	85	19.16	7.85
Whiskered Auklet (<i>Aethia pygmaea</i>)	RU	7	110	1.27	0.67
Unidentified Auklets (Parakeet or Crested)	RU	32	235	5.83	6.60
Auklet subtotal	—	383	—	69.55	65.52
Gray-crowned Rosy Finch (<i>Leucosticte tephrocotis</i>)	R	7	52 ¹	1.27	0.31
Lapland Longspur (<i>Calcarius lapponicus</i>)	M	13	30	2.37	0.33
Snow Bunting (<i>Plectrophenax nivalis</i>)	R	7	50 ¹	1.27	0.30
Passerine subtotal	—	27	—	4.91	0.96
Norway Rat (<i>Rattus norvegicus</i>)	R	5	300	0.91	1.31
Grand Total	—	548	—	100	100

M = migrant R = resident RU = resident in Aleutians but undetermined for Amchitka RM = found near or around but some members migrate

¹ Average of combined male female weight

² Approximate average weight of both species

³ Average between summer and winter weight

⁴ Approximate average adult weight

shifted in some of the colonies. For example, the colony on Kirilof Point had about 10 percent Red-faced Cormorants in 1968, while in 1969, it contained nearly 50 percent Red-faced Cormorants.

Glaucous-winged Gull. The location of Glaucous-winged Gull colonies on Amchitka changed little between 1968 and 1973. The only apparent shift was the abandonment of the Vista Islet colony, which contained five nests in 1968 and none in 1969. Most of the colonies were situated on upland tundra formation, although isolated nests were found in Elymus just above the sea beaches.

Arctic and Aleutian Terns. Tern colonies tended to be comprised of both species. Five colonies normally were used year after year. The largest colony, sighted in 1968, contained about 150 pairs and was located between East Cape and North Bight. Its location made it difficult to reach, so it remained little studied. The colony studied most intensively, one near Rifle Range Point, contained about 85 pairs when first located in 1969. However, by 1973 this colony had decreased to about 25 pairs, the majority being Arctic Terns. We were unable to determine whether colonies generally show such a magnitude of fluctuation or whether the reduction was a response to human disturbance. On the basis of the number of terns in each colony, 500 Arctic and 500 Aleutian Terns breed on Amchitka. The discovery of breeding Aleutian Terns in 1968 was significant since there were no previous records of them breeding west of Umnak Island.

Ecological and Geographic Distribution

To analyze the distribution of birds, certain ecologic formations were characterized by utilizing plant life-forms and distinctive features of topography and geology. This was a necessary first step in determining those environmental parameters, including trophic positions and interrelationships, that permit any given avian species to exist on Amchitka Island. Fourteen ecological formations were characterized as follows:

Pelagic waters	<u>Empetrum-Cladonia</u> tundra	Coastal reefs
Marine littoral waters	Disturbed areas	Sea beach
Lacustrine waters	Alpine tundra	Sea cliff
Fluviatile waters	Riparian meadow	Offshore islands
<u>Carex</u> meadow tundra	Beach ridge	

A schematic ecological profile of Amchitka Island, indicating the relative positions and relationship of these formations, except for disturbed areas and offshore islands, is presented in Figure 4. Principal avian species that exhibit primary preference for each formation are listed below with a brief description of that formation. A few species nest in ecologic formations that are different from those they normally inhabit during the rest of the year. These species are listed under both formations with the formation used for nesting indicated by an asterisk after the common name of the species (e. g., Rock Sandpiper*).

FIGURE 4. ECOLOGICAL PROFILE OF AMCHITKA ISLAND

Pelagic Waters. This formation comprises the marine waters extending seaward beyond approximately 2 miles from land.

Black-footed Albatross**	Fork-tailed Petrel**	Parakeet Auklet**
Laysan Albatross**	Leach's Petrel**	Crested Auklet**
Fulmar**	Pomarine Jaeger**	Least Auklet**
Slender-billed Shearwater**	Ancient Murrelet**	Whiskered Auklet**

Marine Littoral Waters. This formation includes the marine waters bordering the shore and extending approximately 2 miles from land where they merge with pelagic waters.

Pelagic Cormorant	Harlequin Duck	Thick-billed Murre**
Red-faced Cormorant	Common Eider	Pigeon Guillemot
Emperor Goose**	White-winged Scoter**	Horned Puffin**
Oldsquaw	Common Murre**	Tufted Puffin

Lacustrine Waters. All bodies of standing water and their associated emergent vegetation except the smallest ponds of the tundra formations are included in this formation.

Common Loon	European Widgeon	Common Goldeneye**
Red-throated Loon	Wood Sandpiper	Bufflehead**
Mallard	Common Pochard	Red-breasted Merganser**
Pintail	Greater Scaup**	Smew**
Green-winged Teal	Tufted Duck**	Northern Phalarope**

*These birds are not known to nest near Amchitka.

Fluviatile Waters. All flowing surface waters are considered part of this formation. These include the many small streams of the Island together with their margins of sand, gravel, or mud. The latter are usually devoid of vegetation. No species of birds showed a primary preference for this formation during the period of study, although the Wandering Tattler occurs there regularly.

Carex Meadow Tundra. This widespread meadow-like formation is generally moist to wet underfoot and supports lush stands of Carex with associated herbaceous vegetation. The mosses Sphagnum and Hylacomium are common.

Lapland Longspur

Empetrum-Cladonia Tundra. The low vegetation of this tundra is drier underfoot than that of the preceding formation and occupies the better-drained upland sites. Characteristic plants include Empetrum nigrum, Cladonia pacifica, Loiseleuria procumbens, and herbaceous plants including members of the genera Carex, Cornus, Pedicularis, and Erigeron.

Parasitic Jaeger	Glaucous-winged Gull*	Short-eared Owl
Gyr Falcon	Arctic Tern	
Rock Sandpiper*	Aleutian Tern	

Alpine Tundra. This formation in the higher windswept areas of the western half of the Island consists both of bare expanses largely devoid of vegetation and of mosaics of vegetated and bare areas. Characteristic plants include Salix (low prostrate willows), Vaccinium, Loiseleuria, and Empetrum.

Common Raven

Riparian Meadow. This includes the dense, lush stands of herbaceous vegetation bordering many streams on the lower parts of the Island. The diverse genera of plants in this formation include the following: Caltha, Ranunculus, Rumex, Cystopteris, Mimulus, Streptopus, Carex, and Calamagrostis.

Rock Ptarmigan	Pintail*	Greater Scaup*
Mallard*	Green-winged Teal*	Red-breasted Merganser

Beach Ridge. Many of the beaches at the lower eastern end of the Island are bordered on the Island side by ridges of varying heights. These ridges support a characteristic plant association that separates the beaches from the tundra formation. A border of Honckenya peploides frequently occupies the upper slope of the beach, and this is in turn bordered by a more or less distinct band of the composite Senecio pseudoarnica. This composite is bordered by often extensive stands of Elymus arenarius, especially on the higher ridges or bluffs.

Winter Wren Song Sparrow

Coastal Reefs. Exposed, lichen-spattered rocky reefs and headlands that are otherwise devoid of vegetation, are characteristic of much of Amchitka's shoreline. Offshore reefs are typically covered with various species of marine algae.

Black Oystercatcher

Sea Beach. The beaches of Amchitka are variously comprised of dark sand, gravel, rounded or jagged boulders, and piles of talus or massive angular rocks at the bases of cliffs. The vegetation is sparse, although Honckenya is consistently found on higher areas. Windrows of kelp together with driftwood and the remains of marine invertebrates are frequently present on the lower areas.

Golden Plover	Rock Sandpiper	Black-headed Gull
Ruddy Turnstone	Green-winged Teal	
Wandering Tattler	Bar-tailed Godwit	

Sea Cliffs. This formation is comprised of the steep and often sheer rocky cliffs and pinnacles (sea stacks) facing the sea around the perimeter of Amchitka. The sparse vegetation includes members of the genera Draba, Potentilla, and others. The tops of cliffs and pinnacles are often densely vegetated.

Bald Eagle	Glaucous-winged Gull	Snow Bunting
Peregrine Falcon	Gray-crowned Rosy Finch	Pelagic Cormorant

Disturbed Areas. Extensive disturbance of the tundra on the southeastern portion of Amchitka during World War II produced distinctive localized vegetation. The most important of these disturbed areas, in terms of utilization by birds, are the roadside berms and the ridges encircling the deserted quonset huts. These areas are characteristically covered with grasses (Calamagrostis) that provide cover for the nests of Lapland Longspurs, Mallards, and occasionally Rock Ptarmigan. There were also several colonies of Glaucous-winged Gulls whose nests were simple depressions in the grass.

Offshore Islands. The seven larger islets offshore from Amchitka are important nesting areas for some species of birds. The beaches of these islands are variously composed of massive boulders or the bases of steep, and occasionally sheer, rocky cliffs. The island tops have deep overlayers of soil densely covered with Elymus. The nesting burrows of Tufted Puffins were abundant in the deep soil on Bat, Vista, and Windy islands, and on the unnamed islet off Kirilof Point. Remains of Leach's and Fork-tailed Petrels found near or in burrows on Vista and Windy islands suggest that these birds breed there. Bald Eagles and cormorants nested on the islets off Bat, Mex, and Vista islands and an islet off St. Makarius Point.

Feeding Ecology

Definitive accounts of the feeding ecology of Amchitka birds were compiled. Stomach and crop analysis of selected species, field observations on feeding activities, and information from published accounts, enabled comprehensive statements about the diets of 52 species of birds that occur regularly on or near Amchitka (Table 6). A food web diagram (Figure 5) was then constructed (Williamson and Emison, 1969) to show the important trophic relationships of the Amchitka avifauna in five general habitat types: terrestrial, freshwater, sea beach, marine littoral waters, and marine pelagic waters.

TABLE 6. FOODS AND PRIMARY FEEDING HABITATS OF BIRDS ON AMCHITKA

Food Types	Species Feeding Primarily on Food Type		Species Feeding Moderately on Food Type	
	SPECIES	HABITAT	SPECIES	HABITAT
Vegetation (including seeds)	Emperor Goose	T & ML	Greater Scaup	FW
	Mallard	FW		
	Pintail	FW		
	Common Teal	FW		
	Rock Ptarmigan	T		
	Gray-crowned Rosy Finch	T		
	Lapland Longspur	T		
	Snow Bunting	T		
Insects	(Wood Sandpiper)	FW	Mallard	FW
	(Northern Phalarope)	FW	Common Teal	FW & SB
	(Song Sparrow)	SB	Pintail	FW
			Rock Sandpiper	T
			(Winter Wren)	SB
			Gray-crowned Rosy Finch	T & SB
			Lapland Longspur	T & SB
			Snow Bunting	T
Crustaceans	(Slender-billed Shearwater)	MP	(Common Goldeneye)	ML
	(Fork-tailed Petrel)	MP	(Arctic Tern)	ML
	(Leach's Petrel)	MP	Aleutian Tern	ML
	(Bufflehead)	ML	(Song Sparrow)	SB
	(Oldsquaw)	ML		
	Ancient Murrelet	ML		
	(Parakeet Auklet)	MP		
	Crested Auklet	MP		
	(Least Auklet)	ML & MP		
	(Whiskered Auklet)	MP		
	(Winter Wren)	SB		
Mollusks	Greater Scaup	FW	Common Teal	ML
	(Tufted Duck)	FW	(Bufflehead)	ML
	(Common Goldeneye)	ML	(Oldsquaw)	ML
	Harlequin Duck	ML	Common Eider	ML
	White-winged Scoter	ML		
	Black Oystercatcher	SB		
	Rock Sandpiper	SB		
Cephalopods	(Laysan Albatross)	MP	(Slender-billed Shearwater)	MP
	Fulmar	MP		
Echinoderms	Common Eider	ML	Glaucous-winged Gull	ML
Birds	Bald Eagle	T & ML	None	
	Gyr Falcon	T		
	Peregrine Falcon	T & ML		
	Parasitic Jaeger	T		
Fishes	Red-throated Loon	ML	Bald Eagle	ML
	(Black-footed Albatross)	MP	Parasitic Jaeger	FW
	Pelagic Cormorant	ML		
	Red-faced Cormorant	ML		
	Red-breasted Merganser	FW & ML		
	Glaucous-winged Gull	ML & MP		
	(Black-legged Kittiwake)	MP		
	Arctic Tern	FW & ML		
	Aleutian Tern	ML		
	(Common Murre)	ML		
	(Thick-billed Murre)	ML		
	(Pigeon Guillemot)	ML		
	(Horned Puffin)	ML		
	(Tufted Puffin)	ML & MP		
Varied (including carrion)	(Glaucous Gull)	SB & ML	None	
	(Common Raven)	T & SB		

Explanation of abbreviations, etc in table.

Habitat abbreviations T - Terrestrial, FW - Freshwater, SB - Sea Beach, ML - Marine Littoral, MP - Marine Pelagic.

Names in parentheses - Food preferences determined from the literature.

Names not in parentheses - Food preferences determined from collections on Amchitka Island.

FIGURE 5. FOOD WEB RELATIONSHIPS OF THE BIRDS OF AMCHITKA ISLAND

The feeding ecologies of the Peregrine Falcon and the Bald Eagle were studied intensively. Data on foods of Peregrine Falcons, the species of prey and their percent composition in the diet, are presented in Table 5. Small alcids (Crested Auklets, Ancient Murrelets, and Least Auklets) were the most common food during the spring and summer, but during autumn and winter predation on the resident Rosy Finch, Snow Bunting, and Rock Ptarmigan increased. The role of migrant birds in the falcon diet appeared to be minor. The foods are discussed further by White, Emison, and Williamson (1973). Birds made up about 50 percent of the food of the Bald Eagles and fish averaged about 20 percent of the total diet. The Rock Greenling (*Hexagrammos lagocephalus*) was the most important fish food. Mammals comprised about 30 percent of the diet with sea otter pups being a conspicuous food at some eagle nests. As many as four freshly killed pups were found in a single nest on one visit. The otters made up 74 percent of the mammalian prey.

Radionuclide Precautions

As a precaution in the event of accidental seepage of radionuclides following Milrow and Cannikin, specimens of selected species of birds were collected to determine background levels of radioactivity prior to the detonations. Tests for radiation background levels were made by the University of Washington Laboratory of Radiation Ecology. Specimens of nine species, including pelagic, migratory, and "game" birds, were collected for these radionuclide analyses.

To evaluate potential exposure of humans to radionuclides, the ecological and geographical distribution of some migratory game species were investigated. Of most concern in this regard was the Emperor Goose. To receive returns of bands, a large number of geese should have been banded. Because of the difficulty of trapping this species, however, an insufficient number of birds was banded to receive returns. The question of whether the Emperor Goose on Amchitka Island is of Asian or North American origin remains unanswered.

Effects of Nuclear Tests

Predictions of possible direct effects of Milrow and Cannikin on the avifauna fell into three general categories: habitat and nest-site destruction, destruction of birds, and accidental release of radionuclides. Recommendations were made to minimize these effects. First, tests should not be conducted during the height of the breeding season when the greatest number of birds could be affected. The breeding season for such species as the Bald Eagle extends from March-August. This species has received high public attention and is protected by federal law. Second, tests should be conducted during the winter months (November-February), if possible, to eliminate possible transport of radionuclides by fall migrants and birds resident on Amchitka in the summer. To assess the immediate and long-term effects of both Milrow and Cannikin, intensive studies were carried out prior to and just after the detonations, and have continued to the present time. An indirect effect of the nuclear tests came from human activity associated with test preparations. By 1968, associated human activity had disturbed avian habitats, principally with new roads, siltation of freshwater ponds and streams, and rutting caused by driving tracked vehicles across the tundra.

Effects of Milrow

Construction and related activities may have had localized effects on densities of birds prior to the actual Milrow test. Immediate effects of the 1969 test on the Amchitka avifauna were minimal, with significant destruction of just one Peregrine Falcon eyrie and only slight damage to other habitats and nesting sites. Data from pre- and posttest bird censuses did not indicate any change in population densities of species from terrestrial, freshwater lake, sea beach, and marine littoral ecosystems. Long-term effects of Milrow were assessed after the 1970 and 1971 breeding seasons (Williamson, Emison, and White, 1971, 1972). There was no evidence that the detonation appreciably lowered avian breeding populations on Amchitka in 1970, 1 year after the test. If there were long-term effects after 1970, they were masked by the impact of Cannikin.

Effects of Cannikin

The results of the first 2 months of post-Cannikin studies have been summarized by Kirkwood and Fuller (1972). The immediate results of the detonation were (1) the known test-related deaths of 17 birds as determined by Rausch (1973), (2) the loss of two Peregrine Falcon eyries that involved only one pair of falcons, (3) additional damage to a falcon eyrie originally damaged by Milrow, (4) the loss of six Bald Eagle nests, and (5) the damage of one eagle nest. The pair of falcons affected by loss of two eyries are known to have made new nests in the immediate area on the same cliff. They were successful in producing young in 1972 but not in 1973.

The significance of short-term effects of Cannikin can be fully assessed only through long-term studies. Such studies would take at least one generation time of falcons and eagles (5-10 years) for the effects to be detectable. As the generation time of other bird species on Amchitka is shorter, short-term effects on these species should then have time to accumulate within one generation time of eagles. The degree of damage to the avian habitat that was incurred by Cannikin verifies that future detonations of such magnitude should be made only in the autumn after breeding activity has terminated and most migrants have departed.

With respect to long-term effects of Cannikin, it is possible that new nesting habitat for some species of small sea birds such as auklets and petrels (not known to presently breed on Amchitka) was created by Cannikin-induced rockfalls along the Bering Sea coast. The time required for these species to invade new regions for nesting is unknown. However, since there is apparently unused breeding habitat (boulder piles and hillsides) through the Aleutians that is equally good or better than that created by Cannikin, some conditions other than availability of nesting sites may be the limiting factor. Perhaps the distribution of the food sources, plankton, and small fish, determines which nesting habitats will be occupied. To speculate further, we would have to know the distribution and abundance of plankton and small fish in the waters surrounding Amchitka, and such data are not available. Certainly, however, sites of some auklet colonies recorded in 1959 (Murie 1959) are now abandoned or relocated on the same island and new colonies have been established on islands which previously had no known colonies. This suggests that, when factors necessary for successful colonization are available, nest site changes may occur within a few years. Most occupied nest sites are covered by a growth of vegetation suggesting that a period of stabilization of the Cannikin-induced slides will be necessary before we can be certain that these slides offer new nesting habitat.

Effects of Human Activity Associated With Both Tests

In addition to those direct effects of the tests described above, indirect effects from human activity are evident on Amchitka. It is difficult to isolate simple cause and effect relationships between human activity and changes in avian populations because of the complex interactions and interdependencies that produced environmental change. Some examples, however, may be cited.

Construction and maintenance of roads produced gravel piles and dusty borrowpits. These were effectively used by Rock Ptarmigan for observation perches and dust bathing and appeared to be beneficial to that species. Trucks passing along the roads, however,

struck individuals of several species, e.g., Rock Ptarmigan, Lapland Longspur, and Bald Eagles. The U. S. Fish and Wildlife Service requested that some of the quonsets be burned and subsequently several frame buildings were burned by the fire department. At least four of these latter buildings had been used by Rosy Finches for nesting; the effect was detrimental in that existing nesting territories were removed.

All effects of AEC Amchitka Island activities on avian species can probably never be determined accurately because the results of fox farming and World War II activities were not measured prior to AEC involvement and because data from the early part of the century are lacking.

Summary and Conclusions

Of 126 species of birds recorded on Amchitka since 1955 an average of 27 species breed there annually. Census plot data on the more common terrestrial birds suggested that Lapland Longspurs have a breeding density of about 37 pairs per 100 acres of usable habitat, Rock Sandpipers about three pairs per 100 acres, and Rock Ptarmigans about 1.3 pairs per 100 acres. The census data further suggested that Lapland Longspurs, with about 10,000 breeding pairs, were the most common species.

Waterfowl, a conspicuous element of the avifauna, were commonly found on the beach and intertidal perimeter of the Island as well as on freshwater lakes during spring and summer. Waterfowl traditionally used only about 0.7 percent of the more than 2,500 lakes for flocking and feeding in the fall.

Cliff-nesting species, Peregrine Falcons, Bald Eagles, and Pelagic and Red-faced Cormorants, were important species on sea and beach cliffs. The nesting density averaged about 60 pairs of eagles, 18 pairs of falcons, and perhaps 2,000 pairs of cormorants of both species.

The Aleutian Tern breeds on Amchitka as well as on Umnak, Adak, and Attu; it is not known to breed elsewhere in the Aleutians. Although Winter Wrens were reported to have disappeared as a breeding species from Amchitka in the 1950's, it is again a common breeding species.

Fourteen ecological formations were identified. These ranged from pelagic waters to alpine tundra and contained an array of aquatic (fresh and marine) and terrestrial habitats including man-disturbed terrestrial areas. Feeding ecology was described for most of the common species, and a simplified food web was constructed. Feeding habits of Peregrine Falcons and Bald Eagles were examined in detail. The number of prey items taken by each species was between 30 and 40. Sea otter pups, unrecorded as a common prey item in previous food studies of eagles in the Aleutians, comprised about 74 percent of the mammalian prey. Postmortem examination of the pups indicated that most were taken alive.

The studies of population dynamics and the feeding and breeding ecology of the avifauna have shown that the principal detrimental effects of the AEC test program were (1) the direct mortality of a few individuals of some species within a limited radius of Cannikin SZ, and (2) the destruction of a limited amount of cliff nesting habitat. A possible positive effect of the test program was the creation of potential nesting habitats for some species not known to breed on the Island.

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TABLE A-1. SPECIES, STATUS, AND SEASONAL DENSITY OF BIRDS FOUND
ON OR NEAR AMCHITKA, 1967 TO 1973 WITH DATA FROM
PREVIOUS RECORDS SINCE 1960

	Status ⁽¹⁾	Sp	Seasonal Density ⁽²⁾		
			Su	A	W
<i>Gavia immer</i> Common Loon	M	-	<10	-	-
<i>Gavia arctica</i> Arctic Loon	M	-	acc	-	-
<i>Gavia stellata</i> Red-throated Loon	B	25	100	100	-
<i>Podiceps auritus</i> Horned Grebe	M	-	-	-	-
<i>Diomedea albatrus</i> ⁽³⁾ Short-tailed Albatross	-	-	-	-	-
<i>Diomedea immutabilis</i> Laysan Albatross	M	-	Pr	-	-
<i>Diomedea nigripes</i> Black-footed Albatross	M	-	Pr	-	-
<i>Fulmarus glacialis</i> Northern Fulmer	M	Pr	Pr	?	-
<i>Puffinus tenuirostris</i> Short-tailed Shearwater	M	?	Nu	?	?
<i>Pterodroma inexpectata</i> Scaled Petrel	M	-	acc	-	-
<i>Oceanodroma furcata</i> Fork-tailed Storm Petrel	R	Pr	Pr	Pr	?
<i>Oceanodroma leucorhoa</i> Leach's Storm Petrel	R	Pr	Pr	Pr	?
<i>Phalacrocorax auritus</i> Double-crested Cormorant	M	-	acc	-	-
<i>Phalacrocorax pelagicus</i> Pelagic Cormorant	R,B	1,500	2,000	2,000	1,500
<i>Phalacrocorax urile</i> Red-faced Cormorant	R,B	500	500	500	500
<i>Olor cygnus</i> Whooper Swan	M	<20	-	-	20
<i>Branta canadensis</i> Canada Goose	M	-	acc	-	-
<i>Branta bernicla</i> Black Brant	M	-	acc	-	-
<i>Phylacte canagica</i> Emperor Goose	M	-	-	500	5,000

APPENDIX

SPECIES, STATUS, AND SEASONAL DENSITY OF
AMCHITKA BIRDS AND ESTIMATED ANNUAL
BREEDING POPULATIONS 1967 TO 1973

TABLE A-1. (Continued)

	Status ⁽¹⁾	Sp	Seasonal Density ⁽²⁾		
			Su	A	W
<i>Aser fabalis</i> Bean Goose	M	-	acc	-	-
<i>Anas platyrhynchos</i> Mallard	R,B	50	150	200	500
<i>Anas strepera</i> Gadwall	M	-	acc	-	-
<i>Anas acuta</i> ⁽⁴⁾ Pintail	R,B	200	50	100	200
<i>Anas falcata</i> Falcated Teal	M	acc	acc	-	-
<i>Anas creca</i> Green-winged Teal	R,B	1,000	1,000	1,000	1,000
<i>Anas formosa</i> Baikal Teal	M	-	acc	-	-
<i>Anas querquedula</i> Garganey	M	acc	-	-	-
<i>Mareca penelope</i> European Widgeon	M	<20	<20	<20	-
<i>Mareca americana</i> American Widgeon	M	acc	acc	-	-
<i>Anas clypeata</i> Shoveler	M	<10	-	<10	-
<i>Aythya ferina</i> ⁽⁴⁾ Common Pochard	M	<10	<10	-	-
<i>Aythya marila</i> Greater Scaup	R,B	150	200	150	150
<i>Aythya collaris</i> ⁽⁴⁾ Tufted Duck	M	<25	<25	-	-
<i>Bucephala clangula</i> Common Goldeneye	R	100	10	50	4,000 ⁽⁴⁾
<i>Bucephala islandica</i> Barrow's Goldeneye	M	acc	acc	-	-
<i>Bucephala albeola</i> Bufflehead	R	50	10	1,000	2,000 ⁽⁴⁾
<i>Clangula hyemalis</i> Oldsquaw	M	-	-	-	50
<i>Histrionicus histrionicus</i> Harlequin Duck	R	1,500	500	2,500	2,500
<i>Somateria mollissima</i> Common Eider	R,B	1,500	1,500	500	200
<i>Melanitta deglandi</i> ⁽⁴⁾ White-winged Scoter	M,R	<10-100	<10-200	<10	<10-200

TABLE A-1. (Continued)

	Status ⁽¹⁾	Sp	Seasonal Density ⁽²⁾		
			Su	A	W
<i>Melanitta nigra</i> Common Scoter	M	<10	<20	<10	-
<i>Mergus albellus</i> Smew	M	acc	acc	-	10
<i>Mergus merganser</i> Common Merganser	M	?	-	?	10
<i>Mergus serrator</i> Red-breasted Merganser	R,B	<50	<50	<50	<100
<i>Buteo lagopus</i> Rough-legged Hawk	M	acc	acc	-	-
<i>Haliaeetus leucocephalus</i> Bald Eagle	R,B	230	230	230	<300
<i>Haliaeetus pelagicus</i> Steller's Sea Eagle	M	acc	-	-	-
<i>Circus cyaneus</i> Marsh Hawk	M	acc	-	acc	-
<i>Pandion haliaetus</i> Osprey	M	acc	-	acc	-
<i>Falco rusticolus</i> Gyr Falcon	R	<10	<5	<5	<10
<i>Falco peregrinus</i> Peregrine Falcon	R,B	<50	<50	<75	<50
<i>Falco columbarius</i> Pigeon Hawk	M	acc	-	acc	-
<i>Lagopus mutus</i> Rock Ptarmigan	R,B	1,400	1,400	1,800	2,500
<i>Grus canadensis</i> Sandhill Crane	M	acc	-	acc	-
<i>Haematopus bachmani</i> Black Oystercatcher	R,B	300	300	300	300
<i>Charadrius hiaticula</i> Ringed Plover	M	acc	-	-	-
<i>Charadrius semipalmatus</i> Semipalmated Plover	M	acc	-	-	-
<i>Pluvialis dominica</i> American Golden Plover	M	<50	-	<50	0
<i>Arenaria melanocephala</i> Black Turnstone	M	acc	-	-	-
<i>Arenaria interpres</i> Ruddy Turnstone	M	100	-	500	-
<i>Numenius phaeopus</i> Whimbrel	M	-	acc	-	-
<i>Numenius madagascariensis</i> Far Eastern Curlew	M	-	-	acc	-

TABLE A-1. (Continued)

	Status ⁽¹⁾	Sp	Seasonal Density ⁽²⁾		
			Su	A	W
<i>Tringa glareola</i> ⁽⁴⁾ Wood Sandpiper	M,B	<20	<20	-	-
<i>Heteroscelus incanum</i> Wandering Tattler	M	<50	-	100	-
<i>Tringa flavipes</i> Lesser Yellowlegs	M	acc	-	-	-
<i>Calidris ptilocnemis</i> Rock Sandpiper	R,B	3,000	3,000	3,500	3,000
<i>Calidris acuminata</i> Sharp-tailed Sandpiper	M	-	-	<50	-
<i>Calidris melanotos</i> ⁽⁴⁾ Pectoral Sandpiper	M	<10	-	<100	-
<i>Calidris bairdii</i> Baird's Sandpiper	M	-	acc	-	-
<i>Calidris minutilla</i> Least Sandpiper	M	acc	-	-	-
<i>Calidris subminuta</i> Long-toed Stint	M	acc	-	-	-
<i>Calidris alpina</i> Dunlin	M	acc	-	-	-
<i>Philomachus pugnax</i> Ruff	M	acc	-	-	-
<i>Limosa lapponica</i> Bar-tailed Godwit	M	100	-	-	-
<i>Limosa limosa</i> Black-tailed Godwit	M	acc	-	-	-
<i>Calidris alba</i> Sanderling	M	<10	-	?	-
<i>Phalaropus fulicarius</i> Red Phalarope	M	Pr	Pr	Pr	-
<i>Lobipes lobatus</i> Northern Phalarope	M,B	-	50	-	-
<i>Stercorarius pomarinus</i> Pomarine Jaeger	M	acc	-	-	-
<i>Stercorarius parasiticus</i> Parasitic Jaeger	M,B	10	50	?	-
<i>Stercorarius longicaudus</i> Long-tailed Jaeger	M	acc	-	acc	-
<i>Larus hyperboreus</i> Glaucous Gull	M	?	-	?	50
<i>Larus glaucescens</i> Glaucous-winged Gull	R,B	4,000	4,000	4,000	4,000
<i>Larus ridibundus</i> Black-headed Gull	M	acc	-	-	-

TABLE A-1. (Continued)

	Status ⁽¹⁾	Sp	Seasonal Density ⁽²⁾		
			Su	A	W
<i>Rissa tridactyla</i> Black-legged Kittiwake	R?	Pr	Pr	Pr	?
<i>Pissa brevirostris</i> Red-legged Kittiwake	R?	acc	?	acc	?
<i>Sterna paradisaea</i> Arctic Tern	M,B	50	500	-	-
<i>Sterna aleutica</i> Aleutian Tern	M,B	50	500	-	-
<i>Uria aalgae</i> Common Murre	R?	<10	<10	Pr	?
<i>Uria lomvia</i> Thick-billed Murre	R?	<10	<10	Pr	?
<i>Cephus columba</i> Pigeon Guillemot	R,B	50	200	50	10
<i>Synthliboramphus antiquum</i> Ancient Murrelet	R	500	Pr	?	?
<i>Cyclorhynchus psittacula</i> Parakeet Auklet	R	Pr	Pr	Pr	?
<i>Aethia cristatella</i> Crested Auklet	R	Nu	Nu	Pr	Pr
<i>Aethia pusilla</i> Least Auklet	R	Nu	Nu	Pr	Pr
<i>Aethia pygmaea</i> Whiskered Auklet	R	Pr	Pr	?	?
<i>Ptychoramphus aleutica</i> Cassin's Auklet	R?	acc	-	-	-
<i>Cerorhinca monocerata</i> Rhinoceros Auklet	M?	acc	-	-	-
<i>Fratercula corniculata</i> Horned Puffin	R,B	100	200	50	?
<i>Lunda cirrhata</i> Tufted Puffin	R,B	1,200	4,000	500	?
<i>Cuculus canorus</i> Common Cuckoo	M	acc	acc	-	-
<i>Nyctea scandiaca</i> Snowy Owl	M	2	2	2	?
<i>Asio flammeus</i> Short-eared Owl	M	<10	-	-	-
<i>Riparia riparia</i> Bank Swallow	M	acc	-	acc	-
<i>Hirundo rustica</i> Barn Swallow	M	-	-	acc	-
<i>Petrochelidon pyrrhonota</i> Cliff Swallow	M	acc	-	-	-
<i>Corvus corax</i> ⁽⁴⁾ Common Raven	M	<10	<10	<10	?

TABLE A-1. (Continued)

	Status ⁽¹⁾	Sp	Seasonal Density ⁽²⁾		
			Su	A	W
<i>Troglodytes troglodytes</i> Winter Wren	R,B	700	1,000	1,000	700
<i>Turdus obscurus</i> Eye-browed Thrush	M	acc	-	-	-
<i>Oenanthe oenanthe</i> Wheatear	M	acc	-	-	-
<i>Luscinia calliope</i> Siberian Rubythroat	M	acc	-	-	-
<i>Phylloscopus borealis</i> Arctic Warbler	M	acc	acc	-	-
<i>Muscicapa griseisticta</i> Gray-spotted Flycatcher	M	acc	-	-	-
<i>Motacilla alba</i> White Wagtail	M	acc	acc	-	-
<i>Motacilla cinerea</i> Gray Wagtail	M	acc	-	-	-
<i>Motacilla flava</i> Yellow Wagtail	M	acc	acc	-	-
<i>Anthus spinoletta</i> Water Pipit	M	acc	acc	-	-
<i>Bombus garrulus</i> Bohemian Waxwing	M	-	-	acc	-
<i>Leucosticte tephrocotis</i> Gray-crowned Rosy Finch	R,B	2,000	2,000	2,000	2,000
<i>Fringilla montifringilla</i> Brambling	M	acc	-	-	-
<i>Acanthis flammea</i> Common Redpoll	M	acc	acc	acc	-
<i>Junco hyemalis</i> State-colored Junco	M	acc	-	-	-
<i>Melospiza melodia</i> Song Sparrow	R,B?	<10	<10	<10	<10
<i>Calcarius lapponicus</i> Lapland Longspur	M,B	20,000	38,000	20,000	-
<i>Plectrophenax nivalis</i> Snow Bunting	R,B	2,000	2,000	2,000	2,000
<i>Emberiza rustica</i> Rustic Bunting	M	acc	-	-	-

(1) M = migrant; B = breeder; R = resident

(2) Sp = Spring; Su = summer; A = Autumn; W = winter; acc = accidental;

Pr = present; Nu = numerous

(3) no recent data

(4) number vary from year to year

TABLE A-2. ESTIMATED ANNUAL AVERAGE AVIAN BREEDING POPULATIONS ON AMCHITKA ISLAND, 1967-1974

Species	Breeding Pairs
<i>Calcarius lapponicus</i>	Lapland Longspur
<i>Erolia ptilocnemis</i>	Rock Sandpiper
<i>Leucosticte tephrocotis</i>	Rosy Finch
<i>Plectrophenax nivalis</i>	Snow Bunting
<i>Larus glaucescens</i>	Glaucous-winged Gull
<i>Somateria mollissima</i>	Common Eider
<i>Phalacrocorax pelagicus</i>	Pelagic Cormorant
<i>Lagopus mutus</i>	Rock Ptarmigan
<i>Lunda cirrhata</i>	Tufted Puffin
<i>Troglodytes troglodytes</i>	Winter Wren
<i>Anas crecca</i>	Common Teal
<i>Haematopus bachmani</i>	Black Oystercatcher
<i>Sterna paradisaea</i>	Arctic Tern
<i>Aythya marila</i>	Greater Scaup
<i>Cephus columba</i>	Pigeon Guillemot
<i>Haliaeetus leucocephalus</i>	Bald Eagle
<i>Sterna aleutica</i>	Aleutian Tern
<i>Anas platyrhynchos</i>	Mallard
<i>Fratercula corniculata</i>	Horned Puffin
<i>Phalacrocorax urile</i>	Red-faced Cormorant
<i>Anas acuta</i>	Pintail
<i>Mergus serrator</i>	Red-breasted Merganser
<i>Lobipes lobatus</i>	Northern Phalarope
<i>Gavia stellata</i>	Red-throated Loon
<i>Falco peregrinus</i>	Peregrine Falcon
<i>Stercorarius parasiticus</i>	Parasitic Jaeger
<i>Melospiza melodia</i>	Song Sparrow
<i>Tringa glareola</i>	Wood Sandpiper
Total for the 28 Species	28,000