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Ascertainment of Fox Eradication on Big Koniuji Island in the Shumagin Islands, Alaska, and Census of Crested Auklets with Notes on Other Fauna and Islands.

July 1987

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The Shumagin Islands (55 N, 160'W) are located between 8 and 110 km off the south side of the Alaska Peninsula and about 160 km from the western tip of the Peninsula. The Shumagins are comprised of some 30 named islands, reach a maximum elevation of 620 m, and spread over an area of approximately 72 x 88 km (Figure 1).

The climate in the Shumagins is similar to that of the nearby Aleutian Islands and the south side of the Alaska Peninsula, which are characterized by frequent clouds, wind, and precipitation. The July mean temperature is about 52 F with an extreme of 80 F. Precipitation at Sand Point on Popof Island averages near 60 in annually and is heaviest in the fall and least during spring. The lowest winter temperature recorded in the Shumagins is - 19 F, but the mean January temperature is a mild 28 F. Snow accumulates in large drifts because of high winds. More clear days occur in the Shumagins than in the Aleutians because the mountains on the nearby Alaska Peninsula act as a barrier to moist air flowing from the Bering Sea during periods of high barometric pressure when northwesterly winds generally prevail.

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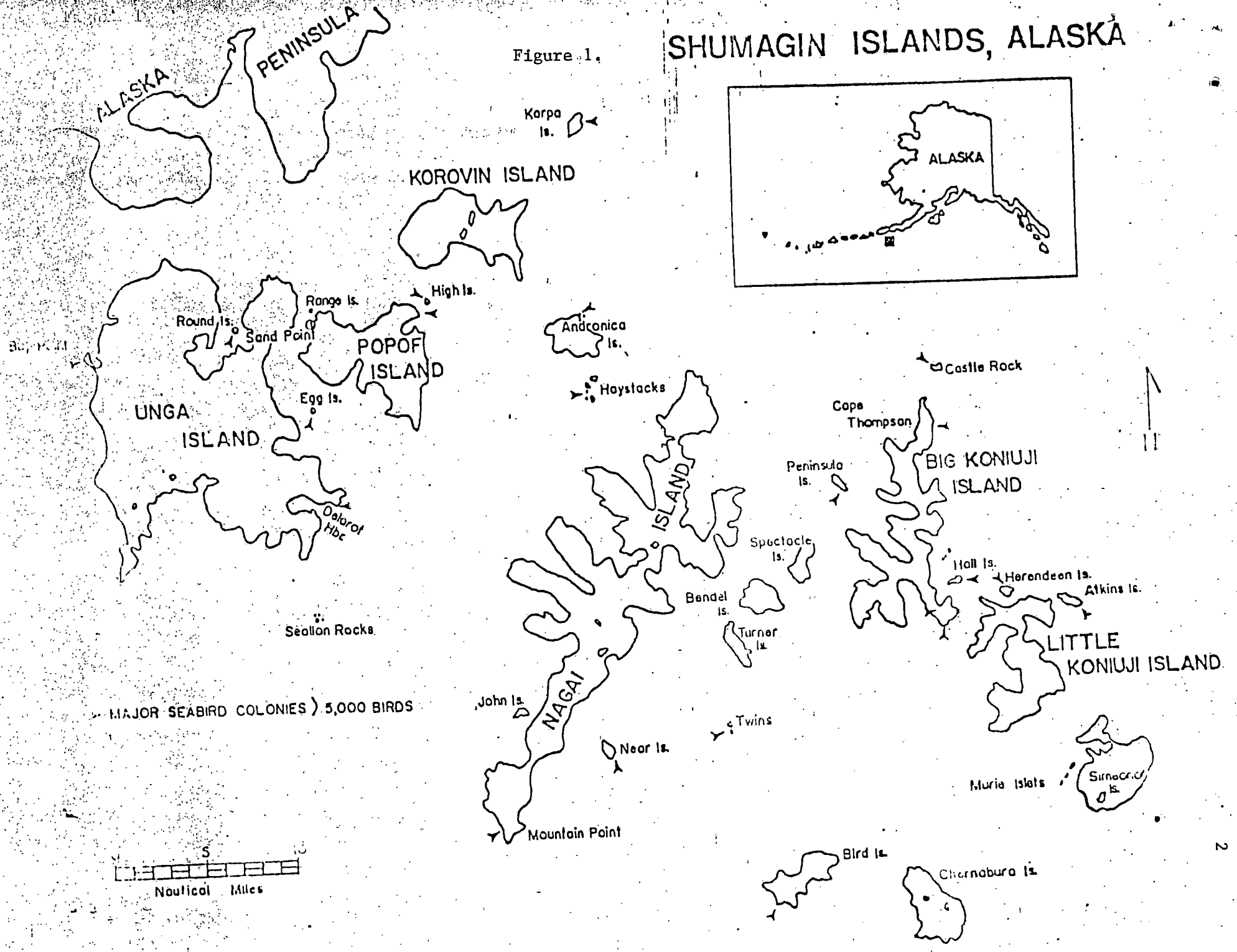
In 1976, 7.75 in of rain were reported at Yukon Harbor on Big Koniuji in July (Moe and Day 1977). In May and June 1985, 5.35 and 2.62 inches, respectively, were recorded at Flying Eagle Harbor. During 1 month between 12 June and 12 July 1986 a total of 4.10 inches of rain was recorded here. In 1987, 3.10 in of rain fell at Flying Eagle Harbor between 6 July and 1 August. Winds exceeding 40 knots were were experienced 25% of the time in Yukon Harbor in 1976 (Moe & Day 1977); our base camp at Flying Eagle Harbor is more protected, though gusts to 80 knots were experienced in 1986.

Considerable local weather variation occurs in the Shumagins because of the mountainous larger islands, primarily Unga, Nagai, and Big Koniuji. Insular mountain passes and massive headlands create extreme winds in some areas during certain meteorological conditions, and several islands are frequently shrouded in fog while others remain open.

The mean tidal range in the Shumagins is approximately 1.7 m with extreme ranges exceeding 3.6 m a few times a year. Moderate tide rips are found around the tips of some islands and in narrow passes between islands.

No native trees exist in the Shumagins, but Sitka spruce (Picea sitchensis) were introduced in the village of Sand Point and at a few previously inhabited places on other islands. None are on Big Koniuji. Most of the larger Shumagin Islands, particularly Nagai, Unga, Big Koniuji and Popof, are covered with tall, dense stands of alder (Alnus crispa sinuata) at lower elevations. Pacific red elder (Sambucus racemosa pubens), willows (Salix spp.), and

Figure 1.


SHUMAGIN ISLANDS, ALASKA
ALASKA
PENINSULA
Karpa Is.
KOROVIN ISLAND
High Is.
Range Is.
Round Is.
Sand Point
POPOF ISLAND
UNGA ISLAND
Egg Is.
Delarof Hbr.
Sealion Rocks
Andronica Is.
Haystacks
Castle Rock
Cape Thompson
Peninsula Is.
BIG KONIUJI ISLAND
ISLAND
Spectacle Is.
Bendel Is.
Turner Is.
Hall Is.
Herendeen Is.
Atkins Is.
LITTLE KONIUJI ISLAND
NAGAI
John Is.
Twins
Near Is.
Mountain Point
Muria Islets
Simeonof Is.
Bird Is.
Chernabura Is.
MAJOR SEABIRD COLONIES) 5,000 BIRDS
5
Nautical Miles

salmonberry (Rubus spectabilis) also commonly occur with alders; dwarf birch (Betula nana) and Andromeda polifolia occur in poorly drained areas.

The higher elevations of Big Koniuji and other surrounding islands, usually above 300 m, are dominated by lichens, and crowberry (Empetrum nigrum). Blueberry (Vaccinium uliginosum), lingonberry (V. vitis-idaea), and bearberry (Arctostaphylos uva-ursi) also are common shrubs in mountainous parts of most of the islands.

Grasses and sedges predominate in meadow areas, on some slopes, and on the small rocky islands devoid of shrubs. Cow parsnip (Heracleum lanatum), hemlock parsley (Conioselinum chinense), beach lovage (Ligusticum scoticum Hultenii), and Angelica lucida are abundant in open grassy slopes. Sixteen species of sedges and 31 grasses have been collected in the Shumagin Islands (Hulten 1968). The most conspicuous grass is beach rye (Elymus arenarius mollis). Besides beach rye, Mertensia maritima, Lathyrus maritimus, Honckenya peploides and Senecio pseudo-Arnica are the principal plants comprising beach communities. A total of 104 different species of vascular plants was collected on Big Koniuji in 1976 (Moe and Day 1977).

Big Koniuji (8900 ha), the largest island presently entirely owned by the refuge in the Shumagins, is surpassed in area only by Unga and Nagai islands. Only one historic place (ANCSA 14h-1) site is on Big Koniuji, but the island is also entirely covered by residual selections (ANCSA Sec. 14h-8). Though the one historic place selected by the Shumagin Native Corporation does not appear valid, in 1986 archaeologists found at least seven former sites inhabited by Aleuts (Johnson, pers. comm.). Most of the island is exceedingly rugged, with peaks reaching nearly 580 m in elevation. Over 30 peaks surpass 300 m, and all parts of this island are less than 2 km from the ocean. Stretching 24 km in length, the axis of Big Koniuji lies north - south; the island's width ranges from less than 1 km to 11 km.

The Shumagin Formation, which is intruded by a granitic batholith, consists of underlying sandstone and mudstone. This formation of generally dark-colored rock comprises the western arms of the island which contrast sharply with the remainder of the island which is composed of intrusive granodiorite (Moe and Day 1977). Gleaming white sand beaches dot the southern and eastern portion of this scenic island. Surface streams are small with considerably more water flowing beneath granite talus.

The only terrestrial mammals on Big Koniuji besides red fox (Vulpes vulpes) are shrews (Sorex sp.), arctic ground squirrels (Citellus parryi) and river otters (Lutra canadensis). We did not encounter shrews until 1986. Whether ground squirrels are indigenous or whether they were

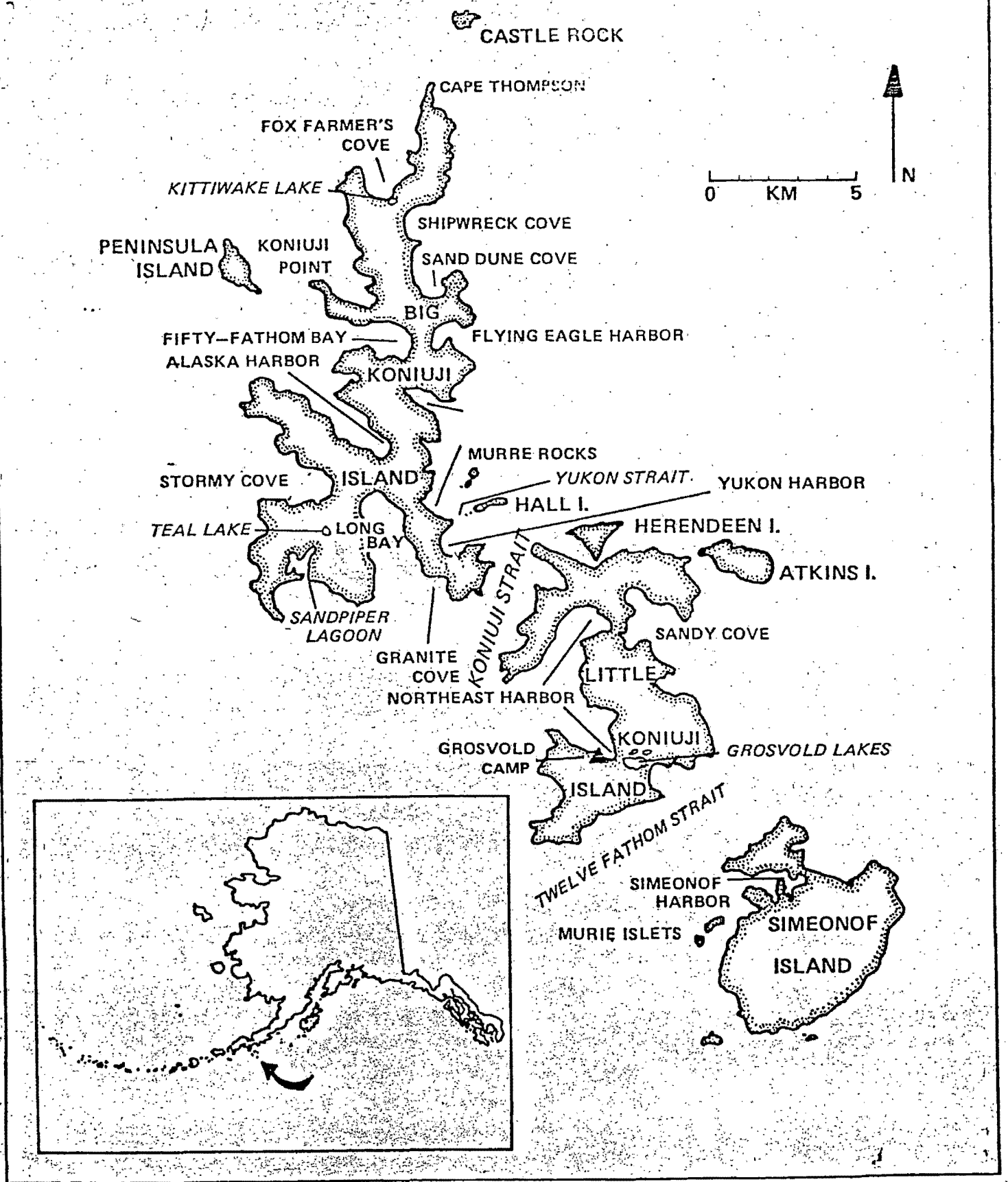
introduced by fox farmers is unknown. They reportedly were put on Big Koniuji by the Russians (Rogers, pers. comm.). When Steller first arrived in the Shumagins in 1741 and landed on Turner, Bird, and Nagai islands, he saw ground squirrels and red foxes on Nagai (Stejneger 1936, Golder 1925). Steller never visited Big Koniuji, which lies north of the aforementioned three islands (Figure 1).

Contrary to Moe (1978), Moe and Day (1977), Day (1977 and 1984), and my 1977 paper citing the first two references, Big Koniuji did not originally have foxes. In 1916 Oscar Olsen, a resident of Unga Island, introduced 13 pairs of red foxes to Big Koniuji Island, and he planned to release 17 more pairs (Bower and Aller 1917). This report on the introduction of red foxes on Big Koniuji also is confirmed by a 1933 diary of L. Y. Reeve, a former resident of Unga Island (Gronholdt, pers. comm.). These notes and my interview with Raymond Rogers, who was Olsen's grandson and a trapper on the island in 1934, revealed that the foxes were obtained from the Alaska Peninsula and that in 1925 arctic fox (Alopex lagopus) also were introduced. Gronholdt and Osterback (pers. comm.) likewise stated arctic fox once were on Big Koniuji. Arctic fox evidently were eliminated through competitive exclusion by the dominant red fox. Arctic fox originating from Attu in the Aleutians were first successfully released on five of the Shumagins in the 1890's (Bailey 1978, Gronholdt, pers. comm.); later they were introduced to at least three more islands. They persist only on nearby Little Koniuji, Simeonof, and Chernabura islands.

The remains of five cabins in different bays (Figure 2) of Big Koniuji (Fox Farmer's Cove, Long Bay, Alaska Harbor, Stormy cove, and Sandpiper Lagoon) attest to the once thriving fox trapping there. In 1935 there also were cabins in Yukon Harbor and Stormy Cove (Rogers, pers. comm.); the latter cove was the main camp, since it was the safest to reach by small boat from Sand Point.

Biological literature concerning Big Koniuji and surrounding islands is very limited. Early cursory observations in the Shumagins included Dall (1873), Townsend (1913), Stejneger (1936), Murie (1959), Gabrielson (1946), and Gabrielson and Lincoln (1959). Wildlife on nearby Simeonof Island was documented in 1960 (Kenyon 1964), and I first visited Big Koniuji in 1973 (Sowl 1973) and then again in 1976 and 1977 (Bailey 1978). The only extensive biological investigations on Big Koniuji were conducted in 1976 when over 3 months were spent studying nesting seabirds (Moe and Day 1977, Moe 1977, Day (1977 and 1984).

Figure 2. Big Koniuji and ambient islands in the Shumagins.



METHODS

Fox Eradication

Since a 1972 executive order banned the use of strychnine and sodium monofluroacetate ("1080"), which are the most efficient means of eliminating introduced fox from islands, we have been relegated to the use of only traps and firearms.

Because Big Konuiji Island is not a known former nesting site for endangered Aleutian Canada geese (Branta canadenis leucopareia), we also were unable to employ cyanide projectiles (M-44's or M-50's), which have been again recently used in the Aleutians.

Wells Stephensen, Animal Damage Control Specialist with the Department of Agriculture; Nancy Norvell, Biological Technician; volunteers Steve Albert and Shawn Stephensen; and Edgar Bailey arrived at Big Koniuji Island aboard the R/V Tiglax on 9 July 1987. We proceeded to Sand Point via inflatables on 31 July to fly back to Homer.

Flying Eagle Harbor was again used as our base camp on Big Koniuji in 1987. We reset all of the approximately 250 no. 1 3/4 coil spring leg-hold traps set the previous two summers (Bailey 1985 & 1986) that could be relocated. Some new traps were used in place of traps too rusty to restore and to replace sets on beaches lost in winter storms. A .223 caliber rifle was nearly always carried, and both oral and recorded predator calls were employed in certain areas. Primarily dirt-hole sets along trails and beaches were used with various commercial fox lures and red fox urine; sets also were used in past areas of regular fox activity. Traps were checked as frequently as possible, but some difficult to reach traps were checked only once. Approximately 150 traps and a few snares were left set around the island when we left on 30 July.

Bird Island was examined for the presence of fox enroute to Big Koniuji, and we reconnoitered Little Koniuji to locate the best site for a base camp in 1988.

Seabird Monitoring

On 18 July Nancy Norvell, Shawn Stephensen, and Steve Albert established a camp below the crested auklet (Aethia cristatella) colony at Yukon Harbor, where activities were monitored at the colony until 30 July. After defining and photographing the boundaries of the colony, hourly counts of birds flying from the talus and enumerations of birds observed on five 10 X 10 m plots delineated in 1985 were made.

Three methods of counting the birds in the colony on the five plots were used: modified Bedard method, net movement method, and birds per 5 minutes passing overhead. Bedard (1969) devised a technique for estimating auklet populations. His method consists of counting the birds present on plots (standing on the surface) at regular intervals (e.g. every 15 minutes) throughout selected activity periods. Bedard's method was orginally used to estimate population size. It has been modified to provide a population index for monitoring schemes. Numbers of birds in plots are averaged for use as an index and are not a population estimate. Byrd (1983) developed a "net movement" monitoring technique. This method consists of counting arriving birds (landing on a plot) and departing birds (leaving a plot) at regular intervals (e.g. 15 minute periods) during selected activity periods. The net movement is then calculated by subtracting departures from arrivals. The numbers of birds passing overhead per 5 minutes was used during tent days at the beach camp. This method consisted of counting all birds flying down from the colony for a 5-minute period every 20 minutes. A second method of counting for a 1-minute period out of every 5 minutes was used also. The two methods were compared and found to provide similar numbers. The 5 minutes per 20 minutes procedure was used primiarly.

Counting in the plots using the Bedard and net movement methods was begun around 0900 ADT (2 hours later than solar time) and continued until 2300 hr, or just before it was too dark to scramble down the boulder talus slope. On 4 of the 8 days counts were begun from 0545 hr to 0800 hr in order to get a better idea of early morning movements. At least one person was present throughout the day in the colony.

Counts of the birds per minute passing overhead were used to determine the activity periods during bad weather. The lower beach camp was situated directly below the colony. When the birds exit the colony, they fly straight down the talus to the harbor, flying directly over or near the tents. We could sit in the tents in stormy weather and count the birds flying overhead into the harbor. The birds fly down in loosely formed strings or small flocks. It is fairly easy to count or estimate the numbers of birds as they pass overhead on their way out of the colony. Once the birds begin returning to the colony mid-morning, they are counted twice with this method. This method was used only for understanding the colony's daily activity pattern.

All black-legged kittiwake (Rissa tridactyla) nests on the north side of Hall Island in Yukon Harbor were counted from an inflatable, and general observations on seabirds, marine mammals, raptors, and other wildlife were recorded.

A brief stop also was made at Bendel Island to see if mew gulls (Larus canus) still nested there.

RESULTS AND DISCUSSION

Fox Eradication

Bird Island. On 8 July we examined Bird Island to ascertain whether fox eradication efforts in 1984 were successful, as believed. Much of this 1740 ha island was traversed by five people. Trails nearly everywhere were growing over, and only a few traces of old scats were detected; no tracks were discovered. Though the population of arctic fox in 1984 was extremely low, as manifested by the capture of only 13 animals, it now appears that no fox remain.

The absence of fox was confirmed at the southeast end of the island where a gull colony formerly restricted to an offshore pinnacle has spread onto an adjacent point of Bird Island accessible to fox. We found 27 glaucous-winged gull (Larus glaucescens) nests within an hour in this new colony. Eight large downy chicks were noted, and a thorough search of rank vegetation would have revealed more nests and chicks. Only one egg was encountered. Old fox trails lead to this colony site from a lengthy ridge above, and it is very doubtful that any nests would have survived if fox persisted on the island.

The only important part of Bird Island not checked for fox sign was the rugged area above Point Welcome and the seabird cliffs on the south side. On so small an island, however, it is not likely that any surviving fox would have overlooked the new gull colony. We feel that an arctic fox population originating from introductions in 1916 no longer exists on Bird Island. Nevertheless, annual visits should continue at Bird Island to further substantiate the absence of fox and monitor the response of insular avifauna.

Big Koniuji Island. Between 9 and 30 July we camped at different sites on Big Koniuji Island and searched for sign of any remaining red fox. For the first 9 days all five people on the island looked for evidence of fox; then only two biologists traversed the island while three people censused crested auklets at Yukon Harbor and did some checking of traps near the auklet colony.

When we left Big Koniuji on 12 July 1986, the tracks of at least one fox were still present, but despite exhaustive searches over the entire island no fox tracks or fresh scats were detected this year. Most of the traps set the previous two summers were sprung by ground squirrels or were inoperative because of corrosion.

Only about 20 traps that were still set remained operative, and all of these were along ridges or at other locations at high elevation far from the ocean. Many of the survey tape trap markers clearly visible in 1985 and 1986 had largely disintegrated or vanished, making some traps difficult or impossible to find. All traps relocated and reusable were

reflagged. It is apparent that no traps will be reusable in the field after 2 years. Besides the usual ground squirrels the only other animals found in traps were a river otter (Lutra canadensis) and a raven (Corvus corax).

Nearly every part of Big Koniuji was checked two or more times for sign, and practically all traps were rechecked after being reset. Particular attention was devoted to Sand Dune, Shipwreck, and Fox Farmer's coves; Long Bay; Yukon Harbor; and Sandpiper Lagoon (Figure 2) because these were the areas with the most fox activity in the past. We found no activity around two den sites where pups were destroyed in 1986. One remote basin on the east side of the island which has such difficult access that it never previously was visited was examined this year along with a high rugged pass south of Fox Farmer's cove. Since our first check of Big Koniuji corresponded with an unusual period of dry, calm weather, conditions were ideal for examining tracks on sand beaches. Fox also are more active during good weather. Except for a stormy week during the middle of our stay, favorable weather facilitated our efforts to discover fox sign.

Besides being unable to detect any direct evidence that fox were still present on Big Koniuji there also were other indicators that none remained. Except for along some alpine ridges where growing conditions are less favorable because of higher winds, more dessication, and colder temperatures, most trails appeared to be growing over, especially with dogwood (Cornus suecica) and various grasses and sedges. Overgrown trails in some areas on both Big Koniuji and Bird islands appeared as conspicuous light green strips of dogwood. Admittedly we were present on these islands about a month later this year than in 1985 and 1986, and consequently vegetation was far more advanced than in May and June. Nevertheless, regular use of trails would preclude the observed growth in them. If such trails were used, it would have to be very infrequent.

Most of the tussocks used as scent posts in past years also seemed to be growing over, not to mention the conspicuous absence of scats on them. In past years the regular urination and defecation on many of these tussocks inhibited further growth due to excess nitrates and trampling.

In 1987 the ground squirrel population appeared to have irrupted. The presence of more ground squirrels may be partly attributed to our being on the island later in the summer; consequently the abundance of young squirrels and the general activity of these rodents are greater because of warmer weather in July. In 1976 young ground squirrels began emerging from burrows as early as 13 July (Moe 1977). However, the superabundance of ground squirrels compared to previous years probably also reflects the removal of 71 adult fox in 1985 and 4 fox in 1986. Had we not trapped most of

the fox in May and June when pups were not yet born or were not weaned, over 100 more fox would have been present later in the summer to prey on ground squirrels and birds. Examination of scats in previous years revealed that ground squirrels constituted a significant portion of the diet of fox, especially in areas far away from seabird colonies. Thus, fox diets in 1976 varied greatly at different locales and at different times of the year (Moe 1977). For example, scats collected at Cape Thompson and Sandpiper Lagoon indicated heavy reliance of ground squirrels, while birds were the most utilized prey near Yukon Harbor. Birds were overwhelmingly the chief food at three den sites examined by Moe (1977). As auklets and other seabirds leave the island in late August red fox rely more on ground squirrels until they hibernate, at which time they switch predominantly to invertebrates, carrion, and plants. Birds cached during the summer also are utilized in winter.

On Dolgoi Island, located in the nearby Pavlof Islands, Murrie (1959) found that voles occurred in 52% of the scats of red fox, whereas birds occurred in only 22% of the 57 droppings analyzed. However, no seabird colonies are present on Dolgoi Island, and voles supplant ground squirrels on Dolgoi. Obviously ground squirrels and voles are an important component of the diet of insular red fox, and the tremendous apparent increase in ground squirrel numbers in 1987 on Big Koniuji may be due to the elimination of fox. Unfortunately we were not on the island the last half of July in 1985 and 1986, so a seasonal comparison of rodent numbers can not be made.

Another indicator that fox are absent, or at least nearly so, was the abundance of ptarmigan this summer. During May and June 1985 only eight ptarmigan, mostly rock ptarmigan (Lagopus mutus), were recorded; no broods were seen and all ptarmigan were at high elevations. No ptarmigan were seen in June or July 1986, yet in 3 weeks during July of this summer we encountered 13 broods of willow ptarmigan (L. lagopus), all of which were at or near sea level. Some ptarmigan broods were along beaches which had among the highest densities of fox in 1985. Ptarmigan populations fluctuate greatly from year to year due to variations in weather and food supply, but ptarmigan populations are much higher on islands free of fox, provided good habitat is available. One reason for encountering so many broods was the timing of our stay on the island in 1987. Last year we left on 12 July, approximately the same date we arrived in 1987, so this summer we were there after most ptarmigan clutches hatched. Still no ptarmigan nests were found in previous summers despite our longer durations on the island and despite shorter vegetation to conceal nests. In spite of their precocity, ptarmigan broods are exceedingly vulnerable to fox predation, particularly at lower elevations where fox are more common, and thus few chicks survive. Even though ptarmigan are cyclic, the dramatic increase in numbers of

ptarmigan observed appears to be a direct response to the elimination of fox, and we anticipate seeing even more ptarmigan in 1988. Nagai Island, the second largest island in the Shumagins, is a good example of the response of ptarmigan to the elimination of fox. Indigenous red fox were poisoned off the island decades ago, and the ptarmigan population on most of it is consistently very large.

Yet another clue suggesting the disappearance of fox on Big Koniuji, was the discovery of an American black oystercatcher (Haematopus bachmani) chick on the beach outside of the lagoon at the south end of the island. In 1985 six fox were trapped on this short stretch of beach, more than on any comparable section of beach. Surely no oystercatcher nests would survive on this beach with the presence of fox.

Of all the indications of the disappearance of fox on an island, newly expanded colonies of accessible seabirds are the most conclusive. As with the previously mentioned case on Bird Island, gulls also began nesting in areas on Big Koniuji which could be reached by fox. A new glaucous-winged gull colony was first noted south of the entrance to Flying Eagle Harbor in 1986, but since most of the colony was on ledges situated on a headland it was questionable whether any significant number of birds were accessible to any fox which may have been present. Though a few cormorants were present, no gulls reportedly nested here in 1976 (Moe and Day 1977 and Day 1984). Also, they were not noted in 1984 during a brief visit prior to the commencement of fox eradication (Bailey and McCargo 1984). Despite our being on Big Koniuji Island for 2 months in 1985, only 10 pairs of gulls were observed nesting on the island, and all were in the Cape Thompson area (Bailey 1985). A few gulls regularly were seen apparently loafing south of Flying Eagle Harbor in June 1985, but their behavior did not suggest that any were nesting. The spring and early summer of 1985 was exceptionally cold, and nesting success of gulls on nearby Hall Island was extremely poor, and likewise, the big kittiwake colony at Cape Thompson largely failed (Bailey 1985). Hence, in 1985 a few gulls may have attempted to nest on ledges inaccessible to fox at this new colony site south of Flying Eagle Harbor. In June 1986 approximately 100 pairs were sighted here. The estimated number of pairs of gulls was based on a combination of actual nests sighted from the water and evident pairs occupying ledges on the headland.

On 9 July 1987 we counted approximately 170 pairs of gulls using the new colony near Flying Eagle Harbor. The colony not only was much larger than in the previous year, but it had expanded significantly in area. Whereas comparatively few pairs consistently were seen on accessible parts of the headland in 1986, many pairs with presumed nests were located at sites that fox could reach. We regularly passed beneath this colony in an inflatable from our base camp and noted pairs in the same places. Also, most of the birds exhibited

all the behavior patterns characteristic of gull colonies. The gulls were too high on cliffs above the water for us to see nests or chicks in the rank vegetation, especially in July, and access from the ocean is impossible without calm seas and technical climbing gear. This colony could be reached at considerable risk from the inland side of the headland by climbing over a precipitous 600 m ridge and descending unstable, steep, rocky slopes to the upper part of the colony. The only safe way to monitor the evident expansion of the colony is by counting adult pairs.

The breeding of glaucous-winged gulls on Big Koniuji was further corroborated by the discovery of another new colony in 1987. On 31 July, 15 nests were noted close to sea level on a point near the entrance to Granite Cove. Several nearly fledged chicks also were present at this easily accessible colony. This colony was an expansion of a small one situated on an offshore pinnacle. With gulls now breeding at two sites accessible to fox, it appears highly doubtful any fox remain on the island. Gulls can be expected to recolonize Cape Thompson from several sea-stacks nearby in the next year or two.

Though difficult to census because they nest in many small colonies scattered in colluvium around Big Koniuji, parakeet auklets (Cylorrhynchus psittacula) appear to be increasing in numbers. Crested auklet activity also seemed greater at the Yukon Harbor and Granite cove colonies this summer. If any fox did survive on the island, it would seem likely that they would eventually appear at these auklet colonies, which represent the best supply of food during summer, yet no sign of fox was found at these preferred sites despite the continuous presence of observers here for nearly 2 weeks.

Seabird Monitoring

Crested Auklets.

The weather cooperated well this year (Table 1) compared to the previous year when counts were possible on only 2 days out of 11. Plots were counted on 8 days out of 12 this year. On 2 other marginal days the plots were counted for a brief time, but the cold, dampness and lack of visiblity forced the crew back to the tents. Two days were very inclement and thus no counting was attempted.

Daily activity patterns at Yukon Harbor for all five plots in 1987 were similar to other crested auklet colonies (Byrd 1987, Bedard 1969). They have a bimodal activity pattern with a broad morning range of activity and a short, sharp evening peak just before dark (Figures 1A-1H and 2). Auklets began leaving the colony at the onset of dawn (first light) around 0630 hrs and began to return to the colony around 0900-1100 hrs. There was an afternoon lull ranging in general from 1500 to 1900 hrs. Then a short, sharp peak of activity occurred

Table 1: Weather conditions at Yukon Harbor, July 1987.

DAY	WEATHER
7/18	rain, fog, wind SW to 20 kts, ceiling to 50 m.
7/19	rain, fog, wind SW to 45+kts, ceiling to 100 m.
7/20	rain, fog, wind variable SW to 20 kts, ceiling to 150 m.
7/21	rain, fog, winds SE to 45 kts, ceiling 0, clearing in evening (1030) to 250 m.
7/22	rain, fog, wind SE to 25 kts, ceiling 0, clearing in mid-afternoon to 600 m.
7/23	wind variable NW to 10 kts, warm and sunny afternoon evening, broken ceiling to 600 m.
7/24	rain, fog, wind SE to 5 kts, clearing 2130, ceiling to 450 m.
7/25	wind light and variable, less than 10 kts, warm, ceiling 1500 m.
7/26	wind light and variable, less than 5 kts, warm, unlimited ceiling.
7/27	wind light and variable, less than 10 kts from W, warm, unlimited ceiling until evening, fog-ceiling 150 m.
7/28	wind light and variable, less than 10 kts from W, slight fog in evening, ceiling unlimited.
7/29	wind light, less than 5 kts from NW, fog, ceiling 150 m., fog lifting in afternoon to unlimited ceiling.
7/30	wind light and variable, less than 5 kts from NW, unlimited ceiling.

FIGURE 1A: DAILY ACTIVITY PATTERNS OF CRESTED AUKLETS ON FIVE PLOTS AT YUKON HARBOR, JULY 22, 1987.

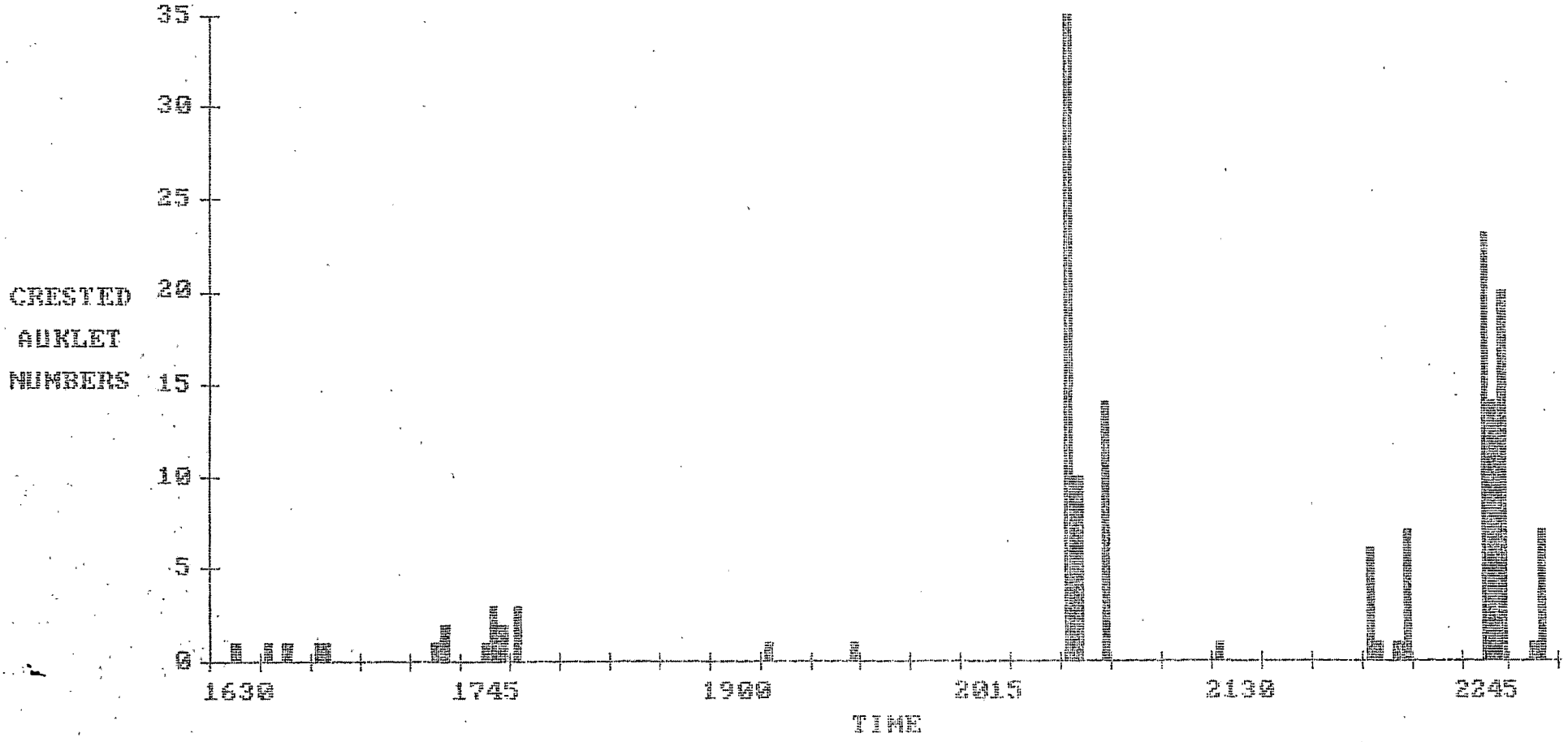


FIGURE 1B: DAILY ACTIVITY PATTERNS OF CRESTED AUKLETS ON FIVE PLOTS AT YUKON HARBOR, JULY 23, 1987.

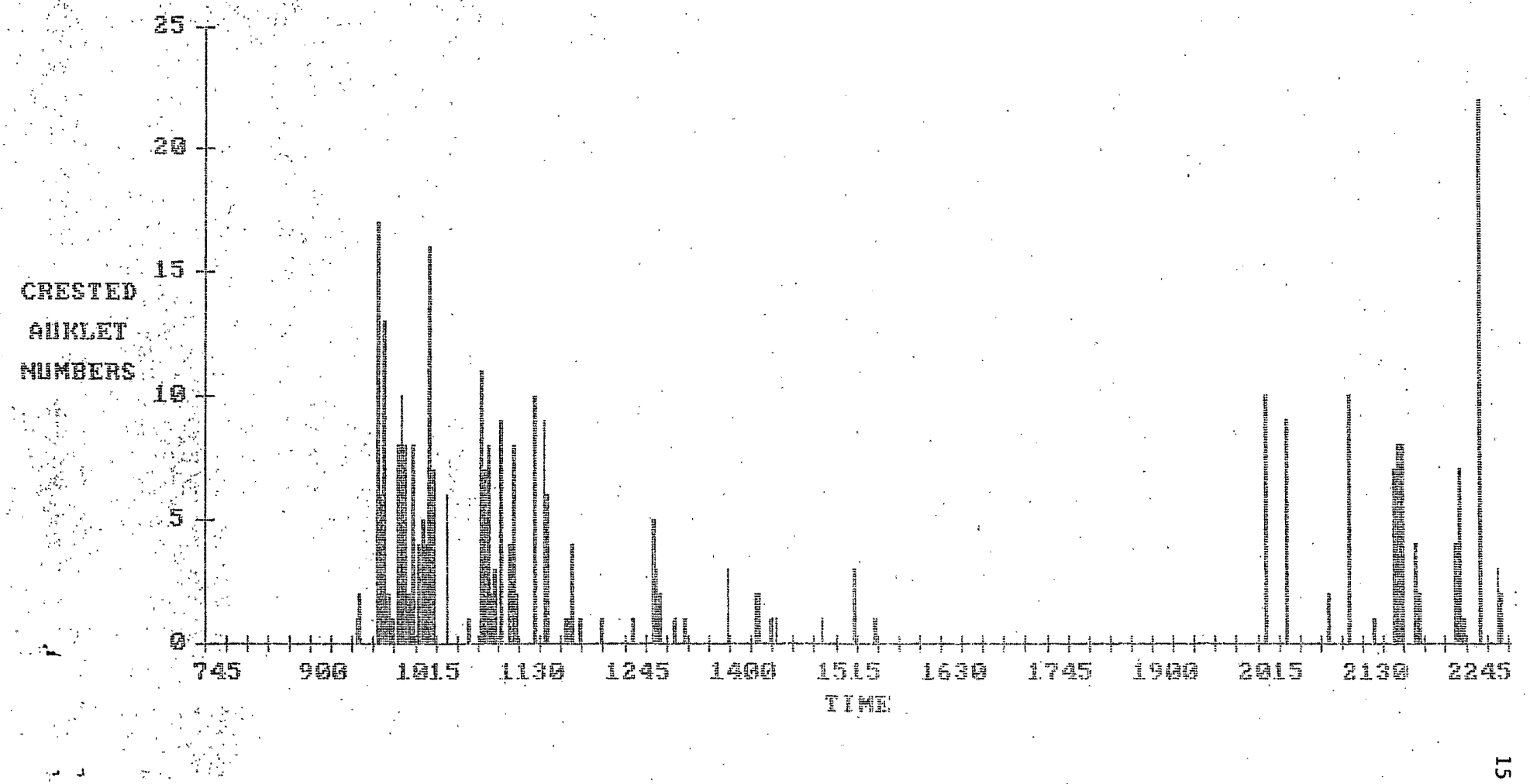


FIGURE 1C: DAILY ACTIVITY PATTERNS OF CRESTED AUKLETS ON FIVE PLOTS AT YUKON HARBOR, JULY 25, 1987.

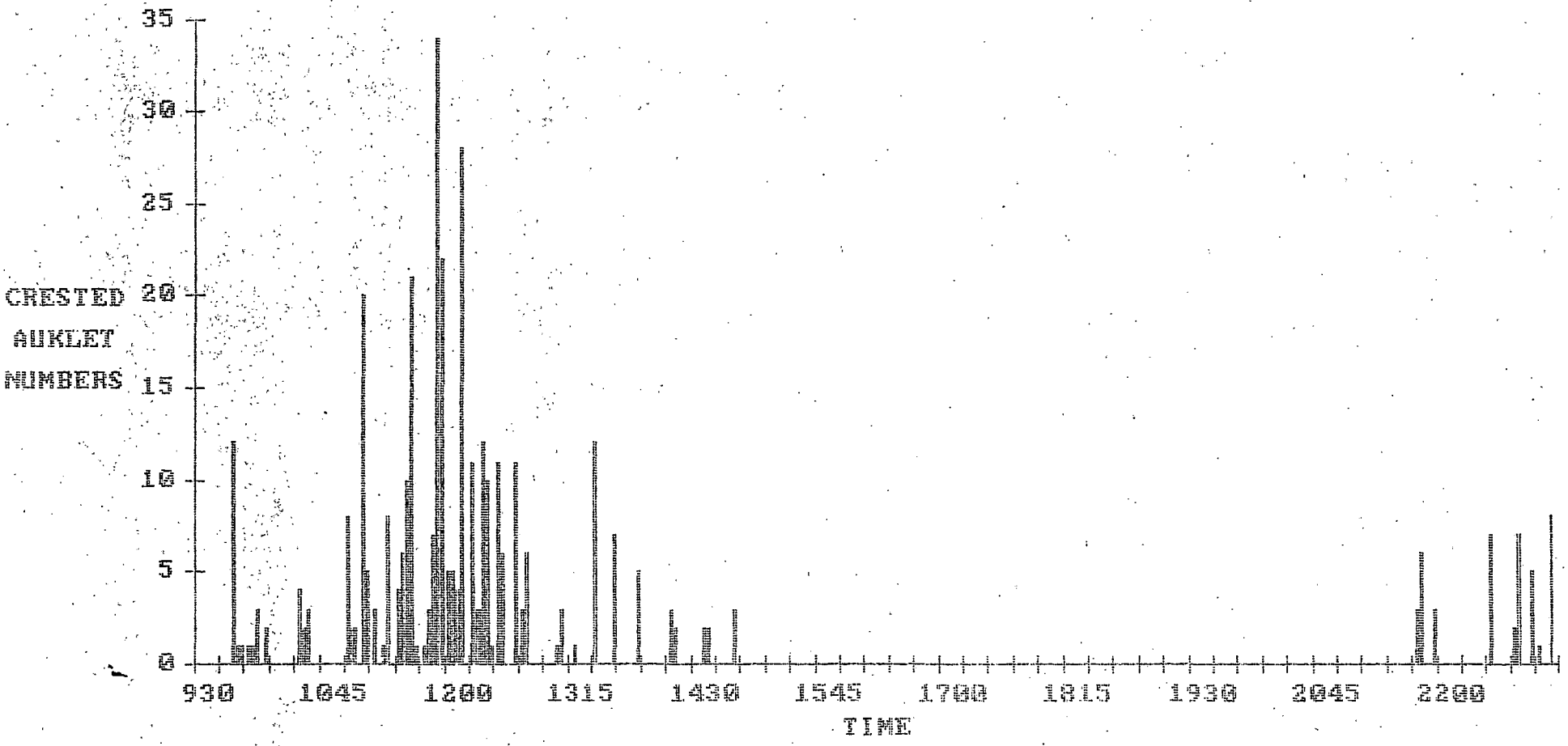


FIGURE 1D: DAILY ACTIVITY PATTERNS OF CRESTED AUKLETS ON FIVE PLOTS AT YUKON HARBOR, JULY 26, 1987.

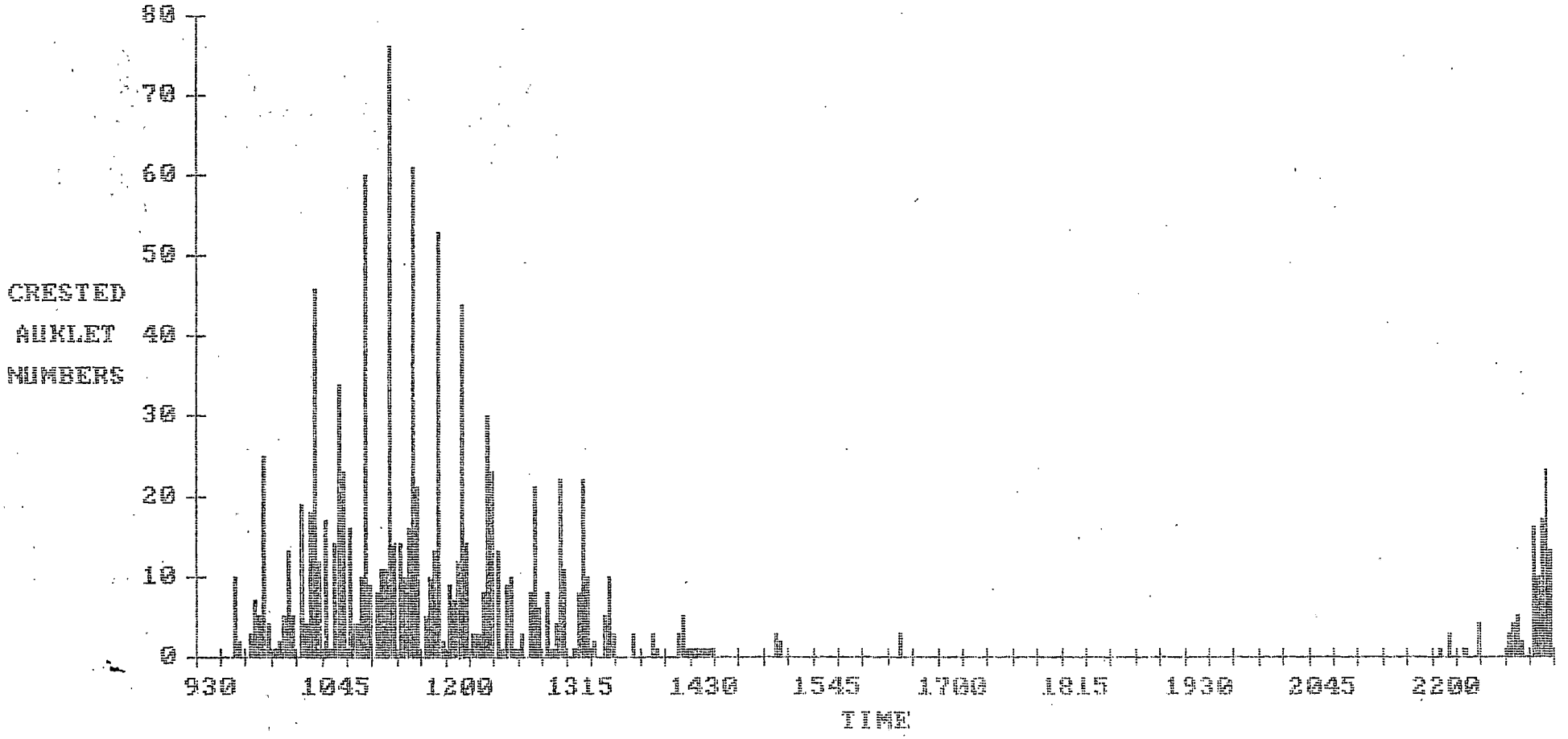


FIGURE 1E: DAILY ACTIVITY PATTERNS OF CRESTED AUKLETS ON FIVE PLOTS AT YUKON HARBOR, JULY 27, 1987.

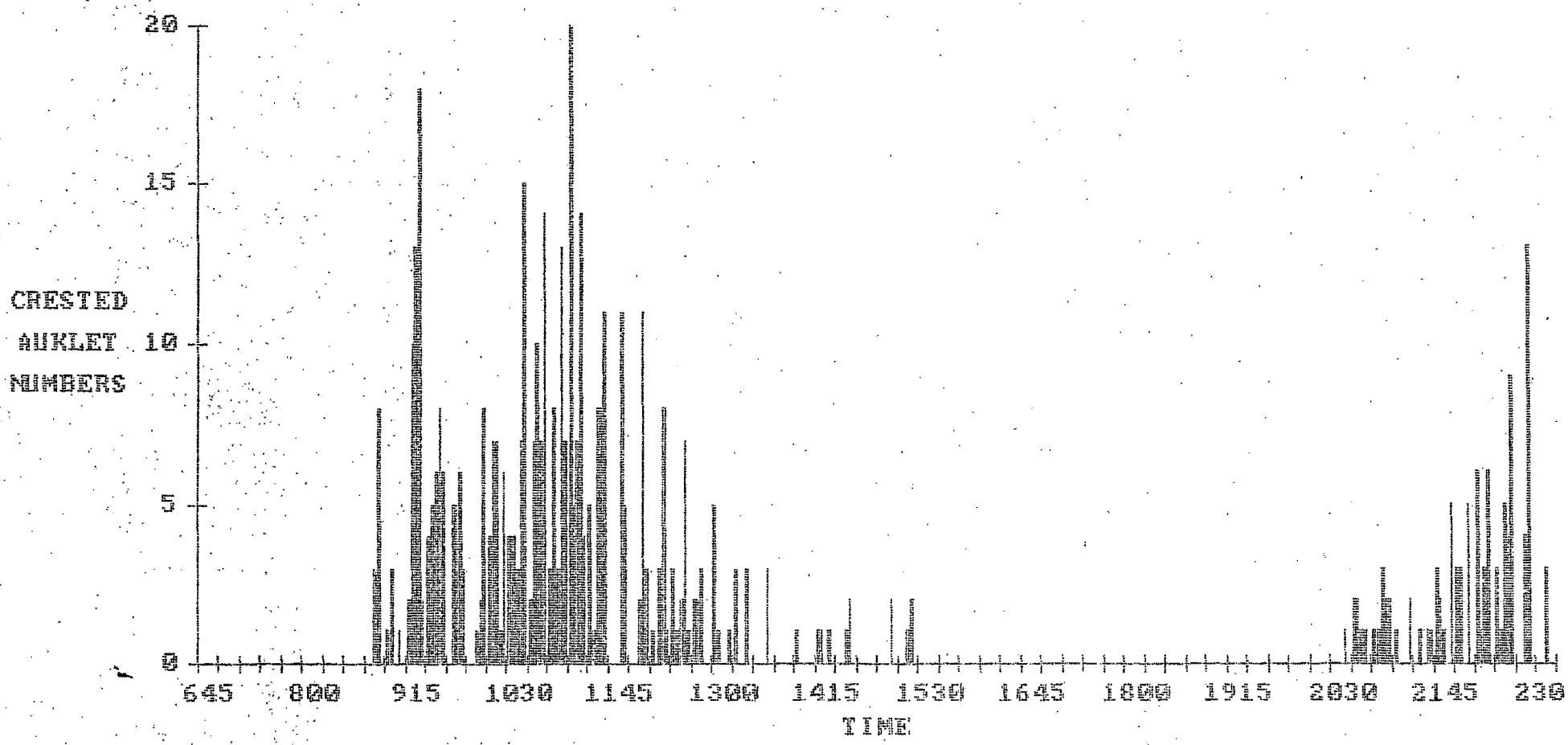


FIGURE 1F: DAILY ACTIVITY PATTERNS OF CRESTED AUKLETS ON FIVE PLOTS AT YUKON HARBOR, JULY 28, 1987.

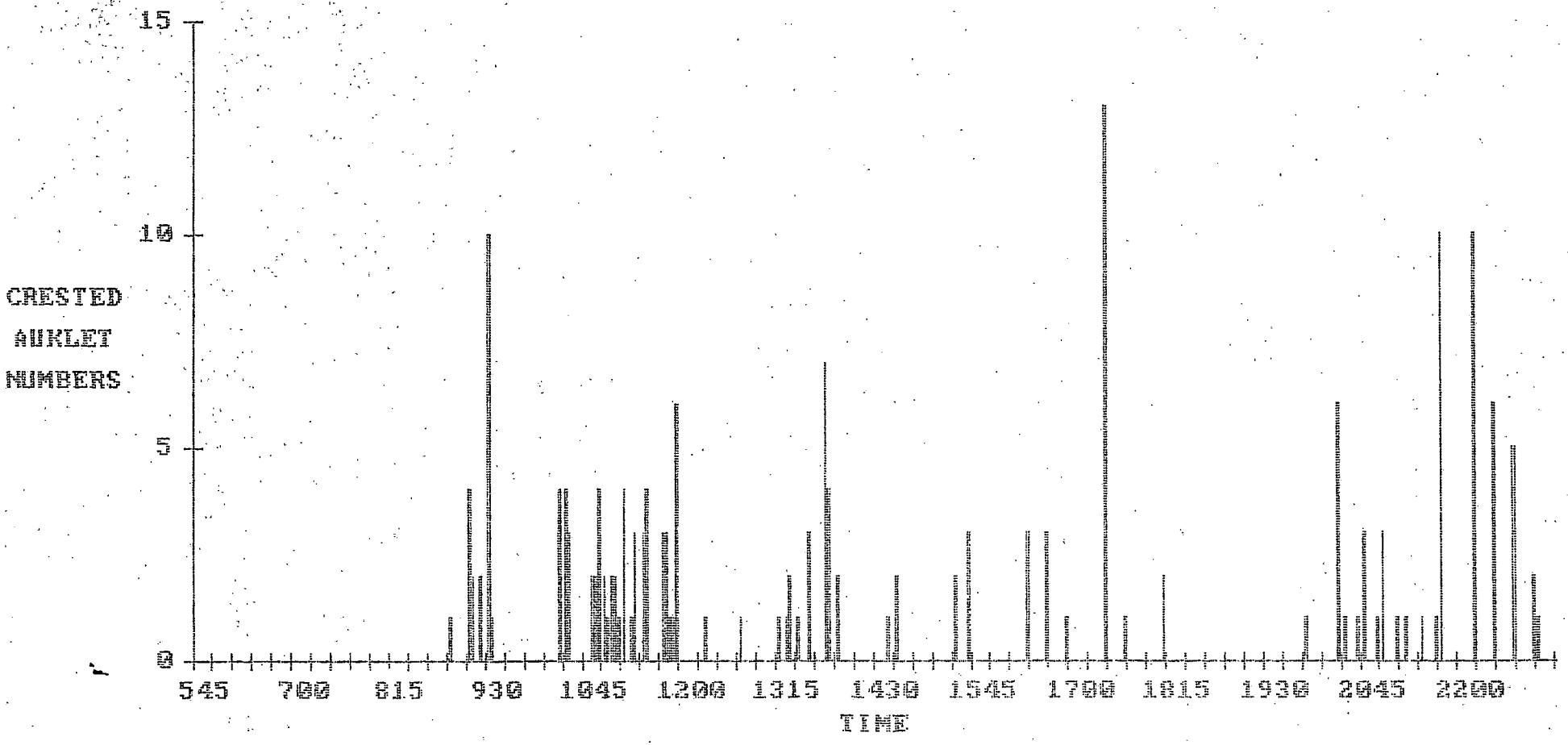


FIGURE 1G: DAILY ACTIVITY PATTERNS OF CRESTED AUKLETS ON FIVE PLOTS AT YUKON HARBOR, JULY 24, 1987.

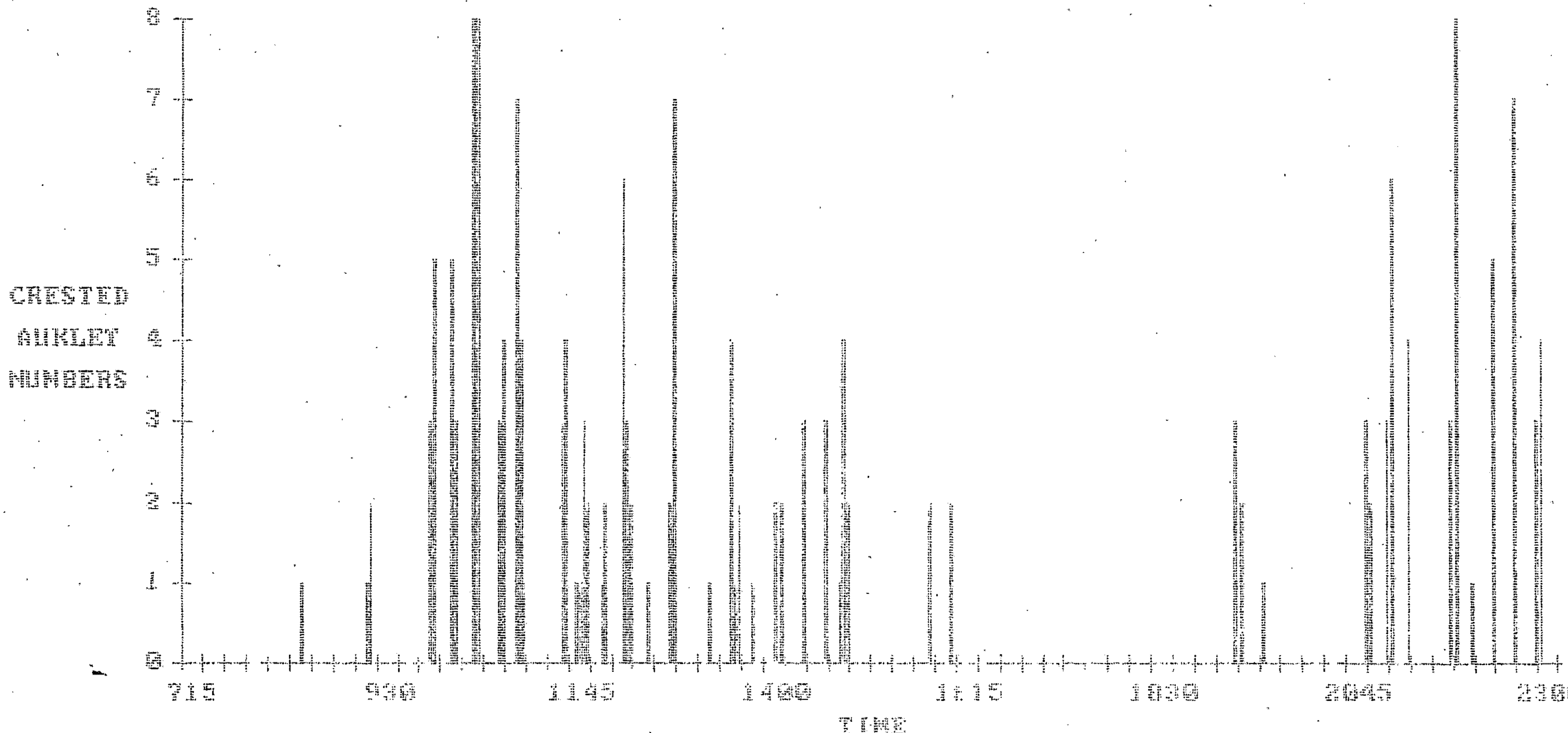


FIGURE 10: DAILY ACTIVITY PATTERNS OF CRESTED AUKLETS ON FIDE PLOTS AT YUNGA HARBOR, JULY 30, 1987.

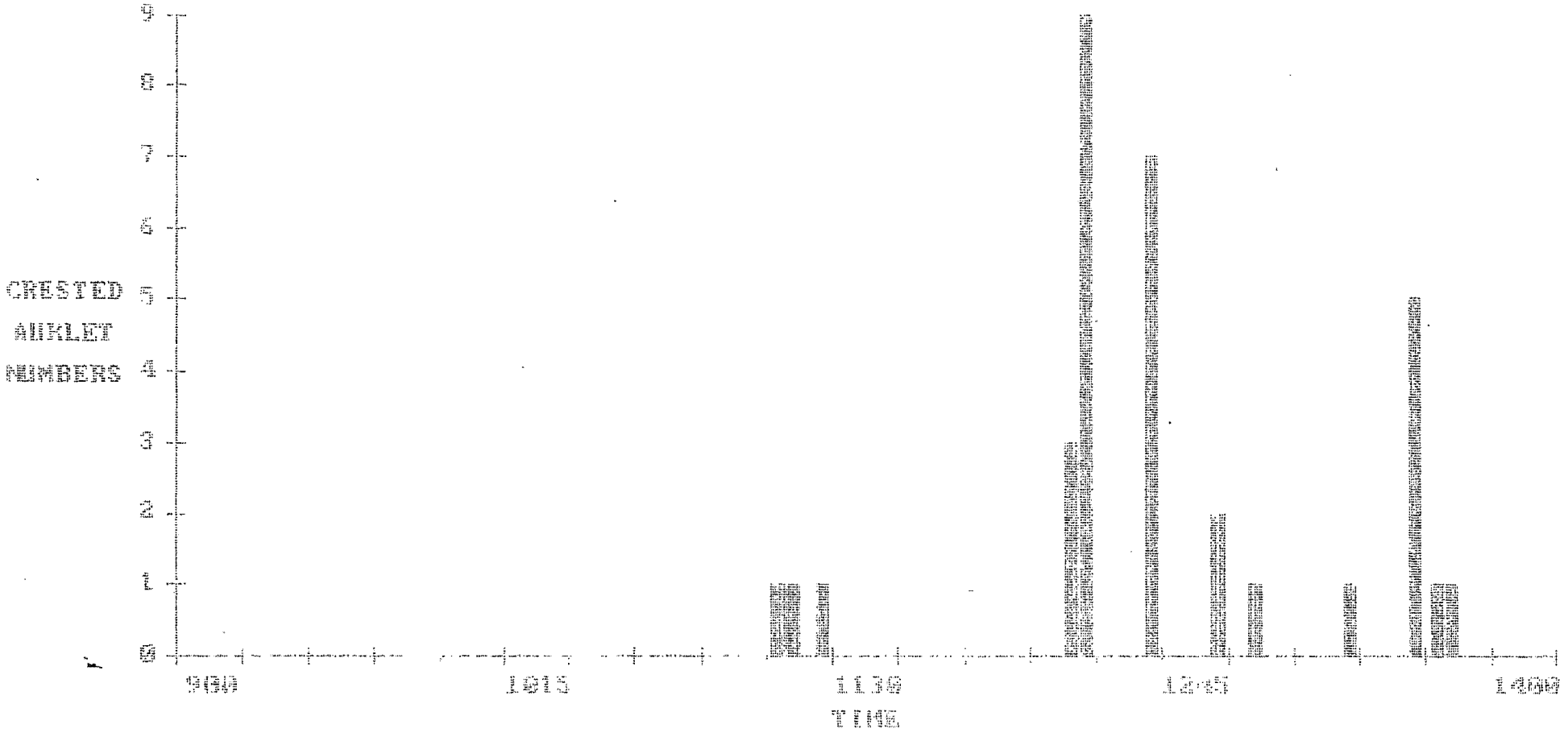
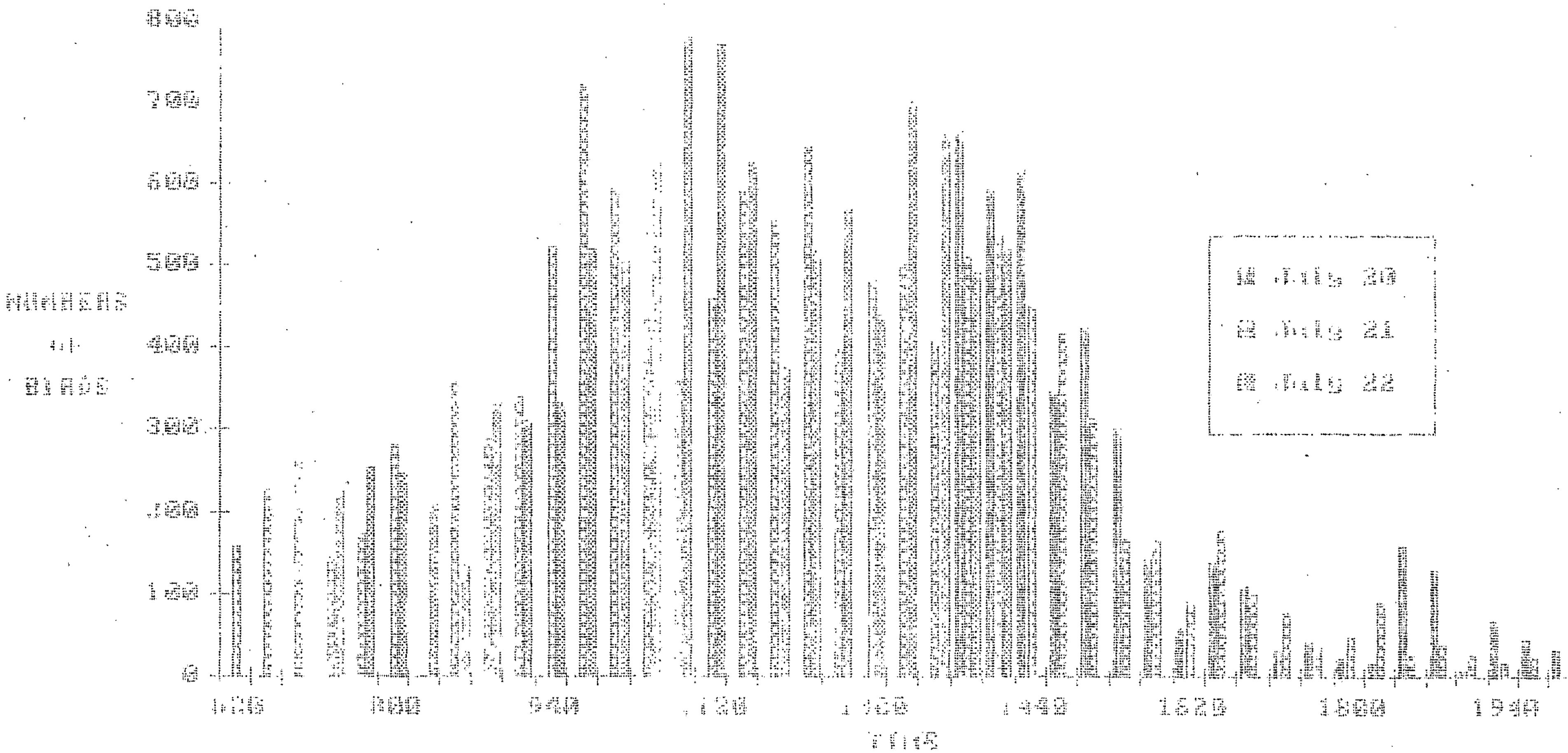


FIGURE 3: ACTIVITY PATTERNS OF CRESTED AUKLETS AT YUKON HARBOR USING BIRDS FLYING OVERHEAD, JULY 1987



just before dark around 2200 to 2300 hrs. Occasionally there was a day when the typical afternoon pattern of no activity failed to materialize and birds continued to fly into the colony and land. On 28 July, birds were flying into and landing in the colony until 1800 hrs, just before the beginning of the evening activity period which started at 1945 hrs.

Average daily peak attendance of birds on plots varied widely from plot to plot (Table 2). Plot counts on 30 July had a range from 0.2 birds/plot to 2.5 birds/plot while 26 July had a range from 5.9 birds/plot to 21.7 birds/plot. Plot comparisions suggest the magnitude of interannual variability (Byrd 1987). Weather, time of day, predators and human disturbance affect these numbers.

On 3 days, 20, 21, and 22 July, numbers of birds were counted as they flew down to the harbor (Figure 2). Birds began descending from the colony early, around 0600 hrs, had a broad peak of activity in mid-morning, and tapered off in the afternoon. There was a high of 780 birds per 5 minute period at 1100 hrs and a low of seven birds per 5 minute period at 1920 hrs.

Nesting chronology for the crested auklet colony at Yukon Harbor was first delineated in 1976 by Moe and Day (1977). They estimated hatching occurring 12-17 July and fledging occurring 15-20 August. The estimated nesting chronology in 1987 is similar to their 1976 findings. We estimated the hatching period to be the week previous to our arrival, 12-18 July and fledging probably occurred 10-15 August, based on chick vocalizations and the development of two chicks that were found in the colony. During our first visit to the colony 18 July, we heard adults chortling but no chick vocalizations. We began spending a major amount of time monitoring the plots on 22 July. Chick vocalizations were faintly heard on 22 July and as the days passed vocalizations became louder. On 28 July, two chicks were found outside the burrows on the boulders. One chick was found dead on the rocks outside the crevices. It was very small and downy, being less than 1-week old. The second chick was seen sitting on plot 5's observation point. It was slightly more than half the size of an adult and was beginning to develop pin feathers on its wings and tail. Food laden sublingunal pouchs were also noticed during this period of monitoring, indicating that chicks were being fed.

Predators of crested auklets can be divided into two groups: ground and aerial predators. Ground predators consist of introduced red fox and perhaps ground squirrels. Aerial predators consist of bald eagles, peregrine falcons and ravens. Red fox predation has been previously discussed.

Arctic ground squirrels are known to be carnivorus and cannabalistic (Cade 1950). Cade had no direct proof that

Table 2: Average daily peak attendance for the crested auklet colony at Yukon Harbor, July 1986 and 1987.

PLOT NUMBER	1986 7/10	7/11
1	--	9.7
2	--	8.2
3	.06	16.6
4	9.5	17.2

PLOT NUMBER	1987 7/23	7/25	7/26	7/27	7/28	7/29	7/30
1	6.3	6.4	10.9	5.0	3.6	0	0.2
2	4.5	3.6	5.9	5.6	1.5	0.1	0.3
3	5.1	5.3	12.1	6.5	1.4	3.7	0.3
4	4.2	13.0	21.7	10.6	2.0	3.7	2.5
5	3.0	5.5	14.3	7.9	0.9	2.9	---

ground squirrels were predators in the seabird colonies on St. Lawrence but suspected that they were depredating seabirds. Other small mammals are known to effect seabird colonies. Deer mice (Peromyscus maniculatus) prey heavily on unattended Xantus murrelet (Endomchura hypoleuca) eggs on Santa Barbara Island with 44% of the eggs laid being depredated (Murray et. al. 1983). Sealy (1982) found on St. Lawrence Island that vole (Microtus spp.) predation had an effect on crested auklet populations. Egg predation ranged from 1.9% to 3.4% in 1966 and 1967; nestling predation was 5.3% in 1966 and 1967. Twenty percent of the parakeet auklet nests were depredated on St. Lawrence Island (Sealy 1982). At the colony at Yukon Harbor, ground squirrels are present. Considering the large size of the colony, they probably have little effect.

Based on 1976 research on predation at Big Koniuji (Moe 1977), bald eagles (Halieetus leucocephalus) ingest a variable amount of seabirds including crested auklets. Remains of crested auklets have been found in pellets and nesting sites, but we never saw actual attacks on auklets. Adult and juvenile bald eagles were often seen soaring above the cliffs and in the harbor. In 1987 two adults and two juveniles were seen soaring above the colony and the harbor. No aerial attacks or scavenging on auklets were ever seen.

Peregrine falcons (Falco peregrinus) were dramatically present in the colony in 1976 and 1987. Moe (1977) concludes that the pergrine falcon's diet consists entirely of crested auklets. In 1987 a pair of peregrine falcons was seen often in the colony. On four occasions actual stoops were noted. On 25 and 26 July, peregrines stooped on auklets as the auklets flew into the plot areas, but they had no success. On 29 July a peregrine stooped just overhead while we were at the observation point for plots 1 and 2; it knocked an auklet off a rock in plot 1 but did not catch the bird. The falcon then flew around to the far side of the colony and into an incoming flock of auklets, whereupon it flew into the middle of the flock and slowly reached out its talons and grabbed an auklet. On 30 July a falcon stooped on an incoming flock and was sucessful. Five auklet carcasses were found in the colony. The carcasses were picked clean with skeletons intact, and some still had the feet skin left on the feet. Typical feeding behavior of falcons is to pick the carcass clean.

Ravens were present at the colony. A family group of five was seen all the days we were monitoring the colony. Often during monitoring, one or two ravens would land in the colony and hop from rock to rock peering down inbetween the boulders. During this time chick vocalizations were becoming louder. One raven was seen taking a live adult auklet while the auklet was standing on a boulder. Having the ravens present in the colony often discourged the auklets from landing.

An unusually marked auklet was present at the colony this year on plot 5. It had a small white collar around the throat area and a white rump patch. The bird was seen on 23, 26, 27, and 29 July. Notes on its arrivals and entrance into the burrow were taken (Table 8). Photographs of the bird are on file at AMNWR, Homer, Alaska. This bird probably is a partial albino. Two partial albinos and a full albino crested auklet were seen in 1973 (Bailey, pers. obs.).

Delineation of plot and colony boundaries revealed a colony similar in nesting density and boundaries to the previous year (see photos on file, AMNWR). Polaroid prints were taken of the plots and the colony and an attempt was made to stratify nesting density. Highest nesting density seems to be in the higher portion of the colony where the plots are located. Lower nesting density occurs in the lower, more vegetation-covered talus slope. The plots are located at the following heights: plot 1 & 2, 284 m; plot 3 & 4, 292 m; plot 5, 308 m.

Average daily attendance was similar for 1986 and 1987 (Table 2). The numbers of birds in plots 1 and 3 in 1986 falls within the range for 1987. Counts in 1986 for plot 2 and 4 slightly exceeded those of 1987. Peak numbers of auklets standing in the plots were higher in 1986 than in 1987 (Table 3). These high numbers could be a result of the timing of monitoring. Auklets have a more consistent activity schedule during the incubation period and seem to spend more time standing on the rocks (Byrd 1987). In 1986 monitoring was done during early July, presumably the incubation period, but the weather was exceptionally poor that period. In 1987 monitoring was done in late July during the early chick-rearing stage, with the weather often being excellent. Tables 3, 4, and 5 reveal the long periods of inactivity as shown by the zero counts early in the morning, mid-afternoon and early evening. However, these periods of inactivity are misleading. When analyzing the net movement method numbers, the periods of activity begin earlier in the morning and extend later into the day (Table 7). Often the numbers of birds entering a plot (vanishing down the crevices) are much higher than the numbers of birds standing on the surface; 1986 had greater extremes in numbers of birds on the plots (Table 6) than 1987 in the same time periods (Tables 4, 5). The morning activity period had more consistent action in 1987 than in 1986 (Tables 4, 5, 6). Several more years of data need to be collected to see if this variablity in numbers is of significance for this monitoring technique.

Gulls. Expanding gull colonies on Big Koniuji in apparent response to fox removal were discussed earlier. Because of our late arrival to the Shumagins and our relatively short stay in 1987 we were unable to census the gull colony at Hall Island due to very high grass and umbelliforms this late in the season. In addition, when we attempted to census the colony on 23 July, the chicks were nearly fledged and were

Table 3: Comparisions of peak numbers of crested auklets in plots at Yukon Harbor in 1986 and 1987.

	1986			1987		
	Date	Time	Number	Date	Time	Number
Plot 1	--	--	--	7/22	2045	**35**
Plot 2	--	--	--	7/26	1115	**11**
Plot 3	7/11	945	**110**	7/20	1015	**65**
Plot 4	7/10	1130	**94**	7/26	1115	**76**
Plot 5	--	--	--	7/26	1045	**23**

Table 4. Numbers of crested auklets observed in 10m x 10m quadrats at Yukon Harbor on 26 July, 1987.

Time (ADT)	Count Plot 1	Count Plot 2	Count Plot 3	Count Plot 4	Count Plot 5	Time (ADT)	Count Plot 1	Count Plot 2	Count Plot 3	Count Plot 4	Count Plot 5
0930	0	0	0	0	0	1800	0	0	0	0	0
0945	0	0	10	2	0	1815	0	0	0	0	0
1000	3	7	5	25	4	1830	0	0	0	0	0
1015	1	2	5	13	5	1845	0	0	0	0	0
1030	19	4	18	46	12	1900	0	0	0	0	0
1045	17	1	14	34	23	1915	0	0	0	0	0
1100	16	4	10	60	9	1930	0	0	0	0	0
1115	8	11	11	76	14	1945	0	0	0	0	0
1130	14	10	16	81	23	2000	0	0	0	0	0
1145	5	10	13	53	1	2015	0	0	0	0	0
1200	9	7	12	44	6	2030	0	0	0	0	0
1215	3	3	8	30	11	2045	0	0	0	0	0
1230	13	1	9	10	10	2100	0	0	0	0	0
1245	3	0	8	21	3	2115	0	0	0	0	0
1300	8	1	4	22	0	2130	0	0	0	0	0
1315	0	1	8	22	0	2145	0	0	0	0	0
1330	2	0	5	10	1	2200	0	1	0	3	0
1345	0	0	0	3	0	2215	0	1	0	0	4
1400	0	0	3	1	0	2230	0	0	0	0	0
1415	0	0	3	5	1	2245	3	4	5	2	0
1430	1	1	1	1	1	2300	16	10	17	23	13
1445	0	0	0	0	0						
1500	0	0	0	0	0						
1515	0	0	3	2	0						
1530	0	0	0	0	0						
1545	0	0	0	0	0						
1600	0	0	0	0	0						
1615	0	0	0	0	0						
1630	0	0	3	0	0						
1645	0	0	0	0	0						
1700	0	0	0	0	0						
1715	0	0	0	0	0						
1730	0	0	0	0	0						
1745	0	0	0	0	0						

Table 5. Numbers of crested auklets observed in 10 x 10 quadrats at Yukon Harbor on 27 July, 1987.

Time (ADT)	Count Plot 1	Count Plot 2	Count Plot 3	Count Plot 4	Count Plot 5	Time (ADT)	Count Plot 1	Count Plot 2	Count Plot 3	Count Plot 4	Count Plot 5
645	0	0	0	0	0	1445	0	0	0	2	0
700	0	0	0	0	0	1500	0	0	0	0	0
715	0	0	0	0	0	1515	0	0	1	2	0
730	0	0	0	0	0	1530	0	0	0	2	0
745	0	0	0	0	0	1545	0	0	0	0	0
800	0	0	0	0	0	1600	0	0	0	0	0
815	0	0	0	0	0	1615	0	0	0	0	0
830	0	0	0	0	0	1630	0	0	0	0	0
845	0	0	3	0	0	1645	0	0	0	0	0
900	1	3	0	8	0	1700	0	0	0	0	0
915	2	10	13	1	2	1715	0	0	0	0	0
930	4	5	6	18	6	1730	0	0	0	0	0
945	0	5	5	8	3	1745	0	0	0	0	0
1000	0	0	1	6	8	1800	0	0	0	0	0
1015	4	7	7	2	6	1815	0	0	0	0	0
1030	4	4	3	1	15	1830	0	0	0	0	0
1045	2	7	10	7	14	1845	0	0	0	0	0
1100	3	8	3	7	7	1900	0	0	0	0	0
1115	20	5	7	13	4	1915	0	0	0	0	0
1130	5	1	8	14	11	1930	0	0	0	0	0
1145	0	0	0	8	5	1945	0	0	0	0	0
1200	0	0	2	11	3	2000	0	0	0	0	0
1215	1	0	3	11	1	2015	0	0	0	0	0
1230	3	1	2	8	1	2030	0	0	0	0	0
1245	2	2	3	7	0	2045	2	2	1	1	0
1300	5	1	0	0	1	2100	1	1	3	1	2
1315	3	0	0	0	0	2115	1	0	0	2	2
1330	0	0	0	3	0	2130	0	1	0	0	1
1345	0	0	0	3	0	2145	3	2	1	1	5
1400	1	0	0	0	0	2200	3	3	0	0	0
1415	1	1	0	0	0	2215	6	1	3	5	0
1430	0	0	1	1	0	2230	3	1	5	6	9
						2245	-	-	4	4	-
						2300	-	-	3	13	-

Table 6. Numbers of crested auklets observed in 10 x 10m quadrats on 11 July 1986 at Yukon Harbor, Big Koniuji Island.

Time (ADT)	Count Plot #1	Count Plot #2	Time ADT	Count Plot #3	Count Plot #4
0945	30	24	0925	36	52
1000	0	0	0930	0	0
1015	38	26	0945	110	33
1030	0	0	1000	0	0
1045	0	0	1015	0	62
1100	0	0	1030	0	0
1115	1	0	1045	0	0
1130	0	0	1100	0	0
1145	0	0	1115	0	0
1200	0	0	1130	0	0
1215	28	32	1145	0	0
1230	0	0	1200	0	0
1245	0	0	1215	20	25
1300	0	0	1230	0	0
			1245	0	0
			1300	0	0

Table 7. Numbers of crested auklets observed in 10 x 10 plots using the net movement method at Yukon Harbor on 25 July, 1987.

Time	Plot 1		Plot 3		Plot 5	
	arriving	departing	arriving	departing	arriving	departing
0930	--	--	--	--	--	--
0945	0	2	12	1	4	6
1000	30	27	39	46	26	22
1015	16	11	48	45	19	11
1030	50	35	19	14	6	15
1045	40	24	0	0	5	4
1100	12	5	79	30	59	20
1115	65	31	32	53	5	26
1130	19	16	41	39	33	32
1145	15	1	42	50	59	39
1200	36	22	20	43	2	28
1215	64	35	41	29	5	15
1230	13	38	--	--	16	18
1245	23	43	4	6	0	10
1300	31	35	42	49	41	22
1315	22	15	0	5	10	15
1330	3	16	24	45	21	17
1345	0	4	7	33	9	8
1400	7	8	0	3	0	0
1415	0	7	18	32	1	5
1430	2	9	8	26	3	4
1445	--	--	3	14	13	7
1500	14	3	0	0	0	5
1515	1	13	0	0	2	0
1530	--	--	0	0	0	1
1545	--	--	0	0	1	1
1600	--	--	--	--	0	0
1615	--	--	--	--	2	2
1630	--	--	--	--	0	0
1645	--	--	--	--	0	0
1700	--	--	--	--	0	0
1715	--	--	--	--	0	0
1730	--	--	--	--	0	0
1745	--	--	--	--	3	0
1800	--	--	--	--	9	2
1815	--	--	--	--	0	0
1830	--	--	--	--	0	2
1845	--	--	--	--	0	0
1900	--	--	--	--	0	0
1915	--	--	--	--	0	0
1930	--	--	--	--	0	0
1945	--	--	--	--	0	0
2000	--	--	--	--	0	0
2015	0	1	--	--	0	0
2030	0	3	--	--	5	1
2045	0	0	0	0	0	0
2100	0	0	0	0	0	0
2115	0	0	0	0	0	0
2130	0	1	0	0	0	0
2145	18	3	0	0	10	0
2200	0	0	47	2	9	1
2215	57	10	0	0	0	0
2230	4	4	84	12	23	1
2245	103	13	0	0	12	0
2300	--	--	167	16	110	15

Table 8. Notes on activity of partial albino crested auklet at plot 5, Yukon Harbor, Big Koniuji Island, July 1987.

Date	Time arrived	Time entered burrow	Time flew away
7/23	1035	1035	---
7/26	1150	1233	---
7/27	929	---	936
	949	953	---
	2058	2059	---
7/29	1107	1107	---
	2138	2143	---

away from nests hidden in tall vegetation. Despite several attempts no counts were made at this gull colony in 1986 because of fog. In 1985 only 39 glaucous-winged gull nests and about 300 adults were counted on the western third of Hall Island. This long, narrow, rugged island is easily divided into three sections because of dividing clefts. The mew gull colony found on Bendel Island in 1977 (Bailey 1978) was revisited on 30 July. Since nesting was over, no attempt was made to count nests or birds.

Kittiwakes. On 23 July we counted 245 black-legged kittiwakes nests on the north side of Hall Island, compared to 377 nests a month earlier in 1986. Since this colony is small, all nests on the north side of the island are counted as one plot. Very few chicks were noted. Moe and Day (1977) counted 155 nests at Hall Island in 1976. Although we passed by the huge kittiwake colony at Cape Thompson on the north end of Big Koniuji several times, no census was attempted because of the difficulty of making counts at any parts of this colony from a boat. In 1984 approximately 7800 nests were counted here (Bailey and McCargo 1984), nearly the same as found in 1976 by Moe and Day (1977). Kittiwakes are considered the third most abundant species of breeding seabirds in the Shumagin Islands (Bailey 1978). Sixty kittiwake nests were counted at the new colony near the entrance to Flying Eagle Harbor this summer, compared to 33 nests in 1986. A new colony comprised of 100 pairs of nesting kittiwakes was discovered at Popof Head on the east side of Popof Island while enroute to Sand Point to return home.

Cormorants. The lack of nest site tenacity by cormorants was well exemplified on Big Koniuji this year. In 1986 a large increase in numbers of all three species of cormorants nesting in the Shumagins occurred on the cliffs below the gull colony south of the entrance to Flying Eagle Harbor. This colony burgeoned from 38 nests in 1976 to 370 nests, mainly red-faced cormorants (Phalacrocorax urile), 10 years later. However, in 1987 no nests were found here, yet the number of gulls rose 70% from the previous year. Most of the birds from this colony probably moved to the north side of Hall Island, where we counted about 400 and 55 nests of red-faced and double-crested cormorants (P. auritus), respectively. Nesting success was high, especially for double-crested cormorants, because most nests had large chicks. It was not possible to accurately quantify numbers of chicks per nest because some of the higher ones were difficult to see and because some chicks were on ledges away from nests. Curiously neither in 1976 (Moe and Day 1977) nor in 1986 (Bailey 1986) were any cormorants reported breeding on Hall Island. Unlike past years no cormorants were observed at Granite Cove on Big Koniuji, site of another expanding gull colony. Albeit no thorough examination of the cliffs north of Cape Thompson were made this summer, no cormorant nests were seen here either. A systematic census

of this area in 1985 revealed 40 pairs of red-faced cormorants. It appears that virtually all of the cormorants formerly nesting on Big Koniuji relocated to Hall Island in 1987.

Puffins. Several visits were made to the once enormous horned puffin (Fratercula corniculata) colony south of Yukon Harbor. This colony is only a remnant of the some 60,000 birds breeding here more than a decade ago (Moe and Day 1977). Because of the elevation and inaccessibility of this colony and the difficulty with ascertaining populations of horned puffins, which have an erratic attendance pattern at colonies, no quadrats have been established. Nevertheless, annual visits should reveal any large increases in puffins which are anticipated following the eradication of fox.

Jaegers. Parasitic jaegers (Stercorarius parasiticus), including one light phase bird, were spotted on Little Koniuji, where they probably nest. Six to eight were seen on Bird Island.

Raptors

On 8 June we checked the golden eagle (Aquila chrysaetos) eyrie discovered 3 years earlier on Bird Island. An adult eagle flew from above the site and two nearly fledged eaglets were present in the nest along with two ground squirrels. One downy chick was initially present in early May 1984, but it vanished from the nest before we left the island at the end of the month (Bailey and McCargo 1984). Except for Kodiak Island (Berns 1979), this eyrie on Bird Island represents the only insular record for nesting golden eagles south of the Alaska Peninsula. The only record on the Alaska Peninsula is near Cold Bay (Bailey 1975). No census of bald eagle eyries at Big Koniuji was conducted this year because of our late arrival on the island.

Peregrine falcons appeared more numerous this summer, and a probable new eyrie was located on the east side of Big Koniuji between Yukon and Flying Eagle harbors. Four peregrines and five ravens were preying on crested auklets at Yukon Harbor.

Other birds

Unlike in all past summers no new species of passerines, waterfowl or other birds were seen in 1987. Pine grosbeaks (pinicola enucleator) were again noted in two different parts of Big Koniuji and now appear well established on the island. As previously mentioned, willow ptarmigan were numerous compared to past years on Big Koniuji. Only one ptarmigan was encountered on Little Koniuji during 3 days of exploring the island. The seemingly lower ptarmigan population on Little Koniuji probably is a result of the presence of arctic fox. Although much more time was spent on Big Koniuji than

on Little Koniuji, the latter island probably serves as a good control on the effects of the elimination of fox on insular ptarmigan. If the increase in ptarmigan on Big Koniuji this year were due to favorable weather, food supply, or some other factor other than fox removal, then more ptarmigan also should have been on adjacent Little Koniuji, which has similar habitat.

Marine Mammals

Atkins Island was circumnavigated on 26 July to census Steller's sea lions (Eumetopias jubatus) breeding there. A total of 898 adults and 262 pups was tallied under clear, calm weather conditions. Moe and Day (1977) estimated 4000 sea lions here in 1976. Surveys by the Alaska Department of Fish and Game in June 1978 revealed 3943 adults and 2750 pups; counts the next year totaled approximately 5000 adults and 4538 pups (Caulkins and Pitcher 1982). Obviously this rookery, the largest in the Shumagins, is manifesting the sharp decline witnessed throughout most of the state. The only other rookery in the Shumagins, Chernabura Island, was not visited.

RECOMMENDATIONS

In June 1988 certain sand beaches and prominent trails across a few passes on Big Koniuji Island should be examined for fox tracks and scats. We feel that another thorough search and reexamination of traps over the entire island is not warranted in view of the apparent absence of fox noted in 1987. However, continued surveillance of this island should continue for several more years to be certain that no fox remain. If any fox did survive, tracks would almost certainly appear at such preferred locations as beaches along Long Bay, Fox Farmer's and Shipwreck coves, and the beach at Sandpiper Lagoon. Moreover, if any viable pairs of fox remain, pups will soon begin to repopulate the island. Whenever in the area, Bird Island also should be rechecked for fox sign, though the likelihood of their presence on this smaller island is extremely remote because of the appearance of an easily accessible gull colony. The rate at which trails and scent posts on tussocks become overgrown and vanish in different habitats also should continue to be documented.

Both new gull colonies on Big Koniuji should be revisited to detect population changes, and areas such as Cape Thompson where there is a probability of recolonization should be rechecked in 1988. Monitoring of the crested auklet colony at Yukon Harbor, preferably after hatching in July, should continue for approximately 2 weeks. At least two or three visits should be made to the horned puffin colony on Big Koniuji, and the kittiwake and gull colonies on Hall Island should be recensused in the same manner as in past years.

In addition to reassessing the status of red fox on Big Koniuji and conducting the aforementioned seabird censusing, the eradication of arctic fox on nearby Little Koniuji should be initiated. This would entail relocating the base camp to a centralized site at Northeast Harbor. A reconnaissance of the island in 1987 divulged that a spot on the isthmus west of Sandy Cove meets all the requisites for a secure base camp. Though 3 km further from the auklet colony than the previously used base camp at Flying Eagle Harbor on Big Koniuji, this cove is on the west and generally leeward side of Little Koniuji. Moreover, in rough weather an inflatable can be left in Shoal Bay, an easy hike to base camp and a scant 6 km, or roughly half the distance between Yukon and Flying Eagle Harbor. Because it is smaller and much less rugged and brushy and because arctic fox are easier to trap than red fox, removal of fox from Little Koniuji should be considerably easier than from Big Koniuji. Little Koniuji has a perimeter of only 66 km, 50 km less than that of Big Koniuji. Besides being a propitious site from which to support monitoring of crested auklets and eventually perhaps horned puffins on Big Koniuji, Northeast Harbor seems an ideal location from which to base fox eradication efforts because both the east and west sides of the island can be worked from the isthmus at this locale. Furthermore, most of the island also can be reached on foot from here.

Little Koniuji has some of the best waterfowl, gull, tern, and shorebird nesting habitat in the Shumagins; it also formerly had large numbers of some unidentified species of burrowing seabirds prior to fox farming (R. Rogers, pers. comm.). Like Bendel Island on the west side of Big Koniuji the absence of fox will probably witness the recovery of mew gulls, terns, jaegers, and other aquatic avifauna.

Unless done by ADF&G or NMFS sea lions should be recounted on Atkins Island, and also at Chernabura, in view of the drastic declines that are occurring.

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