WATERBIRD USE OF AND MANAGEMENT CONSIDERATIONS FOR COOK INLET STATE GAME REFUGES

by

Richard Sellers

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The coastal marshes of Cook Inlet have long been recognized as important resting and staging areas for waterbirds during spring and fall migrations. A 1962 spring survey estimated over 100,000 birds utilized Susitna Flats for resting (E.J. Cramer and J.L. Bergstrand, unpublished report of the Alaska Department of Fish and Game [ADF&G]). P.D. Havens (1973, unpublished report for ADF&G) stated that tens of thousands of waterfowl fed and rested on Susitna Flats during the spring. He observed that fall bird use was equal to or greater than spring, and was spread over a longer period. Quimby (1972) reported over 10,000 waterfowl on Chickaloon Flats in spring 1971. A peak concentration of just under 9,000 waterfowl occurred about 1 October, 1970. These estimated "peak populations" did not account for total waterfowl use because the rate of "turnover" was not determined.

Quimby's study and ADF&G aerial surveys begun in 1975 (Timm 1978) revealed the importance of Cook Inlet marshes as waterfowl breeding habitat.

These coastal marshes, in addition to being important to waterbirds, provide hunting and other recreational opportunities in Alaska's most heavily populated area. From 1971 to 1976 approximately 26 percent of the statewide duck hunting effort and 29 percent of the duck harvest occurred in Cook Inlet (Timm). During this period, Susitna Flats and Palmer Hay Flats were the two most popular waterfowling areas in Alaska, averaging 4,473 and 4,150 hunter days per year, respectively. Potter Marsh, Trading Bay and Goose Bay were also among the top 25 waterfowl hunting areas with average hunting pressure of 814, 508 and 522 days per year, respectively (Table 1).

To insure protection and adequate management of these marshes, the Alaska State Legislature created State Game Refuges at Potter Point Marsh (1971), Palmer Hay Flats (1975), Goose Bay (1975), Susitna Flats (1976) and Trading Bay (1976).

The bills passed in 1976 stated that these game refuges were established to protect fish and wildlife habitats and populations and to protect public uses of fish and wildlife, particularly waterfowl , moose and bear hunting, viewing, photography and other recreation. Oil and gas leases were let on some areas of these marshes before refuges were established, and exploration and development have continued under the terms of the pre-existing leases. Future lease agreements would only be made when compatible with the stated purposes of the refuges. The legislation prohibits State aquisition of private inholdings by eminent domain and ensures access to inholdings. However, the Alaska Department of Natural Resources was given authority to adopt zoning regulations under Alaska Statue 44.62 when necessary to insure the intended uses of refuges. Trading Bay State Game Refuge legislation differs from the other bills in that the Department of Natural Resources was directed to establish regulations governing the issuance of permits, for seasonal cabins existing on June 24, 1976. The cabin site permits were not to exceed 5 years, but could be renewed.

Table 1. Waterfowl hunter days and average harvest per day on Cook Inlet Refuges, 1971-1976, calculated from statewide waterfowl hunter mail surveys.

Refuge	Hunter Days						1971-1976 average	Percent of State waterfowl hunter days 1971-1976	Average ducks/ day/ hunter	Average geese/ day/ hunter
	1971	1972	1973	1974	1975	1976				
Susitna Flats	3885	3798	7060	3763	3112	5280	4473	7.9	2.3	0.05
Palmer Hay Flats	3081	3561	4861	4162	4292	4945	4150	7.3	1.5	0.02
Goose Bay	-	-	984	342	161	601	522	0.9	1.6	0.0
Trading Bay	-	594	174	342	697	735	508	0.9	3.0	0.21
Potter Marsh	536	415	810	1170	668	668	814	1.4	1.1	0.0

Although some information existed, ADF&G realized that more ecological information on these refuges was needed to formulate long range game management objectives, especially with regard to oil-gas development, interspersion of land ownership (private, native, borough and state), the fate of private cabins on public land, public access, and the possible problem of lead poisoning of waterfowl. Intensive studies began in late May, 1978 on Susitna Flats, Palmer Hay Flats and Goose Bay with these objectives: to determine waterbird densities in early, mid and late summer; to measure habitat preferences of waterfowl and shorebirds; to measure waterfowl production; to determine migration of locally produced ducks; to resolve the issue of possible ingested lead shot poisoning; and to evaluate late summer and fall food habits of ducks. Also, data and personal impressions were obtained on how human activities (gas exploration, private cabins and aircraft traffic) affect wildlife habitat and its use. One of the principle reasons for establishing State Game Refuges was to provide recreational opportunities. To help assess public use and opinions on management of these refuges, questionnaires were distributed from June to December 1978.

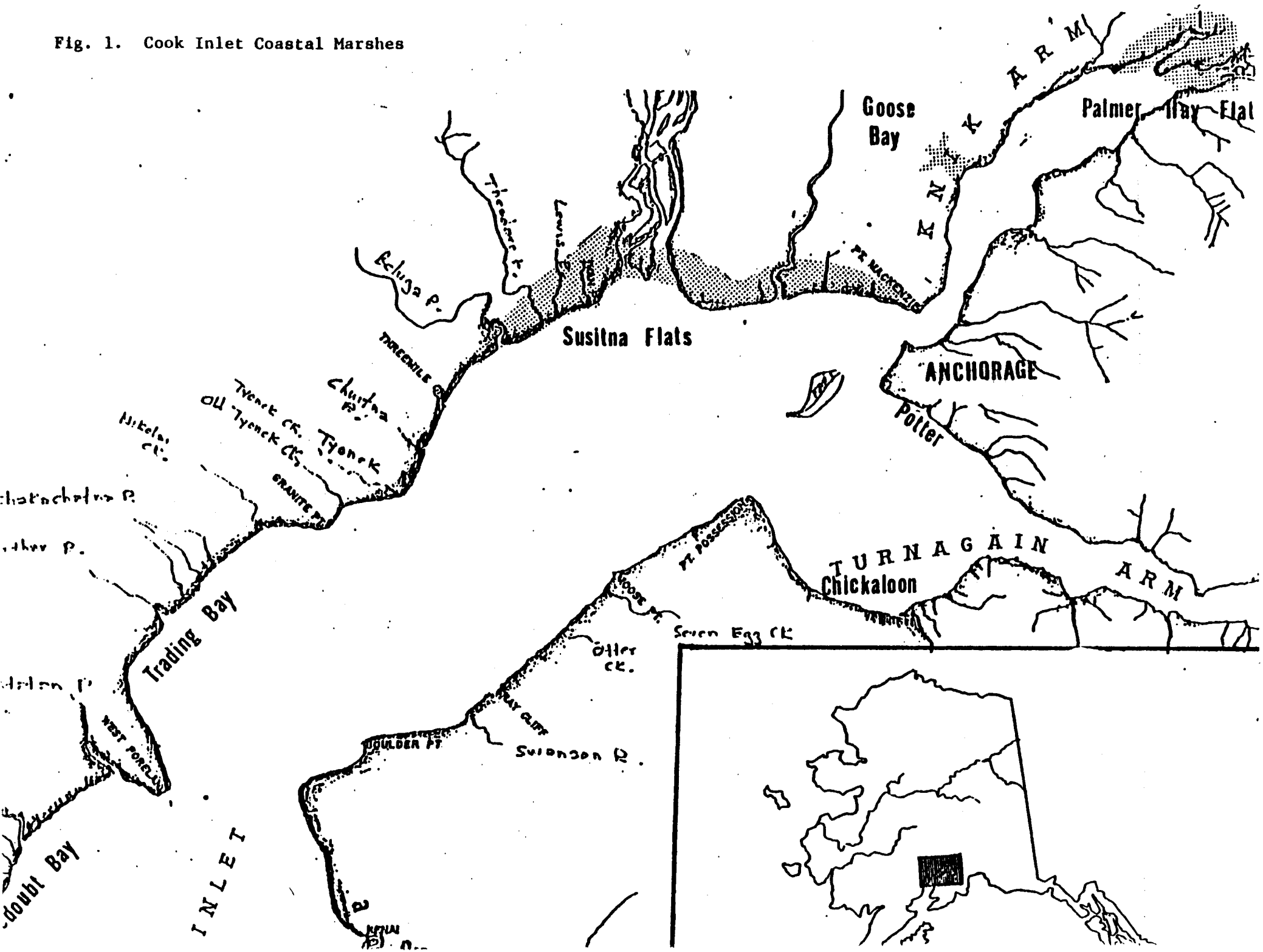
The studies accomplished by ADF&G and reported here focused on wildlife use of State Game Refuges. Our understanding of these areas will be greatly complimented by an independent study of the ecology of salt marsh plant communities on Susitna Flats begun in 1978 by Allison Snow, University of Massachusetts, and Susan Vince, University of Michigan. They were funded during the summer of 1978 by the Alaska Waterfowl Association, and ADF&G provided only limited logistic support and technical assistance. This study is scheduled to continue in 1979.

STUDY AREA

Unlike some coastal marshes in Southcentral Alaska, (i.e. Copper River Delta, Portage, Chickaloon Flats), the three Cook Inlet marshes in this study - Susitna Flats (136 sq mi), Palmer Hay Flats (42.7 sq mi) and Goose Bay (9.2 sq mi), Fig. 1 - were relatively unaffected by the 1964 earthquake. Foster and Karlstrom (1967) reported, "Along the west shore of Cook Inlet from Point McKenzie to Kamishak Bay, there was 1 to 2 feet of subsidence along the slumped front of the Susitna Delta area.... Probably most of this subsidence can be attributed to slumping and compaction of the delta front and adjoining elevated tidal flats between the Susitna River and McKenzie Point. This conclusion seems reasonable because (1) the coastal margin was extensively cracked during the earthquake and (2) changes in bathymetry of the bordering seaway record a major slump of material along the coast...." They did not describe the disturbance at Goose Bay or Palmer Hay Flats.

Quimby (1972) described vegetation patterns at Chickaloon Flats related to frequency of tidal flooding. Tolerance of salt water affects the distribution of plant communities on other coastal marshes in Cook Inlet in a similar way. Ground transects measuring bird densities on all three Refuges included habitat from intertidal mud flats to a shrub-bog community. These transects on Susitna Flats were located within the outlined study area (Fig. 2), and those on Palmer Hay Flats and Goose Bay are shown in Figures 3 and 4 respectively.

Fig. 1. Cook Inlet Coastal Marshes



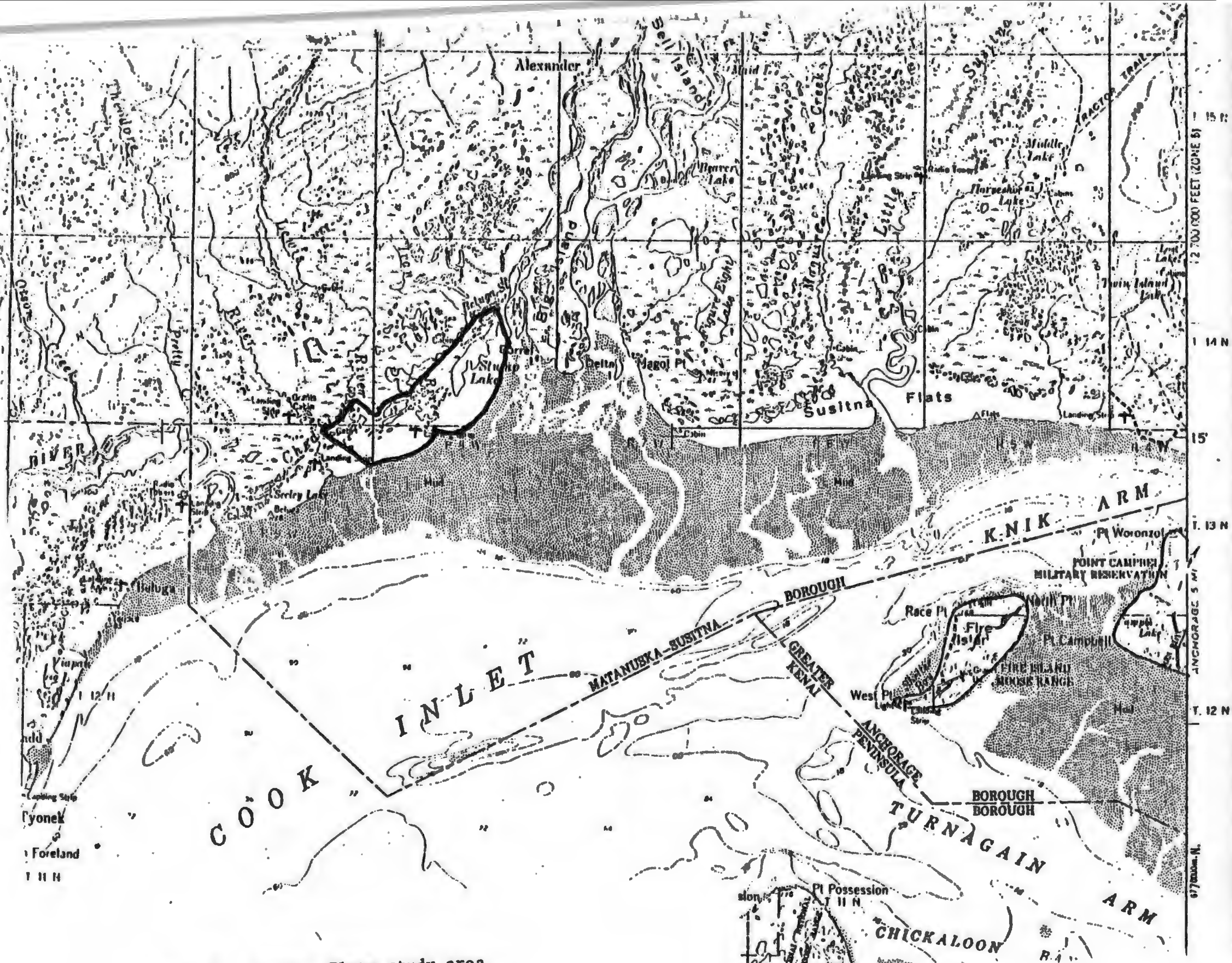


Fig. 2. Susitna Flats study area.

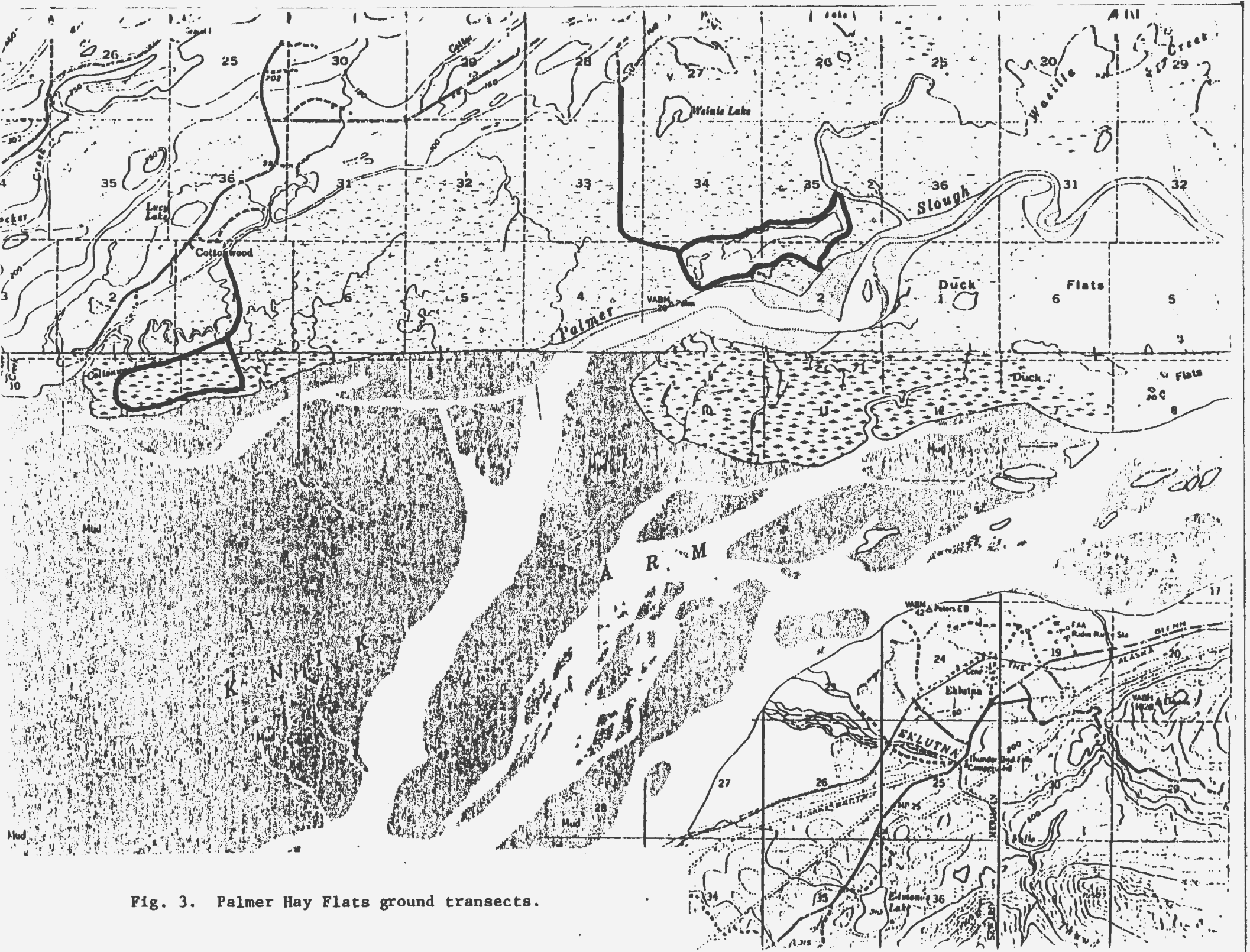


Fig. 3. Palmer Hay Flats ground transects.

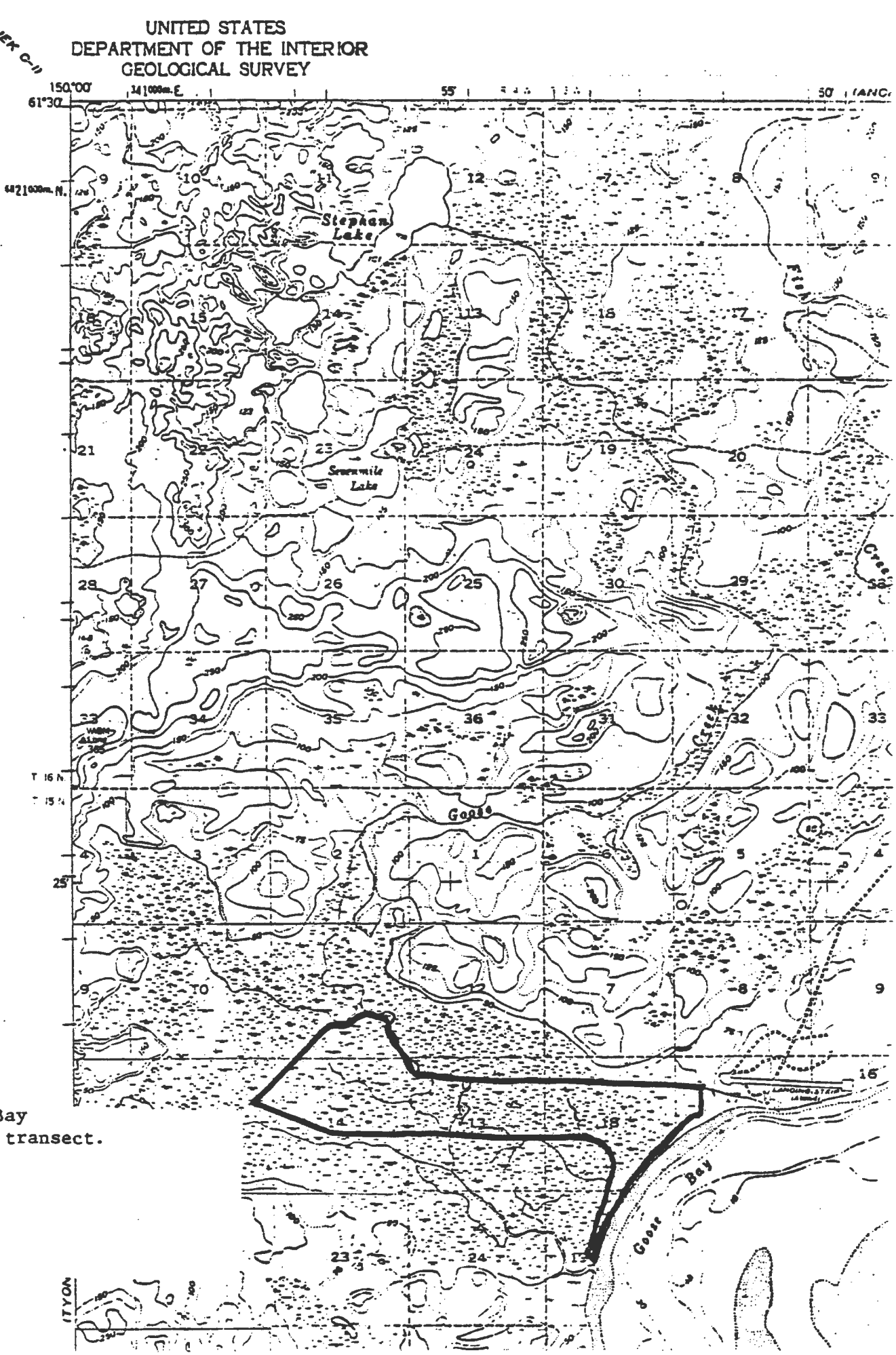


Fig. 4. Goose Bay ground transect.

For purposes of determining habitat usage, five broad types of plant communities were identified on all three areas:

Tidal Flats (TF) extend towards the inlet from about mean high tide line and consist of exposed mud flats vegetated only by algae.

Puccinellia-Trigochin (PT) Community is located just inland from mean high tide line and is dominated by patches of creeping alkali grass (*Puccinellia phygranodes*), clumps of large alkali grass (*Puccinella grandis*) and seaside arrow-grass (*Triglochin maritimum*) interspersed with patches of mud often colonized by slender glasswort (*Salicornia europaea*), spurry (*Spergularia canadensis*), sea blight (*Suaeda depressa*) and algae. Other important plants in this community are goose tongue (*Plantago maritimajuncoides*), Pacific sliverweed (*Potentilla egedii grandis*) and sea milkwort (*Glaux maritima*). Recently exposed mud, such as where ponds were drained by tidal guts (e.g., parts of Stump Lake west of the Susitna River) often support nearly pure patches of creeping alkali grass.

Ramenski sedge - shallow pond (RS) Community begins further inland where Ramenski sedge (*Carex Ramenski*) gains dominance over the Puccinellia-Triglochin community. Clumps of seaside arrow-grass are often scattered in the RS community. Ponds within this habitat are shallow (generally less than 2 ft) with sharply defined shorelines, little emergent vegetation and usually unvegetated bottoms. Near the interface with the marsh community, ponds are deeper and have four-leaf mare's tail (*Hippuris tetraphylla*) and may support pondweed (*Potomageton filiformis*). Slightly elevated ground, such as banks of tidal guts and edges of oxbows, are vegetated by by grass-forb communities featuring beach rye (*Elymus arenarius mollis*), bluejoint (*Calamagrostis canadensis*), blue grass (*Poa eminens*), r fescue (*Festuca rubra*), Pacific silverweed, Artic daisy (*Chrysanthemum arcticum*), wild iris (*Iris setos*) squirrel-tail barley (*Hordeum jubatum*), lupine (*Lupinus arctiais*), beach lovage (*Legusticum scoticum*), wild celery (*Angelica lucida*), shooting star (*Dodecatheon palchellum*) and *Saussurea nuda*.

Marsh (M) Community is a diverse interspersion of wetland, wet meadow and grass-forb communities. Waterbodies vary from shallow ponds to small lakes, and are characterized by indistinct shorelines with a fringe of emergent vegetation. Many of the smaller wetlands are nearly covered by emergents, the most prevalent being sedges (*Carex* spp), creeping spike rush (*Scripus paludosus*), four-leaved mare's tail and bulrush (*Scripus validus*). Many ponds support submergents including pondweeds (*Potomageton* spp), horned pondweed (*Zanichellia palustris*), water milfoil (*Myrophyllum spicatum*) and wigeon grass (*Ruppia spiralis*). Wet meadows are inundated by high tides (+32 ft) several times during the year. Plants growing here (sedges, silverweed, goose tongue, and seaside arrow-grass) are tolerant of saturated alkaline soil conditions. Drier sites have grass and forb species as described for the RS community.

Shrub-bog (SB) Community is the least affected by tidal flooding and covers the largest area on these three refuges. It extends inland from the marsh community to where elevation and drainage allow upland plants to grow. Ponds within this habitat are generally deeper and have distinct,

though often floating, shorelines and little aquatic vegetation. The shrub-bog community is poorly drained but thickly vegetated. Important plants include sweet gale (*Myrica gale*), dwarf birch (*Betula nana*), Arctic dock (*Rumex arcticus*), water hemlock (*Cicuta douglosii*), cotton grass (*Eriphorum* spp.), bluejoint, marsh five fingers (*Potentilla palustris*) and buckbean (*Menyanthes trifoliator*). Slightly drier sites have willow (*Salix* spp.), black spruce (*Picea mariana*), heaths (*Ledum* spp.) and (*Kalmia* spp.).

The width of these plant communities and the proportion of wetland in Marsh and RS Communities varies considerably between and even within refuges. The extent of the PT Community is much greater and generally less densely vegetated on Susitna Flats east of the Susitna River, where subsidence was greater following the 1964 earthquake. Here the RS and Marsh areas are restricted to a strip about 0.4 mi. wide. West of the Susitna River, the PT community is narrower and more densely vegetated, and the RS and Marsh habitat is about 0.8 mi. wide.

METHODS

Annual breeding bird surveys of these three coastal marshes commensed in 1975 (Timm 1976), and the areas were again flown on 26 May 1978. On 19 July 1978 a brood survey was flown using the same procedure except the count area was reduced to 1/8 mi. wide.

Ground transects in 1978 sampled bird densities in habitats from tidal mud flats to shrub-bog. Since none of the refuges were type mapped, the extent of various plant communities have not been quantified. Consequently, we did not attempt to establish ground transects to cover habitats in proportion to their total occurrance. At Susitna Flats most transects were straight strips running north-south. To agument these N-S strips, additional transects along tide line and along two streams sampled all communities except the SB. Logistical and topographic considerations at Palmer Hay Flats and Goose Bay precluded straight line transects. Transects on these two refuges followed subjective routes (Fig. 3 and 4). All transects were 1/8 mile wide (110 yards either side of the observer), with boundaries estimated by eye and by correlating land marks with color aerial photos (scale 4":1 mile). Transects were segmented by quarter mile intervals, and each segment was classified by plant community so bird densities by habitat type could be calculated.

Timing of ground surveys was:

	Susitna Flats	Palmer Hay Flats	Goose Bay
Early Summer	31 May-8 June	12 and 14 June	13 June
Mid Summer	8-15 July	26 July	25 July
Late Summer	21-24 August	29 and 31 August	28 August

Public questionnaires and cover letters (Figs. 5 and 6) were mailed to Susitna cabin owners, sporting goods stores, the USFWS, and the Audubon Society in June 1978, and they were available in the Anchorage, Palmer and Soldotna offices of ADF&G from June to the completion of this report. Some questionnaires were also distributed directly to hunters using refuges in September 1978.

PUBLIC QUESTIONNAIRE ON UPPER COOK INLET REFUGES

Please answer each question for each refuge, only if you have used that refuge.

	SUSITNA FLATS	PALMER HAY FLATS	TRADING BAY	GOOSE BAY
(1) About how many days per year do you use the refuge to:				
a) Hunt waterfowl				
b) Hunt other game				
c) Sport fish				
d) Commercial fish				
e) General enjoyment of nature				
f) Other uses (name them)				
Comments:				
(2) About how much game did you shoot last year on the refuge?				
a) Ducks				
b) Geese				
c) Snipe or cranes				
d) Other game (name species)				
Comments:				
(3) How many years have you hunted waterfowl on each area?				
(4) If you have hunted on the refuges for 5 or more years, do you think the waterfowl hunting is getting better, worse or no change?				
Comments:				
(5) If you answered the question above, why do you think your hunting success may have changed?				
Comments:				
(6) Should use of the following mechanized vehicles on refuges be: unrestricted, restricted by time and/or area, or prohibited?				
a) Airboats				
b) ATV's				
c) Aircraft				
Comments:				
(7) Do you object to all weather internal roads within refuges? (e.g. BP Road on Palmer Hay Flats and Lewis River Road on Susitna)				
Comments:				
(8) Do you or friends you hunt with own a cabin on the refuges? If so, where on the refuge (general area)?				
(9) Do you think the number of cabins on refuges are too many, too few or about right?				
(10) Would you like to see Fish and Game operate public use cabins at a nominal fee?				

(11) Other comments: _____
(use back of page if necessary)
Your Name and Address: _____
Deliver to an Alaska Department of Fish and Game office or mail to the Game Division
333 Raspberry Road, Anchorage 99502. You will be notified of a public meeting this fall.

Fig. 5. Public questionnaire (reduced by 65%)

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STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF FISH AND GAME

333 RASPBERRY ROAD
ANCHORAGE 99502

June 1978

ATTENTION SPORTSMEN

State game refuges were recently created by the Legislature on Susitna Flats, Palmer Hay Flats, Trading Bay and Goose Bay. These refuges were created primarily for waterfowl, other wildlife and fisheries and for the people who use and enjoy these resources.

For Fish and Game to administer these refuges in the best interests of the public, it is essential that we know what you use the refuges for and how you think they should be managed. As the population grows around Upper Cook Inlet, public use of these areas will likewise intensify. It will be our job to not only protect wildlife, but to also perpetuate public use and to minimize conflicts between user groups.

Until we determine the present and potential impacts of cabins on refuges, there is a moritorium on any new cabin construction. Also, some sort of a lease or use permit system will evolve for those cabins on the Refuges.

Late this fall we will hold several public meetings regarding future refuge management. To assist us in preparing for these meetings and to find out more about your use of the refuges, please fill out the attached questionnaire. Mail it to the Game Division, 333 Raspberry Road, Anchorage, 99502, or drop it by an Alaska Department of Fish and Game office in Palmer, Kenai or Anchorage. You will be notified of the time and place of the public meeting at a later date.

Thanks for your help.

Sincerely,

John Vania
Regional Game Supervisor

Fig. 6. Cover letter distributed with public questionnaire on State Game Refuges.

Waterfowl reactions to aircraft were noted whenever observed. Data were recorded on type of aircraft, visual estimate of verticle and horizontal distance between birds and aircraft, type of habitat, number and species of waterfowl and the birds' reaction.

Results of the lead poisoning and food habits study will be covered in a separate report.

RESULTS AND DISCUSSION

Summer Use of Refuges by Waterbirds

Ducks - Cook Inlet marshes host large numbers of ducks during spring migration and may later serve as a staging area for drakes and nonbreeders prior to their moving to molting areas (Timm 1975). Aerial surveys were initiated in 1975 to estimate the breeding population of waterfowl on these marshes. However, determining the number of ducks nesting on these areas may be confounded by the presence of late migrants and/or congregations of post and nonbreeding drakes from surrounding habitat. Timing of breeding population surveys is critical to an accurate estimate. Ideal timing would be during an interval after departure of migrants and before gathering of post-breeding drakes from other areas, if in fact such an interval occurs.

Results of aerial and ground estimates of waterbird densities in 1978 are compared to previous years in Table 2. The 1978 aerial survey showed a drop of over 50 percent from 1977 duck densities which were inflated with birds that overflew drought stricken Canadian prairies

(Timm 1978). Breeding duck populations in 1978 on other areas in the Kenai-Susitna region, as estimated by the U.S. Fish and Wildlife Service, declined 70 percent from 1977 (King and Conant 1978).

A second reason for the lower aerial count in 1978 might have been timing. Only 2 percent of all dabblers recorded during the 1978 survey were in flocks, while 31 percent were in pairs and 67 percent were lone drakes (Timm 1978). It appears that the 1978 survey was well timed.

During the June 1978 ground counts, only 16 percent of the dabblers were paired, and the vast majority of birds observed were drakes in small to medium sized flocks up to 15 birds. Spring was early in 1978, and 23 broods and broody hens were found during the June ground transects. Ground counts were apparently conducted too late to accurately measure the nesting population and they probably included a number of drakes from other areas congregating in preparation for a molt migration.

Another reason we recorded higher dabbler densities on ground transects than estimated from the aerial survey (Table 2) was that relatively less SB community was sampled on the ground. On Palmer Hay Flats, Goose Bay and Susitna Flats, 42 percent of the aerial survey was flown over SB while only 14 percent of the ground transects were in SB. To evaluate waterfowl use of SB versus salt marsh communities (M, RS, PT and TF), the 1978 aerial survey of Cook Inlet was divided into 19 sq. mi. of salt marsh habitat and 42 sq. mi. of inland habitat (largely SB). The salt marsh habitat supported 57 dabblers and 8 divers per sq. mi. The inland

.e 2. Breeding Densities of Waterfowl on Cook Inlet State Game Refuges - (Birds/Sq. mi.)

	Palmer Hay Flats					Goose Bay					Susitna Flats				
	Aerial				Ground	Aerial				Ground	Aerial				Groun
	1975	1976	1977	1978	1978	1975	1976	1977	1978	1978	1975	1976	1977	1978	1978
)lers	62.1	37.1	70.8	38.5	550.0	70.1	42.4	84.6	31.9	37.4	54.2	83.6	95.4	32.6	226.4
:rs	14.4	11.5	9.4	15.2	0	3.7	4.0	0.9	0	0	6.7	12.7	2.2	12.3	4.9
)e	2.5	7.4	4.0	2.1	66.2	3.0	0	8.2	5.7	32.3	1.3	15.1	3.5	1.1	4.9
)s	0.3	0	0	0.1	0.9	0	0	0	0	0	0.7	0.3	0.2	0.2	0
lhill)es	1.0	0	0	0	0.9	1.3	1.3	0	2.0	8.5	0	0.3	0.3	0.2	1.4
)s	1.6	0.7	0.5	0.3	0	1.0	2.7	0	0	0	0.5	0	0.7	0.2	0.7

habitat had densities of 14 dabblers and 7 divers per sq. mi. The salt marsh received four times as much dabbler use, but approximately the same level of diver use as adjacent inland habitat. Aerial estimates of waterfowl breeding populations were derived using air:ground visibility correction factors calculated for each species from studies on the Canadian prairies (J.G. King, personal communication). The accuracy of these correction factors has not been verified for Cook Inlet coastal marshes, and may have been a source of error when comparing air and ground surveys. King believes that surveys in Alaska underestimate the population.

The large variation in June dabbler densities (37, 226 and 550 birds per sq. mi. at Goose Bay, Susitna Flats and Palmer Hay Flats, respectively) is probably a result of the small area (between 1 and 2 sq. mi.) sampled on each refuge and unequal coverage of various plant communities. For example 29 percent of the ground transects at Goose Bay were in SB, but only 7 percent of Susitna ground transects were in SB. The four year average dabbler density from aerial surveys of these three refuges (Palmer Hay Flats - 52, Goose Bay - 57, and Susitna Flats - 66 birds per sq. mi.) show little difference in breeding dabbler densities. Goose Bay is small, with few large waterbodies, and the small duck population, as estimated on the June ground survey, probably reflected unsuitability as a premolt staging area rather than inferior breeding habitat. In fact, Goose Bay had a higher brood density in 1978 than Palmer Hay Flats.

The duck species composition on Cook Inlet refuges varied with the survey method, the habitat covered and date (Table 3); but the dominance of dabblers on salt marsh habitat is evident. The SB community generally harbored proportionately more mallards and divers, and the salt marsh supported more pintails.

A search for bird nests (other than gull nests) on Susitna Flats was conducted 31 May to 4 June. One or two people with a dog searched nesting cover near Lewis River Slough. Only 10 nests were found during this period, and seven others were located later or elsewhere. The number of nests and clutch sizes were: four pintails (7, 6, and two found after hatching), four shovelers (11,10,10,8), one wigeon (9), one green-winged teal (10), one unknown duck (10), three Canada geese (6, 5, 4), one bald eagle (2), one sandhill crane (2), and one short-billed dowitcher (4). Of 11 duck nests, 6 were in mixed grass-forb cover within 50 ft. of the Ivan River. All duck nests averaged 64 ft. (range 0 to 175 ft.) from the nearest marsh pond. One duck nest was abandoned within 2 days after being found; six nests were successful; and the fate of the other four was uncertain since no trace of the eggs was found. It is likely that these nests were destroyed by predators (bear, fox, coyote) that remove eggs whole, although one of these nests may have been flooded by a high tide.

A goose nest, located on a small (about 2 ft. in diameter) sedge hummock 50 ft. offshore in front of the field camp on Lewis River Slough, was watched throughout incubation. The incubating goose had the near-constant companionship of two herring gulls that often sat on a log about 1.5 ft. from the goose nest. The nest contained 4 goose eggs,

Table 3. Duck composition (percent by species) for aerial and ground surveys of Cook Inlet Marshes, summer 1978.

Species	1978 Aerial Survey			1978 Ground Survey	
	Palmer Hay Flats, Susitna Flats and Goose Bay	All Cook Inlet		June	July
		Salt Marsh	Shrub Bog	Breeding Population	Broods
Pintail	23	28	11	46	53
Mallard	19	19	19	11	13
Green-winged Teal	12	18	17	15	15
Wigeon	7	4	8	16	5
Shoveler	10	14	11	10	12
Gadwall	2	2	2	0	tr
Blue-winged Teal	0	0	0	1	tr
Scaup	14	10	11	1	1
Canvasback	4	1	6	0	0
Goldeneye	6	1	11	0	0
Redhead	0	1	2	0	0
Merganser	3	1	2	0	0
Sample Size	290	322	92	903	148

with two other broken eggs on the edge of the hummock. No antagonism was observed between the goose or her mate and the two gulls, although opportunities for interactions were observed.

On 3 June 1978 at 7:15 P.M., a float plane took off from Lewis River Slough, flushing the incubating goose and two gulls from the hummock. The goose flew about 150 yds. to the east end of Lewis River Slough where she joined her mate. The gulls circled for about 2 min. and then landed on the end of the log, about 8 ft. from the goose nest. The gulls performed a brief courtship display (bills extended into air) and then preened. After a few minutes of this activity, both gulls walked up the log to within 2 ft. of the goose nest. One gull then hopped into the water and remained near the nest while the other gull jumped down into the nest. The gull removed some nesting material (dead sedge or grass) and deposited it about 2 ft. from the nest near one of the broken goose eggs. Both gulls then swam to another hummock about eight feet west of the nest where they loafed. Meanwhile the geese were swimming back to the nest, arriving at 7:25 P.M. (about 3 minutes after the gull had left the nest). The goose climbed upon the hummock, preened briefly and then sat on the nest. The gander remained on the water about 30 ft. east of the nest for at least 15 min.

Dispite disturbance from float planes using Lewis River Slough, our daily activities and the presence of a pair of gulls, the geese and four goslings left the nest the morning of 10 June.

The other two Canada goose nests were found in SB community on Palmer Hay Flats by an ADF&G employee. Both nests were active when checked a week later (27 May), but their fate was not determined. The bald eagle and sandhill crane nests (located at the edge of the SB community) and the short-billed dowitcher nest (in RS community) all were successful.

Although duck nests were not searched for intensively, some personal impressions were formed. A lack of residual nesting cover and the threat of tidal flooding preclude nesting activity in most of the RS and PT Communities. Nesting was concentrated primarily in grass-forb cover within the marsh community and near the marsh-SB interface. The SB community provided vast amounts of thick residual cover, but the use of this community for waterfowl nesting needs further evaluation. If the SB community proves unattractive to nesting birds, the productivity of these coastal marshes might be augmented by habitat management creating more grass-forb cover.

Mallard and pintail broods first appeared about 22 May, indicating that nesting began about mid-April. Of 45 pintail broods aged and back dated in 1978, 56 percent hatched between 26 May and 5 June, 24 percent from 9-14 June, and 18 percent between 24 June and 1 July. The later group probably resulted from renesting. The mallard hatch was essentially the same as the pintail. Green-wing teal nests began hatching the first week of June, and the hatch was distributed over the next 5 weeks. On 31 August a green-winged teal approximately 34 days old was seen on Palmer Hay Flats. This represents the latest hatch (about 28 July) recorded in 1978. Wigeon and shoveler hatch peaked during the last half

of June. Two broods of greater scaup hatched during the first week of July.

Average brood sizes of dabblers by age class, with sample size in parentheses were: Ia - 8.4(11), Ib - 6.2(15), Ic - 3.8(6), II - 6.0(10) and III - 6.0(5). As observed in studies elsewhere, the greatest duckling losses occured within two weeks of hatching.

The numbers of broods per sq. mi. were 18.0, 15.3 and 8.4 for Susitna Flats, Goose Bay and Palmer Hay Flats, respectively, and averaged 14 broods per sq. mi. for all areas. We did not "beat out" all wetlands on transects, but a trained retriever was used to flush broods or broody hens. I felt that most broods present were detected. Given at least moderate nesting success, brood densities suggest the actual breeding population was lower than estimated from June ground counts on Susitna Flats and Palmer Hay Flats, but was close to that estimated from the air. Species composition of 148 broods observed was 53 percent pintail, 15 percent green-winged teal, 13 percent mallard, 12 percent shoveler, 5 percent wigeon, 1 percent scaup and 1 brood each of blue-winged teal and gadwall. Slightly more pintail and fewer wigeon broods were observed than were expected from the June duck species composition (Table 3).

In the aerial brood survey, flown 19 July over the same transects as the breeding population survey, we recorded an unadjusted density of 1.2 broods per sq. mi. The proportion of broods seen from the air depends upon many variables (species composition, age of broods, type of cover, density of broods, water level, weather and the ability of the observers). With this number of variables, it is understandable that visibility correction factors for aerial brood surveys have not been standardized. The USFWS uses unadjusted brood density as an index of annual production, and does not make direct comparisons between breeding population density and brood density for a specific area.

The USFWS conducted a study from 1961 to 1964 comparing air-ground counts of broods in southern Alberta, Saskatchewan and Manitoba. They determined crude visibility rates for broods based on age class; and found that of all broods located by ground counts, only 10.7, 32.3 and 46.0 percent of class I, II and III broods, respectively, were seen from the air (Henny et al. 1972). We applied these adjustment factors to the aerial brood survey of Palmer Hay Flats, Goose Bay and Susitna Flats and calculated a brood density of 4.3 per sq. mi. Still, this figure is not comparable to the ground estimate of 14 broods per sq. mi. because much of the aerial survey was of SB community. We selected 9.5 sq. mi. of aerial transects (segments 5, 6, 12, 13, 20 - 23, 26, 27, 47 - 49, 50, 57, 59, 60 - 62 - Timm 1976) which covered habitat similar to that covered on the ground, and found an unadjusted brood density of 4.2 per sq. mi. After applying the adjustment factors, the density increased to 13.5 broods per sq. mi., compared to 14 broods per sq. mi. seen on the ground. The adjusted brood density for southern portions of the prairie provinces was 7.65 per sq. mi. Thus, it appeared that the most productive habitat (marsh and RS communities) in Cook Inlet marshes was more productive than the prairie pothole region of Canada, at least for the 1961-1964 period. However sample size in our study was small.

Adult duck densities for the three refuges declined 48 percent from an average of 252 per sq. mi. in June to 129 per sq. mi. in July. When ducklings were included in the July population (14 broods per sq. mi. averaging 6 ducklings per brood), the density rose to 213 ducks per sq. mi. (Fig. 7). Diving ducks were very scarce in June and July, although two scaup broods were seen on Susitna Flats.

By August the average density of dabblers had jumped to 527 birds per sq. mi. (545, 396, and 587 per sq. mi. for Susitna Flats, Palmer Hay Flats and Goose Bay, respectively). The exact composition could not be determined because large mixed flocks were difficult to enumerate by species. It appeared that by late August pintails were relatively less abundant and mallards comparatively more abundant than earlier in summer.

A mixed flock of 250 divers observed on the Palmer Hay Flats in August resulted in a calculated average density of 60 divers per sq. mi. (Fig. 7). Since no divers were seen on Goose Bay and only 14 greater scaup were recorded on Susitna Flats (4.8 divers per sq. mi.), undoubtedly diver use of Cook Inlet marshes in August was lower than indicated in Fig. 7.

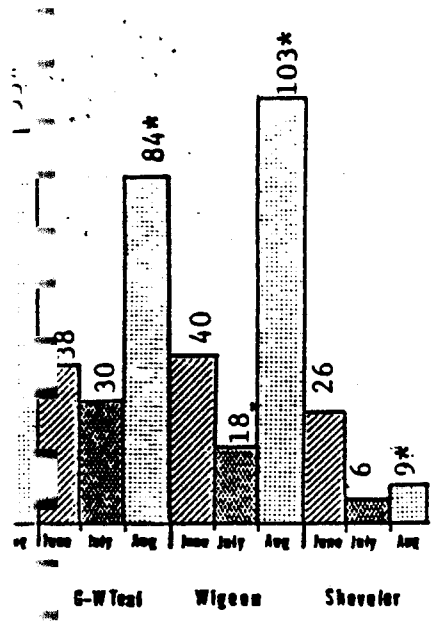
Geese - Estimates of Canada goose populations from the May 1978 aerial survey on Susitna Flats, Palmer Hay Flats and Goose Bay were 147, 91 and 52 geese, respectively. Observations of geese off transect lines indicated closer to 150 geese present on Palmer Hay Flats. Previous estimates of total Canada goose populations for these three refuges (Table 4) were 305 in 1975, 2366 in 1976 and 724 in 1977. Timm (1975, 1976) felt the

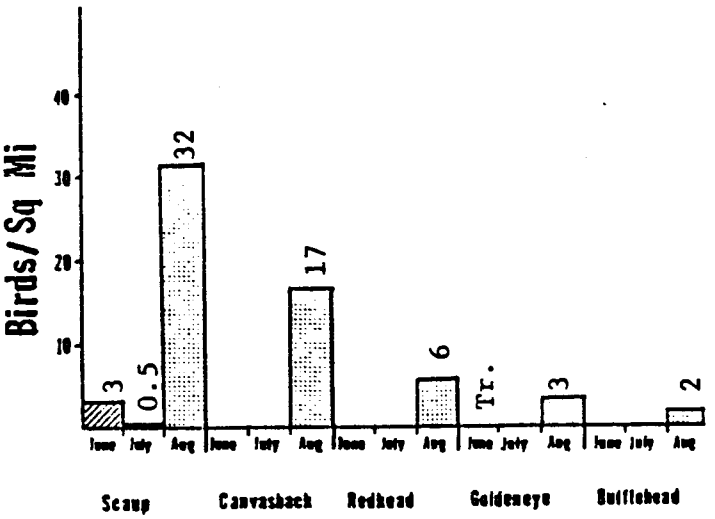
estimate in 1975 was low and the 1976 estimate was high. Nonbreeding geese present during the breeding population survey, especially when distributed unevenly in flocks, probably distorted the estimates of Canada goose breeding population on Cook Inlet refuges. Counts of 150 goslings in 1974 and 448 goslings in 1978 (Table 4) may more accurately reflect the importance of Palmer Hay Flats and Susitna Flats as breeding habitat for Canada geese. Goose nesting has not been verified at Goose Bay.

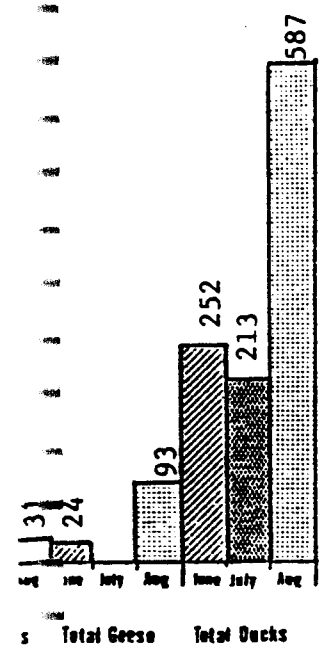
Canada geese were seen on each refuge during June ground transects, but an uneven distribution of flocks on Palmer Hay Flats and Goose Bay rendered density estimates meaningless (Table 2). At Susitna Flats where large flocks of geese were not encountered, the June density was 4.9 geese per sq. mi. No geese were tallied on transects during July ground counts, but by August Canada goose densities had increased to an average of 62 per sq. mi. (79, 60 and 22 geese per sq. mi. at Susitna Flats, Goose Bay and Palmer Hay Flats, respectively).

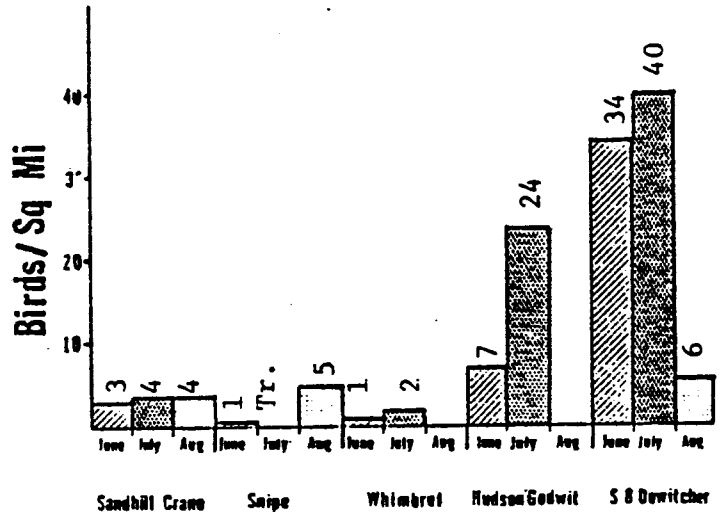
White-fronted geese were not seen on Palmer Hay Flats or Goose Bay during summer, 1978, although a molting subadult was captured on Palmer Hay Flats in 1975. At Susitna Flats, moderate numbers of white-fronts were present in early June, but none were seen in mid summer. White-fronts are early migrants and staging began in early August. By the third week of August whitefronts were abundant at Susitna, reaching a density of 55 geese per sq. mi.

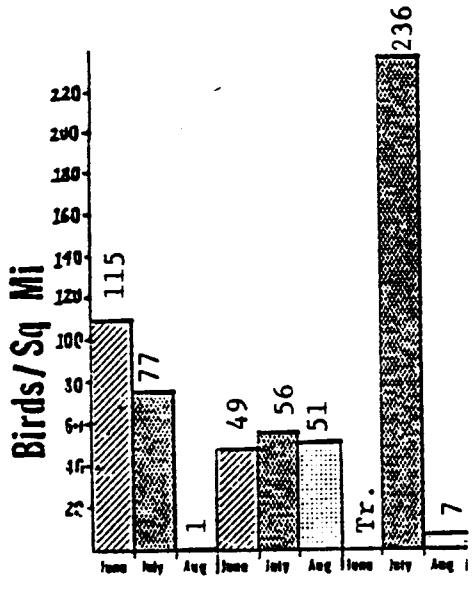
Pacific Whitefront DET











June, July and August bird densities for Susitna Flats, Palmer Hay
d Goose Bay

Table 4. Estimated Canada goose populations on Palmer Hay Flats, Goose Bay and Susitna Flats.

Refuge	30 July 1974		2 June 1975	24 and 25 May 1976	6 June 1977	26 May 1978	19 July 19	
	Adults	Young	Adults	Adults	Adults	Adults	Adults	You
Palmer Hay Flats	345	87	107	315	171	91	37*	3
Goose Bay	0	0	28	0	75	52	0	
Susitna Flats	245	63	170	2051	478	147	149	41
	590	150	305	2366	724	290	186	44

* Seen during June ground counts.

Shorebirds - Northern phalaropes were the most abundant shorebird in June with 115 per sq. mi. (Fig. 7). By July their density had dropped 33 percent, and by late August most phalaropes had departed. Short-billed dowitchers were common in June and July, but had declined about 85 percent by August. Hudsonian godwits peaked in July and vanished by late August. A few whimbrels were seen only in June and July. Small shorebirds (peeps) were extremely abundant in July, especially along tide line at Goose Bay and exposed mud at Stump Lake, Susitna Flats. The most common peeps were least and semi-palmated sandpipers. Western sandpipers, dunlins, semi-palmated plovers, spotted sandpipers and pectoral sandpiper were less abundant. Greater and lesser yellowlegs and sandhill crane populations were rather stable throughout summer. Common snipe were more abundant in August than earlier in the summer.

Other Birds - Bird checklists for each refuge (Appendix A) were used to note other birds seen during ground counts in June, July and August. Each species was subjectively rated as being rare (R), occasional (O), common (C), very common (VC) or abundant (A). Although some birds that occasionally use these refuges during the summer do not appear on the list, the more frequent users are represented, and known breeders are noted.

Arctic terns, herring gulls, glaucous-winged gulls, mew gulls, Bonapart's gulls, tree swallows and cliff swallows were abundant locally. Because these birds spent much time in the air and were difficult to keep track of, their densities were not calculated. Gull and Arctic tern colonies were in marsh wetlands, especially where hummocks and driftwood logs created nesting "islands".

An attempt was made to sample small mammal populations in three plant communities on Susitna Flats. A total of 350 trap nites (standard mouse traps) in June resulted in the capture of no mammals. No other quanitative assessment of mammal use of refuges was attempted. However, mammals known to use Susitna Flats were: red-backed vole, red squirrel, muskrat, mink, weasel, red fox, coyote, wolf, black and brown bear and moose. Moose is the most important big game species on refuges, and the SB community is the most heavily used habitat throughout the year.

Habitat Use

Ducks - The density of adult dabbling ducks was consistently highest in the marsh community, ranging from 300 birds per sq. mi. in July to over 1100 per sq. mi. in August (Fig. 8 and 9). For 3 days following tidal flooding on 20 August, mallards and pintails heavily used the PT community which was covered by 2 to 3 inches of water. By 23 August most water had drained and the duck use of this habitat diminished drastically. Use of tidal flats, particularly by mallards and wigeon, increased in late August. During the hunting season (September and early October), ducks concentrated on these mud flats where they found food (mollusks and algae) security from hunters.

Marsh and RS communities received most brood use in July (46 and 23 broods per sq. mi., respectively).

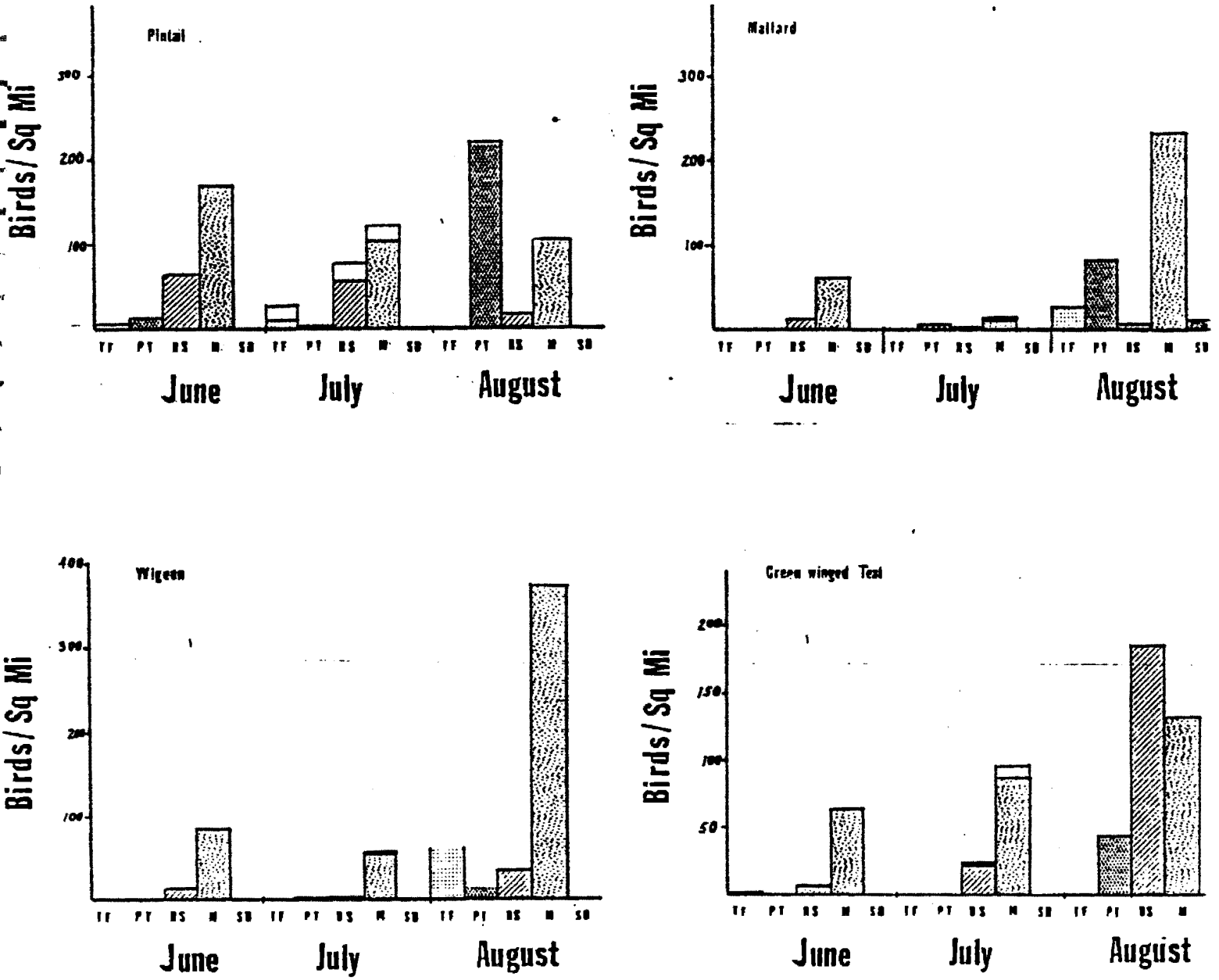


Fig. 8. Bird density by habitat type (TF = Tide Flats, PT = Puccinellia-Triglochin, RS = Ramenski Sedge - Shallow Pond, M = Marsh, SB = Shrub-Bog). Unshaded portion of bars represents broods.

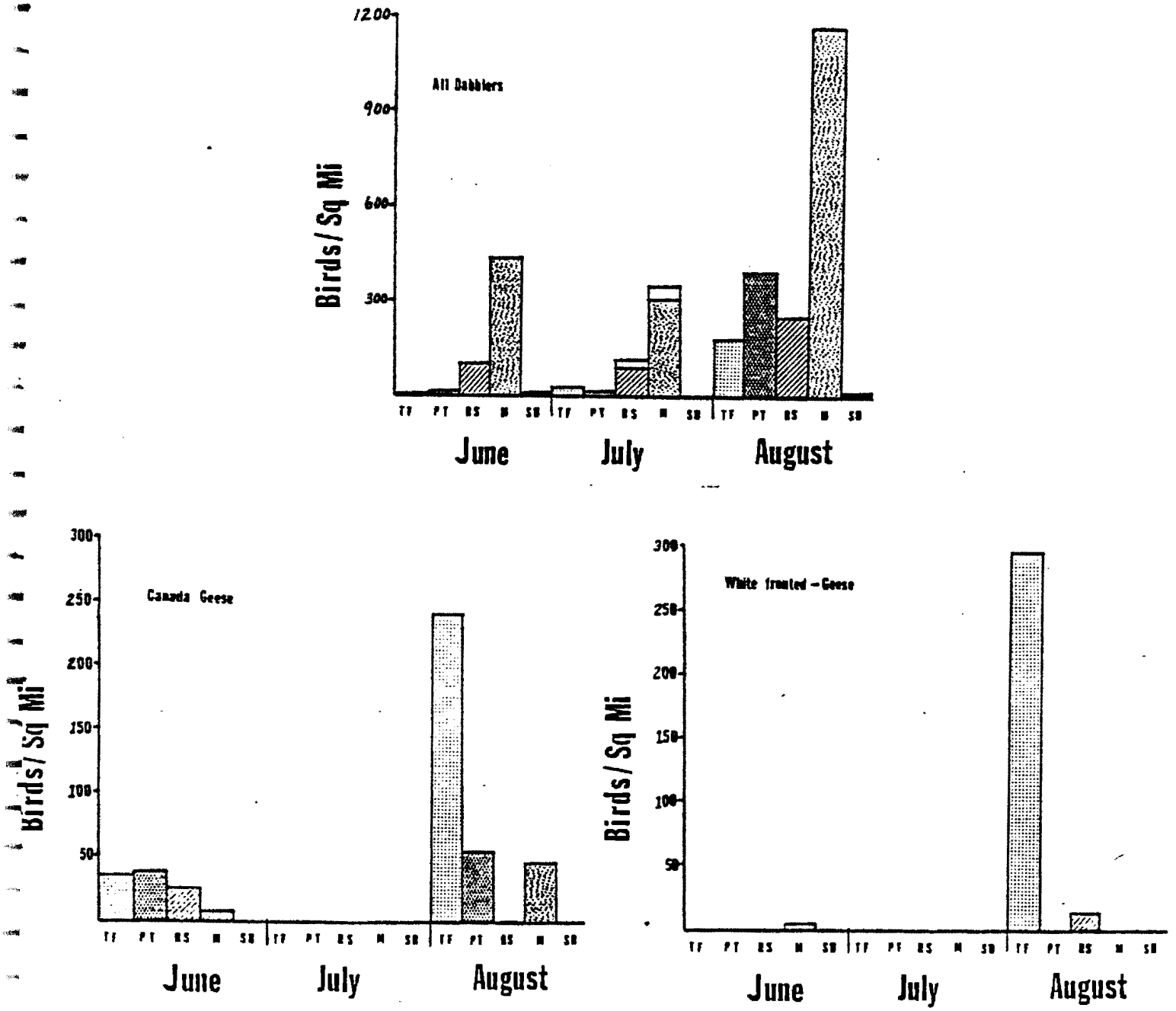


Fig. 9. Bird density by habitat type (TF = Tide flats, PT = Puccinellia-Triglochin, RS = Ramenski Sedge - Shallow Pond, M = Marsh, SB = Shrub-Bog). Unshaded portion of bars represents broods.

Pintail adults and broods used the shallow ponds in the Ramenski sedge community throughout the summer more than any other species, although green-winged teal did show some preference for this habitat in August. Brood use of shallow RS ponds was somewhat surprising because these wetlands offer little escape cover. Food (chironomid larvae, other invertebrates and aquatic plants) did not appear more abundant than in marsh ponds. Perhaps duckling use of RS is related to low mammalian predator density. Three pintail broods were seen at the mouth of Goose Creek, Goose Bay, in July; but no other broods were observed in the intertidal zone.

Diving ducks, mergansers, loons and grebes used deeper waterbodies within marsh and, to a lesser extent, shrub-bog communities. However, coastal marshes of Cook Inlet harbored few of these birds during the summer.

Geese - Canada geese during June used all habitats from the marsh to tidal flats (Fig. 9). During the 19 July aerial survey, most Canada geese on Susitna Flats were in either marsh or RS communities. By late August, Canada geese were concentrated on the tide flats, and only moderate use of the Puccinella-Triglochin and marsh habitat occurred.

White-fronted geese had moved to their breeding grounds by early June, although a few were seen on marshes at Susitna Flats. By mid-August whitefronts again congregated on Susitna Flats, using tide flats primarily (Fig. 9).

Shorebirds - Habitat preference varied both by species and month (Fig. 10 and 11). Unlike other shorebirds, sandhill cranes and common snipe showed a preference for the shrub-bog community. The heaviest use of this habitat by sandhill cranes occurred in August, while snipe shifted from this habitat to the RS Community in August.

Yellowlegs were primarily associated with marsh in June, with SB habitat used secondarily. Later in the summer, use of tidal flats and RS increased and the use of SB areas dropped.

Short-billed dowitchers relied heavily on marsh habitat in June, but later in the summer, as the water levels dropped, they switched to feeding on mud bottoms of shallow ponds in the RS Community. When these ponds were full in early June, a sharp edge was formed where thick Ramenski sedge cover abutted water several inches deep. Perhaps this type of shoreline discouraged use by shorebirds that prefer to wade and feed on exposed mud or in very shallow water.

Hudsonian godwits were most abundant in July and used a combination of marsh, RS and PT habitats. Like dowitchers, Hudsonian godwits concentrated on exposed mud flats adjacent to shallow water. In July only Hudsonian godwits made significant use of tidal sheet water on the PT flats.

Least and semi-palmated sandpipers were abundant during July on tidal mud flats and on exposed mud fringes of drying wetlands.

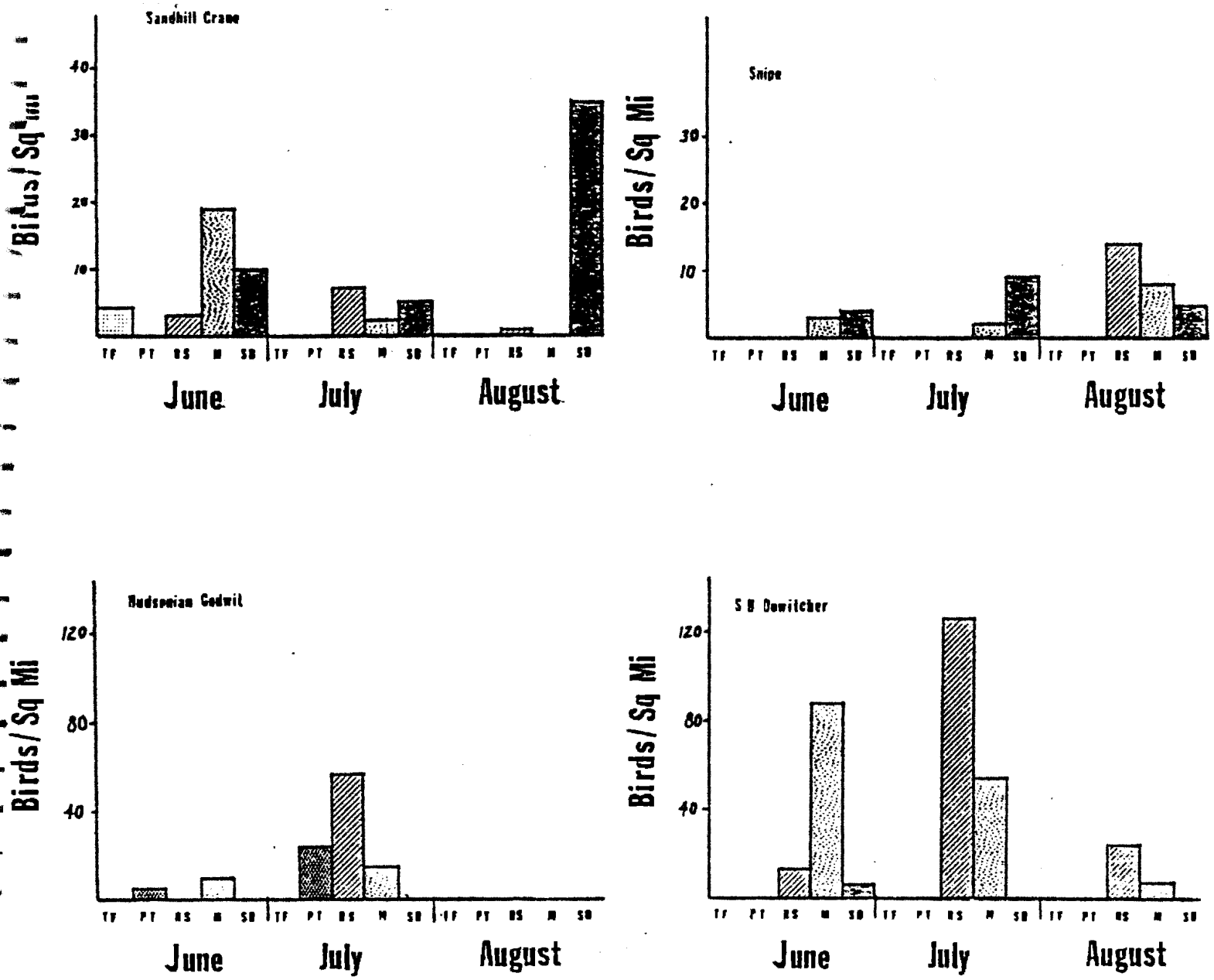


Fig. 10. Bird density by habitat type (TF = Tide Flats, PT = Puccinellia-Triglochin, RS = Ramenski Sedge - Shallow Pond, M = Marsh, SB = Shrub-Bog). Unshaded portion of bars represents broods.

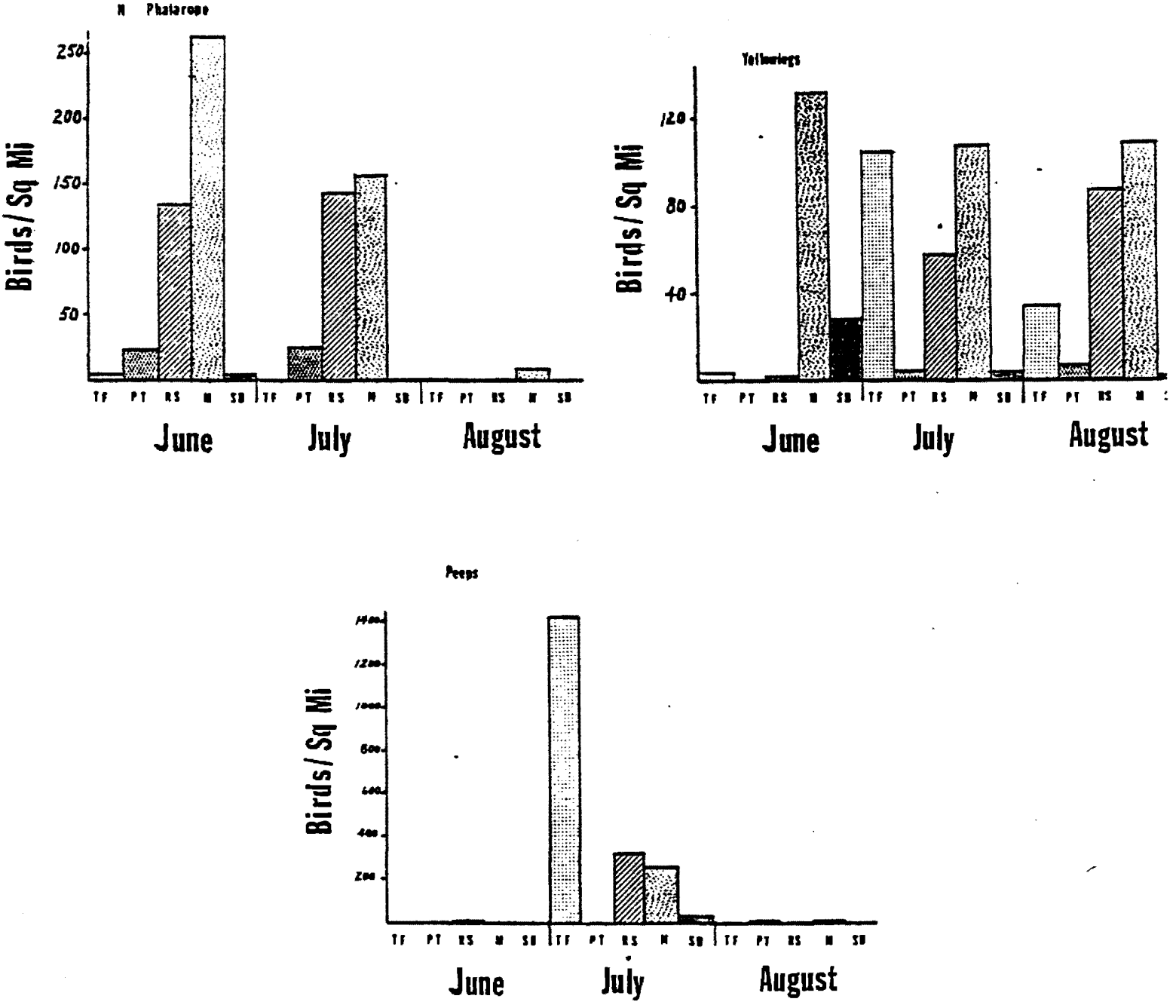


Fig. 11. Bird density by habitat type (TF = Tide Flats, PT = Puccinellia-Triglochin, RS = Ramenski Sedge - Shallow Pond, M = Marsh, SB = Shrub-Bog). Unshaded portion of bars represents broods.

Aircraft Disturbance of Waterfowl

There has been growing concern expressed by ADF&G personnel and sportsmen that increased light aircraft traffic over Cook Inlet refuges has caused disburbance of waterfowl. Reference to the influence of aircraft overflights on waterfowl behavior reported in the literature are somewhat diverse. Rowinski (1958) reported that aerial waterfowl surveys flown at 200 ft. over Minto Flats caused little disturbance of breeding ducks. In British Columbia, Halter (1973) flew surveys, at about 200 feet, of waterfowl using a coastal marsh during fall migration. He noted that the first flights of the survey (5 October) caused all geese to flush; by the 10th survey there was noticably less disturbance, and by the 17th flight (1 November) few geese flushed. Halter was not certain whether the same geese were present throughout this period and simply became accustomed to the survey flights, or whether later arriving geese were less flightly than those present in early October. Dirksen et al. (1978) reported that molting geese and brant on the North Slope of Alaska were affected by low flying planes and helicopters. They observed that the lower the aircraft, the greater the disturbance. To minimize the impact of aircraft on important molting areas, they recommended that overflights be kept above 1525 meters.

During the summer and fall of 1978 data were recorded for 82 incidents of aircraft flying over waterfowl on Susitna Flats. There were many more overflights than this, but the observers were not always in a position to record the reaction of waterfowl. The obvious conclusion from these observations was that flushing rates increased as the distance between birds and aircraft decreased (Table 4). Little disturbance was caused by flights over 400 feet, but substantial harassment of waterfowl resulted from overflights below 200 feet. Data were insufficient to draw conclusions on whether habitat type or species of waterfowl affected the result of an aircraft pass. However, references to aircraft disturbance reported in the literature, personal experience of other ADF&G personnel and my own observations lead to the following theories:

1. Geese are generally more subject to disturbance than are ducks.

2. Helicopters cause more of a reaction from waterfowl than do planes flying at the same altitude.

3. Waterfowl, particularly ducks, can become accustomed to aircraft flying above 400 feet provided there is not a direct association with harassment—i.e. if the passing aircraft does not pose an immediate threat to the birds.

4. When the noise and/or sight of passing aircraft is "frightening enough to pose a threat", the harassment caused is obvious. How close a plane must be to "threaten" waterfowl may vary with the species, location, habitat and time of year. At Izembek and other staging areas along the Alaska Peninsula, geese and brant react to aircraft several thousand feet overhead. At Susitna Flats during the summer, flights above 200 feet may not "threaten" some ducks.

5. Human activity, if associated with an aircraft, may increase the "threat" felt by waterfowl. For instance, if waterfowl are pursued by humans disembarking from an aircraft, the birds' fear of aircraft may be heightened.

Although these theories need further testing, other questions of more immediate and practical concern must be addressed: how many "waterfowl days" on Cook Inlet marshes are lost due to premature departure of birds disturbed by aircraft; how much energy is wasted in birds disturbed by aircraft, and is it significant; is hunter success reduced from waterfowl leaving an area or modifying their behavior; and is recreational enjoyment on refuges diminished by aircraft disturbance?

The extent of the problem can be illustrated on Palmer Hay Flats where a few planes are used to hunt geese on Coffee Point. D. Bader (ADF&G employee with 10 years experience on Coffee Point) has observed some significant changes in use of Coffee Point by staging lesser Canada geese. He attributes aircraft disturbance—caused by hunters landing near geese and then stalking the birds or by hunters who drop off companions and then use the airplane to herd geese back over the companions "hiding in ambush"--with the following adverse impacts:

1. Some frightened geese leave Palmer Hay Flats prematurely to continue their southern migration.

2. Geese have changed their feeding pattern to primarily nocturnal activity, with daylight "activity" restricted to unhuntable locations on the inlet or mudflats.

3. Geese that are disturbed tend to form larger flocks.

4. Interference with other hunters' use of the area and the goose resource.

All of the above impacts reduce the suitability of Coffee Point to migrating geese and diminish the recreational enjoyment of the refuge by many hunters. For instance, Bader observed that the peak goose population using Coffee Point in late September has dropped from between 15,000 and 20,000 in 1976 to 7,000 in 1977 and to about 2,500 in 1978. During this same three years airplane use for hunting has increased from one or two planes per week to about 7 per week.

When asked about aircraft use of Palmer Hay Flats, 46 percent of the respondents to the questionnaire wanted aircraft restricted or eliminated. The sentiment against aircraft is higher at Palmer Hay Flats than at Susitna Flats or Trading Bay because Palmer Hay Flats is accessable by foot or small boat, and possibly because the problems at Coffee Point are recognized.

The data collected on Susitna Flats, the observations on Palmer Hay Flats and the concern voiced by many sportsmen all point to the need for measures to reduce aircraft disturbance of birds, and humans, using state game refuges. These measures should not, however, preclude access to these refuges.

Table 4. Reaction of waterfowl to aircraft, Upper Cook Inlet Refuges, 1978.

Straight line distance between aircraft and waterfowl	Percent of incidents causing birds to flush	Number observations
<100 ft.	64	11
100 - 200 ft.	47	15
200 - 300 ft.	25	20
300 - 400 ft.	22	18
>400 ft.	6	18
		82

Public Opinion on Use and Management of Cook Inlet State Game Refuge

By 1 December 1978, 111 questionnaries (Fig. 5) were received and tabulated. These questionnaires reported a total of 2,196 days of recreation and 120 days of commercial fishing (Table 5). Waterfowl hunting, general enjoyment of nature, sport fishing, trapping and other hunting accounted for 60, 15, 13, 7 and 5 percent of the recreation days, respectively. Although widespread distribution of these questionnaires was made, waterfowl hunters (especially those using Susitna Flats) were probably sampled disproportionately to other users. The Statewide Waterfowl Hunter Mail Survey indicated that Susitna Flats and Palmer Hay Flats received nearly the same hunting pressure from 1971 to 1976 (Table 1). In contrast, 76 percent of the respondents to the Refuge questionnaire reported hunting waterfowl on Susitna Flats, and only 32 percent reported waterfowling on Palmer Hay Flats (Table 6).

Table 6. Percent of 111 respondents using Cook Inlet Refuges for various activities.

	Percent			
Activity	Susitna Flats	Palmer Hay Flats	Trading Bay	Goose Bay
Waterfowl hunting	76	32	14	14
Other hunting	8	6	5	1
Sport fishing	18	10	4	2
Commercial fishing	3	0	0	0
Enjoying nature	22	13	7	6

The reported waterfowl hunting pressure and harvest is shown in Table 7. Thirty-eight percent of hunters on Susitna, and 18 percent of those using Palmer Hay Flats took 20 or more ducks per season. No one reported taking more than 20 ducks at either Goose Bay or Trading Bay. Susitna waterfowlers reportedly spent an average of 11 days per year hunting and achieved a daily bag of about 2.4 ducks. Daily harvest at Trading Bay and Palmer Hay Flats was about 2 ducks, while at Goose Bay it was 1 duck per day. The seasonal goose harvest was also highest at Susitna (1.3 geese per year).

Table 5. Recreational use of Cook Inlet State Game Refuges.

Activity	Susitna		Palmer Hay Flats		Trading Bay		Goose Bay	
	Total Days	Ave. Days Per User	Total Days	Ave. Days Per User	Total Days	Ave. Days Per User	Total Days	Ave. Days Per User
Hunt Waterfowl	898	11	277	7	53	4	88	6
Hunt Other Game	51	6	25	4	34	6	2	2
Sport Fish	129	6	93	8	49	12	10	5
Comm. Fish	100	33	10	10	-		10	10
Enjoy Nature	233	10	40	3	64	8	10	1
Trapping			150	38				

Table 7. Reported average waterfowl harvest on refuges (Public Questionnaire).

	Susitna	Palmer Hay	Trading Bay	Goose Bay
Average Days Hunted/Yr.	11	7	4	6
Ducks Harvested Per Year/Hunter	26	13.0	8.0	6.4
Geese Harvested Per Year/Hunter	1.3	0.2	0.6	1

Table 8. Cook Inlet Refuge duck harvest 1971-1976 calculated from statewide waterfowl hunter mail surveys.

Refuge	Duck Harvest 1971	1972	1973	1974	1975	1976	1971-1976 average	Percent of State Duck Harvest 1971-1976
Susitna Flats	7442	9696	16385	6750	9485	11836	10266	12.6
Palmer Hay Flats	5854	4677	7879	5458	7114	6326	6218	7.4
Goose Bay	NS	NS	2238	287	351	510	846	0.9
Trading Bay	NS	1376	716	1867	1054	2551	1513	1.8
Potter Marsh	502	917	985	1795	615	510	887	1.1

NS = not surveyed

Table 9. Cook Inlet Refuge goose harvest 1971-1976 calculated from statewide waterfowl hunter mail survey.

Refuge	Goose Harvest 1971	1972	1973	1974	1975	1976	1971-1976 average	Percent of State Goose Harvest 1971-1976
Susitna Flats	669	357	1030	224	173	418	478	3.3
Palmer Hay Flats	45	65	257	112	173	72	121	0.8
Goose Bay	NS	NS	0	0	0	0	0	0.0
Trading Bay	NS	NS	37	37	333	29	109	0.7
Potter Marsh	0	11	0	0	0	0	2	0.0

NS = not surveyed

Waterfowl harvest and hunter days in Alaska, including Cook Inlet Refuges was monitored from 1971 to 1976 by statewide waterfowl hunter mail surveys. In the statewide mail survey, Trading Bay hunters reported the highest daily success for both ducks and geese, followed by waterfowlers at Susitna (Tables 8 and 9). Daily harvest at Goose Bay and Palmer Hay Flats were slightly lower.

The greater success at Trading Bay and Susitna Flats probably resulted from more experienced hunters there than other refuges. For example, 43 percent of those hunting on Susitna Flats and Trading Bay had 11 or more years of experience, compared to only 22 percent with this level of experience on other refuges (Table 10). Although not measured in the questionnaire, hunting success on Susitna Flats and Trading Bay (accessable only by aircraft or boat) may be affected by lower hunter densities and/or more waterfowl present during the season.

Question 4 asked if waterfowl hunting had changed—without specifically inquiring about changes in success (birds in the bag) or quality of the hunt (a personal measure of enjoyment). Of 44 hunters with at least 10 years experience on any refuge, 45 percent reported no change in hunting, 43 percent said hunting was getting worse and 11 percent claimed hunting was getting better. Of 48 hunters with less than 10 years experience, 56 percent detected no change; 31 percent thought hunting was poorer; and 13 percent saw an improvement.

Question 5 sought explainations for any observed change in hunting. Those believing that hunting improved credited more ducks (4), personal improvement in hunting ability (2), weather (2), more hunters to keep birds moving (1) and better habitat (1). Hunters feeling that hunting declined gave a wide range of explainations: increased hunting pressure (16), fewer birds (6), loss of habitat (5), harassment by planes and airboats (5), too many gulls (3), too many cabins (3), weather (1) and unknown (3). Many hunters detected yearly differences based on weather and migration patterns, but they did not identify any long term trend in hunting quality and success.

Question 6 dealt with use of mechanized vehicles on refuges. The results were difficult to analyze and may be among the most controversial of the questions. Table 11 shows the percent of respondents favoring unrestricted use, restricted use or a prohibition of airboats, all terrain vehicles and airplanes on refuges. A majority of respondents want no restriction of airplane use on any refuge, particularly on Susitna Flats and Trading Bay where planes are the common method of access. However, 32 percent of those using Susitna Flats favored some restriction of air traffic, probably in reference to unnecessarily low flights. There was strong sentiment for control of ATV's and airboats on all refuges. For Palmer Hay Flats, 81 percent and 66 percent of respondents wanted restriction or elimination of ATV's and airboats, respectively. At Goose Bay and Susitna Flats, 75 percent and 69 percent, respectively, wanted some control of ATV's.

Answers to Question 7 (Do you object to roads within refuges?) showed almost an even split of opinion. For Susitna Flats, Palmer Hay Flats,

Trading Bay and Goose Bay respectively, 55, 50, 50 and 40 percent of the respondents opposed road construction. Most opinions appeared to be based on a desire for or against increased access on refuges. Concern for habitat destruction from road construction was also expressed.

One particular concern of the State of Alaska is the management of recreation cabins on State game refuges. Considering the limited access for Susitna Flats and Trading Bay, waterfowling opportunities, as well as a traditional style of hunting, would be severely restricted without over-night facilities. Camping is not feasible on many areas of the refuges because of wet soil conditions. Over the years "duck shacks" have been built both on private and public land, to allow hunters a chance at harvesting waterfowl and to have a more enjoyable, comfortable hunt. In June 1978 ADF&G announced a moritorium on new cabin construction on State game refuges. At that time Susitna Flats had 109 cabins on State or borough land and 33 cabins on private inholdings. Trading Bay had 2 cabins on private inholdings and, 11 cabins on State land located on the inlet side of the sedge-bog plant community. Additionally, at least 2 cabins were located on State land further inland. A complete reconnaissance of the interior of Trading Bay and of Palmer Hay Flats has not been completed. We are, though, aware of at least three private cabins and one tent frame on Palmer Hay Flats Refuge. Although the Alaska Department of Natural Resources was given authority to issue permits for cabins on State land within Trading Bay State Game Refuge, no permits have been issued to date.

The question asked respondents how they felt about the number of cabins on State Game Refuges. Sixty-seven percent of the respondents owned or had access to a private cabins, primarily on Susitna Flats. Of these people, 78 percent thought the number of cabins on State refuges was "about right", 15 percent thought there were too many and 7 percent felt there could be more cabins. The opinion of those without use of a private cabin was different: only 33 percent thought the number of cabins was adequate, 38 percent thought there were too many and 29 percent wanted more cabins. Forty-seven percent of those without a cabin favored the construction of public-use cabins while only 29 percent of those with access to a private cabin supported this concept.

RECOMMENDATIONS

This report provides baseline information on wildlife and human use of Cook Inlet State Game Refuges sufficient for initial stages of management planning. As the human population of Southcentral Alaska increases (one reputable projection puts the Cook Inlet population at 650,000 by the year 2025) the recreation demands and developmental pressures (gas production on Susitna Flats, coal extraction from the Beluga coal fields, sewage disposal on Palmer Hay Flats, road construction across and/or around Cook Inlet) will require more detailed planning and sophisticated management of these refuges. To prepare for more intensive management of these areas, a better understanding of coastal marshes will be needed. Therefore, the following specific recommendations are presented:

1. A current study by Allison Snow and Sue Vince on Susitna Flats will provide insight on the development, distribution, production and classification of salt marsh communities. This knowledge will be useful in predicting how alteration of the physical environment will affect wildlife habitat and its use. Because of ADF&G budget cutbacks, it is unlikely that funds can be committed specifically for this project. However, ADF&G should encourage this study with technical assistance and logistical support to the extent possible under current fiscal restraints.

2. Pending more detailed discription and classification of salt marsh plant communities expected from the above study, Cook Inlet State Game Refuges should be type mapped. Existing color aerial photos of Susitna Flats can be used. Possibly other refuges could be type mapped from Landsat photo coverage. The Geophysical Institute, University of Alaska - Fairbanks, has color imagery of Cook Inlet (1977 coverage at scale of 1:250,000) available for about $100. Before purchasing these photos the imagery should be evaluated to determine if resolution is sufficient for vegetation typing of stands as small as 10 acres.

3. The composition and size of duck populations should be monitored from first arrival until departure of post-breeders to determine if migrant, breeding and pre-molt populations can be distinguished. If the dabbler population drops after the departure of migrants—expected to occur by the time early nesters begin incubating—and subsequently the population builds up just after the first broods appear, this later assemblege would indicate pre-molt staging. This suspicion could be verified if these flocks are composed primarily of reproductivity inactive drakes and a few barren hens.

   To test this hypothesis, a few ducks of each sex would be collected from these predominately male flocks to determine their reproductive status. At the same time spring and early summer food habits could be examined.

4. After we more fully understand spring behavior and population dynamics of dabblers on coastal marshes, an indicator for proper timing of breeding bird surveys should be found. This "indicator" could be a specific ratio of pairs to lone drakes, a particular stage of spring phenology or some combination of factors which would minimize the count of migrants or congregation of pre-molters.

5. The use of the shrub-bog community as nesting cover by dabblers should be examined. Nest density should be determined in SB at different distances from the marsh interface. If nesting densities are low, perhaps habitat manipulation (fire or mowing) of SB could create more grass-forb cover suitable for nesting.

6. Brood production should be determined for different plant communities using the "beat-out" technique as compared to the method used in this study.

7. Banding of ducklings could be accomplished along with the above objective. It would be desirable to know the migration pattern of locally produced ducks and to measure how much they contribute to local harvest in Cook Inlet.

8. Mallards and pintails used the Puccinellia-Triglochin community for three days following flood tides on 20 August 1978, but the actual food consumed was not documented. If this brief shift in habitat use occurs in 1979, it should be recorded and food consumption measured for a few specimens. Food habits of shorebirds are also not fully documented.

9. A recent study (Selser 1977) indicated that aquatic food chains assimilate lead from spent shot in marsh soil. Perhaps in conjunction with Snow and Vince's study, marsh plants on Susitna and/or Palmer Hay Flats could be assayed for lead.

10. Although the lead poisoning study conducted in 1978 should provide an answer to the extent of the problem in Cook Inlet, unanswered questions about lead versus steel may remain. If in the future ducks are examined for ingested lead, the specimens should also be checked for parasites in the digestive tract to determine if subleathal doses of lead may act as a vermicide.

11. Management policies for public and private cabins on refuges should be formulated by 1 September, 1979 and implemented the following year.

12. A policy on control of aircraft, ATV and airboats should be formulated and implemented before September 1, 1979.

13. Public access to Palmer Hay Flats at Cottonwood Point, the BP pad and possibly one location in between should be secured permanently.

14. The possibility of land trades to secure inholdings of the Mat-Su Borough and Native Corporations should be pursued, as should the purchase of Cottonwood point from private land owners.

15. In the future it may be desirable to limit hunting pressure on refuges. Public sentiment should be tested periodically on what level of hunter density is desirable.

Acknowledgements

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Table 10. Number of hunters with various experience on each refuge.

Refuge	Numbers of Years of Experience							
	1-2 Years		3-5 Years		6-10 Years		11+ Years	
	# of Hunters	Per-cent	# of Hunters	Per-cent	# of Hunters	Per-cent	# of Hunters	Per-cent
Susitna	8	9	24	27	19	22	37	42
Palmer Hay Flats	6	13	13	29	15	33	11	24
Trading Bay	2	12	2	12	4	25	8	50
Goose Bay	5	26	8	42	3	16	3	16

Table 11. Percent of respondents favoring unrestricted, restricted or no use of mechanize vehicles on refuges.

	Susitna Flats			Palmer Hay Flats			Trading Bay			Goose Bay		
Type of Use	Air Boat	ATV	Air Plane	Air Boat	ATV	Air Plane	Air Boat	ATV	Air Plane	Air Boat	ATV	Air Plar
Unrestricted	42%	31%	68%	33%	19%	52%	82%	25%	83%	40%	25%	54%
Restricted	28%	35%	32%	30%	50%	26%	9%	58%	17%	20%	50%	8%
Prohibited	27%	34%	0%	36%	31%	23%	9%	17%	0%	40%	25%	38%
Total number of responses	74	86	80	33	32	31	11	12	12	15	16	13

Location: Susitna Flats

Observer(s): _____

Habitat Type(s): _____

Photo: _____

Date/Time: _____ End Time: _____

Weather: _____

Wind Speed & Direction: _____

Remarks(tide,etc.): _____

Temperature: _____

Cloud Cover: ___

	June/July/Aug.				June/July/Aug.				June/July/Aug.		
Common Loon				Marsh Hawk	R	R	C	Pigeon Guillemot			
Arctic Loon*	O	O	O	Sharpshinned			O	Marbled Murrelet			
Red-throated Loon				Willow Ptarmigan				Kittlitz's Murrelet			
Red-necked Grebe				Sandhill Crane*	C	O	C	Parakeet Auklet			
Horned Grebe*	O	O	R	Black Oystercatcher				Horned Puffin			
Northern Fulmar				Semipalmated Plover				Tufted Puffin			
Shearwater				Killdeer	R						
Fork-tailed Storm-Petrel				Black-bellied Plover				Short-eared Owl	R	R	
Double-crested Cormorant				Hudsonian Godwit	O	C		Belted Kingfisher			
Pelagic Cormorant				Bar-tailed Godwit				Violet-green Swallow			
Red-faced Cormorant				Whimbrel greater&	R	R		Tree Swallow*	A	A	
				Yellowlegs* lesser	C	C	VC	Cliff Swallow*	C	C	
Swan Trumpter	R		O	Spotted Sandpiper				Black-billed Magpie			
Canada Goose*	C	O	C	Wandering Tattler				Common Raven	O	C	C
Brant				Ruddy Turnstone				Northwestern Crow			
White-fronted Goose	O		C	Black Turnstone				Dipper			
Snow Goose	R			Northern Phalarope*	VC	VC	O	Winter Wren			
Mallard*	VC	C	VC	Common Snipe*	O		C	American Robin	O		
Gadwall*	R	R	R	Short-billed Dowitcher*	C	C	O	Varied Thrush			
Pintail*	VC	C	VC	Long-billed Dowitcher				Water Pipit			
Green-winged Teal*	VC	C	VC	Surfbird				Northern Shrike			
Northern Shoveler*	VC	C	VC	Red Knot				Yellow Warbler			
American Wigeon*	VC	C	VC	Western Sandpiper	R			Wilson's Warbler			
Blue-winged teal	R			Least Sandpiper		VC		Rusty Blackbird	O	C	O
Greater Scaup*	O	R	C	Baird's Sandpiper				Grey-crowned Rosy Finch			
Common Goldeneye	R			Pectoral Sandpiper				Common Redpoll	O		
Barrow's Goldeneye				Rock Sandpiper				Savannah Sparrow*	A	A	VC
Bufflehead				Dunlin				White-crowned Sparrow	O	O	
								Golden-crowned Sparrow			
				Parasitic Jaeger		O	O	Fox Sparrow			
Harlequin Duck				Long-tailed Jaeger				Song Sparrow*	A	A	VC
Steller's Eider				Glaucous Gull				Lapland Sparrow			
Common Eider				Glaucous-winged Gull*	A	A	C	Snow Bunting			
White-winged Scoter				Herring Gull*	A	A	C	Bohemian Waxwing	R	R	
Surf Scoter				Mew Gull*	A	A	O				
Black Scoter				Bonaparte's Gull*	C	C					
Common Merganser	R			Black-legged Kittiwake							
Red-breasted Merganser	R	R	R	Arctic Tern*	VC	C	O				
Bald Eagle*	R	R	R	Common Murre							

* Known to breed on Susitna Flats in 1978

Location: Palmer Hay Flats

Observer(s): _____

Habitat Type(s): _____

Photo: _____

Date/Time: _____ End Time: _____

Weather: _____

Wind Speed & Direction: _____ Remarks(tide,etc.): _____

Temperature: _____

Cloud Cover: __

	June/July/Aug.				June/July/Aug.				June/July/Aug.		
Common Loon				Marsh Hawk			O	Pigeon Guillemot			
Arctic Loon		O						Marbled Murrelet			
Red-throated Loon				Willow Ptarmigan				Kittlitz's Murrelet			
Red-necked Grebe			O	Sandhill Crane*	O	O	C	Parakeet Auklet			
Horned Grebe	O	O	O	Black Oystercatcher				Horned Puffin			
Northern Fulmar				Semipalmated Plover		O		Tufted Puffin			
Shearwater											
Fork-tailed Storm-Petrel				Black-bellied Plover				Short-eared Owl			
Double-crested Cormorant				Hudsonian Godwit				Belted Kingfisher			
Pelagic Cormorant				Bar-tailed Godwit				Violet-green Swallow			
Red-faced Cormorant				Whimbrel	R			Tree Swallow *	VC	C	
				Yellowlegs *greater& lesser				Cliff Swallow *	C		
Swan Whistling	R			Spotted Sandpiper				Black-billed Magpie		C	
Canada Goose	C	C	C	Wandering Tattler				Common Raven		C	O
Brant				Ruddy Turnstone				Northwestern Crow			
White-fronted Goose				Black Turnstone				Dipper			
Snow Goose				Northern Phalarope*	VC	C		Winter Wren			
Mallard *	VC	C	VC	Common Snipe		O	C	American Robin	O	C	
Gadwall		O		Short-billed Dowitcher	C	C		Varied Thrush			
Pintail *	VC	C	VC	Long-billed Dowitcher				Water Pipit			
Green-winged Teal *	VC	C	C	Surfbird				Northern Shrike			
Northern Shoveler *	C	C	C	Red Knot				Yellow Warbler			
American Wigeon *	VC	C	C	Western Sandpiper				Wilson's Warbler			
Blue Winged Teal*	C	O		Least Sandpiper	O	C		Rusty Blackbird	C	C	C
Greater Scaup	O		VC	Baird's Sandpiper				Grey-crowned Rosy Finch			
Common Goldeneye				Pectoral Sandpiper				Common Redpoll			
Barrow's Goldeneye				Rock Sandpiper				Savannah Sparrow	C	C	C
Bufflehead			C	Dunlin				White-crowned Sparrow	O		
Canvasback			C					Golden-crowned Sparrow			
Redhead			O	Parasitic Jaeger				Fox Sparrow			
Harlequin Duck				Long-tailed Jaeger				Song Sparrow	C	C	C
Steller's Eider				Glaucous Gull				Lapland Sparrow			
Common Eider				Glaucous-winged Gull	C	C	C	Snow Bunting			
White-winged Scoter				Herring Gull	C	C	C	Bohemian Waxwing	R		
Surf Scoter				Mew Gull*	C	C		Red-winged Blackbird			
Black Scoter				Bonaparte's Gull *	O	C				O	
Common Merganser				Black-legged Kittiwake							
Red-breasted Merganser				Arctic Tern	C	C					
Bald Eagle				Common Murre							

* Known to breed on Palmer Hay Flats in 1978

Location: Goose Bay

Habitat Type(s): _____

Date/Time: _____ End Time: _____

Weather: _____

Wind Speed & Direction: _____

Temperature: _____

Cloud Cover: ___

Observer(s): _____

Photo: _____

Remarks(tide,etc.): _____

	June/July/Aug.				June/July/Aug.				June/July/Aug.			
Common Loon				Marsh Hawk	O			O	Pigeon Guillemot			
Arctic Loon				Red Tailed Hawk				O	Marbled Murrelet			
Red-throated Loon				Willow Ptarmigan					Kittlitz's Murrelet			
Red-necked Grebe				Sandhill Crane *	C	C	C		Parakeet Auklet			
Horned Grebe				Black Oystercatcher					Horned Puffin			
Northern Fulmar				Semipalmated Plover	O	C			Tufted Puffin			
Shearwater												
Fork-tailed Storm-Petrel				Black-bellied Plover					Short-eared Owl			
Double-crested Cormorant				Hudsonian Godwit		C			Belted Kingfisher			
Pelagic Cormorant				Bar-tailed Godwit					Cliff Swallow	C		
Red-faced Cormorant				Whimbrel					Tree Swallow	C	C	
				Yellowlegs greater& *lesser	A	C	VC		Bank Swallow	C		
Swan				Spotted Sandpiper					Black-billed Magpie			
Canada Goose	C		VC	Wandering Tattler					Common Raven		C	O
Brant				Ruddy Turnstone					Northwestern Crow			
White-fronted Goose				Black Turnstone					Dipper			
Snow Goose				Northern Phalarope *	VC	C			Winter Wren			
Mallard *	C	C	VC	Common Snipe *	C	C	C		American Robin	C	C	
Gadwall				Short-billed Dowitcher	C	C	C		Varied Thrush			
Pintail *	C	C	VC	Long-billed Dowitcher		O	O		Water Pipit			
Green-winged Teal *	C	C	VC	Surfbird					Northern Shrike			
Northern Shoveler *	C	C	C	Red Knot					Yellow Warbler			
American Wigeon *	O	C	C	Western Sandpiper					Wilson's Warbler			
				Least Sandpiper	O	C			Rusty Blackbird	C	C	C
Greater Scaup				Baird's Sandpiper					Grey-crowned Rosy Finch			
Common Goldeneye				Pectoral Sandpiper					Common Redpoll		C	
Barrow's Goldeneye				Rock Sandpiper					Savannah Sparrow	C	C	C
Bufflehead				Dunlin					White-crowned Sparrow			
									Golden-crowned Sparrow			
				Parasitic Jaeger					Fox Sparrow			
Harlequin Duck				Long-tailed Jaeger					Song Sparrow	C	C	C
Steller's Eider				Glaucous Gull					Lapland Sparrow			
Common Eider				Glaucous-winged Gull	C	C	C		Snow Bunting			
White-winged Scoter				Herring Gull	C	C	C					
Surf Scoter				New Gull	C	C						
Black Scoter				Bonaparte's Gull								
Common Merganser				Black-legged Kittiwake								
Red-breasted Merganser				Arctic Tern	C	C						
Bald Eagle				Common Murre								

* Known to breed on Goose Bay in 1978