

DIXON HARBOR BIOLOGICAL SURVEY

Final Report on the Summer
Phase of 1974 Research

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PART 8. LARGER TERRESTRIAL MAMMALS

by

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INTRODUCTION

This report on terrestrial mammals larger than mice is the second in a planned series of three. It is structured to allow maximum comparability with last year's report.

The principal objectives this year were: 1) To extend the mammal survey into all seaward portions of the study area; 2) to gain additional time perspectives by comparing 1973 and 1974 mammal populations and distribution patterns.

Observations were made by the author during four periods: 1) 4/25-28/74, Dixon River-Boussole Bay; 2) 5/16-23/74, Torch Bay-Boussole Bay; 3) 6/26-7/30/74, Torch Bay-Boussole Bay; 4) 8/1-8/13/74, Palma Bay. The author's principal foot itineraries are shown in Figure 1. Other members of the study team provided information from these and other periods and places spanning May - August and Palma Bay-Torch Bay. Mammal studies by Sappington (in press) in the Dixon Harbor vicinity bridge most of the time gap between the author's 1973 and 1974 field seasons, and are cited frequently.

For description of field and scat analysis methods, and for definition of the terms "sign", "trail", "den" and "bed", see last year's report.

RESULTS

Bat (*Myotis lucifugus* (?))

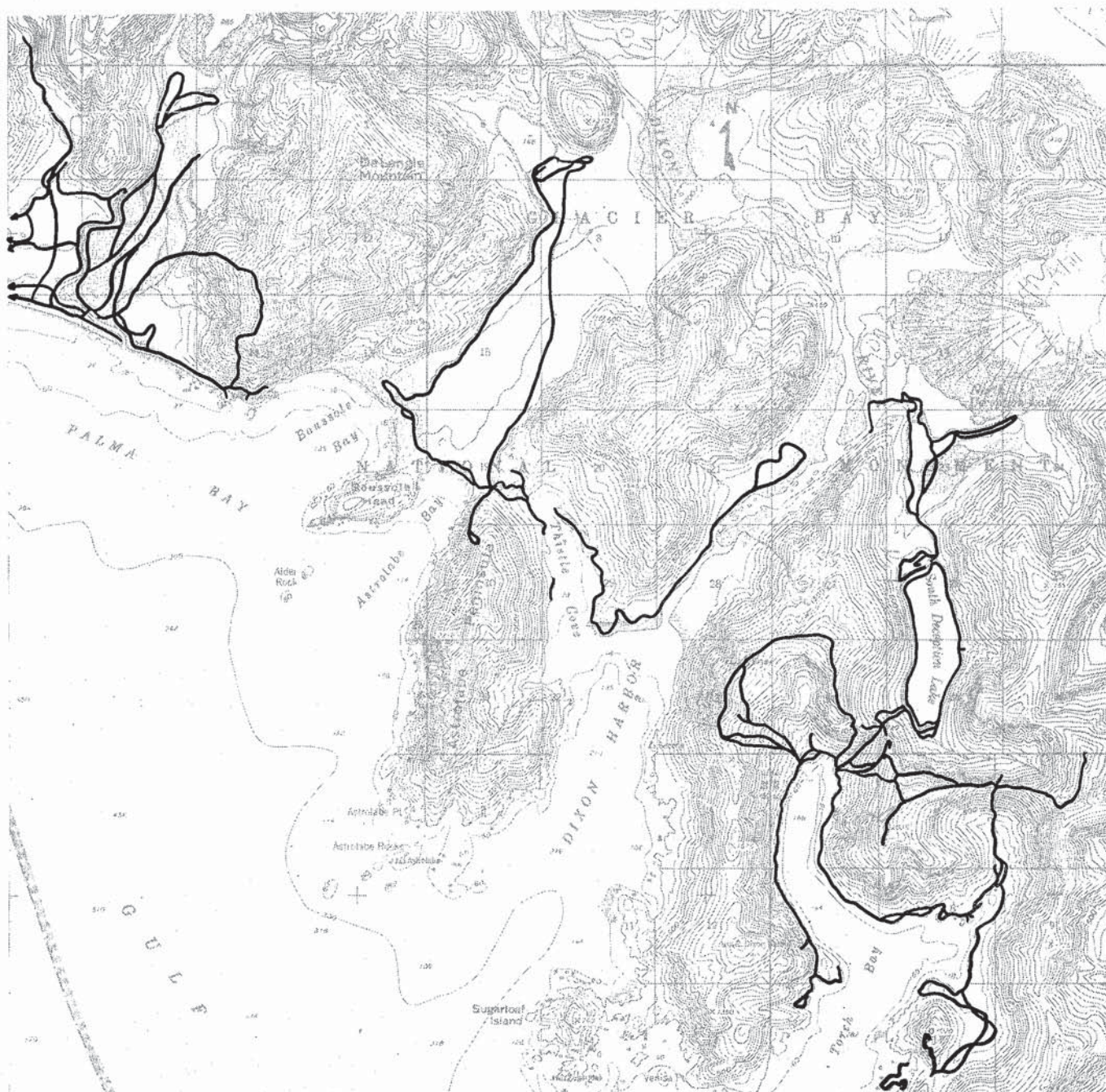
A single individual was noted above Torch Bay camp by Duggins on June 3.

Porcupine (*Erethizon dorsatum*)

Porcupine sign was thinly but widely distributed through the study area below 700 feet, usually in forest-edge localities supplied with scree or morainal boulders and proximate to deciduous shrublands. Sign was most obvious and frequent in well-drained situations beneath large rocks, where concentrations of scat and quills often suggested prolonged residence. The most

INVESTIGATOR'S COMPOSITE ITINERARY

FIGURE 1



dense concentration of sign observed during this year (or last) was found along an interface between mature forest and alder thicket in upper Palma Valley (Figure 2).

Four instances of feeding were noted. Two involved stripping bark from the root buttresses of spruce, and Sitka willow twigs had been nipped off and partially eaten in two localities.

Red Squirrel (*Tamiasciurus hudsonicus*)

A greater effort was made this year than last to delimit squirrel habitat. The result: squirrels are patchily distributed throughout the study area lowlands, principally within a few hundred feet of marine or lake beaches in semi-open localities dominated by large spruces. Densities characteristically decrease quickly inland and with altitude; squirrels are seldom encountered above 500 feet. Occasional individuals are found in predominantly hemlock forests, but associated with the mature spruces.

A squirrel will rarely summer in an alder shrubland, sufficiently far from the forest to make regular visits unlikely. Observation of similar situations in upper Glacier Bay suggest that overwintering is occasionally successful in this habitat, despite great apparent vulnerability to predation.

Judging from leavings around middens, squirrels subsist principally on spruce seeds, though alder seeds and mushrooms are also frequently used. Shrubland individuals apparently rely heavily on alder seeds.

Average squirrel densities in the Torch and Palma Bay vicinities appeared higher than in the central portion of the study area. Limited qualitative comparison of good squirrel habitat around Thistle Cove and Boussole Valley suggested that squirrel densities there had increased during the last (mild) winter. This is in accord with the winter findings of Sappington (in press).

Hoary Marmot (*Marmota caligata*)

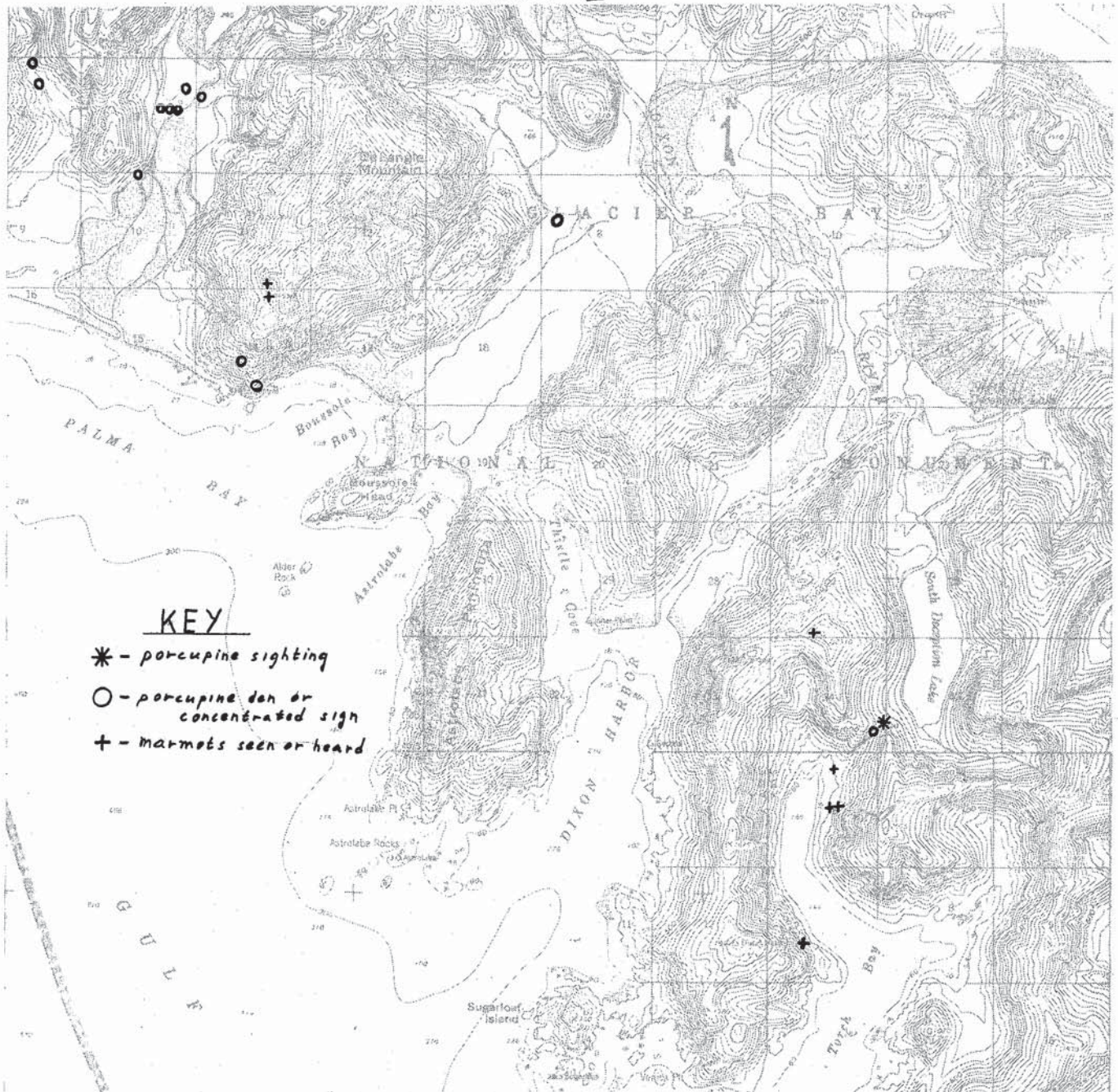
Marmots or their sign were noted in four localities, all other than those in which marmots were noted last year (Figure 2). Two years' observations suggest that though marmots are present on most massifs within seaward portions of the study area (except, perhaps, Astrolabe Peninsula), they generally occur in small numbers.

Two of the 1974 observations were in low alpine meadow situations; the other two were less usual. First, a den was found within a spruce-hemlock forest at 300 feet elevation, near the mouth of Torch Bay, about 50 feet from the base of an alder-dominated avalanche chute that extended to the alpine. Second, an individual was noted along the beach of upper Torch Bay on May 21.

PORCUPINE & HOARY MARMOT

Observed Distribution

FIGURE 2



Its sluggish, dazed condition suggested recent emergence from hibernation. This animal was sighted repeatedly through the summer at the beach edge near a rocky scree pile. Two young were seen with it in early July. A second adult answered the call of this individual from the shrublands 100 feet above this beach site on July 26.

These lowland marmots reinforce observational evidence for scarcity or absence of small canid predators at Torch Bay. Marmots likewise come to sea level along northwest Glacier Bay and upper Dundas Bay, where foxes and coyotes are presently scarce; "ground-hogs" are said to have once been common along lower Glacier Bay (Mills, Dalton, pers. comm.), prior to the arrival of coyotes there.

The one marmot seen clearly this year was a sooty gray individual, approximately intermediate in color between the gray and melanistic pelage types.

Short-tailed Weasel (*Mustela erminea*)

Sappington's winter observations have demonstrated that this species is locally common in the central portion of the study area. During the period covered by the present report, one individual was seen on June 28 by Sam and Renee Patten at the Dixon River estuary, unsuccessfully attacking a blue grouse hen and brood.

Least Weasel (*Mustela rixosa*)

No definite sign of this elusive species was observed, either during the report period or (by Sappington) during winter.

Mink (*Mustela vison*) and Marten (*Martes americana*)

As last year, sign of medium-sized mustelids was distributed from the alpine to sea level, being most common in proximity to land-water interfaces, particularly if coarse scree or cliffs are present. Thus, the most dense sign occurred along the shoreline of Torch Bay and portions of South Deception Lake, while the Palma area contained no notable concentrations. It appears that the rocky shores of upper Dixon Harbor and Torch Bay are roughly equivalent (and excellent) mustelid habitat.

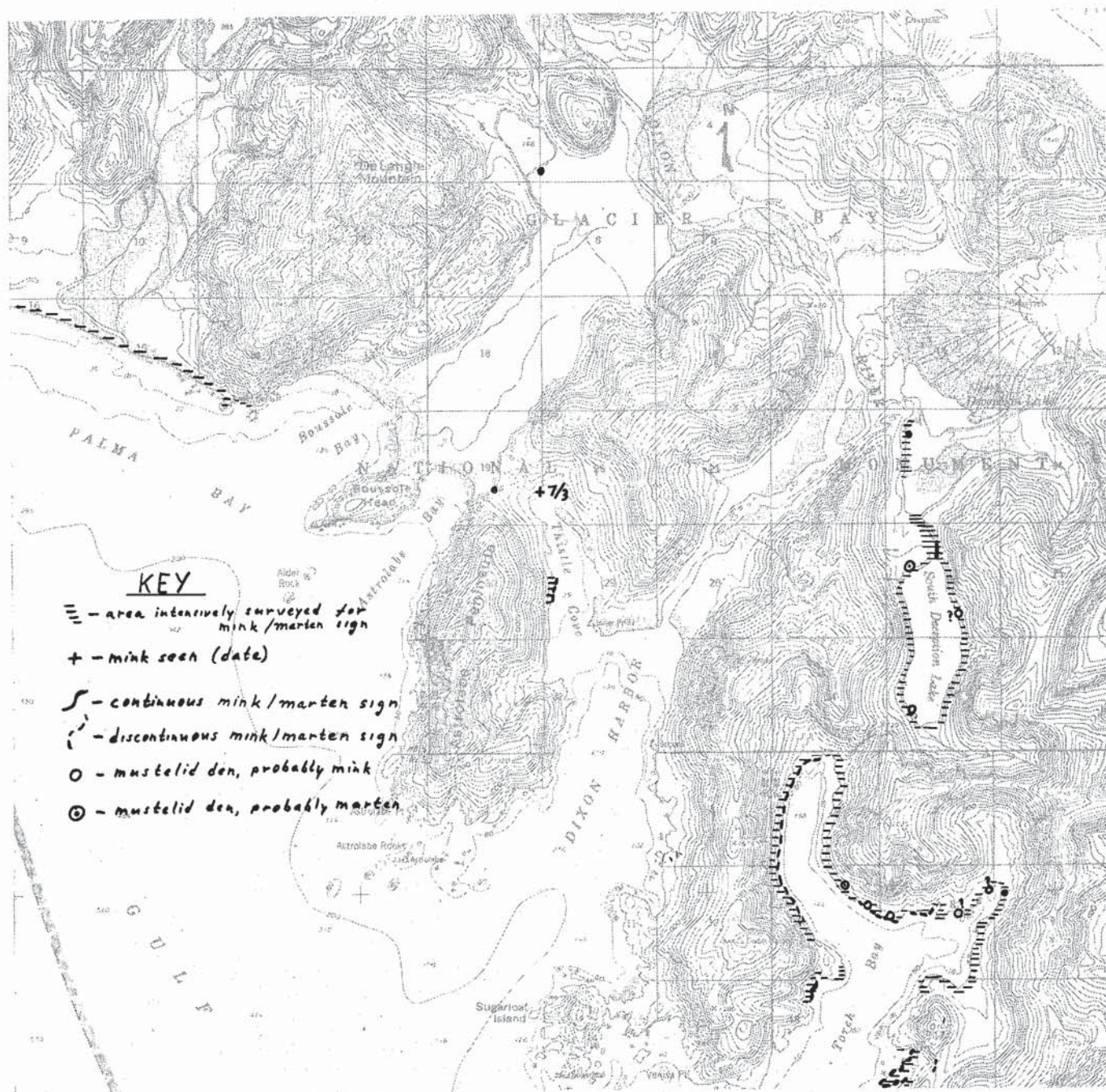
Medium-sized mustelids and their sign were less frequently encountered this year than last. In no instance was heavy sign of recent origin noted in 1974, despite intensive surveys of beach habitats in the Palma Bay, Torch Bay and Deception Lakes vicinities (Figure 3). However, sign predating this summer was more common than fresh sign at Torch Bay and South Deception Lake, as well as in a re-surveyed portion of heavily occupied 1973 mustelid habitat along Thistle Cove.

Since most sign of medium-sized mustelids near beaches in the

MINK & MARTEN

Observed Distribution & Abundance

FIGURE 3



study area is apparently ascribable to mink (see last year's report and that of Sappington, in press), it may be inferred that mink have either generally declined since last summer or have tended to shift their activities to areas away from the water and into habitats where sign is left with lesser frequency. Sappington found that mink in the Dixon Harbor-Boussole Valley area ranged far from open water during the winter of 1973-74.

Impetus for wider ranging since summer 1973 may have been provided by the recent precipitous decline of microtine rodents (see Terry, this volume). Last year, microtines constituted a high proportion of the mink/marten diet; this year's use of microtines remained high, but a partial shift to other dietary items seems evident (Appendix V). It is also possible that this year's larger otter population, whose fresh sign was commonly superimposed on older traces of mink, may have successfully competed with mink for beach habitat. According to Burns (pers. comm.), it is common knowledge among trappers in the Bristol Bay region that mink catches can be increased by thinning otters out along coastal areas.

Sign away from beaches was generally uncommon, perhaps somewhat more so this year than last. However, since 1) old mustelid sign is difficult to recognize in most such places; 2) no adequate resurvey of areas studied last year was made; and 3) mink and marten are probably sympatric in these habitats, no comparative discussion of marten population levels is warranted.

Otter (*Lutra canadensis*)

Otter activity was very much in evidence this summer (Figure 4). Sightings and sign were again concentrated near marine beaches, with secondary concentrations along clear bodies of fresh water, principally South Deception Lake.

Sightings and sign both suggest that the conspicuousness of otter activity this year was due principally to the presence of large family groups in the study area. One or two groups of five to seven individuals were recorded at Thistle Cove, and another of five occupied lower Palma Valley. Heavy use of den sites along Torch Bay indicated at least one large group there as well. It is difficult to account for the frequency of otter sign along South Deception Lake in terms of the single individual sighted there. Tracks of four were seen at Astrolabe Bay. By contrast, last year's largest known otter group in the study area contained three individuals.

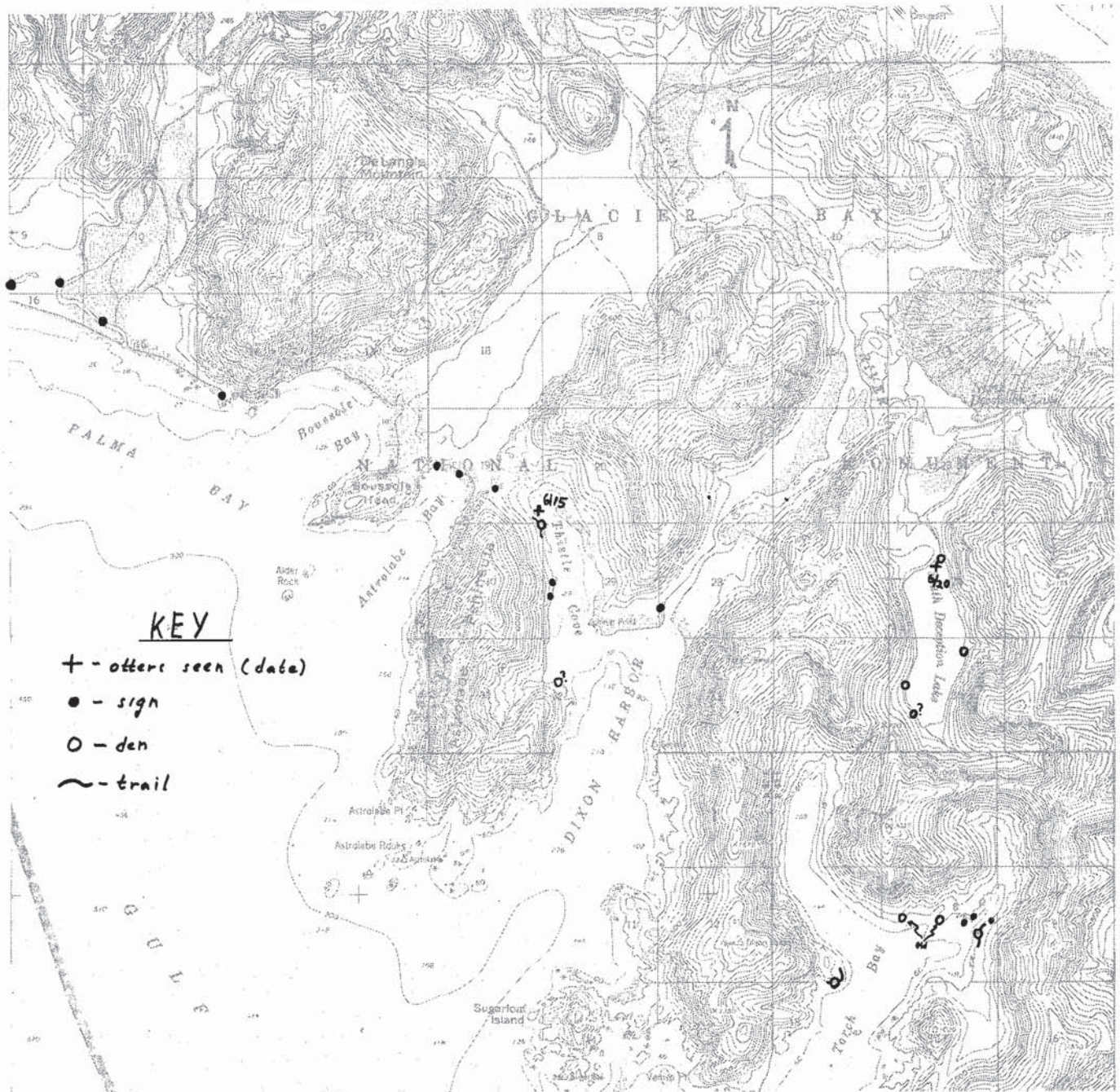
Many localities along Torch Bay contained fresh otter sign superimposed upon old mink sign. A re-survey of a portion of the Thistle Cove shoreline heavily used by mink last year also exhibited this pattern.

Definite otter middens were neither common nor large this year. Those found contained remains of Dungeness Crab (Thistle Cove)

RIVER OTTER

Observed Distribution

FIGURE 4



and intertidal invertebrates, principally Cryptochiton (Torch Bay). By contrast, scats were of frequent occurrence. They were composed principally of fish remains (Appendix V).

Firm evidence of otter mobility was gathered this year. The Palma family group left tracks in numerous localities along the river and slough system at the valley mouth. Otter tracks were found on the wolf trail midway between Thistle Cove and Astrolabe Bay. Sappington's data documents extensive mobility along beaches, streams and valley floors during winter as well.

Wolverine (*Gulo gulo*)

A smallish, rather bedraggled individual was seen this summer progressing from Boussole Head, across Astrolabe beach, then onto the Astrolabe peninsula. Its mode of progression supports the author's previous observations made elsewhere in the National Monument and Sappington's winter observations in the study area, that wolverines tend to range across-country, often ignoring established game trails.

Wolf (*Canis lupus*)

Fresh (summer) and old (winter and spring) wolf sign was widespread throughout seaward portions of the study area from Palma to Torch Bay and from sea level to the alpine (Figure 5).

Track measurements (Appendix VI) suggest the presence of four to six individuals during summer, a number which corresponds closely to minimum population estimates of last summer (Streveler, 1974) and of last winter (Sappington, in press). Four of these individuals were recorded with regularity, traveling in many instances in loosely associated pairs.

One or both members of each of the two regular "traveling pairs" apparently ranged the full coastwise breadth of the study area during summer. It appeared that each pair tended to be in a separate area during any given several-day period. Once, however, tracks of four individuals occurred together at Inner Point (Dean, pers. comm.). One of the pairs definitely moved between the study area and Icy Point on two occasions. No evidence was found of wolf movement from the study area southeastward toward the Graves Harbor-Taylor Bay vicinity.

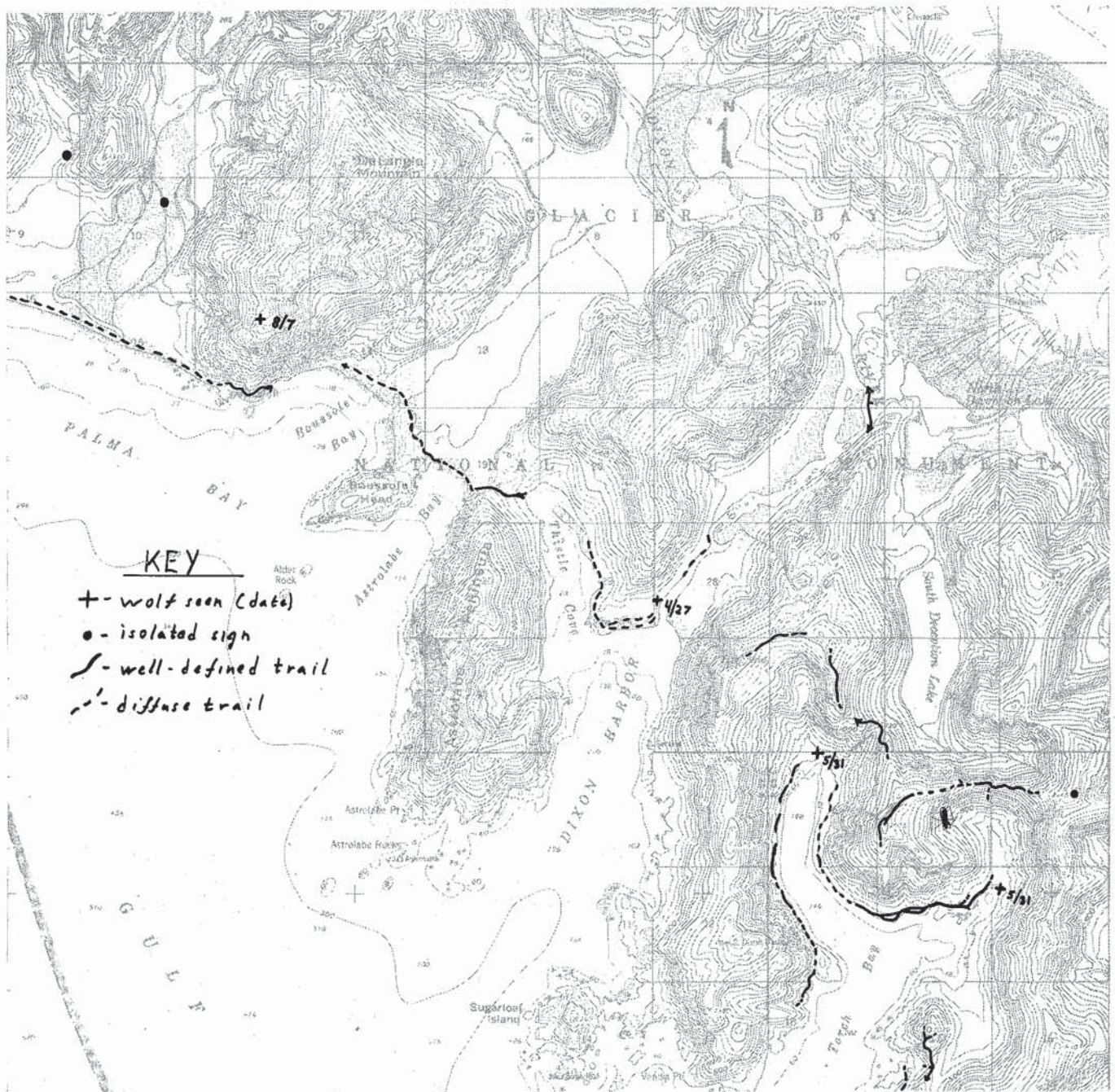
Three or four individual wolves were sighted during the field season. Localities and brief descriptions are given in Table 1.

Sightings and movement patterns suggest that all wolves known in the study area are fully grown and capable of operating as lone individuals. Lack of evidence for breeding during this and last year, the loose association of individuals present, and thoroughfare to the northwest where a pack of at least eight individuals was known to occur in 1973 (Derksen, pers. comm.), suggest that

WOLF

Observed Distribution

FIGURE 5



study area wolves are wide-ranging, non-breeding offshoots of a pack elsewhere along the outer coast.

Other data support this conclusion. Two study area wolves may have had physical impairments: the first individual noted in Table 1, observed very closely, appeared to be an old, somewhat arthritic individual. Tracks of another indicated that it had a crooked foot and may have been slightly crippled. Also, comparison of this and last year's track data demonstrates a high rate of annual turnover among study area wolves: at least two 1974 individuals, both commonly recorded, were not present in 1973.

TABLE 1

Wolf sightings

Inner Point	- black, yellow eyes
Torch Bay	- black with brownish over- tones, yellow eyes
Torch Bay	- reddish brown
DeLangle Mountain	- dark brown with gray over- tones

The last individual is animal #2 in the track data (Appendix VI).

Substantial evidence was found this year for both summer and winter use of the alpine. Scat data (Appendix V) strongly suggest that during both periods a principal reason for alpine use was subsistence on goats. Winter scat distribution also suggests that wolves worked goat winter bedding areas at lower elevations for similar reasons. It may be that dependance on goats was particularly heavy during this low vole year.

Red Fox (*Vulpes vulpes*)

Fox sign first appeared in the central part of the study area during March 1974 and was commonly observed from then through the summer of 1974. No definite evidence of foxes was noted at Torch Bay, though a single small canid (?) scat may have been ascribable to this species. Tracks were common, however, at Palma Bay. This distribution strongly suggests recent (and perhaps temporary) extension of the species into the central part of the study area from the northwest. It is interesting to note that this extension occurred as mice were "crashing" from the very high levels of the previous summer.

Though fox tracks are too small to reliably indicate individual size differences, it was the author's distinct impression that two foxes were present at Palma Bay and that there probably was a single animal utilizing the Boussole beach-Inner Point area. On July 22 tracks of this one individual were noted at the west

edge of Boussole beach leading toward the trail to Palma Bay. An individual seen by Murrell at Thistle Cove on July 8 was about halfway between the Astrolabe and Inner Point beaches. It thus seems very likely that during the study period one of the "Palma foxes" was the individual that ranged sporadically as far south-east as Inner Point.

All fox sign was found in immediate proximity to the sea, except for one instance of tracks about one half mile up the Palma River.

Black Bear (*Euarctos americana*)

Black bears and their sign were found throughout the areas studied this summer, being particularly common in the lowlands adjacent to Torch Bay and particularly scarce in Palma Valley (Figure 6).

Sightings and track analysis (Table 2; Appendix VI) indicate that at minimum, eight to 10 individuals occupied the study area: five or six in the Torch Bay-Deception Lakes vicinity; three in proximity to Dixon Harbor, Astrolabe and Boussole Bays; and perhaps one different individual at Palma Bay. The Torch Bay and Dixon Harbor estimates were made in spring, when bears without cubs tend to gravitate strongly to beaches, and is felt to give a good indication of the number of these individuals in the southeastern two thirds of the study area.

TABLE 2

Selected black bear sightings and track records: Minimum number of individuals in study area

5/22	4-5 bears seen, another tracked, Torch	- 5-6
5/20	1 large bear seen, another tracked, Thistle	- 2
7/21	1 yearling (?) tracked, Thistle	- 1
8/10	1 possibly different individual, Palma	- <u>0-1</u>

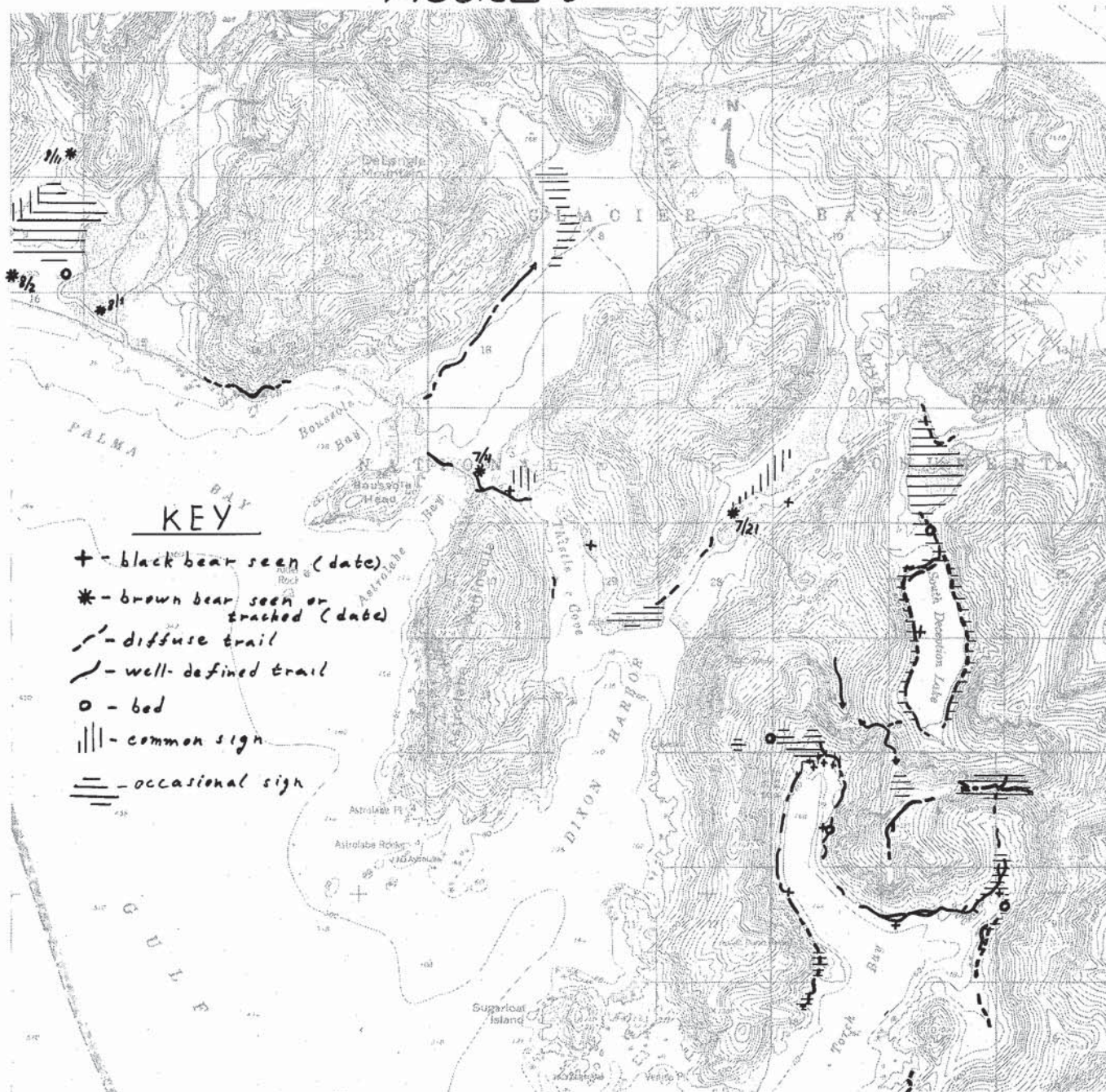
Minimum black bears in study area 8-10

The author saw five different black bears this year; four appeared to be adult males judging from size and proportions of the neck and head. For the second successive year, females with cubs were neither seen nor noted via sign. Studies elsewhere in Alaska have shown that sows with cubs avoid other bears, and that black bears generally remain within a few miles of their birthplace (Erickson, 1965a). It thus seems likely that black bear reproduction does occur in the study area.

Black bear distribution changed through the study period in an apparently seasonal fashion. In early May, virtually all sightings and sign were confined to beaches and immediately adjacent meadows, forests and shrublands. By mid-June, bears had become much less conspicuous, having shifted the bulk of their activity to a variety of shrubby habitats at low and middle elevations

BLACK & BROWN BEAR

Observed Distribution & Abundance
FIGURE 6



along the coast and in interior valleys. Occasional use of the low alpine appeared to begin about this time, and to increase slowly to moderate use levels by late July, when alpine grazing and use of snowbeds as places to escape biting insects was evident. This pattern persisted until August, except for an apparent tendency to favor sub-alpine habitats as the season progressed.

By no means were individual black bears confined to a single valley. Trails and passes between the arms of Torch Bay, Torch Bay and the Deception Lakes, Thistle Cove and Boussole Valley, and Boussole Valley and Palma Bay all showed evidence of thoroughfare. No evidence of passage between the Dixon Harbor and Torch-Deception areas was noted, however.

Based on three days of observation in July 1974, sign in the central portion of the study area seemed distributed differently in several respects than that of last summer. Less sign than last year was found on the west side of Thistle Cove and in the Dixon Valley marshes. Boussole Lakeshore showed less sign than last, while more sign was found in adjacent portions of Boussole Valley. No clear impression regarding change in black bear abundance from 1973 to 1974 was obtained.

Analysis of scats collected in widespread localities in the study area during May - July documents heavy dependence on plant material (Appendix V). The diet during May, just after emergence from hibernation, consisted principally of beach graminoids. Evidence of grazing on Elymus arenarius, Deschampsia cf. caespitosa, and Carex Lyngbyaei was often seen. In June there was a shift away from beach vegetation and toward meadowland species of middle elevations. During this time, sign of heavy use of Carex macrochaeta was noted. The July diet seemed more heavily oriented toward subalpine species, notably Fauria crista-galli, and Athyrium filix-femina. In contrast to last year, very little evidence of skunk cabbage (Lysichiton) use was encountered despite its continued abundance.

No study area data are available for August - September. The author's experience in similar habitat elsewhere in Southeast Alaska supports generalizations made by Erickson (1965a) and Meehan (1974) that black bears depend heavily on berries and sometimes on fish during this time. Just before hibernation in October and early November, grasses may again become important.

Brown Bear (Ursus arctos)

Evidence of brown bears was found, generally sparsely, throughout seaward portions of the study area (Figure 6). Sign abundance seemed inversely related to that of black bear, being most common at Palma Bay and nonexistent at Torch Bay except for the remains of a yearling or two-year old that had been dead on the beach for about a year.

Evidence for the presence of at least four living individuals was found, two of which were a sow and first year cub (Appendix VI). This minimum estimate for the entire coastal extent of the study area corresponds closely with that made last year in the study area's central portion. However, brown bear habits make it difficult to assume any relationship between these minima and the total population. Erickson (1965b) notes that several attempts to measure brown bear abundance in portions of Southeast Alaska using various techniques (including track measurements) have given inconclusive results.

Inspection of 1973 and 1974 track data (Appendix VI) at first raises the possibility that the same bears were noted each year; that they simply grow larger during the interval between measurements. However, data from Kodiak Island (Appendix VI) suggest that brown bear front foot widths of the sizes measured in 1973 increase an inch or less annually. Thus, it is unlikely that more than one of the "1974 bears" was recorded in the 1973 track data.

As during last summer, no brown bear sign was noted in the middle portion of the study area until early July, after which time the presence of two individuals was noted on several occasions. By contrast, tracks, scats and signs of grazing noted in early August at Palma suggests prolonged residence by one to three brown bears, principally in the brushy forests of Palma Valley's west side. There is evidence of coastwise brown bear movement along trans-headland trails to and from Palma Valley, both toward Icy Point and Boussole Bay. These facts, taken together, tend toward the conclusion that during both summers the principal seat of brown bear activity has been in the northernmost coastal part of the study area and thence northwestward, from which area several individuals have made forays into central parts of the study area as the season progressed.

All definite brown bear sign was located below 300 feet elevation, and, except in a single instance, within one mile of the sea. Dense shrublands seemed to be the principal habitats occupied, though forays onto beaches, meadows and river outwashes were occasionally made. Typically, Southeast Alaskan brown bears utilized open habitats extensively, especially during spring (Erickson, 1965b; Meehan, 1974).

Little is known at present about brown bear diets in the study area. Three August scats from Palma Valley consisted mainly of horsetails and skunk cabbage. Great geographic variability in brown bear food habits (cf. Erickson, 1965b; Clark, 1957) makes extrapolation from the literature undesirable.

Deer (*Odocoileus hemionus*)

A careful and extended search for deer sign in the Torch Bay-Deception Lakes vicinity produced negative results, as did last year's effort in the Dixon Harbor-Boussole Valley vicinity.

Carnivore scats have contained no deer remains. Its very likely that deer are not presently found in the study area.

Moose (*Alces alces*)

The alder-willow flats of lower Palma Valley lie adjacent to Icy Point, where moose have been sighted by fishermen and pilots since 1966. However, a thorough search during August turned up no evidence of moose at Palma. Adding these negative results to those of last year from the Dixon and Boussole Valleys, it can be stated with some certainty that moose are not presently found within the study area.

A visit by geologists of the study team to Icy Point in June produced no records of moose or their sign. These investigators also noticed little sign between Lituya Bay and Crillon Lake during a two month field project in 1973 (not connected to the present study). If moose populations in these coastal localities northwest of the study area are not sizeable at present, there may be little impetus for range expansion. It is noteworthy that the largest nearby moose population, in the Yakutat vicinity, began a decline in 1971 from which it has not yet recovered.

Mountain Goat (*Oreamnos americana*)

The study area's only known ungulate is distributed in loose herds, each occupying the alpine portions of a single massif during summer (Figure 7). Population estimates for six massifs were obtained by repeated land-based observation (Table 3).

TABLE 3

Maximum goat counts for study area massifs

<u>Massif</u>	<u>1973</u>	<u>1974</u>			
	<u>Total</u>	<u>Total</u>	<u>Ad.</u>	<u>Yearling</u>	<u>Kid</u>
Mtn. W of Torch Bay	29	32	20	3	9
Mtn. NE of Thistle Cove	18	23			
Astrolabe Peninsula	24	28			
DeLangle Mtn.	22	13			
Subtotal	93	98			
Mtn. N of Torch Bay		36	28	3	5
Mt. Marchainville		2*			
1974 Total		136	48	6	14

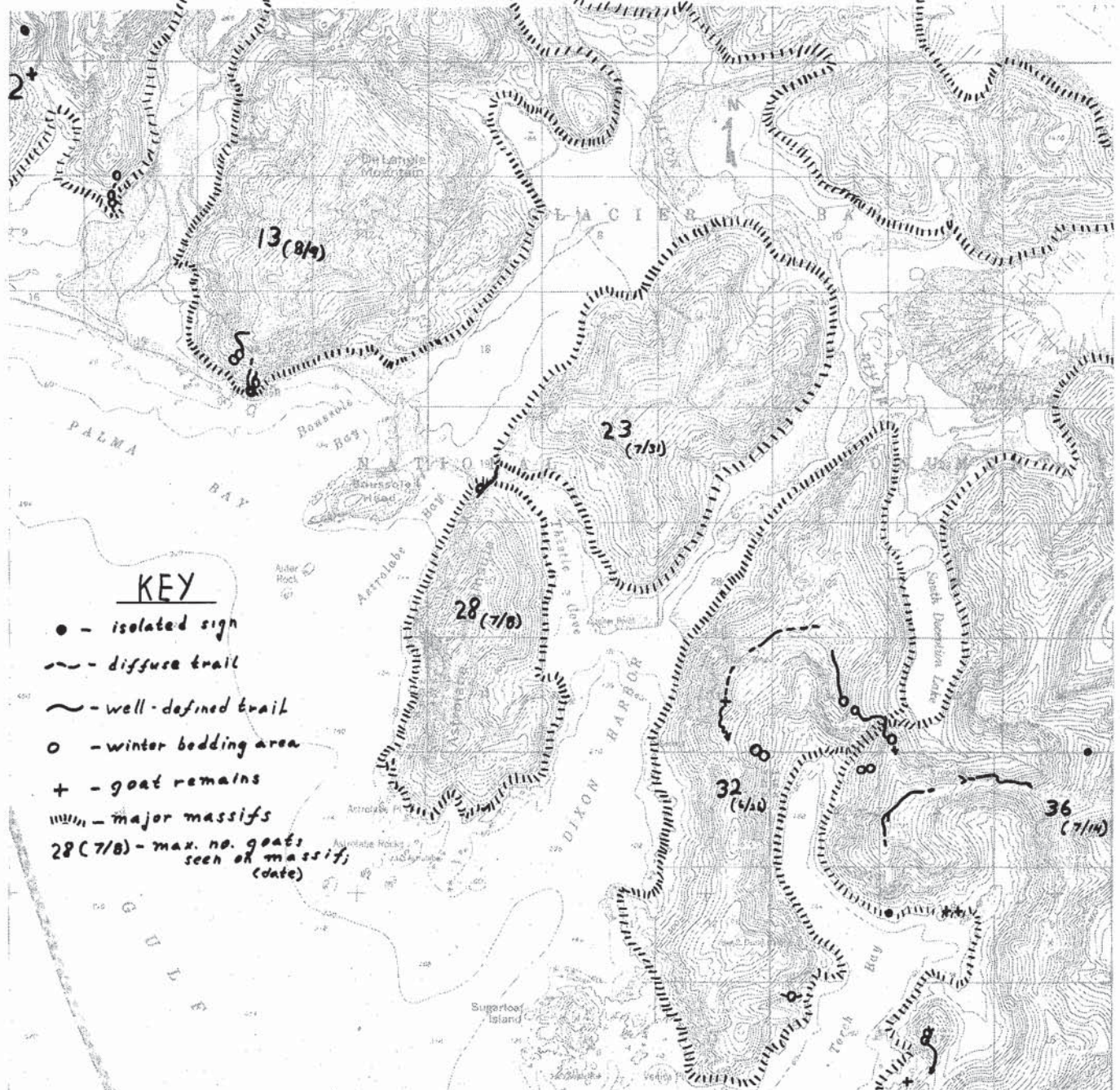
*Spring and winter sign of at least two individuals noted, but none seen despite careful aerial and ground-based scanning.

These counts are probably not inflated by duplication. Careful monitoring of lowland trails during two summers has produced only four records of goat passage (usually lone individuals) from

MOUNTAIN GOAT

Observed Distribution & Abundance

FIGURE 7



one massif to another. On the other hand, there may be biases leading to under-estimation. Wandering individuals and small groups are easy to miss on a given day, and two massifs near the Brady Glacier remain unsurveyed. However, only a few lone individuals seem to be present on any one massif, and the massifs near the Brady are unlikely to have substantial populations, judging from the author's general observations of these and similar localities. It is likely, therefore, that the 1974 total of 136 individuals is a reasonably close, if somewhat low, estimate of the study area goat population.

Population sizes seem not to be correlated with the extent of alpine summer range on the various massifs (Figure 7); thus, the likelihood that summer range is limiting to goat populations seems small, unless there are substantial variations in range quality. It may be significant, however, that goats seem to use only a fraction of the total alpine range. Especially in mid and late summer, they tend to concentrate near permanent snow patches where it is cool and where avoidance of biting insects is most successful.

Here, as elsewhere along the Gulf Coast (Hjeljord, 1971) winter range appears to be quite restricted. In the study area it is characteristically concentrated in steep, forested terrain fronting on the sea, where cliffs, beaches and ravine edges provide numerous overlooks and windswept sites. It may be that food is most limited in this habitat.

Hjeljord (1971) suspects that on Kodiak Island the principal mortality factor is winter accidents on treacherous upland terrain. Predation may also affect goat population sizes in the study area, though unlikely on Kodiak where wolves are absent. Wolf scat analysis and activity patterns during summer and winter, as inferred from sign, both suggest considerable wolf interest in goats as a food source.

The near-identity of 1973 and 1974 census totals on goats suggests that the overall study area population size has changed little during this period (Table 3). Assuming a constant population size, available age class data suggest about a 60% ($\frac{3}{4}$) mortality rate during the first year of life, and an average annual adult mortality of somewhat over 10% ($\frac{1}{10}$). The proportion of kids (.27) in late summer is much smaller than that (.57) of the transplanted and expanding Kodiak Island population (Hjeljord, 1971).

Though no careful dietary analyses have been made, repeated alpine observations have produced surprisingly few signs of heavy foraging, given the considerable amounts of time goat herds spent in restricted localities. The species evidencing heaviest use was Carex macrochaeta. By far the most obvious impact of goats on their habitat is the disturbance of soil and vegetation due to the digging of dust-wallows. These common features of alpine uplands are often then enlarged by wind, water and rodent activity.

DISCUSSION AND CONCLUSIONS

Size of the Fauna

28 species of larger terrestrial mammals occur elsewhere in northern Southeast Alaska (Manville and Young, 1965). Of these, 15 are now known to occur in the study area. The snowshoe hare may be present as well, but winter data from Palma Valley is needed to evaluate this possibility. The status of such generally inconspicuous or uncommon species as the lynx, flying squirrel and various bats remains unknown.

It is likely that geography has played a key role in determining the size of the study area fauna. The segment of outer coast which includes the study area is essentially an island, being of limited size and surrounded by formidable barriers to mammal dispersal (Figure 8). "Islands", whether isolated from the "mainland" by water or other barriers to dispersal, place special constraints on faunal size.

These constraints have been discussed at length by MacArthur and Wilson (1967), and more recently by Young (1973) and Terborg (1973). These authors point out that, in theory, island faunas are strongly influenced by island size (which tends to control the rate of extinction) and degree of isolation (which tends to control the rate of immigration). When these two parameters are essentially constant over long periods, an island's fauna approaches a dynamic equilibrium characterized by an essentially constant number of species present.

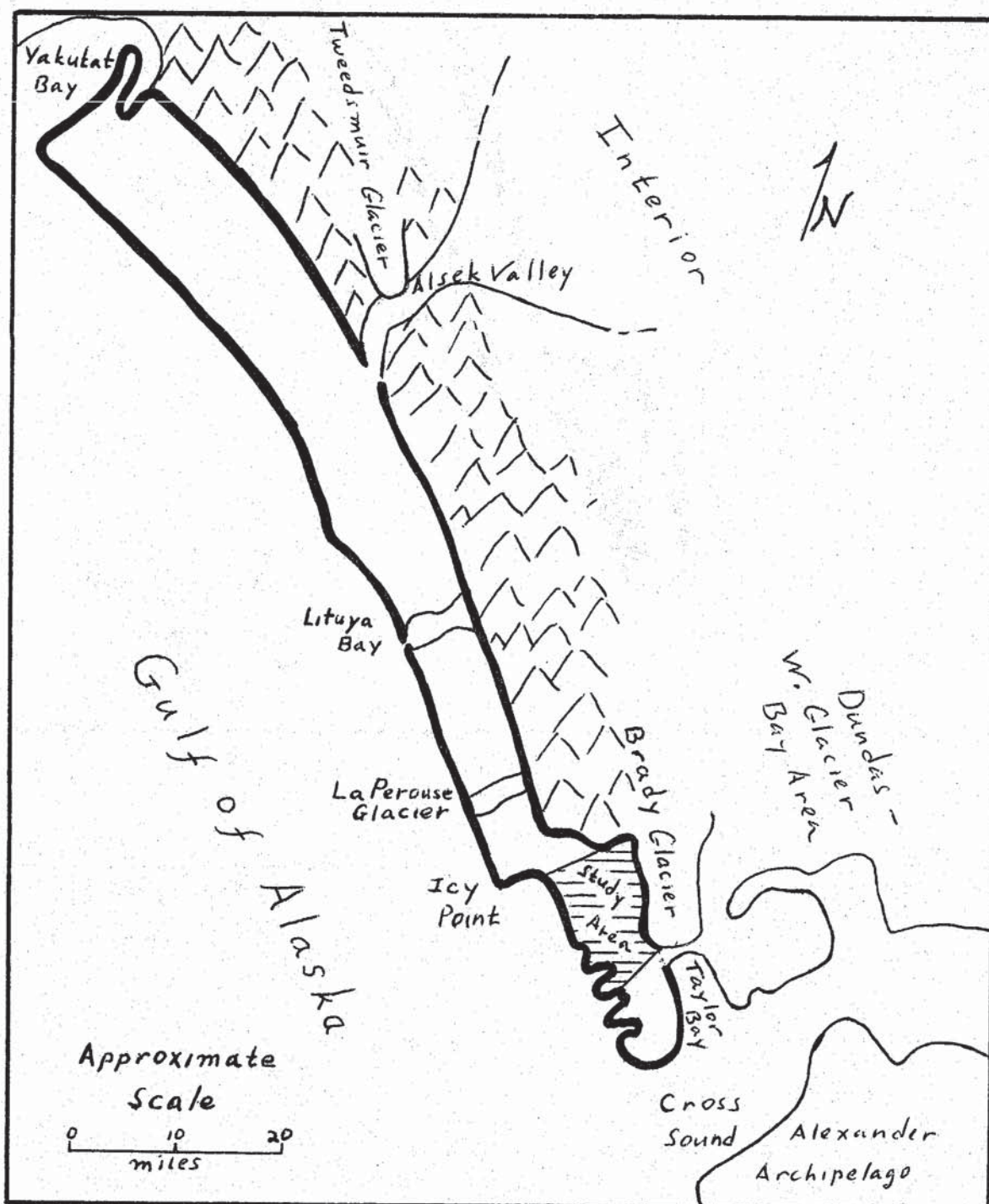
However, in instances when island boundaries are dynamic, size and degree of isolation become inconstant. The result is a shifting theoretical equilibrium point: that is, temporal variation in faunal size is encouraged. If the fluctuations of an island's size and degree of isolation can be determined through a period of time, it then should become possible to trace the theoretical tendencies toward faunal expansion or contraction during that period.

Boundaries of the "outer coast island" have been altered considerably during the last 15000 years, principally due to variations in glacier dynamics and land/sea relationships. The major features of these changes, insofar as known or reasonably inferred, are outlined below.

"Island" Size. During Late Wisconsin time, the "outer coast island" was partially buried by a number of large valley glaciers and piedmont ice masses generally aligned at right angles to the coast. Only segments of the lowland between LaPerouse Glacier and Yakutat Bay, perhaps joined to a strip of continental shelf exposed by lower sea levels, remained free of ice and above the sea (Streveler and Paige, 1971; Goldthwait, et. al., 1963; Klein,

FIGURE 8

*Schematic Representation of the
"Outer Coast Island"*



1965; Derksen's Figure 1, this volume).

As Wisconsin ice waned, the gain in newly ice-free lands was in part counterbalanced by losses to the sea. A combination of higher sea levels, isostatically depressed land levels and paucity of valley fill resulted in dissection of the area south of Icy Point into small islands, and in marine transgression upon coastal lowlands to the north of that point (Derksen, 1974; Derksen, Figure 3, this volume).

During Hypsithermal time, the islands south of Icy Point were very likely rejoined to each other and to the main portion of the "outer coast island" by isostatic rebound and fluvial activity (Derksen, this volume). Climatic conditions somewhat warmer and drier than at present (Goldthwait, 1966) probably resulted in substantial glacier shrinkage and accretion of biotic lands. LaPerouse Glacier, which at present oscillates at the sea coast, was probably of no consequence as a partial impediment to mammal movements at that time. Lituya Bay was reduced in width or spanned by outwash deposits (cf. Goldthwait, et. al., 1963), and thus was also less significant than at present in dissecting the "outer coast island" into smaller segments.

The onset of the Neoglacial period was marked by glacial readvance which resulted in considerable shrinkage of "island" size (Derksen, this volume; Goldthwait et. al., 1963). Neoglacial ice at its maximum directly covered substantial acreages of biotic lowlands, and, by virtue of its complete occupation of the Lituya (and probably the LaPerouse and other) depressions, tended to dissect the "outer coast island" into several pieces.

Since the Neoglacial, these tendencies have reversed, producing conditions of "island" size approaching those of Hypsithermal time. Ice masses are considerably shrunk; LaPerouse Glacier bares a strip of beach on most years. Only Lituya Bay, now a narrow marine fjord, provides a potentially significant interruption in the contiguity of "island" lands.

"Island" Isolation. Tweedsmuir and Brady Glaciers straddle small segments of the "outer coast island" boundary (Figure 8). As in the cases of LaPerouse and Lituya Glaciers, their frontal positions and/or outwash discharges have had an effect on "island" size that follows the pattern discussed above. But beyond this, these boundary segments take on significance as potential isthmuses connecting the "island" to large biotic lowlands that may serve as reservoirs for immigration. More than any other factors, they appear to have controlled the variability in the "outer coast island's" isolation from the "mainland".

The first of these isthmuses - outwash controlled by the Brady Glacier in Taylor Bay - links the "outer coast island" with the Dundas - west Glacier Bay area. Though large, this area's significance as a faunal reservoir is restricted by its own essen-

tially insular nature. However, the second isthmus, controlled by the Tweedsmuir Glacier in Alsek Valley, provides a link with the much richer fauna of the continental interior.

These isthmuses have, at present, been open for somewhat less than 200 years (Derksen, this volume) and 50 years (Klein, 1965), respectively. Both were closed by ice for at least portions of the Neoglacial (Derksen, Klein, op. cit.). Climatic conditions during the Hypsithermal strongly favored glacier retreat and formation of extensive outwash plains (Goldthwait, 1966) which, in turn, would have favored opening of both isthmuses. Their early post-Wisconsin status is unknown; however, Klein (1965) suggests the possibility of an ephemeral connection with the newly deglaciated Alexander Archipelago via a strip of continental shelf during this time. All isthmuses were certainly closed during the late Wisconsin.

The results of the foregoing discussion are depicted graphically in Figure 9.

The most evident suggestion arising from Figure 9 is that during periods of glacial severity, constraints on both "island" size and interconnection with other biotic areas have tended to be maximal. If these tendencies are accurately identified and sufficiently pronounced to exert an appreciable influence on faunal size, and if the outer coast fauna is capable of responding to these influences within the time-frames available, then theory predicts a linkage between glacial severity and faunal depauperation. Pending evaluation of the above reservations, it may thus be stated as a working hypothesis that the coastal region, including the study area, supported relatively few species during and just after the Wisconsin ice age; that a larger fauna developed during Hypsithermal time, but was again reduced by Neoglacial conditions; and that faunal expansion is occurring at present. The last portion of the hypothesis is consistent with the observation that in recent decades at least three and probably four mammals - moose, coyote, beaver and snowshoe hare - have become established on the coast and are radiating toward the study area.

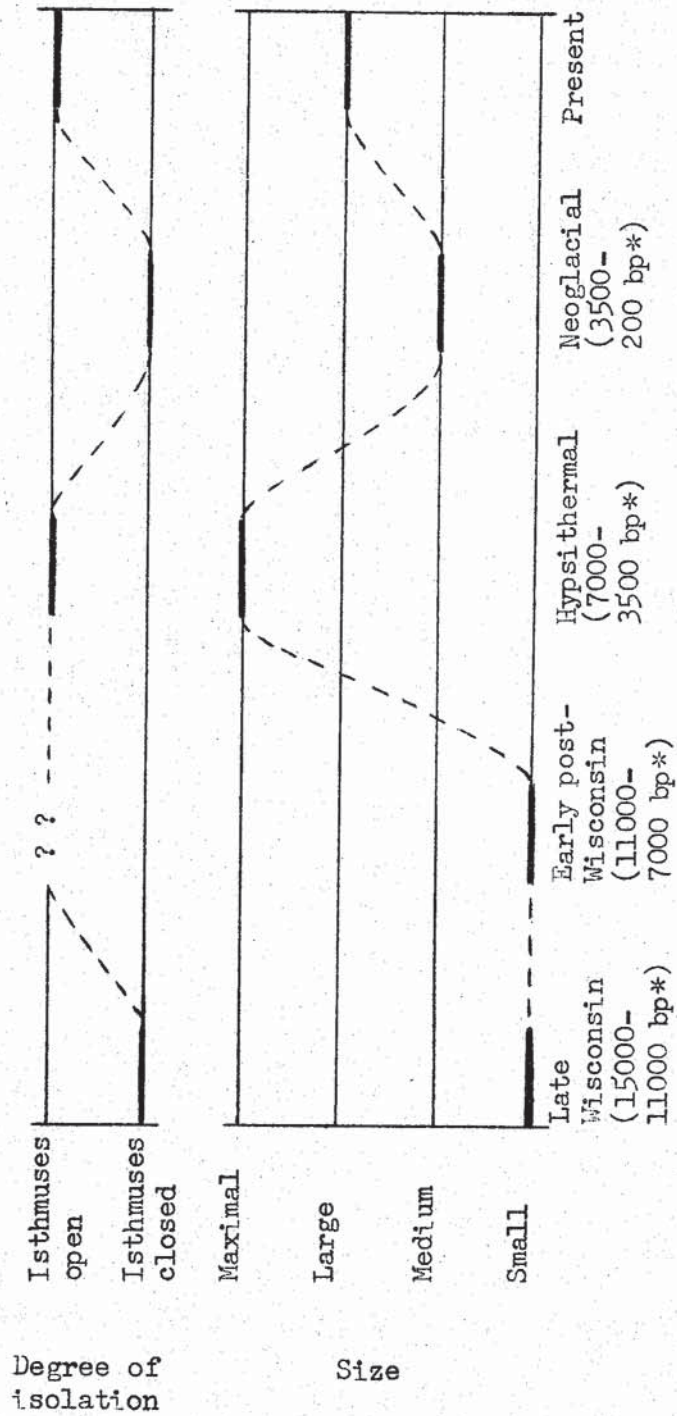
Faunal Origins

Wisconsin ice almost certainly excluded all larger mammals from presently terrestrial portions of the study area and from virtually all of northern Southeast Alaska. The fauna reconstituted since retreat of the ice has been derived from two or three principal sources (Klein, 1965): 1) interior and western Alaska; the continent south of the Wisconsin ice sheet; and 3) perhaps local refugia such as those postulated to exist near Lituya Bay and on the exposed continental shelf. Refugia in the Queen Charlotte Islands may be of minor importance in this context (cf. Foster, 1963).

Klein provides evidence that the brown bear has arrived from the

FIGURE 9

Apparent fluctuations in "outer coast island" size and isolation from other biotic lowlands



* Dates approximate, after Streveler and Paige, 1971

north, while the wolf, goat and black bear originated in the south. The origin of other species is obscure, but may involve the local refugia, if in fact any larger mammal species were able to survive there. Survival in these small areas would seem most likely in the cases of species with: large population densities; small home range requirements and/or ability to traverse glaciers and barren country; high reproductive rates; ecological plasticity, including the ability to withstand periglacial conditions. None of the largest mammal species of the study area appear to conform closely to this group of criteria. Klein (1965) has reached a similar conclusion regarding the Southeast Alaskan fauna in general. Perhaps the most probable refugium survivors are to be found among the rodents and smaller mustelids.

Faunal Composition

The present taxonomic composition of the larger terrestrial mammal fauna of the study area differs considerably from that of northern Southeast Alaska in general (Table 4).

TABLE 4

Taxonomic composition of larger terrestrial mammal faunas,
study area vs. northern Southeast Alaska

<u>Group</u>	<u>No. species</u>	
	<u>Northern SE Alaska*</u>	<u>Study area</u>
Bats	4	1
Rabbits and pikas	2	0
Larger rodents	7	3
Mustelids	6	6
Canids	3	2
Ursids	2	2
Felids	1	0
Ungulates	3	1
Total	28	15

* Data from Manville and Young, 1965 (a dubious record of the arctic ground squirrel is not included).

The differences between the species lists of Table 4 lie principally in the herbivorous groups; only four of the 12 northern Southeast Alaskan species are known to occur in the study area. By contrast, 10 of the 12 carnivorous and omnivorous species (excluding bats) are present.

Three of the four herbivorous species in the study area may reasonably be considered "common". Of these three, the porcupine appears to be generally impervious to predation. This leaves the mountain goat and red squirrel as common herbivorous prey species for mammalian carnivores and omnivores. The goat is generally unavailable as prey to all but the largest predators due to its size, herd behavior and habitat choice.

It is reasonable to postulate that this scarcity of larger herbivorous mammals has influenced the presence and abundance of carnivores. Canids and felids, which tend to depend upon such prey, either extend tenuously into the study area or are absent; on the other hand, mustelids, which depend heavily on mice and marine resources, are fully represented and generally common. The expected natural arrival of moose, beaver and snowshoe hare may thus have pronounced effects on canid and felid distribution and abundance in the study area.

Patterns of Faunal Distribution

Known larger mammal distribution patterns in the study area will first be summarized in this section according to habitat and then according to geography. The first of these analyses is given in Figure 10. Winter data from Sappington (in press) add considerably to those derived from summer observation and sign interpretation in the case of mustelids, and ^{are} included for these species.

Present information thus suggests that: 1) The greatest number of species occur in forests, moraines and outwashes, shrublands, and supratidal meadows; while aquatic habitats, peatlands and snowbed margins contain the fewest species. 2) Most habitats contain at least two species in greater than average abundance and/or at least one species in great abundance; only peatlands, shrublands, moraines and outwashes, and snowbed margins are excepted.

The analysis in Figure 10 does not illustrate an additional fact; that larger mammal use of habitats is often concentrated at their margins.

Figure 11 indicates geographic localities in which, according to 1974 data, at least two species occurred in greater than average numbers or where one species was very abundant. Identical treatment of 1973 data will be found in Figure I-9 of last year's report. It will be noted that, as a rule, concentrations of mammals were found in alpine areas and along a variety of topographic interfaces, most consistently those involving a shoreline. The evident shifts in areas of mammal concentration depicted within central portions of the study area between 1973 and 1974 are due principally to changes in bear and mustelid distribution and/or abundance.

Further discussion of lowland species' distribution patterns is facilitated if the study area is divided into three geographic sub-units: Palma Valley, the Dixon-Boussole area, and the Torch-Deception area.

Palma Valley is notably barren of wildlife sign except in its lush western margin and along its marine beach. Its principal apparent significance is that of a conduit between the central portions of the study area and points northwestward, though brown

FIGURE 10

Larger terrestrial mammal distribution in various habitats
1973 and 1974

Habitat	Bat	Porcupine	Squirrel	Marmot	Mink	Marten	Otter	Wolverine	Fox	Wolf	Black bear	Brown bear	Goat	No. species present (+,*,●)	No. species with greater than average abundance (*,●)	No. species with much greater than average abundance (●)
Inshore marine waters	-	-	-	-	*	-	●	-	-	-	-	-	-	2	2	1
Rocky shores	-	-	-	+	●	-	●	+	+	+	+	+	-	8	2	2
Beaches	-	-	-	-	+	-	*	+	*	*	*	+	-	7	4	0
Supratidal meadows	-	+	-	+	+	+	-	+	+	*	●	+	-	9	2	1
Spruce parklands	-	-	+	+	●	+	*	+	-	-	+	+	-	8	2	1
Spruce forests	+	+	*	-	+	●	+	+	-	+	+	+	+	11	2	1
Hemlock forests	-	+	+	+	+	●	+	+	-	+	+	+	+	11	1	1
Peatlands	-	-	-	-	+	+	-	+	-	-	+	+	-	5	0	0
Coniferous subforests and shrublands	-	-	-	-	+	+	-	+	-	-	*	●	+	6	2	1
Deciduous shrublands	-	*	+	+	+	+	-	+	-	-	+	+	+	9	1	0
Marshes	-	+	?	-	+	-	+	-	-	-	●	*?	-	5	2	1
Fresh water	-	-	-	-	*	-	*	-	-	-	+	+	-	4	2	0
Barren moraines and outwashes	-	*	-	-	+	+	+	+	+	+	+	+	+	10	1	0
Cliffs and gullies	-	*	-	+	-	-	-	+	-	+	+	-	●	6	2	1
Alpine fellfields	-	-	-	+	-	+	?	-	+	-	*	+	-	6	2	0
Alpine meadows	-	-	-	*	-	+	?	-	+	-	*	*	-	6	4	1
Alpine snowbed margins	-	-	-	+	-	-	-	+	-	+	+	-	*	5	1	0

Key: - Species absent or essentially so
+ Species present as more than occasional transient
* Species present in greater than average abundance
● Species present in much greater than average abundance

bear, foxes and porcupines are noteworthy residents.

The Dixon-Astrolabe-Boussole area, with its varied and substantial complement of beaches, lowlands and aquatic habitats, contains the most substantial populations of mammals. Goats and black bears are common residents. Foxes and brown bears extend in from Palma Valley. Wolves and wolverine(s) also range the area from the northwest, and appear to reach the southern limit of their winter territories here. Mustelids of all kinds are resident or (in the wolverine's case) transient.

The southern most sub-unit of the study area is seldom occupied by brown bears and, perhaps, never by foxes. However, goats, black bears and such rocky beach animals as otters and mink are common along Torch Bay and to some degree along South Deception Lake. The flats and barrens between South and North Deception Lakes lack any notable concentration of mammals.

Most large mammal movement between these three areas occurs via low passes and (in the case of wolves) alpine ridges. Of the headlands, only those bounding Palma Valley contain important mammal trails.

Sign analysis by the present author and by Sappington (in press) suggests that canids and wolverines are the most mobile carnivores. Ursids are moderately mobile, both within and between the individual areas, especially in late summer. Otter and smaller mustelids show moderate winter mobility at least within a given area and roam more extensively at least upon occasion; summer mobility is poorly known.

Squirrels, porcupines and marmots seem generally quite sedentary, though the presence of occasional squirrels and marmots in isolated localities suggests that certain individuals may at times wander extensively.

Mountain goat populations straddle the boundaries of the lowland areas described above. Movement of goats across lowlands does occur on a limited basis, however, at least during winter.

Potentials for Human Impact

Certain properties of the study area fauna deserve amplification in the context of potential human impact.

Ecological Considerations. Scarcity of larger mammalian herbivores probably makes establishment of any additional herbivorous species that arrive unusually likely. Man may thus alter existing faunal relationships either by direct introduction (e.g., rabbits) or by indirect assistance in dispersal toward the study area (e.g., introductions, population increases in the Yakutat vicinity).

Addition of herbivores may well change the status of carnivores. Canids (and felids?), provided with a more diverse prey base, may become more solidly entrenched in the study area. This might in turn have an (depressive?) effect on mustelids such as otter, mink and marten, which now may enjoy particularly high population levels in part as the result of canid scarcity; canids are demonstrably capable of predation upon mustelids and mustelid foods in the study area.

Increasing canid abundance and/or diversity would very likely cause marmots to become more highly restricted to alpine habitats. It could also substantially reduce goat use of lowland winter habitat; reduced winter habitat in turn may limit goat abundance.

On the other hand, the tenuousness with which canids are established in the study area makes them particularly sensitive to competition or harassment by man or feral carnivores. Total elimination of the study area's wolves seems intuitively probable in the face of even moderate impact.

Medium-sized mustelids are highly dependant on microtine and inshore marine resources. The latter, especially, might be effectively eliminated by human habitat alteration or mustelid timidity in the face of human sea-side development.

Bears have shown no tendency thus far to gravitate toward human activity in the study area, but experience elsewhere in Southeast Alaska suggests that black bears, especially, may be expected to do so when the rewards (garbage, etc.) are sufficient. Bear distribution and behavior (and abundance?) would change substantially as a result.

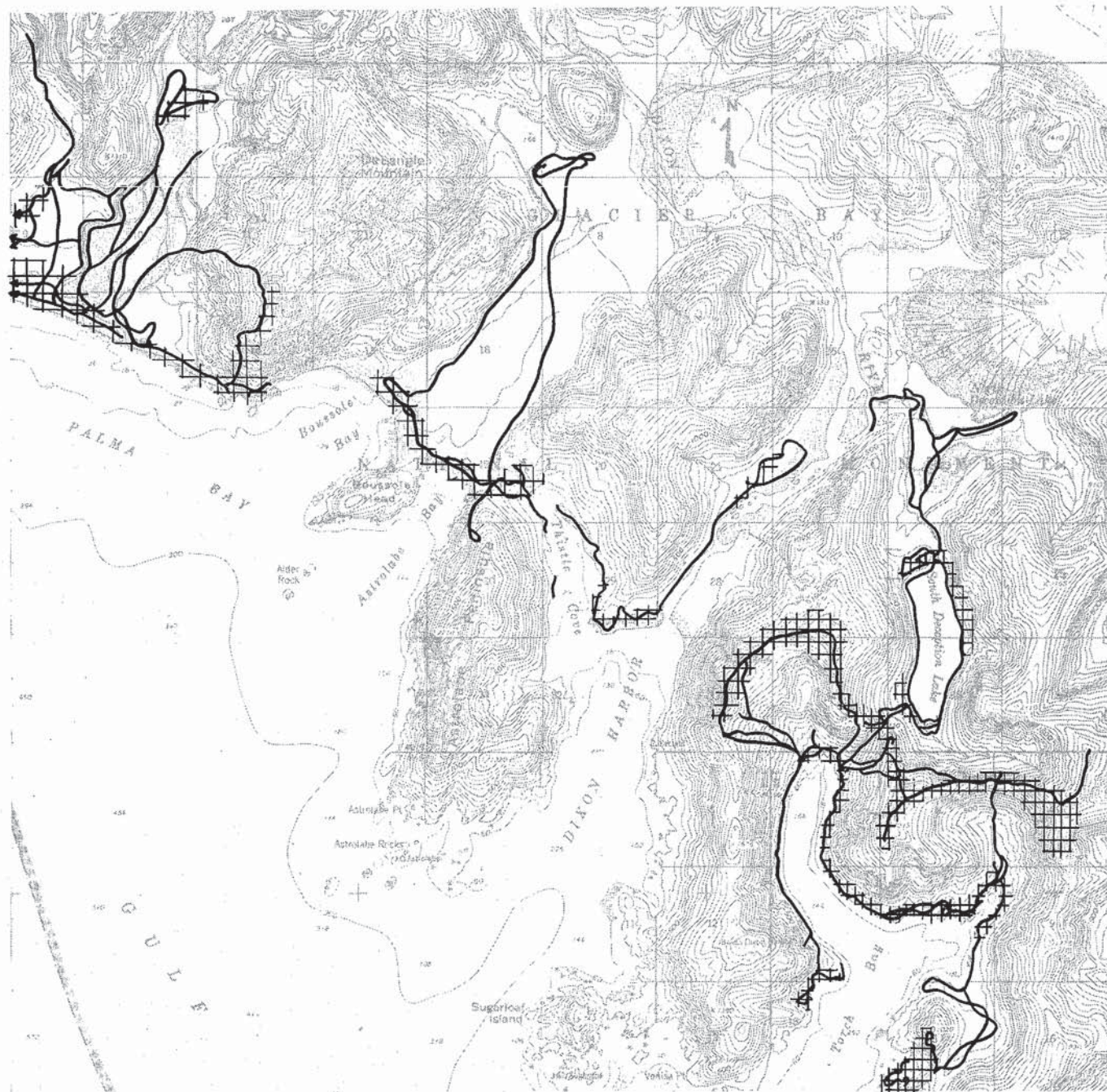
Geographic and Habitat Considerations. As illustrated in Figure 11 and the associated discussion, mammal concentrations tend to occur in certain classes of geographic localities. Human activity may generally be expected to have maximum impact on larger mammals when it is focused on these localities. It is possible to refine this statement by consideration of certain specific sites which seem especially critical to larger mammals in the study area.

The trail junction atop the Astrolabe Bay-Thistle Cove escarpment is discussed in last year's report. Palma, Boussole, Astrolabe and Inner Point beaches are regularly traversed and scavenged by a variety of carnivores; enforced shifting of mammal travel away from these beaches and trails would necessitate selection of more difficult routes and/or remove a source of food. Both these effects would be most critical in winter.

Dixon Valley marsh and the cedar subforests near Palma Bay contain unusual amounts of summer bear foraging sign; beaches of

AREAS OF MAMMAL CONCENTRATION COMPARED TO INVESTIGATOR'S COMPOSITE ITINERARY

FIGURE 11



uppermost Torch Bay are heavily foraged by black bears, and to a substantial extent by wolves, in spring. Spring foraging areas are of especially limited extent and may be critical for bears when they are emerging from hibernation.

Brown bear use of the study area seems concentrated in restricted localities, the disturbance of which could lead to complete or near elimination of this species. (Brownies resident along the southeastern fringes of Glacier Bay National Monument have ceased using substantial areas in the vicinities of human development.)

Goat winter use areas (Figure 7; Figure I-8 of last year's report) extend into lowlands on steep, forested headlands and near-shore valley walls in the relatively few localities where shelter, view and wind-exposed feeding sites are all available. Goats appear to use such localities when other range is unavailable due to weather and snow conditions; any deterioration in, or reduced availability of, these localities may be reflected directly in goat population levels.

SUMMARY

15 terrestrial mammal species larger than mice are known from the study area, as compared to 28 for northern Southeast Alaska in general. Herbivore species are especially few in number, while mustelids and ursids are fully represented.

Mountain goats and black bears are the most numerous large mammals. Mink and otters are prominent among the medium-sized species, while the red squirrel is a conspicuous smaller resident.

Greatest mammal abundance is generally found in a variety of habitats in the low alpine and along geographic interfaces, principally those interfaces involving shorelines.

Thoroughfare between valley systems (except in the Torch Bay vicinity) is considerable, principally via coastwise trails. Substantial faunal relationships exist with the lowlands to the northwest, in terms of 1) present animal interchange and reproductive centers, and 2) past and present immigration toward and into the study area.

Conditions during Wisconsin time probably exterminated the larger terrestrial mammal fauna of the study area and severely reduced that of adjacent coastal lowlands. Faunal reduction was probably favored again during the Neoglacial, when conditions were less conducive to immigration and more conducive to extinction than during the Hypsithermal or the present.

Post-Wisconsin large mammal colonists were derived from central and western Alaska, as well as from continental areas south of Wisconsin ice. Local refugia may have retained some species, such

as rodents and the smaller mustelids.

Human alteration of the status quo may have serious consequences when it infringes upon the status of study area herbivores; upon the more sensitive carnivores (e.g., wolf, brown bear); or upon key localities, principally those near shores or in the alpine.

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