Kisla Sections

From:

RESULTS OF A MARINE BIRD AND MAMMAL SURVEY OF THE WESTERN ALEUTIAN ISLANDS SUMMER 1978

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ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE

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I. INTRODUCTION

The 1978 field season of the Aleutian Islands National Wildlife Refuge continued a wildlife inventory program begun in 1977. The main objectives of the program are to survey and census all islands within the refuge with special emphasis on describing marine bird and mammal colonies.

The Aleutian Islands and their wealth of wildlife play an important role in the marine ecosystem of the subarctic North Pacific Ocean and the Bering Sea. Nevertheless, the overall biology of the Aleutian Islands Refuge and the magnitude of its populations are poorly known as a result of remoteness and inaccessibility. Highlights of the biological knowledge gained during the few previous studies are discussed in Day et al. (1978).

The results of the 1978 field season are presented in this report. In addition to census work on marine birds and mammals, the field crew accomplished numerous other projects to expand wherever possible information on Aleutian Islands and their fauna and flora:

1) Pelagic bird transects and locations of cetacean sightings were recorded as part of long-term projects for determining the distribution and abundance of these animals within the Aleutians.

2) Murre activity patterns were studied at Agattu Island to aid in planning future census techniques for the two species.

3) Permanent monitoring plots were set up and worked on various islands to document long-term population changes of marine birds.

4) Intensive initial studies were conducted at the auklet colony on Kiska Island to catalog the colony and to better understand these birds, the most abundant marine bird species in the Aleutians.

5) Terrestrial transects and plots were worked on islands recently eliminated of foxes, in order to observe the effects of foxes on terrestrial bird communities in the Aleutians.

6) Raptor aerie locations and populations were recorded to develop a catalog of Aleutian raptor aeries for future monitoring.

7) Beached animal surveys were run to determine natural mortality of marine birds and mammals in the Aleutians.

Despite the accomplishments, the work completed in the 1978 season was only a fraction of what was scheduled. Poor weather, mechanical difficulties, scheduling conflicts, and numerous other problems combined to drastically reduce the field crew's efficiency. The remaining available work time was used to advantage: Table 1 presents the timetable of activities in the 1978 field season.

The authors of this report would like to acknowledge and thank the following people for their aid in the summer's project:

Kent Hall assisted in collection of the field data and in editing this report.

Personnel of the Refuge Office in Adak aided in numerous ways throughout the field season.

Dennis Woolington and Dan Yparraguirre allowed us to share their Aga Cove camp during storm and sun.

Personnel of the Amchitka Field Station provided hot showers, good food, and fine companionship.

The crew of the R/V Aleutian Tern was the lifeline during the project and provided mighty fine food and companionship and excellent boatsmanship.

G. V. Byrd, D. D. Gibson, and R. D. Jones offered background information on the Aleutians from previous work in the islands.

This report is dedicated to the handfull of explorers and biologists who have given us a finer appreciation for this last stretch of true frontier in Alaska.

Table 1. Schedule of events for the 1978 field season.

DATE	PERSONNEL AND PLACES	ACTIVITY
17 May	Day, Lawhead, Rhode aboard R/V Aleutian Tern at Kodiak	
27 May-4 Jun	Day, Lawhead, Rhode aboard Tern from Kodiak to Adak	pelagic transects
28 May	Day, Lawhead, Rhode ashore Baby Islands	census colonies
5-15 Jun	At Adak	
19-23 Jun	Day, Early, Hall, Lawhead, Rhode ashore Agattu	aid with Goose Release
23 Jun-6 Jul	same ashore Agattu	census cliff-nesters, permanent plots, beached animal surveys
7-10 Jul	Day, Early, Lawhead, Rhode ashore Nizki and Alaid	census sea lions, beached animal surveys terrestrial transects
13-25 Jul	Day, Hall, Lawhead, Rhode ashore Buldir	permanent plots, beached animal survey, census sea lions,
26 Jul	Day, Early, Hall, Lawhead, Rhode at Kiska	coastline surveys
27-28 Jul	same ashore Sirius Point (old flow)	map auklet colonies, auklet plots
29,31 Jul	same ashore Sirius Point (new flow)	auklet plots
1-8 Aug	same ashore Sirius Point (old flow)	auklet plots
9-11 Aug	same at Kiska	coastline surveys, beached animal survey, census sea lions
12 Aug	same at Little Kiska and Tanadak	coastline surveys, beached animal survey, census sea lions
13 Aug	Same at Amchitka	end of season

II. CENSUS TECHNIQUES

Following the system set in 1977, our methods for censusing marine birds and mammals were catagorized by two basic techniques: coastline surveys and onshore counts. Coastline surveys involved recording the number of individuals of each species encountered while circumnavigating each island in a Zodiac boat. In order to record the location of these sightings, the perimeter of an island was divided into segments (transects), the length of each transect depending upon species densities espected and the presence of distinguishing topographic features to aid in replication of boundaries. The distance between observers and shoreline varied from 25 to 500 m, reflecting the width of the kelp band surrounding an island.

Onshore counts, used mostly for birds, were made in areas where systematic sampling of the species present lent itself to a better estimate of the population. Methods varied from burrow-sampling to a census technique based upon a bird's diurnal rhythm activities.

In all cases, the goal was to use a uniform set of techniques that minimized observer error and allowed repetition. In addition, methods needed to be sufficiently precise to enable detection of real changes in populations and to allow monitoring of population trends. Only data from permanent census plots are sufficiently precise to be used in the latter context. The major problem is that any censusing program is a compromise (albeit sometimes poor) between the need for accuracy and the need for speed.

The following discussion lists the techniques used in censusing and in estimating bird and mammal populations in the Aleutian Islands. This will form the basis both for a set of uniform methods to be used within the Aleutians and for a starting point in further discussions on census techniques.

Northern Fulmar

All colonies located were recorded on large-scale maps. Counts were made of all birds in flight above the colony. Although detailed counts of the number of nests present are preferable to flight counts, colonies in the Aleutians are generally inaccessible due to topography; Nettleship (1976) discusses methods for censusing from nest counts.

In extrapolating our estimates from flight counts, we assumed the following: (1) all the birds had been flushed from the nests; (2) one-half of the population (i.e., one member of each pair) was off feeding at sea; and (3) approximately 35% of the birds present in a colony were non-breeders (Hatch 1977, 1978).

$$\#\text{ of breeding pairs} = (\#\text{ of birds counted}) \times (0.65)$$

However, the estimation of the actual number of pairs is much more complex. Populations of birds on colony vary widely during the course of a season, depending on the stage of breeding and reproductive success. Data from Hatch (1977, 1978) show that population estimates may vary as much as 1,000% from the actual breeding population. In addition, Dott (1975) discusses the importance of weather and time of day to colony attendance. This, censusing Northern Fulmars is an extremely complex project that needs further exploration. Indeed, it becomes questionable whether the estimates for Fulmar colonies which were derived in the 1977 field season are actually worth quoting.

Leach's Storm Petrel and Fork-Tailed Storm Petrel

All colonies located were recorded on maps. Although a systematic burrow count is the preferred method (Nettleship 1976; Byrd 1976), this method is not feasible in most of the Aleutians because of difficulties associated with locating nest-sites. Presumably, foxes have forced most petrels to nest in crevices rather than their preferred burrow nests.

Double-Crested Cormorant, Pelagic Cormorant, and Red-Faced Cormorant

The first species nests only as far west as the Islands of the Four Mountains in the Eastern Aleutians. The technique for censusing this species was the same as for the latter two more common species.

All colonies observed were recorded on maps. Colony location is especially important since cormorants frequently change nesting cliffs from year to year. The numbers of occupied (active) nests were tallied for each species; use of unoccupied nests is discussed under "cormorant species". Numbers of birds not on colony were identified by species when possible to gain an idea of species ratios;

however, this was possible in very few cases.

# of breeding pairs = # nests occupied (for any given species)

Cormorant Species

The calculation process for the numbers of cormorants relied on the results of the estimation of breeding pairs of individual species, discussed in the preceeding listing.

For all colonies or nests that were mapped, unoccupied nests were listed in this "species" category. Also, all flying or feeding cormorants seen during the course of the coastline survey were recorded. Then, using the assumption that one member of each breeding pair of an individual species was away from the nest, we subtracted the number of breeding pairs (not birds) of identified species from the total number of cormorants counted to determine the number of non-breeders.

# of non-breeders = (# birds counted) - (# breeding pairs of individual species)

# of nests = # of nests counted

Note that the number of non-breeders would include both immatures and non-breeding adults.

An attempt to determine specific identification and age of as many birds as possible was made, but this was generally too time-consuming for the data it yielded.

Glaucous-winged Gull

All colonies located were recorded on maps. Counts of individual adults, immatures, and fledglings were recorded. The sum of the number of adults seen was divided by two to calculate the number of breeding pairs. This technique probably over-estimates the number

of breeding pairs because no correction factor is used to account for non-breeding adults. Totals were calculated for the numbers of immatures and fledglings seen.

$$\#\text{ of breeding pairs} = (\#\text{ of adults}) \div 2$$

$$\#\text{ of immatures} = \#\text{ of immatures}$$

A more preferred method of censusing (especially on large colonies) is a sampling scheme of actually counting nests, as discussed in Nettleship (1976). However, on islands with foxes present, gulls select nest sites on inaccessible areas.

Black-legged Kittiwake and Red-legged Kittiwake

All colonies located were recorded on maps. All nests were counted since each represented a breeding pair. A nest was defined as a structure which appeared large enough to contain an egg. All colonies were photographed for later detailed counts.

$$\#\text{ of breeding pairs} = \#\text{ of nests counted}$$

When counting nests, it is preferable to subdivide the cliff-face into smaller sections, especially in large colonies. While this reduces the possibility of great error in counting, it does not completely eliminate it. Brun (1971) demonstrated that repetitive counts on the same cliff are best for more accurate estimates of numbers of nests, and showed that single counts may have a counting error of up to 2.5% of the estimated number of nests (the mean value of the number of nests counted in all repetitive counts). This method is certainly something to strive for, but would be far too time-consuming in extremely large colonies.

Arctic Tern and Aleutian Tern

All colonies located were recorded on maps. All birds that flew over the nesting area were counted when flushed. The number of

adult birds counted was then divided by two to obtain the number of breeding pairs.

$$\#\text{ of breeding pairs} = (\#\text{ of adults counted}) \div 2$$

White et al. (1977) used this technique to census the large, low-density tern colonies on Amchitka Island. It appears to be the most reasonable technique and may be critically important for low-density colonies in that the added disturbance from a large-scale sampling scheme (see Nettleship 1976) would probably cause great desertion in these easily-disturbed species. However, if these counts are done during the chick-rearing stage, the number of breeding pairs would be underestimated by this technique.

On small offshore islands where these species sometimes nest, the entire island would be censused for nests (if it was early in the breeding season). Otherwise, the number of birds over the colony would be counted, as discussed above.

Common Murre and Thick-billed Murre

All colony sites located were recorded on maps and photographed. A visual count of individual birds was made and recorded in terms of numbers of birds present at a certain time of day. Data were then analyzed following the procedure outlined in "Section IX - Murre Study Plots".

Pigeon Guillemot

The number of birds observed during each coastline survey was recorded: any large concentrations (fairly rare) were noted on a map. We subjectively estimated that only 50% to 60% of those birds present were counted due to the advanced state of the breeding season. This corrected estimate of the number of breeding birds was then divided by two, in order to determine the number of breeding pairs.

$$\#\text{ of breeding pairs} = [(\#\text{ of birds counted})\ (1.8)] \div 2$$

Kittlitz's Murrelet

This species is sufficiently rare in the Aleutians to be noted simply as absent or present and to record location and number of birds when present.

Ancient Murrelet

As discussed in the storm-petrel section, the most accurate way of estimating a burrow-nesting species is to make a burrow count, either by direct census or in random plots. This is usually impossible in the Aleutians, so most of the estimates are subjective. For a more thorough discussion of the main techniques, see the previous account for storm-petrels.

Parakeet Auklet

This species generally nests in low density along most coastlines in the Aleutians. Hence, the estimator used is primarily the same as for the other low-density species. The main assumption is that 50% of the breeding birds were seen on each coastline census; the corrected number was then divided by two to calculate the number of breeding pairs. (However, since 0.5 and 2 are reciprocals, they divide out in the formula, leaving the number of pairs essentially the same as the number of birds counted.)

\# of breeding pairs = \# of birds counted

Parakeet Auklets occasionally nest in colonies along with the Aethia auklets; when this happens, the census technique follows that used for those species (see next discussion).

Crested Auklet, Whiskered Auklet, and Least Auklet

These birds are probably the most difficult of all the Aleutian seabird species to census. Censusing them is a time-consuming project since many plots are needed for accuracy and each plot takes one evening for a person to complete.

The census technique is based upon auklet work done by Byrd and Knudtson (in prep.) on Buldir Island in 1976, with a slight modification in 1977 (Day et al. 1978). These species show very specific patterns of arrival and departure on the colony throughout the day (see Fig. 1 for a schematic chart of colony attendance). Since the patterns diverge most during the evening hours, this is the best time to census auklets. The essential premise of the census technique is that the number of birds entering the talus minus the number of birds leaving (plus a correction factor for the number which just stand around on the rocks) yields a reasonably good estimate of the total number of breeding birds in the colony.

The assumptions underlying this technique are that: (1) daily changes in colony attendance are not great; (2) both members of a pair enter their nest site daily after 1800 hours during the post-hatching period; and (3) non-breeders comprise an insignificant part of the colony population during the chick-rearing stage.

The following is a detailed description of the sampling and estimation schemes.

A. Sampling Scheme

1) Examine the colony on foot and delineate the area covered by the colony on a map.

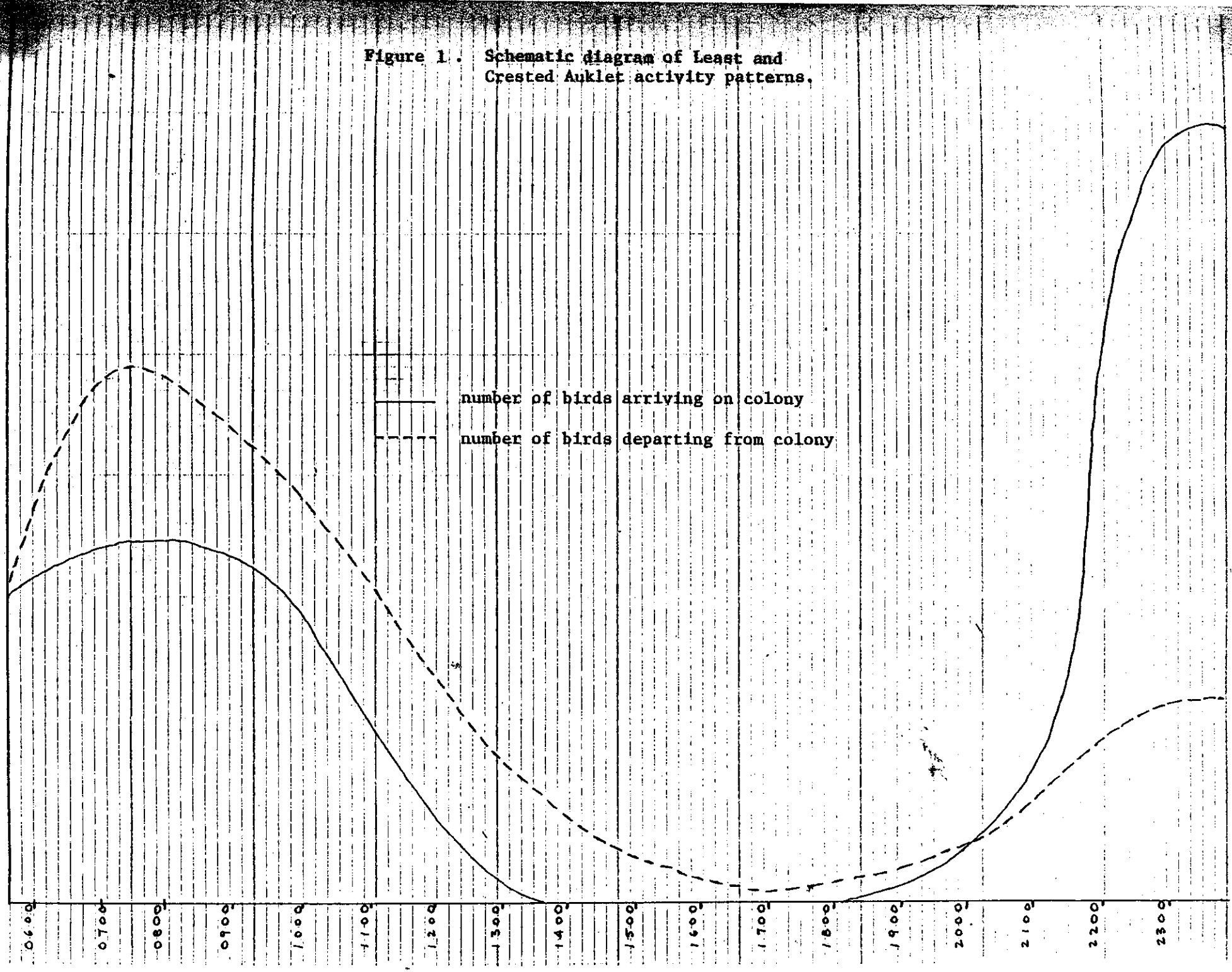
2) Divide the total area covered by the colony into 100 m^2 (10 X 10 m) plots.

3) Sample these plots either randomly or as a replicative sample with plots laid on a compass bearing. It is better to use the latter method on large colonies for ease in relocating plots. Select as many plots as time will allow for examination.

4) Locate these plots in the field and mark the corners with permanent markers.

5) Conduct counts during alternate 15-minute periods starting when there first appears to be a net number of birds into the plot. This varies from colony to colony, but generally begins between 1630 and 1900 hours. End the counts as late as possible (preferably either when lack of visibility prohibits further observations or when birds stop moving). Make all counts from the same observation post, located at least five meters from the edge of the plot (to avoid disturbance to the birds).

Figure 1. Schematic diagram of Least and Crested Auklet activity patterns.



6) Record the following plot characteristics before counting each plot:

   (a) the stage of the breeding cycle (i.e., egg-laying, incubation, or size of the chick),

   (b) weather conditions (wind speed, direction, temperature, barometric pressure, and precipitation),

   (c) the location of the plot (in the colony),

   (d) altitude, aspect (°True), elevation and distance from water,

   (e) percentage of vegetation cover and vegetation type,

   (f) approximate talus size and depth,

   (g) observer,

   (h) date.

7) Record the following for <u>each</u> species during <u>each</u> 15-minute count:

   (a) the number of birds <u>standing</u> on the surface of the plot at the moment the count begins,

   (b) the number of birds <u>landing</u> on the surface of the plot during the entire observation period,

   (c) the number of birds <u>leaving</u> the surface of the plot during the entire observation period,

   (d) the number of birds standing on the surface of the plot at the moment the count ends,

   (e) all disturbances which cause 50% or more of the birds on the plot to depart,

   (f) the time of the count, and

   (g) any other pertinent information affecting the numbers of birds in the count.

B. Estimation Scheme

1) Record the data in the following manner:

Time		Symbol (for any species)
t_1	# of birds at the beginning of each 15-minute count	a
	# arrivals	b
	# departures	c
t_2	# of birds at the end of each 15-minute count	d

2) The net number of birds arriving at each plot during each 15-minute period equals the number of birds arriving (b) minus the number of birds departing (c), plus the number of birds standing on the rocks at the beginning of the count (a) minus the number of birds standing at the end of the count (d).

$$\text{net number of birds arriving} = (b-c) + (a-d)$$

3) Sum the net totals of each 15-minute period for each species and double it since observations were made for only one-half the evening (15 minutes out of each half-hour period). This equals the total estimate (X) for the net number of birds that entered the plot that evening.

4) Sum total net values (X) of all plots worked and then calculate a mean and standard deviation for the plots (again for each species). In most cases the inter-plot variation is great enough and plots are few enough in number that the standard deviation generally is close to the mean in size.

5) Variance (s^2) is calculated as follows:

$$s^2 = \frac{\left(\sum_{i=1}^{n} X_i - \bar{X}\right)^2}{n-1}$$

where X_i = net number of birds in any particular plot

$\bar{X}$ = average net number of birds per plot

n = the total number of plots in the sample

6) The total number of birds of a particular species in the colony equals the mean number of birds per plot multiplied by the total number of plots in the colony (N).

$$\# \text{ of birds} = \bar{X} \cdot N$$

This estimator scheme should be calculated for each species.

7) The standard deviation of this estimate is the sample standard deviation (square root of the variance) multiplied by the total number of plots in the colony.

Horned Puffin and Tufted Puffin

The preferred method of censusing these species is to census burrows in random plots. However, inaccessibility of puffin burrows in most cases makes this technique unusable in the Aleutians. This is critical since these birds nest in low densities along all of the coastline. Thus, a technique of only censusing large concentrations would lead to an underestimation of the numbers of puffins actually present.

All colonies located were recorded on maps. The number of birds observed during coastline surveys was also recorded. The assumption was made that only 10% of the birds present in the area surveyed were seen. The corrected estimate for the number of birds was then divided by two, in order to calculate the number of breeding pairs.

$$\#\text{ of breeding pairs} = [(\#\text{ of birds counted})(10)] \div 2$$

This was the estimator for low-density populations. However, the method of estimation for small offshore rocks with more concrete numbers of birds in a small area was slightly different. It consisted of a subjective field estimate of the number of pairs present, determined directly by the number of birds seen around the island and the amount of available habitat.

Bald Eagles and Peregrine Falcons

Aeries and adults encountered during the coastline surveys were recorded; the aeries or approximate nest sites were plotted on the maps. Falcon nest site locations often were judged only by the presence of defensive birds. The number of aeries was used to estimate breeding pairs.

$$\#\text{ of breeding pairs} = \#\text{ of aeries/suspected aeries counted}$$

The young in or nearby each aerie were recorded and also noted on the map with the nest location. For estimating production of fledged young per successful nest and for further discussion of raptors, see the section "Avian Predators".

Sea Otters, Steller Sea Lions, and Harbor Seals

Marine mammals were counted as part of each coastline survey. Several locations permitted onshore counts (see section "Marine Mammals" regarding sea lions), otherwise all censusing was conducted from the Zodiac or the R/V Aleutian Tern when rip tides were too dangerous.

Table 2. Approximate areas and shoreline distances for islands visited in 1978*

ISLAND	AREA	SHORELINE
Baby Islands	285 acres	3.8 miles
Bogoslof	160 (in 1947)	-
Agattu	55,535	70.5
Alaid	1,468	9.4
Nizki	1,707	11.8
Buldir	4,915	12.0
Kiska	69,598	89.5
Little Kiska	1,843	9.7
Tanadak	-	-

* from Sekora (1973)

\- information not available

BULDIR ISLAND

Buldir is the westernmost of the Rat Islands and the most isolated of the Aleutians (Fig. 10). Kiska to the east and Shemya to the west are each about 70 miles from Buldir. This three-by-five mile island is volcanic in origin and has four prominent peaks, the tallest being 2,152 feet in elevation. Only two relatively large areas are flat, one being suitable for camping. Most of the shoreline is precipitous, with slide areas and vertical cliffs offering ample crevice and cliff nester habitat. Narrow boulder and cobble beaches provide breeding and hauling grounds for sea lions. The lush vegetation typical of the shore fringe on other islands extends inland more than one-half mile and up to 1,000 feet in elevation. The interior and sea slopes offer prime burrow-nester habitat. There are only two small lakes but many freshwater streams. Foxes were never introduced here and the island supports the last wild breeding population of Aleutian Canada geese. The island has been studied intensively by refuge biologists since 1974.

KISKA ISLAND

An active volcano rising to 4,004 feet dominates the northeastern end of this 22-mile long island (Fig. 11). The southwestern portion, a glaciated submarine ridge, is crowded with rugged mountains and deep, U-shaped valleys. The western shoreline is quite precipitous. Several extensive lava flows have emerged from Kiska volcano: an older, down-slope flow one to several centuries old; and a 1965 basal flow, both providing outstanding auklet habitat. A low, broad valley lies southwest of the volcano and holds several large brackish lakes and many freshwater ponds. Another pass, much narrower, cuts across the island from Kiska Harbor on the eastern shore to a small bight on the western side. Kiska Harbor is one of the few well-sheltered anchorages in the western Aleutians; it has black sand beaches, as do many of the island's valley outlets. Rocky shorelines and offshore rocks predominate along the southwestern end of Kiska and provide the island's major sea lion habitat. Kelp grows thickly around most of the island except below Kiska Volcano where water depth plunges to 600 fathoms. The nearest islands are Little Kiska and Tanadak, off the mouth of Kiska Harbor, and Segula about 20 miles east.

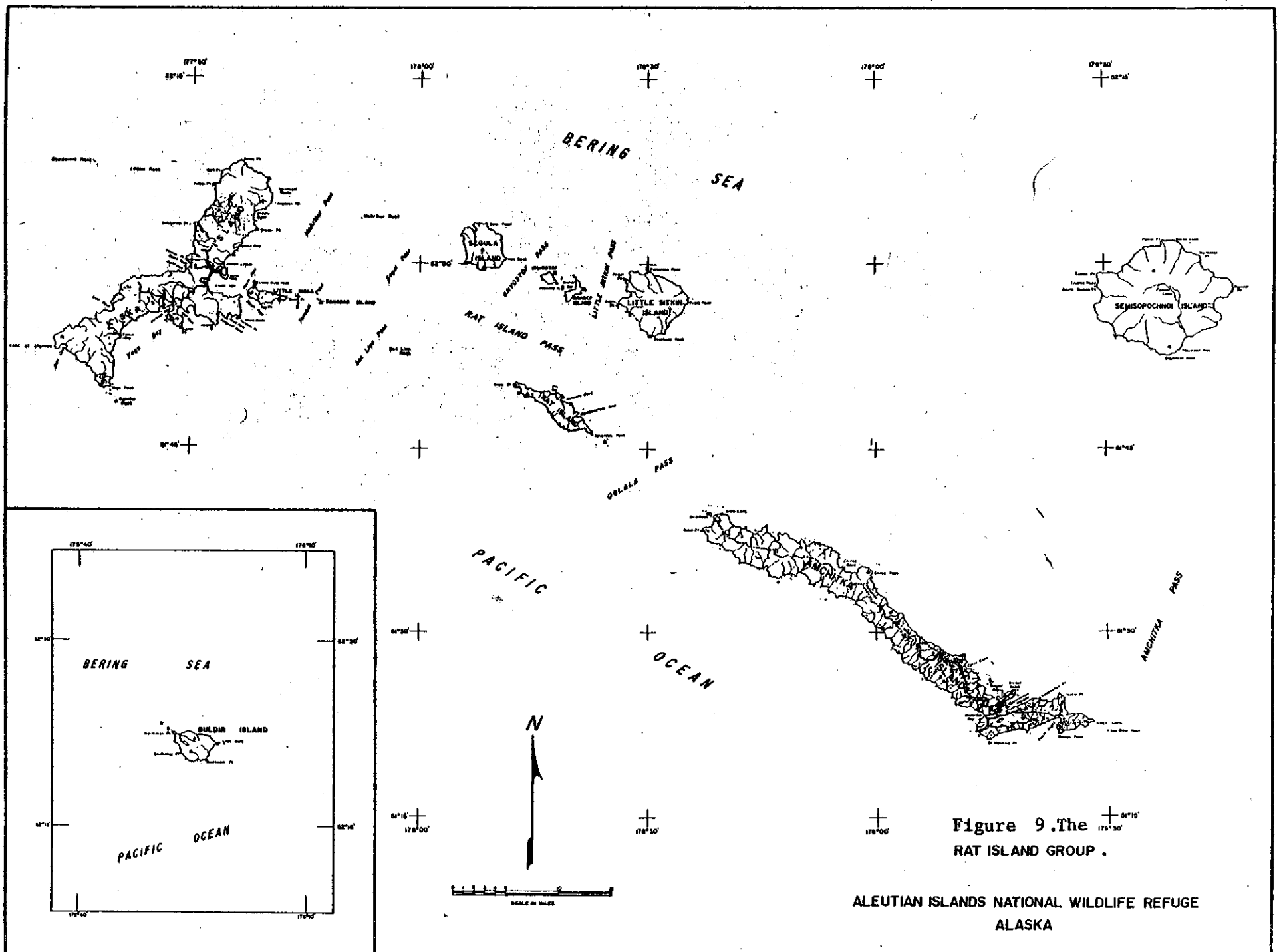
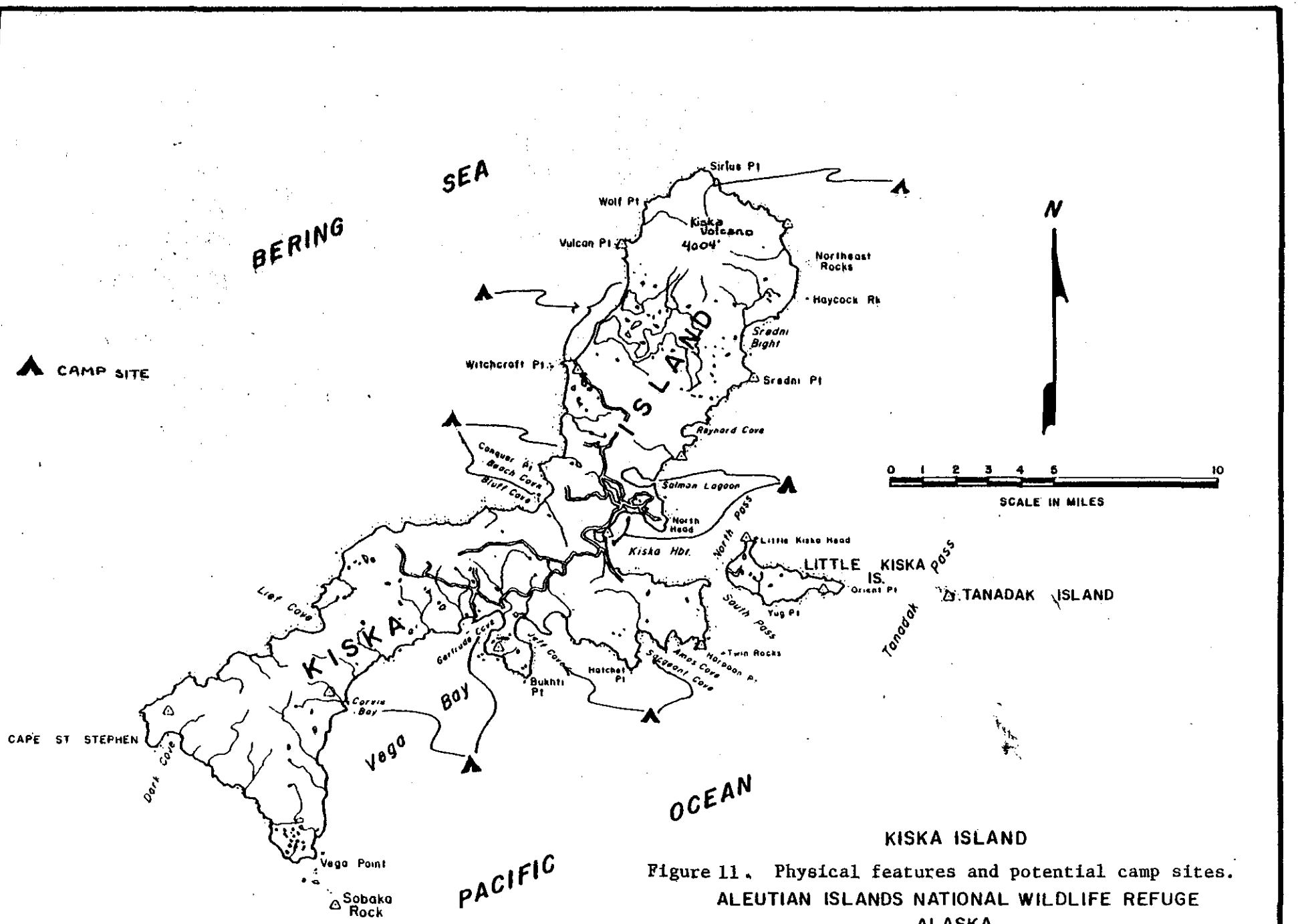


Figure 9.The
RAT ISLAND GROUP.

ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE
ALASKA



KISKA ISLAND

Figure 11. Physical features and potential camp sites.
ALEUTIAN ISLANDS NATIONAL WILDLIFE REFUGE
ALASKA

Although Byrd (unpub. notes) saw only 60 Pigeon Guillemots, we counted almost 200 birds in our survey.

We did not find any burrows of nocturnal seabirds during our onshore survey of Baby #2. However, we did see remains of two Ancient Murrelets. Byrd (unpub. notes) saw several hundred Ancients in the vicinity of the islands in the early evening, so there is a strong probability of nesting by this species (and probably by petrels also) somewhere in the group.

Horned Puffins were not common in this area: Byrd observed "a few" and we counted only 80 birds. They are definitely overshadowed by the tremendous numbers of Tufted Puffins.

Passerines were fairly common here. We saw three Common Ravens and an abundance of Song Sparrows on Baby #2. No Lapland Longspurs or Gray-crowned Rosy Finches were noted on Baby #2 and their status in the rest of the group must be questioned.

In summary, the Baby Islands contain excellent, but small, mixed colony of seabirds that is densely populated by Tufted Puffins. In addition to puffins, a number of other species of marine birds nest here. Cormorants and murres prefer this area as well as eiders and seals; in general, the islands have a good mix of species. They would be ideal for a study of Tufted Puffins in the eastern Aleutians although the lack of freshwater and the presence of strong tide rips could pose problems. This group would be an excellent acquisition to the existing refuge as the islands represent one of the finest seabird colonies in the eastern Chain. It was with disbelief that we read the signs posted on the beach: "No Hunting, No Fishing, No Trespassing - Property of Akutan Native Corporation."

Kiska Island (Table 3, Figs. 14 and 15)

We spent a total of 17 days on and around Kiska, a majority near the auklet colony. Kiska is a large island with many foxes; consequently, nesting birds are generally inaccessible. The exception to this is the auklet colony at Sirius Point.

Auklets are by far the most abundant species of marine birds nesting on Kiska Island. As discussed in "Section VIII - Auklet Census," the colony itself is easily divided into three sub-colonies: 1) a large new lava flow which rose from the ocean in 1965, 2) a large

old flow several centuries old (Coats et al. 1961), and 3) a smaller old flow or talus east of the main colony (Fig. 14).

The tremendous number of auklets is almost impossible to describe. Estimates indicate the number of birds on Kiska may be approximately three times the size of the large Gareloi colonies! However, due to the greater acreage, the densities are much lower on Kiska. With a total estimate of 1.4 million Least and Crested Auklets on Kiska (Leasts outnumbering Cresteds five to one), there is little doubt that this is the largest auklet colony known. (The next-largest colony known is 1.1 million auklets on Little Diomede Island, W. Drury, pers. comm.) It also must be noted that this is a minimum figure, for many birds had fledged by the time we were finishing our work. For a more thorough discussion of this colony, see the sections "Auklet Census" and "Permanent Plots."

Parakeet Auklets also were primarily concentrated in the area along the north side of the island. Since none were seen in the Sirius Point plots, we assume they were nesting in cliff-crevices; however, farther east along the coast they were nesting in talus areas at the water's edge.

Although no Whiskered Auklets were seen on colony, a number of birds were present around the island. We observed approximately 600 birds in tide rips off Cape St. Stephen on 10 August, and a few birds came aboard the boat at night while anchored north of Vega Point. Unfortunately, we were unable to determine the origin of these birds.

The Sirius Point auklet colony was also home to many arctic fox living a life of plenty by denning in the lava crevices. No attempt was made to estimate the number of dens in the colony, but the density appeared quite high. A majority of bird carcasses found in fox food caches were those of hatching-year birds, especially Least Auklets. One cache contained at least 5 crested and 15 least auklets outside the den with the heads bitten off. These birds emerge frequently from their nest crevices a day or two before fledging and stand on the surrounding rocks, totally vulnerable to prowling foxes.

A small Black-legged Kittiwake colony occupied the cliffs midway between the west side of the auklet colony and Wolf Point. Approximately 100 nests were on a small offshore rock and the rest (290)

Table 3. Population estimates for Kiska Island.

SPECIES		ESTIMATE
Leach's Storm - Petrel		+
Fork-tailed Storm-Petrel		+
Pelagic Cormorant		26p
Red-faced Cormorant		77p
Cormorant sp.		6+n
Cormorant sp.	nonbreeders	890i
Glaucous-winged Gull		480p
Glaucous-winged Gull	nonbreeders	280i
Black-legged Kittiwake		390p
Murre sp.	nonbreeders	30i
Common Murre	nonbreeders	15i
Pigeon Guillemot		280p
Ancient Murrelet		+
Kittlitz's Murrelet		+
Parakeet Auklet		2,000p
Crested Auklet		116,000p
Whiskered Auklet		+
Least Auklet		580,000p
Horned Puffin		2,750p
Tufted Puffin		5,000p
Bald Eagle		19a
Bald Eagle	nonbreeders	26i

NOTE: a = aeries
i = individuals
n = nests
p = pairs
+ = present, no estimate made

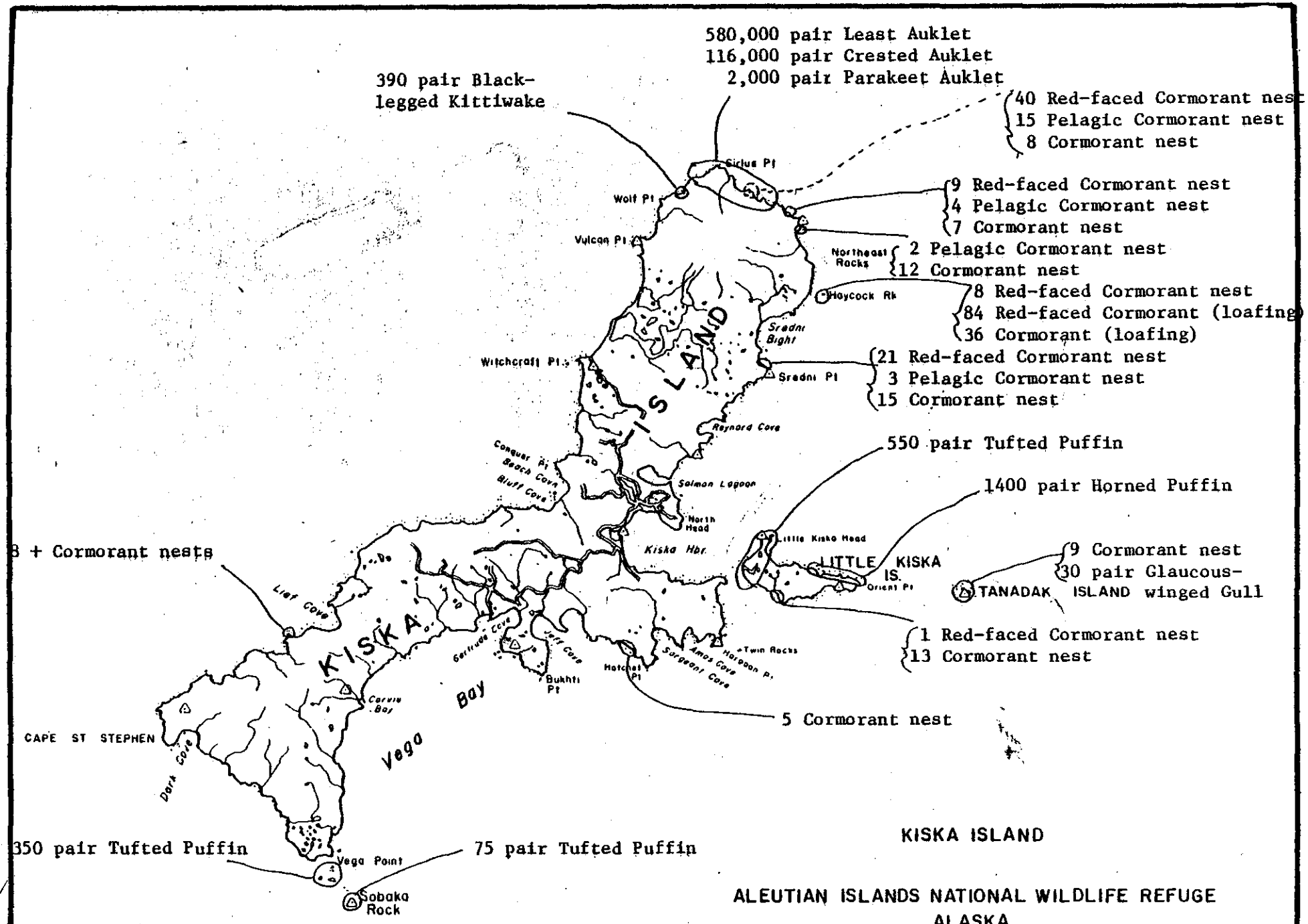


Figure 15. Location of seabird concentrations in the Kiska Island area.

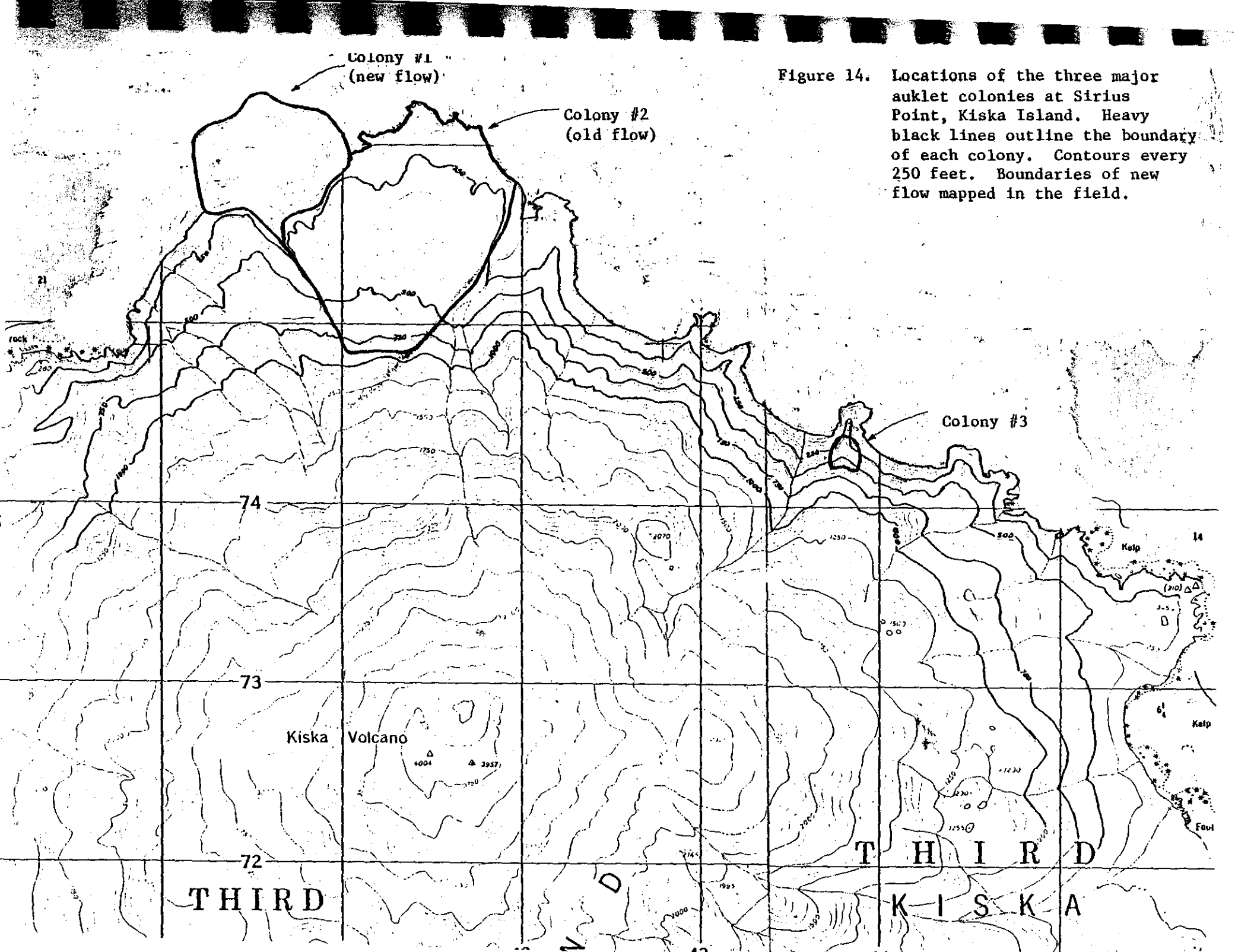


Figure 14. Locations of the three major auklet colonies at Sirius Point, Kiska Island. Heavy black lines outline the boundary of each colony. Contours every 250 feet. Boundaries of new flow mapped in the field.

were either clinging to the cliffs about 200 feet above the water or on cliffs just above wave height on the southwest side of the small bight. A total of 839 individual kittiwakes were counted from photos taken from the Zodiac at time of census.

Small cormorant colonies were scattered along the coastline on cliff faces. The largest colony was in a small cove just east of Sirius Point (Fig. 15); two small colonies were present just east of this large colony. Other cormorant colonies were observed at Haycock Rock, the north side of Sredni Point, just west of Hatchet Point, and just south of Lief Cove.

Puffins appeared to be nesting along the entire shoreline in low densities, while the offshore rocks appeared to be heavily utilized; this was especially true in the Sobaka Rock area. The same phenomenon was noted last year, in that birds apparently move onto the offshore rocks to nest if the main island has introduced foxes.

One of the more interesting observations this year was that of three Kittlitz's Murrelets sitting at the mouth of Gertrude Cove. This is in an area of fairly deep bays with high peaks and ridges nearby, so it is feasible that they were nesting in this area.

Once again we had great difficulty in determining the numbers of nesting nocturnal birds. The size of Kiska Island defies quick surveys and even good guessing. Although Leach's and Fork-tailed Storm-Petrels were observed frequently at Kiska Harbor and off the northeast side of the island, their nest locations are unknown. Storm-petrels were also sighted near the south end of the island where the Sobaka Rock group probably provides nesting habitat. Numerous Ancient Murrelets were observed sitting in Kiska Harbor, but we could not determine where they nested.

Low numbers of Common Eiders and Harlequin Ducks were present around Kiska's coast, and a few broods of eiders were observed. Parasitic Jaegers were also present here, apparently nesting in low numbers.

In summary, Kiska Island is a rather limited marine bird colony for variety. It hosts only a few cormorant colonies and a kittiwake colony, all small in size. However, the incredible populations of auklets nesting in the lava on Sirius Point make this island one of the most important marine bird colonies in the Aleutians, and certainly the largest auklet colony known to science.

Little Kiska Island (Table 4, Fig. 15)

Little Kiska, a small island just east of Kiska, was spared the introduction of foxes. Consequently, even though it could not be described as a spectacular colony, the island has an abundance of birds.

Glaucous-winged Gulls were found in profusion, taking advantage of the lack of terrestrial predators. We observed them nesting on hummocks in the tundra and in old bomb craters. Trapp (1976) considered them abundant and noted two small colonies near the west end.

Cormorants were quite common, and a small colony was located on the south side near Yug Point. All nests were deserted except for one of a Red-faced Cormorant. In contrast, Trapp (Ibid.) found a colony of 70 to 75 Red-faced Cormorants nesting on the cliffs just east of Little Kiska Head on 2 July 1976, so this colony has obviously been deserted in the past two years.

Tufted Puffins were abundant, occupying the bluffy areas around Little Kiska Head and along the south shoreline where they were especially common. Horned Puffins, in contrast, were uncommon around most of the island except for the rocky talus and cliff areas on the northeast coast.

Lawhead, Early, and Hall were able to confirm nesting by Ancient Murrelets and both storm-petrels on the island. Active burrows of these nocturnals were found on an overgrown boulder area near the peak of Little Kiska Head. No attempt was made to sample the extent of nesting over the entire island, so a reliable estimate of numbers is unavailable. No sample plot was established due to multiple nesting in single burrows and the large talus creating spacious nesting areas in inaccessible locations. Trapp (Ibid.) observed a flock of 150-200 Ancient Murrelets just north of Navy Cove on 2 July 1976, indicating at least that many nest there. The area appears to have the best burrow habitat on the island, so most of the nocturnal birds probably nest there.

Rock Ptarmigan, Rock Sandpipers, and Northern Phalaropes all breed on Little Kiska, as indicated by Trapp (Ibid.). He considered the ptarmigan to be abundant but noted only small numbers of the latter two species. Not surprisingly, numerous Parasitic Jaegers nest here.

V. AVIAN PREDATORS

As in 1977, avian predators were counted during the course of each coastline survey. This year, in addition to tallies of raptors, the location of known or suspected aeries were noted on a map (Fig. 16). These locations should be checked in future years to see how many aeries are used again. Variability in nest site use occurs on Amchitka (White et al. 1977); however, the Amchitka population may represent a special case due to the artificially high numbers of breeding pairs (Ibid., page 251) occurring there at the time White et al. (1977) did their work. Thus Amchitka's variability may not have been characteristic of an entirely natural population.

The Bald Eagle is the most abundant avian predator in the Aleutians (Day et al., 1978). In 1977 the field crew counted 55 aeries and estimated another three or four aeries in the census area. In 1978, censusing only 25% of the amount of territory covered in 1977, we located between 30-35% of the same number of aeries. Data on numbers of aeries and the inter-aerie distances for islands surveyed in 1977 and 1978, and for Amchitka for 1969 to 1974, are presented in Table 6. Note that these figures indicate the number of pairs which set up territories and raised young, rather than the number which just set up territories. Unfortunately, this method has limitations, for Sherrod et al. (1976) noted that some bias occurs when estimating the percent of successful nests from single trips to aeries. However, as most of the aeries were located when the young were fairly large, it is doubtful that few, if any, of these aeries would have been abandoned later in the season due to eaglet mortality.

Shown in Table 6, the average distance between aeries in 1977 was fairly uniform, with a few exceptions. Gareloi probably had two more aeries than were located, bringing the total to four aeries and placing the subsequent mean distance between aeries surprisingly close to the computed average for all the islands (see Table 7). Hundreds of thousands of seabirds nest on Gareloi, making it likely that more than two breeding pairs of eagles are able to take advantage of the tremendous food supply. However, the possibility remains that two or more aeries failed early in the season. It is also feasible that a number of aeries on Amatignak and Semisopochnoi were missed during the survey, as evidenced by the great distances between sites on these islands. Note that the "small" Delarofs (with coastline mileages much less than 10 miles each) only had one or two aeries apiece. These were

Figure 16. Location of Bald Eagle and Peregrine Falcon aeries on Kiska, Little Kiska, and Tanadak Islands and neighboring rocks. Numbers in parentheses refer to the number of young in the nest or fledged. Aeries with question marks in parentheses probably exist, but are not known for certain. The larger the area of the circle, the more uncertain we are about exact location of the aerie.

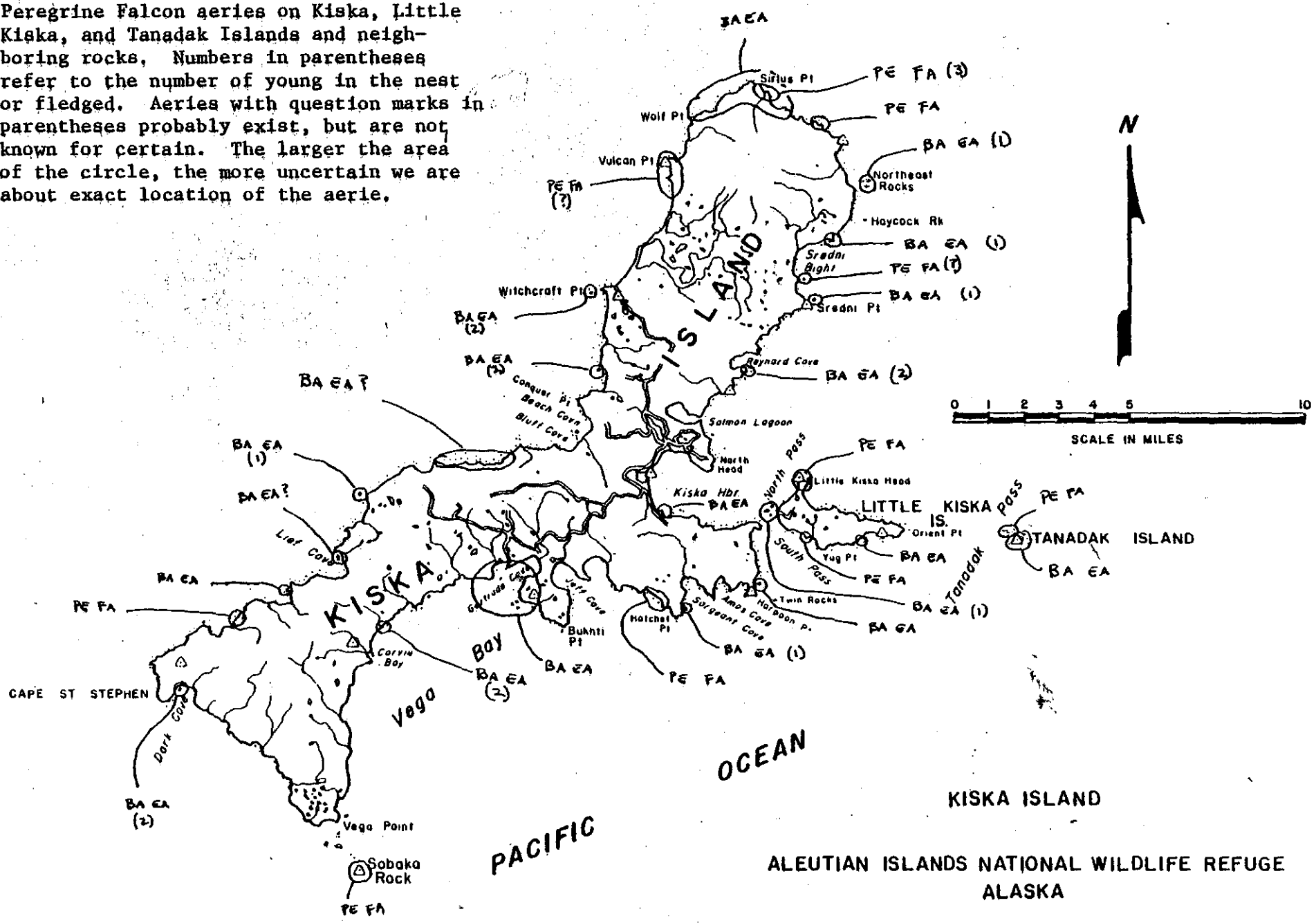


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Table 6. Number of successful aeries and inter-aerie distances of Bald Eagles and Peregrine Falcons on selected islands in the western Aleutians. Numbers in parentheses indicate maximum possible numbers of successful aeries and their respective inter-aerie distances.

		BALD EAGLE		PEREGRINE FALCON	
ISLAND	MILES OF COASTLINE*	# OF AERIES	# OF MILES BETWEEN AERIES	# OF AERIES	# OF MILES BETWEEN AERIES
1977					
KANAGA	114.6	25	4.6	6	19.1
BOBROF	8.2	1	8.2+	1	8.2+
GARELOI	19.4	2 (4)	9.7 (4.8)	2 (3)	9.7 (6.5)
ULAK	18.4	4	4.6	1	18.4+
AMATIGNAK	16.2	1	16.2+	1	16.2+
KAVALGA	13.8	3	4.6	1	13.8+
"SMALL" DELAROFS* (TOTAL)	21.5	7	3.1	3	7.2
SEMISOPOCHNOI	40.0	2 (4)	20.0 (10.0)	1 (2)	40.0 (20.0)
* ILAK, SKAGUL, OGLIUGA, UNALGA					
1978					
KISKA	89.5	15 (17)	6.0 (5.3)	5 (7)	17.9 (12.8)
LITTLE KISKA	9.7	2	4.8	2	4.8
TANADAK	0.9	1	0.9+	1	0.9+
1969-1974					
AMCHITKA	106.5	39.3[x]	2.7	12.7°	8.4

* from Sekora (1973)

x average for 1969, 1970, 1974 from White et al. (1977)

° average for 1970-1972 from White et al. (1977)

usually at opposite ends of the islands. Small islands (less than three miles of coastline) from the 1977 survey not discussed in the table (e.g., Gramp Rock, Tag Islands) seem to be too small to allow more than one pair of eagles to nest there. Tanadak (east of Little Kiska) seems to follow this trend, for it also has only one aerie. However, the data at this point are too incomplete to predict the maximum size an island may be and yet have only one active pair of eagles. Undoubtedly, there are other factors involved that have not been taken into account.

Table 7 gives the weighted averages of distances between aeries on most islands surveyed in 1977 and 1978, as well as from Amchitka between 1969 and 1974. Data for 1971 and 1972 from Amchitka are not used since there is some indication that the AEC garbage dump allowed an abundance of eagles to breed (see White et al. 1977). As in Table 6, these figures are for aeries actually producing young. The difference between 1977 and 1978 averages is probably due to differences in habitat, although undetected breeding failure may have been a cause. Using our method, the average inter-aerie distance at Amchitka is small, averaging about one-half that of the islands we surveyed. It is assumed that this is a result of both abundant nesting habitat and an abundant food supply.

A minimal field estimate for production of fledged young in 1977 was 1.2 young produced per successful nest. Sherrod et al. (1976) recorded an average of 1.42 young produced per successful nest at Amchitka, close to our 1977 figure. In 1978 information was gathered on 11 aeries in the Kiska Island area: six contained one young and five contained two young for a mean of 1.45 young produced per active aerie. Although some mortality may have taken place before fledging as discussed by White et al. (1977), this was probably negligible on the current survey for most young were very large (and thus quite close to fledging) or had already fledged. Thus, it is likely the calculation of 1.45 young produced per active aerie is close to the average number actually produced. Therefore, we estimate that between 25 and 28 Bald Eagles were fledged on Kiska, Little Kiska, and Tanadak Islands in 1978.

Although much less common that the Bald Eagle, the Peregrine Falcon is the second most abundant avian predator in the Aleutians. In the 1977 survey area there were approximately 30% as many active Peregrine Falcon aeries as active Bald Eagle aeries (Day et al. 1978); in the

Table 7 . Weighted averages of Bald Eagle inter-aerie distances (in miles of coastline) from selected islands in the western Aleutians.

YEAR	$\bar{X}$*	S.D.	n (AERIES)	COMMENTS
1977	4.5	0.8	44	Excludes Amatignak and Semisopochnoi and uses lower average for Gareloi
1978	5.2	0.2	19	Kiska and Little Kiska; uses lower average for Kiska
1969,1970,1974 (AMCHITKA)	2.7	0.2	118	Data approximated from White et al. (1978)

*$\bar{X}$ = mean inter-aerie distance

Shumagin Islands in 1976 there were approximately 25% as many (Day 1977; Moe 1977). A rough approximation from the data presented in White et al. (1977) indicates that the figure for Amchitka was about 32%, a ratio remarkably consistent with the other areas. In contrast, the data from the Kiska area for 1978 (Table 7) indicate Peregrine aeries were about 45% as abundant as eagle aeries. The reason for this is not known, although it is probable that the large population of auklets in the Sirius Point colony contributes to this increased relative number of aeries. There should be no shortage of food with the great number of auklets present (see section "Auklet Census"). Aeries were relatively evenly spaced around the perimeter of the island except for extra aeries in the vicinity of the Sirius Point auklet colony.

As was discussed in the 1977 report, the difficulty of determining the exact location of most Peregrine aeries made it impossible to estimate the production of active aeries. Our meager data indicate between two and three young are fledged from each successful nest every year. White et al. (1977) demonstrated a fledging success of 2.66 young per successful falcon nest at Amchitka, a high fledging rate when compared with other areas.

Judging from the decreases in population size and fledging rate at Langara Island, British Columbia, Nelson and Myres (1976) concluded that both were primarily the result of a decrease in the Peregrine's primary prey, the Ancient Murrelet and the Cassin's Auklet. At this point there is no way to determine whether Crested Auklet populations in the Aleutians are decreasing and thus project potential changes in falcon populations since this species was found to be the major food of Peregrines at Amchitka (Williamson and Emison 1969). However, at Buldir Island, Ancient Murrelets appear to be as important as Crested Auklets (pers. obs.), so there is the possibility that any decline in populations of either of these prey species could cause a decrease in falcon populations in the Aleutians.

As was noted earlier, our census method is not precise enough to determine decreased production of falcons (due to difficulty in locating nests), so it is doubtful that gradual long-term population changes due to decreased production will be detected. However, our technique hopefully is good enough that repeated censuses of the coastline will reveal any large-scale population changes.

Location of Hauling Ground or Rookery		Estimated Number of Sea Lions				
		1957-58[1]	1959-60[2]	1965[3]	1969-72[4]	1978[5]
AGATTU:	Gillon Point	1000	3000		750	1500*
	Otkriti Bay	30	100	1300	--	0
	Cape Sabak	--	3300		8635	8100*
ALAID		--	1500	2500	2500	4800
BULDIR:	North shore	550	--		--	--
	Northwest Point	--	--	3500	--	1850*
	South shore	--	2500		4350	--
KISKA:	Sirius Point	--	--		65	22
	Wolf Point	--	--		--	14
	N of Lief Cove	--	--	1485	--	3750*
	Cape St. Stephen	--	1000		--	1350*
	Vega Point-Sobaka Rocks	150	400		--	930*
TANADAK		--	50		--	670*
BOGOSLOF:	Old Bogoslof	6813*	1000	--	--	800-1000
	Fire Island		100	--	--	0

[1]Source: Mathisen & Lopp 1963
[2] " : Kenyon & Rice 1961
[3] " : Kenyon & King 1965
[4] " : Sekora 1973
[5] " : Present study
*Including pups

Table 10. Estimated numbers of Steller sea lions on selected islands; see text for details of surveys. Dashed spaces indicate areas not surveyed or for which no information is available.

figures are only approximate; anyone who has attempted to count densely packed sea lions in high winds and wind driven mist can appreciate the problems. Despite the poor weather, however, we are confident that no pups were present. All other age and sex classes were represented, with a preponderance of subadult males. Several cows were observed "flirting" with large bulls, but no harems were apparent. Thus, when Trapp's observations are considered with ours, it appears that Alaid is primarily a hauling ground for subadult and nonbreeding animals, although breeding may occur to a very limited extent in some years.

Like Trapp (1975), we found no hauling areas on Nizki Island. The only sea lions observed were the carcasses of several bulls.

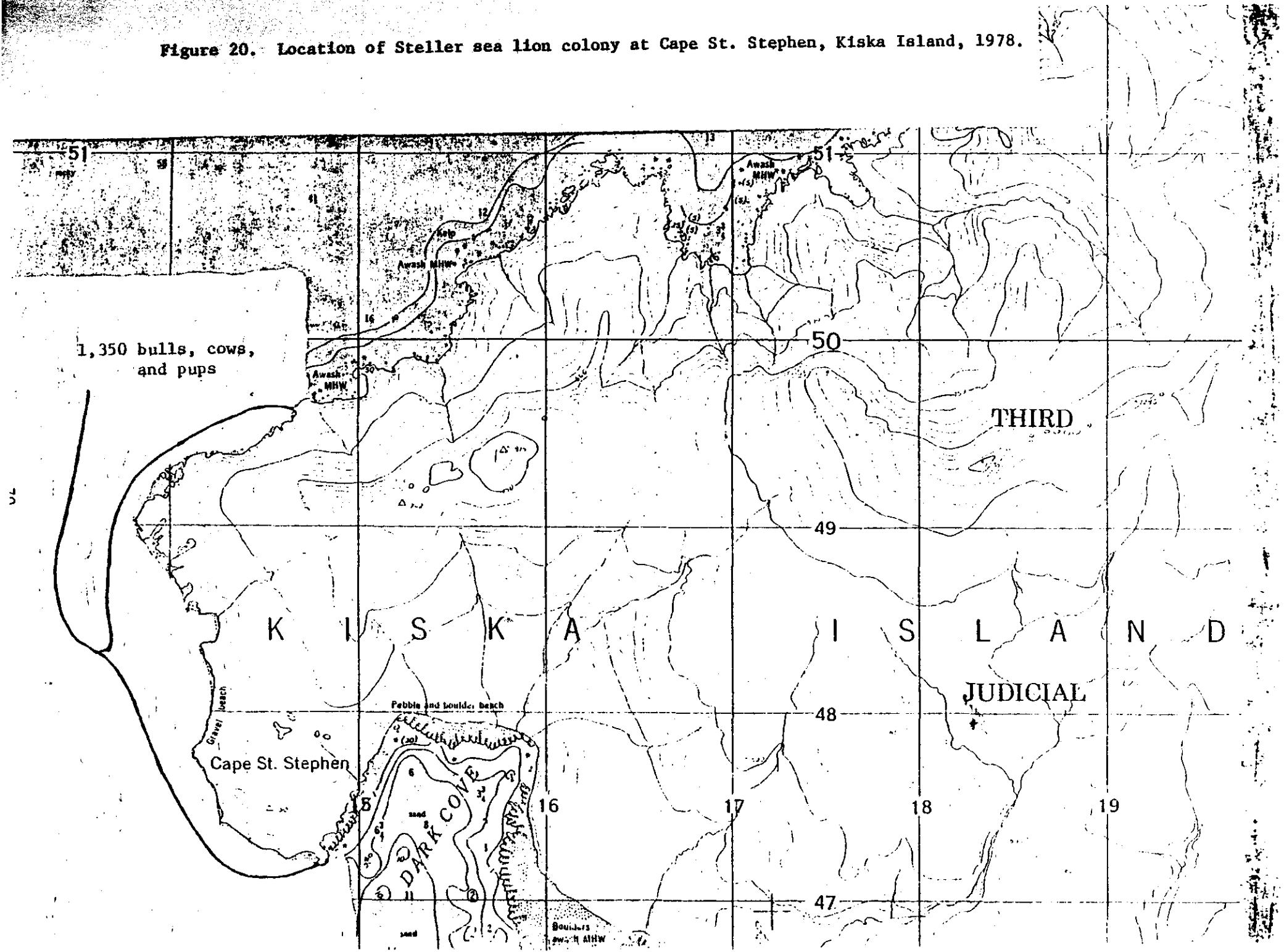
BULDIR ISLAND: Visual estimates from F.R.I. tagging vessels in the summer of 1957 provided the figure for the north shore. Kenyon led an aerial survey between 19 and 27 May 1959 and another on 2 May 1965. No details are available for Sekora's (1973) estimate.

We did not attempt a census of the island; instead, K. Hall counted the animals present between the tip of Northwest Point and North Bight Beach on 21 July, as part of an ongoing monitoring effort. Sixteen percent of the total were pups. These numbers are certainly minimal, since pups were quite large and an unknown (but probably small) percentage had already left the area. A census made by Byrd and other refuge personnel in 1974 revealed that between 5,000 and 6,000 sea lions used the island (Day, pers. comm.). A complete census should be done in 1979.

KISKA ISLAND: The only information prior to Kenyon's aerial surveys was an estimate of 150 sea lions on Sobaka Rock in the summer of 1957 by F.R.I. personnel. The dates of Kenyon's aerial surveys were the same as for Buldir. Sekora never completely surveyed the island (D.D. Gibson, pers. comm.) and presented only an estimate for Sirius Point.

Our surveys were conducted on 26 July (Sirius and Wolf Points) and 9 to 11 August (remainder of colonies). The counts of the Cape St. Stephen (Fig. 20) and Lief Cove (Fig. 21) colonies were made from

Figure 20. Location of Steller sea lion colony at Cape St. Stephen, Kiska Island, 1978.



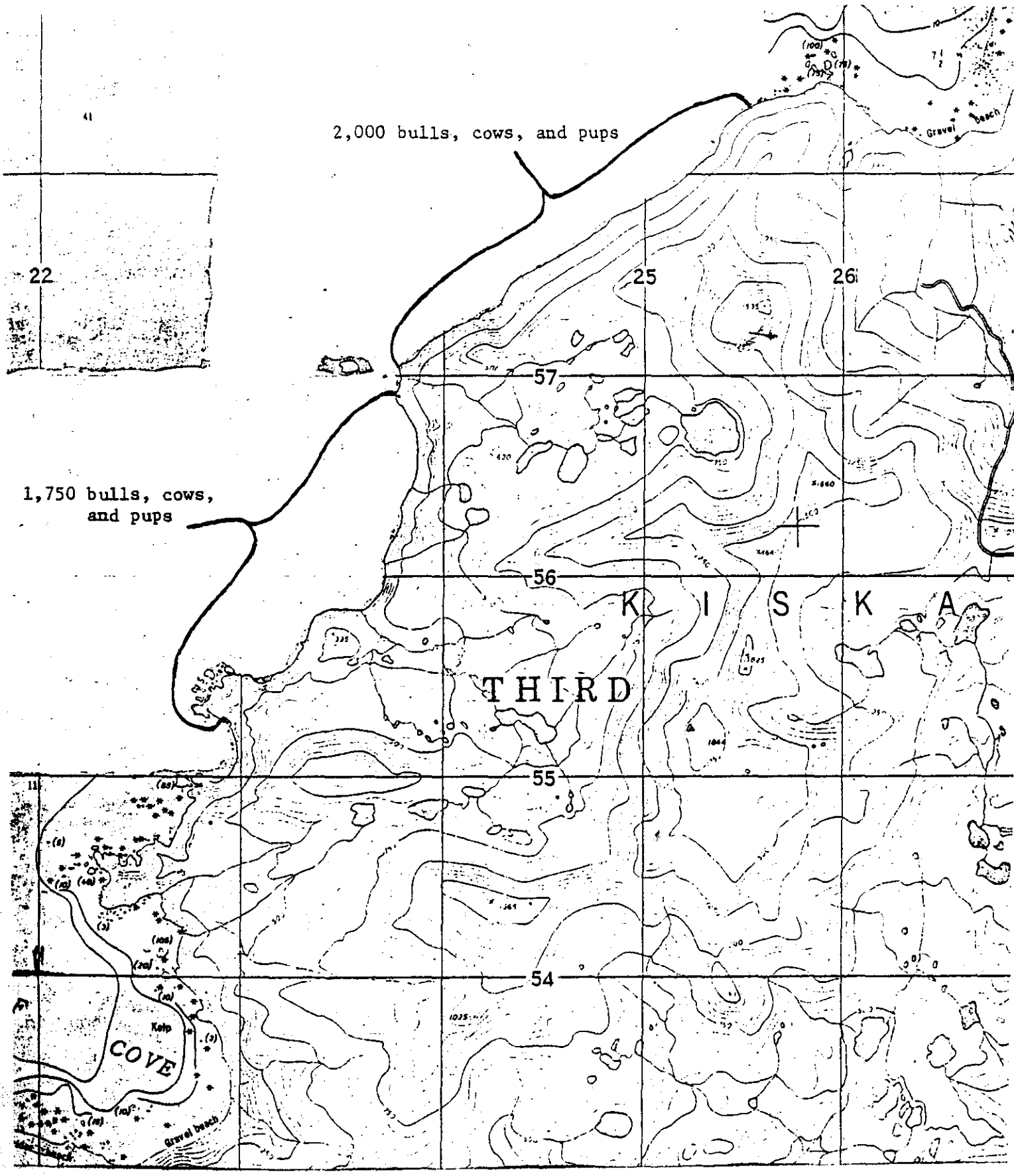


Figure 21. Location of Steller sea lion colony near Lief Cove, Kiska Island, 1978.

Figure 22. Location of Steller sea lion colony at Vegu Point, Kiska Island, 1978.

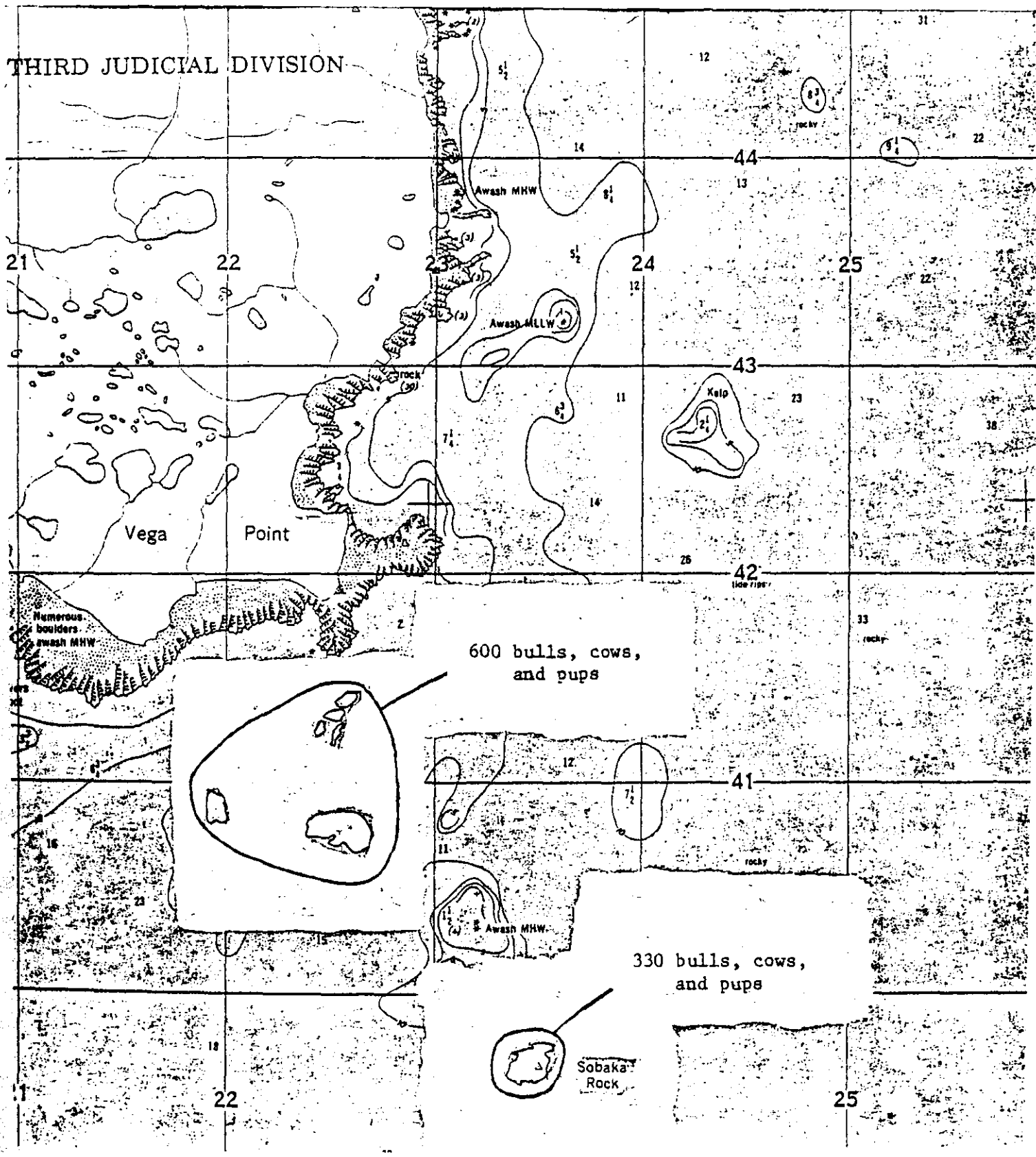
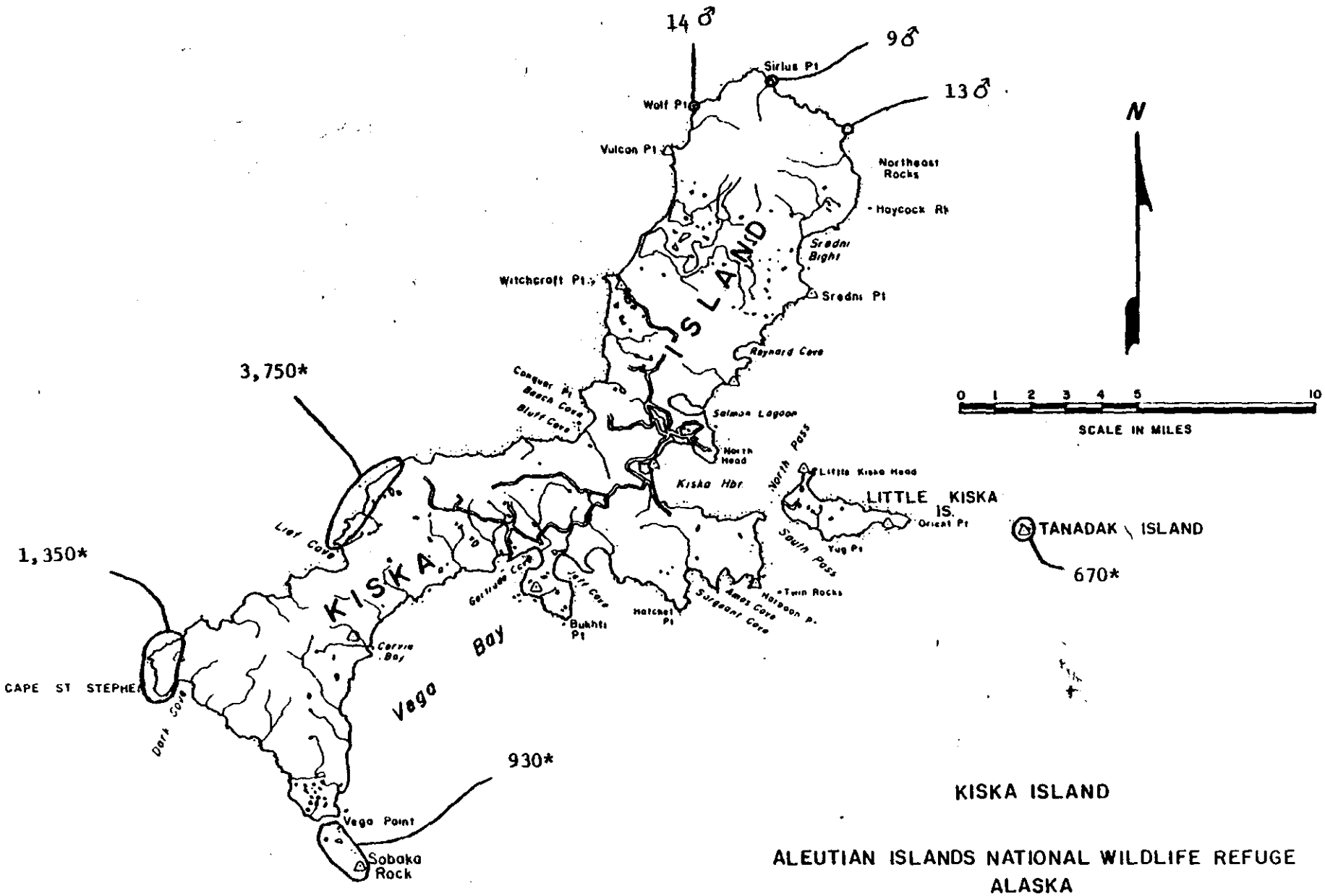


Figure 23. Locations of all Steller sea lion populations near Kiska Island, 1978. Numbers marked with an asterisk (*) include bulls, cows, and pups.



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Based on our brief reconnaissance of Bogoslof on 31 May 1978, we estimated that 800 to 1,000 animals were present. The cows had just begun pupping, so the majority of animals probably had not arrived yet. However, it is possible that this colony is subject to large fluctuations in size in different years.

Agattu, Alaid, Kiska, and Tanadak all have experienced substantial increases in sea lion populations since the work by Kenyon and Rice (1961). This fact, when considered with our discovery of a new rookery on Kiska, places the findings of Braham et al. (1977) in an interesting light. They reported an apparently substantial decline of sea lion populations in the eastern Aleutians to "less than half of the estimated numbers in the late 1950's." Once all of the sea lion colonies in the western Aleutians have been adequately censused, it will be possible to compare the eastern and western populations and gauge the magnitude of the changes that have occurred.

Whether natality and/or mortality rates differ between the two regions, or whether a large-scale population shift from east to west has occurred, are questions that need to be addressed. At this juncture, without data from other unsurveyed western islands, we can only speculate on the nature and causes of the observed increase in the western Aleutians.

Several considerations are important when planning and executing future sea lion censuses:

1) Timing of surveys on a seasonal basis is crucial. Surveys should commence no earlier than the latter half of May and no later than the first half of July. Ideally they should be done as soon after pupping as possible and should be completed before post-breeding dispersal begins.

2) Diurnal rhythms of the animals must be considered. Kenyon and Rice (1961), Mathisen and Lopp (1963), and Sandegren (1970) all found that the number of animals hauled out on colonies was greatest in the afternoon, between about 1200 and 1600 hours. Animals leave in the evening to feed, returning by early morning. Sandegren (1970) recorded the highest levels of activity in territorial bulls at high tide and in the evening and night, and the lowest at low tide.

VIII. AUKLET CENSUS

Sekora et al. (in press) found that Crested, Least, Whiskered, and Parakeet Auklets comprise 41.5% of the total breeding birds within the Aleutian Islands National Wildlife Refuge. They further state that these species have their center of abundance in the Delarof and Rat Island groups. Providing verifying evidence in 1977, Day et al. (1978) found that well over 80% of the birds in the islands surveyed within these groups were of the above four species. Further work in the Rat Island group this field season shows that the auklets (primarily Leasts and Cresteds) comprise well over 95% of the birds in the Kiska Island area.

In preparation for censusing, the Sirius Point auklet colony on the lava flows of Kiska Volcano was divided into three strata (colonies) based on a field appraisal of density and geographic differences (Fig. 24). The census technique employed originated from auklet studies on Buldir Island in 1976 (Byrd and Knudtson in prep.) and was discussed in detail by Day et al. (1978). The technique was essentially used intact except for one major change: instead of making plot locations entirely random as was done in 1977, plots were laid out on a compass bearing (see Fig. 47 in "Section XI - Permanent Plots"). This was in answer to the immense size of the Kiska auklet colony, where the old lava flow covers an area of 9.3×10^5 m^2 and the new lava flow is 4.2×10^5 m^2 in area; obviously, that is far too large an area to relocate random plots with only one corner of each plot marked. In addition, the large, gently-sloping lava flow there lent itself easily to this technique.

A patch of flow 75m wide on the east side of the flow was not counted in the total area estimate of the old flow, for it was heavily overgrown with Elymus and contained few birds. We assumed that densities in Colony #2 were the same on the two side areas of lava as in the much larger center section which we sampled.

The plots were laid out in groups of five along a compass bearing of 012°T; this bearing line ran along the longest length of the largest part of the colony (see Fig. 47 in "Permanent Plots"). A replicative sampling scheme was used to locate the plot lines, which in this case were 10 plots (100m) apart. Location of plots on the transect lines was also determined by replicative sample, with intervals of 240 or 280m between seaward plot edges. All plot poles were placed in the lower (seaward) east corner of each plot.

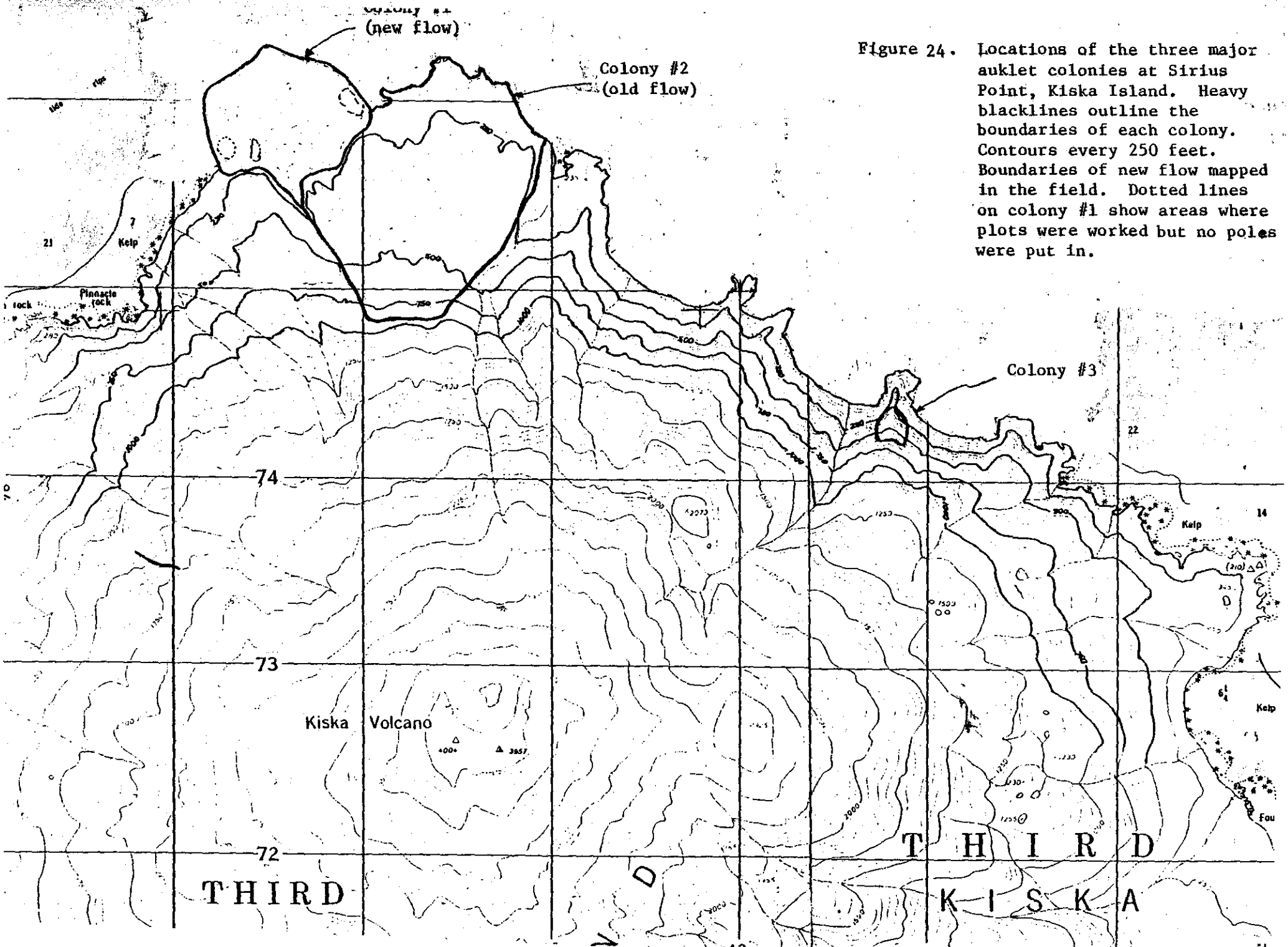

Figure 24. Locations of the three major auklet colonies at Sirius Point, Kiska Island. Heavy blacklines outline the boundaries of each colony. Contours every 250 feet. Boundaries of new flow mapped in the field. Dotted lines on colony #1 show areas where plots were worked but no poles were put in.

Data on the 15 marked plots on the old lava flow are presented in Table 29 ("Permanent Plots"). Note that only ten of those plots were worked this year. We arrived on colony too late to catch all the birds: many had fledged or were fledging, and we were able to observe the decline each evening. By the time we were able to count the last plots, too few birds remained to make it worthwhile to continue. All of the plots should be worked next season; this should be done earlier in the breeding cycle to avoid the problem encountered this year.

In addition to the plots on the old lava flow, a total of ten plots were worked on the new lava flow (colony #1). We attempted to lay plots on a compass line, as in the old flow, but the extremely unstable new rocks made this impossible. Also, climbing over the rugged surface proved too dangerous to permit using this technique; thus, no permanent plots were located there. Plots were not entirely random, for they were placed only in areas easily accessible from the water. Location of these plots is shown in Figure 24.

The number of 10 x 10m plots in each stratum (colony) is given in Table 15. The average number of birds in each stratum and total estimates of auklet populations for each colony are also presented in Table 15. Note that although we were unable to work on colony #3, we used the mean densities from colony #2 for the estimate of total auklets there. Colony #3 appeared at least that densely-populated, looking at it from the sea.

As practiced last year, we omitted the confidence intervals from our estimates. The variability between plots is so great that the confidence interval essentially "swallows up" the estimate. This is a result of the limited number of plots worked on each colony--a poor compromise between the need for accuracy and the need to cover a large geographic area during the summer.

As is shown in Table 15, there are approximately 1.4 million Crested and Least Auklets on Sirius Point, with Leasts outnumbering Cresteds by a ratio of 5 to 1. At this point, it is the largest known auklet colony in the world. However, we feel the estimate is an absolute <u>minimum</u> and believe that the actual population is closer to two million birds. By carrying out the plan to resurvey these plots earlier in the season and to work more plots, the estimate in future years should become more accurate.

Table 15. Estimate of total populations of Crested and Least Auklets on the Sirius Point Auklet Colony.

COLONY NUMBER	# OF PLOTS SAMPLED (n)	# OF PLOTS IN COLONY (n)	AVERAGE # LEAST AUKLETS/PLOT	AVERAGE # CRESTED AUKLETS/PLOT	EST. # LEAST AUKLETS	EST. # CRESTED AUKLETS	TOTAL AUKLETS
1	10	4,300	180.2	14.8	774,860	63,640	838,500
2	10	9,300	37.4	17.8	347,820	165,540	513,360
3	0	300	37.4*	17.8*	11,220	5,340	16,560
TOTAL					1,133,900	234,520	1,368,420

* Average densities from colony #2 used for colony #3.

The Kiska's new flow (colony #1) has the greatest number of birds, approximately 800,000 auklets. Although it is less than one-half the size of the old flow (colony #2), it contains approximately 1.6 times as many auklets. There are many more Least Auklets in the new flow than in the old; but the density of Crested Auklets is actually greater in the old flow. Although this may be a result of earlier fledging by Leasts (plots on the old flow were worked late in fledging), most of this difference is attributable to poorer nesting habitat for Least Auklets in the old flow. Since the flow is several hundred years old, many of the smaller crevices have filled in with debris, leaving primarily larger crevices that are the preferred habitat of Cresteds. Aggression by Cresteds could play the major role in the reduction of Least Auklets where potential nest-site competition becomes important. For a thorough discussion of this aspect of habitat use, see Bedard (1969).

In summary, the auklet colonies at Kiska Island are the largest known in the world, with an estimated minimum of 1.4 million birds nesting there. The Least Auklet is the most abundant species, comprising approximately 80% of the total colony. The relatively unweathered new lava flow (colony #1) has both the greatest number of birds and the greatest number of Least Auklets, the latter is probably due to the greater abundance of nesting crevices available for these birds.

Kiska Island survey #1 (Fig. 39) runs the length of the beach in Jeff Cove on the southeastern shore of the island. The southern boundary is a sea-cliff at the water's edge, and the northern boundary is the outfall of the stream draining several lakes just behind the beach. The beach is sand and very small gravel for its entire length. There is a small stretch of cobble beach just north of the northern boundary, but it was not included in the survey. Only a sea lion scapula and a sea otter skeleton were found on this survey.

Little Kiska survey #1 (Fig. 40) was run in early August, approximately the same time as last year. The only remains found were the wing of an adult Glaucous-winged Gull and the vertebral column of an unidentified bird. These represent fewer carcasses than last year.

In summary, seven beached animal surveys were conducted on six islands this summer. Most surveys produced nominal results; Buldir Island again had the most beached animals, presumably because of the tremendous populations of marine birds and mammals present there. Abnormally high numbers of remains were recorded at Buldir for Glaucous-winged Gulls and Steller sea lions; the former were thought to be the result of a severe storm and its accompanying "food crunch" in the fall or winter, and the latter appeared to be the result of a failed attempt at extending the Northwest Point sea lion colony onto North Bight Beach itself. In contrast to 1977, no oiled birds or mammals were found.

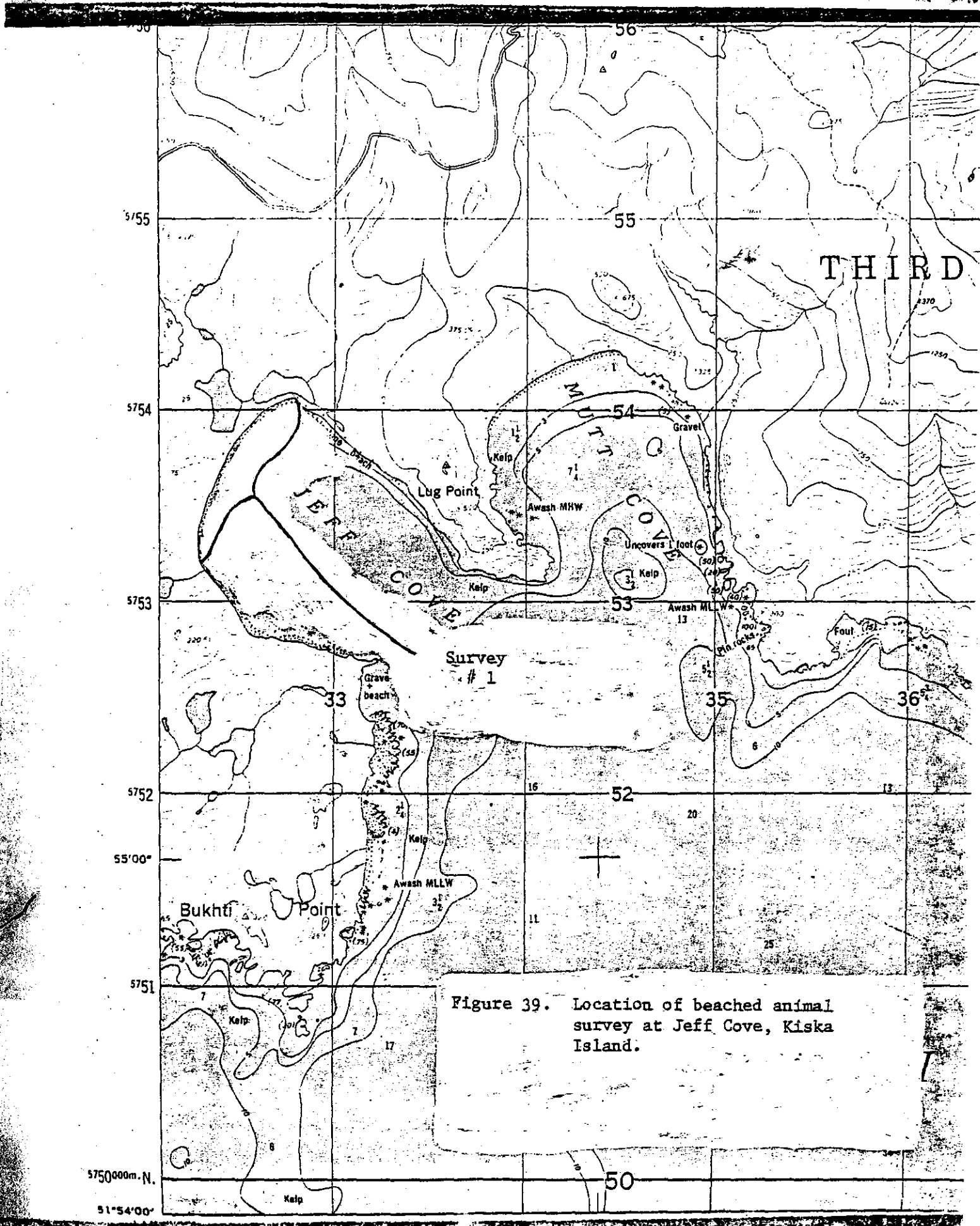

Figure 39. Location of beached animal survey at Jeff Cove, Kiska Island.

In addition to the burrow-nester work, we planned to count murres and kittiwakes at East Cape for monitoring purposes, but poor weather conditions and scheduling conflicts precluded it.

In summary, six long-term population monitoring plots for burrow nesters were worked on Buldir Island, four of which had been used previously for studies on the biology of storm-petrels. Approximately 625 burrows were checked, of which more than 75% were storm-petrels. The remainder was divided among Ancient Murrelets, Tufted Puffins, and Cassin's and Parakeet Auklets. The first Cassin's Auklet colony of the Aleutians in recent years was discovered at Buldir during our work, and the nine known burrows were marked to be checked in future years.

Kiska Island

The only permanent plots located on Kiska Island were those associated with the census of the large auklet colonies (see section on "Auklet Census"). These plots play an important double function by being used both for long-term population monitoring and for population estimation of auklets on various colonies.

A total of 15 plots were located on the old lava flow of Sirius Point; however, as discussed in "Auklet Census", we were only able to work 10 of them.

Sirius Point has three readily-definable lava flow colonies (Fig. 53): (1) a large flow that is "...one to several centuries old..." (Coats et al. 1961); (2) a small, inaccessible flow or talus area approximately three km east of the point; and (3) a large new lava flow which emerged from the sea in 1965. No plots were staked on the last colony although we attempted to do so but found the rock too unstable to hold marker poles. The only permanent plots were located on the large old flow (colony #2). The photograph of (1) and (3) above is shown in Fig. 54.

As discussed in the section on "Auklet Census," plots were set up on a compass bearing traversing the longest part of the colony. We laid out three of these compass lines this year, and five plots were located along each bearing line. This was primarily for ease in relocating plots. Fig. 55 shows the location of the plot lines, and Table 29 contains the mensural data on each plot. Only plots on plot lines #1 and #3 were worked this year due to two major factors: (1) fledging

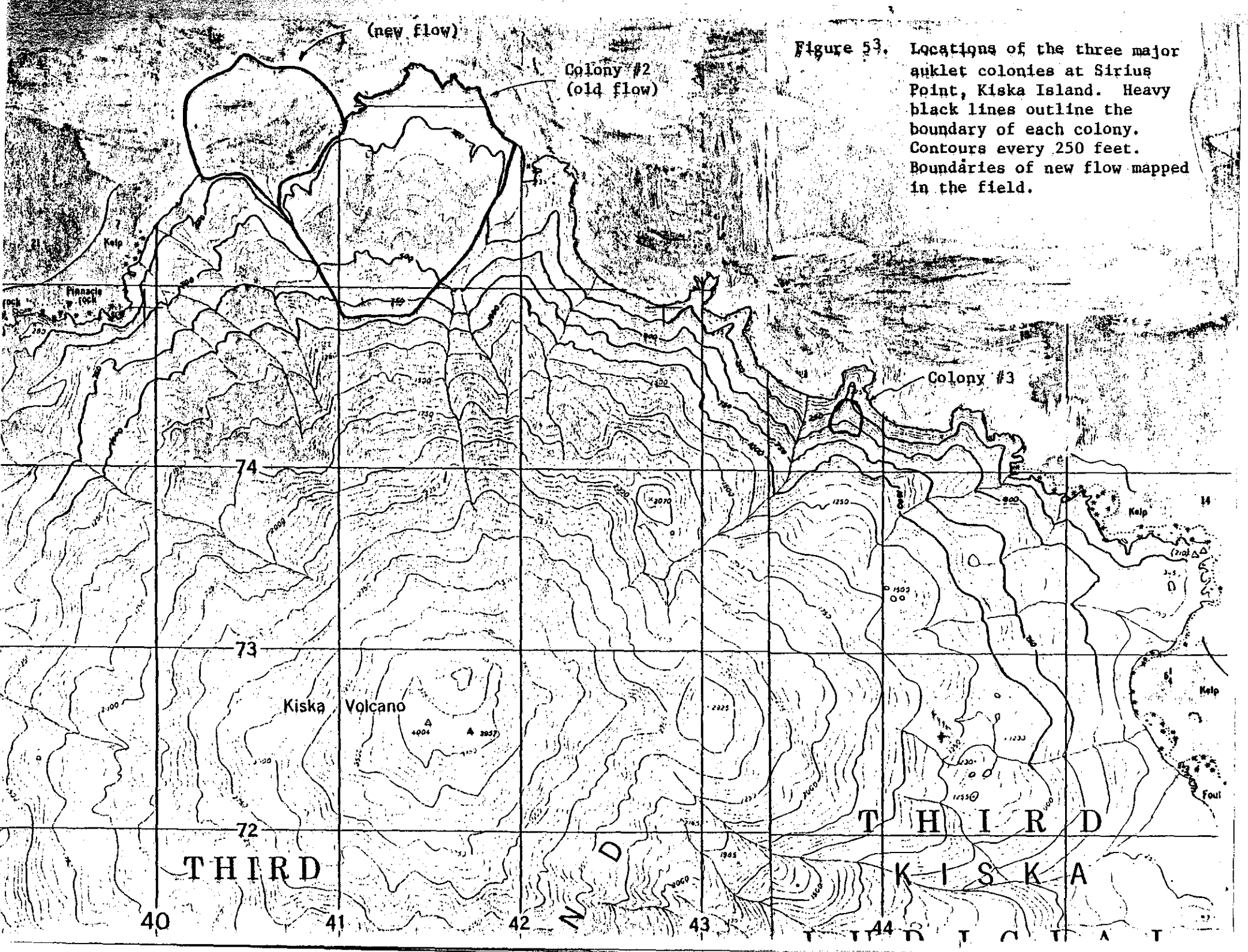

Figure 53. Locations of the three major auklet colonies at Sirius Point, Kiska Island. Heavy black lines outline the boundary of each colony. Contours every 250 feet. Boundaries of new flow mapped in the field.

Figure 54. Photograph looking north across the large auklet colony on Sirius Point, Kiska Island. The dashed line to the left points out the area of the new lava flow and the remainder is the old flow. Our tent camp can be seen at the far right side of the photograph.

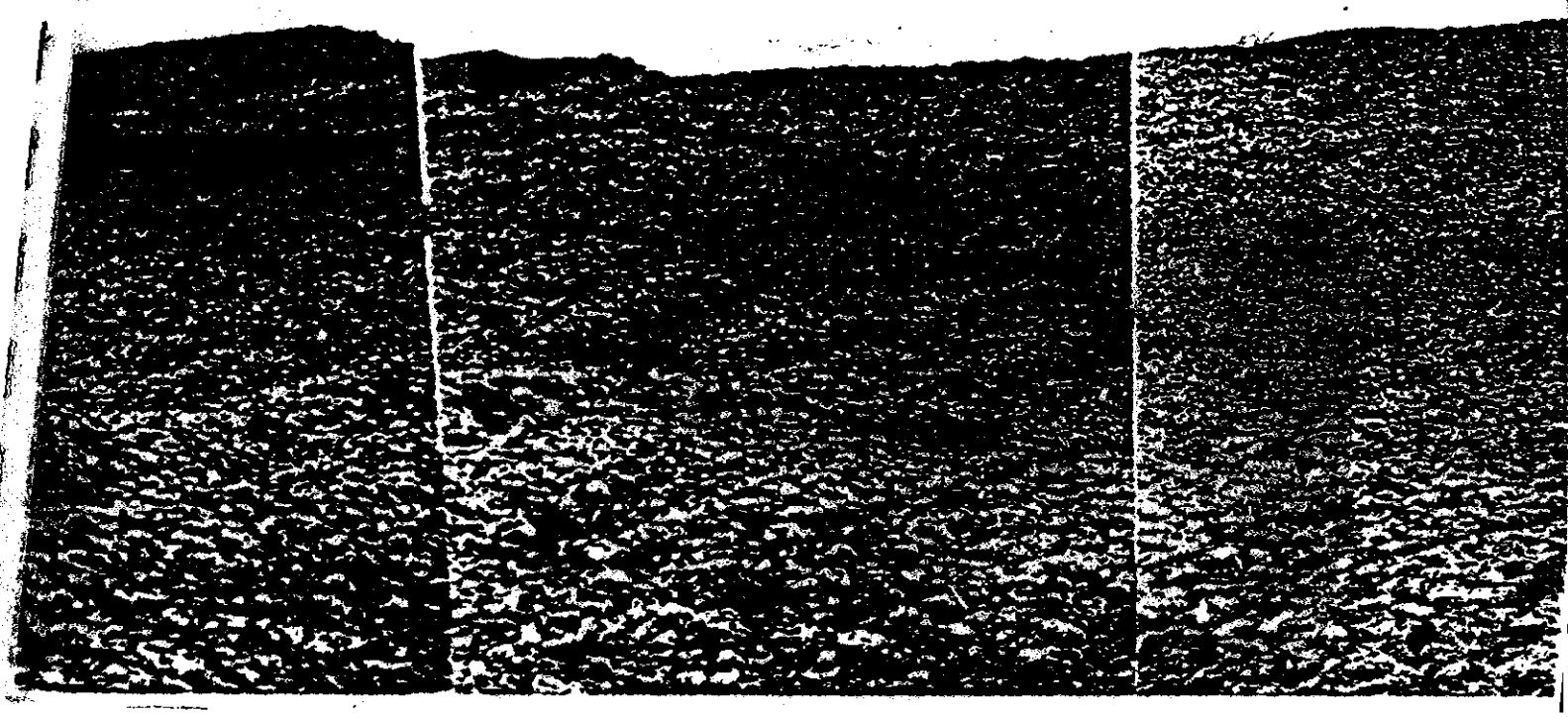

Figure 54.

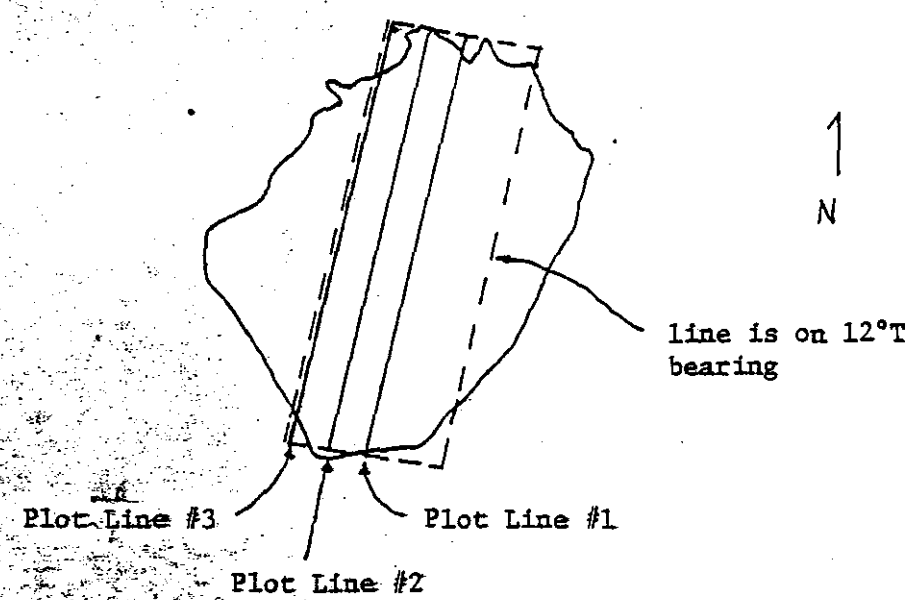

Figure 55. Locations of plot lines on old lava flow, Kiska Island. Plot lines form the eastern edge of each plot.

Table 29. Mensural data on auklet plots in old lava flow (Colony #2), Kiska Island.

	INLAND →			SEAWARD	
PLOT #	1	2	3	4	5
Plot Line #1					
Pole #	26	47	90	89*	-
Distance from "top" of Colony (m)	210	490	770	1050	1330
Elevation (ft)	575	390	280	300	220
Aspect (°T)	5	0	354	10	10
Distance from water (m)	800	690	460	230	75
Slope (°)	29	5	4	0	2
Plot Line #2					
Pole #	72	71	83*	98*	49
Distance from "top" of Colony (m)	123	363	603	843	1083
Elevation (ft)	750	460	425	370	300
Aspect (°T)	335	354	18	-	30
Distance from water (m)	1020	850	640	420	210
Slope (°)	25	8	5	0	3
Plot Line #3					
Pole #	36	65	61	67	40
Distance from "top" of Colony (m)	48	288	528	768	1008
Elevation (ft)	770	610	305	340	365
Aspect (°T)	15	15	20	94	30
Distance from water (m)	1050	850	650	430	210
Slope (°)	5	10	15	5	3

* pole # glued on upside-down

had peaked so populations of auklets on colony were decreasing steadily; and (2) extremely poor weather forced us to hibernate much of the time. Plot line #2 was laid out just before we left so that the plots need only to be relocated in order to be run. In addition, we left 15 poles at the camp site to be used for marking new plots next season.

Data on the average numbers of birds per plot are presented in Table 15 ("Auklet Census"). Since we were only able to work the colony after the birds started fledging, we believe that many of the birds had already left. To avoid this in future surveys, the field crew should return to Kiska earlier in the breeding season and work all the plots again, plus put in 15 more plots. This should give better data for long-term population monitoring, as well as yield better data for a population estimate.