WATERBIRD HABITAT AND USE OF CHICKALOON FLATS

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WATERBIRD HABITAT AND USE

OF CHICKALOON FLATS

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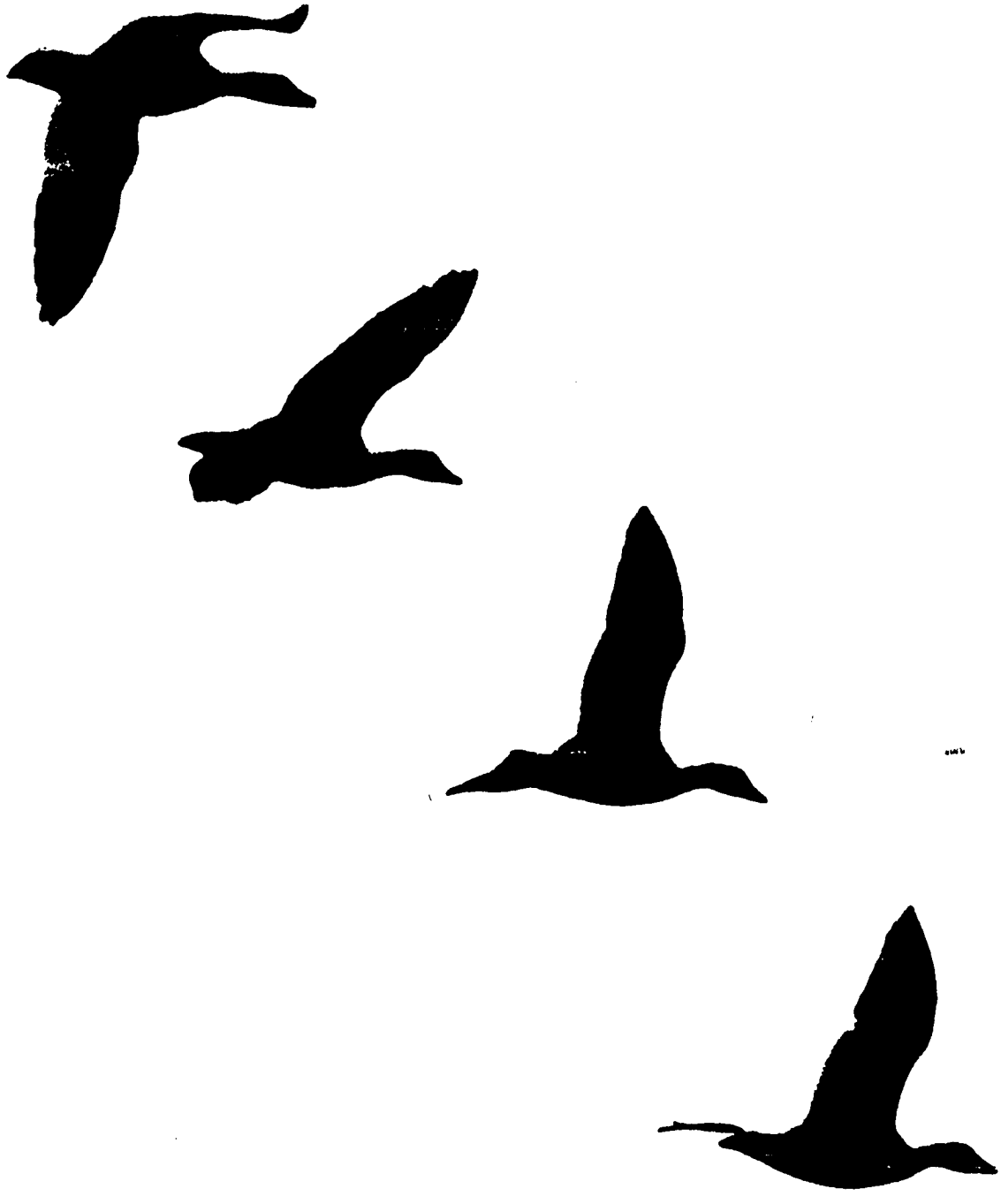

Frontispiece. Snow geese in flight.

ABSTRACT

Waterbird populations and habitat were studied at Chickaloon Flats during part of 1970 and 1971. Plant communities were described and mapped and recreational hunting use of the area was described.

The 1964 earthquake caused a drop in elevation of approximately 3-1/2 feet and subsequently increased siltation and inundation by salt water. This destroyed some areas of upland communities while favoring the establishment of plant communities comprised of species with a tolerance to salt water.

Bird use of the plant communities varied with the season and the species present at any particular time. The Flats were intensively utilized by ducks and geese during the spring and fall migrations while a much smaller but more stable population of ducks was present throughout the summer. Densities of nesting ducks were 1 pair per 7.3 acres in 1970 and 1 pair per 4.0 acres in 1971 in selected areas of Marsh Community. Mallards (Anas platyrhynchos), pintails (A. acuta), green-winged teal (A. carolinensis) and American widgeon (Mareca Americana) comprised 89% of the breeding population in both years.

The Type 3 Unvegetated Mud Community was utilized by shorebirds, while the Marsh, Floating Marsh, Seaside Arrow-grass Conglomerate and Seaside Arrow-grass - Large Alkali-grass communities were valuable to ducks and geese.

I do not believe that total duck and geese use of Chickaloon Flats has changed signigicantly as a result of the 1964 earthquake.

Acknowledgements

I would like to thank John Hakala, former Refuge Manager at the Kenai National Moose Range, who provided the opportunity and financing for the study and Robert A. Richey, Assistant Refuge Manager and pilot, who provided camp support and conducted many aerial surveys during the study. On numerous occasions Bob worked extra hours and weekends in addition to making some hazardous landings on the Chickaloon River to keep the project operating.

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INTRODUCTION

Chickaloon Flats, a locally important migratory bird production and nesting area, is located in one of the major earthquake zones of the world. This zone follows the Aleutian Chain up into Prince William Sound. On March 27, 1964, a large earthquake occurred in the Chugach Mountains approximately 80 miles southeast of Anchorage. It registered 8.3 to 8.4 on the Richter scale which places it among the strongest earthquakes that have occurred in recent time. Associated with the earthquake were extensive zones of uplift and subsidence. The Chickaloon Flats subsided from 2 to 4-1/2 feet causing changes in bird habitat from siltation and flooding.

Presently, there is a proposed road which would connect the Kenai Peninsula to Anchorage with a bridge across Turnagain Arm and pass nearby the Flats. The project is still in the study stage and it is difficult to say when, if ever, such a highway will be constructed. The opening up of this area will have both good and bad effects depending on land use classification and the individual's point of view.

Because of changes to bird habitat and a possible increase in recreational use, a study of the Chickaloon Flats was initiated. The objectives of the study were: (1) to determine the utilization of Chickaloon Flats by migrant and resident waterfowl and shorebirds; (2) to make a cover map of current vegetation and to determine re-vegetation of coastal areas inundated as a result of the 1964 earthquake; and (3) to determine recreational use of Chickaloon Flats by

waterfowl hunters and to predict future utilization of the Flats by waterfowl and man for the purpose of managing a renewable resource.

I arrived on the Flats on May 13, 1970, and worked there until September 25, 1970, with the exceptions of a week in July and a week in August. Because a majority of northerly migrating waterfowl had already passed through by May 1970, I returned in April of 1971 to census the spring migration and to obtain more information on nesting waterfowl.

DESCRIPTION OF THE STUDY AREA

Location

Chickaloon Flats is located in southcentral Alaska along the northern edge of the Kenai Peninsula (Fig. 1). The area is bounded on the north by Turnagain Arm, an extension of Cook Inlet, on the east and southeast by the Kenai Mountains, and on the south and west by the Kenai Lowlands. The Chickaloon River, which divides the Flats approximately in half, and seven smaller streams traverse the study area (Fig. 1).

Chickaloon Flats at mean high tide is roughly 27 square miles in area. If the mud flats exposed at low tide are included, the area would be greater.

Geology

Chickaloon Flats is underlain by glacialacustrine deposits, fluvial deposits, marine deposits and eolian deposits (Karlstrom 1964).

The area up river from the U. S. Fish and Wildlife Service Cabin and under the river bed is composed of fluvial deposits. The area up river and east and west of the fluvial deposits is underlain by glacialacustrine deposits. The eolian or cliff-head dune sand deposits are exposed as a sandy beach running from the north bank of Bedlam Creek to the end of the Flats and beyond to Point Possession (Fig. 1). The eolian is the only deposit not entirely covered by marine silt at the present time.

The grey laminated tidal silt is the prominent surficial geological

feature of the Flats. Many of the changes since the 1964 earthquake are due to deposition of this silt in previously vegetated areas. Underlying the present layer of tidal silt are three organic layers; the newest, resulting from siltation of vegetation following the earthquake, is a sedge peat, and the two older layers are woody peats (Neiland 1971). The second and third layers of peat have been attributed to glacially caused fluctations in sea level and radiocarbon dating indicated that they were formed near 1250 A.D. and 850 B.C. (Karlstrom 1964). Earthquake induced changes in elevation of these tidal marshes may have caused the formation of the two oldest layers of peat.

Glaciation of the area is a recurring phenomenon. Very slight advances and declines of glaciers have pronounced effects on tidal marshes and they often occur over a relatively short span of time.

There are five Pleistocene and two post-Pleistocene glaciations recognized within the Kenai area (Karlstrom 1964). Glaciers during three Pleistocene advances coalesced in Cook Inlet and formed a large lake, while the last two advances filled Turnagain and Knik Arms with ice. The two post-Pleistocene glaciations were not as widespread as those of the Pleistocene although they still exerted a dominant influence over vegetation in the area.

During the 1964 "Good Friday" earthquake, the west side of the Flats subsided approximately 2 feet and the east side sank approximately 4-1/2 feet (Fig. 1). Averill Thayer (Plafker 1965) estimated that the Flats subsided from 3 to 4 feet based on changes in tidal levels in relation to the floor of a hunter's cabin in an area that was for the

first time partially inundated during the high tides following the earthquake. This cabin is located near the center of the Flats and was the basis for determining subsidence of Chickaloon Flats. Plafker (1965) believed that this subsidence was due to both the lowering of the land as well as compaction of underlying fine grained layers.

The earthquake also caused ground breakage which extended from Kasilof to Chickaloon Flats (Foster 1967). Although ground breakage was considerable, there was little vertical or horizontal displacement. Cracking at Chickaloon Flats consisted of a network of fractures perpendicular to the shore and some fractures parallel to the shore. Chickaloon and Kasilof Flats were cracked while other flats in similar geological situations were not.

Tides

Tides are an important ecological factor in Cook Inlet and on Chickaloon Flats.

Tides transport and deposit large quantities of suspended material, recharge with water and nutrients some temporary and permanent wetlands and contribute to erosion.

There is neither a tide gauge nor a tidal correction factor for Chickaloon Flats. Tides crested approximately at the same time as tides at Anchorage. Variations in times were due primarily to wind direction and velocity. The extreme tide levels during 1970 occurred on February 8 with the lowest tide of -5.3 feet and on August 18 and September 16 with the highest tide level of +32.4 feet for a

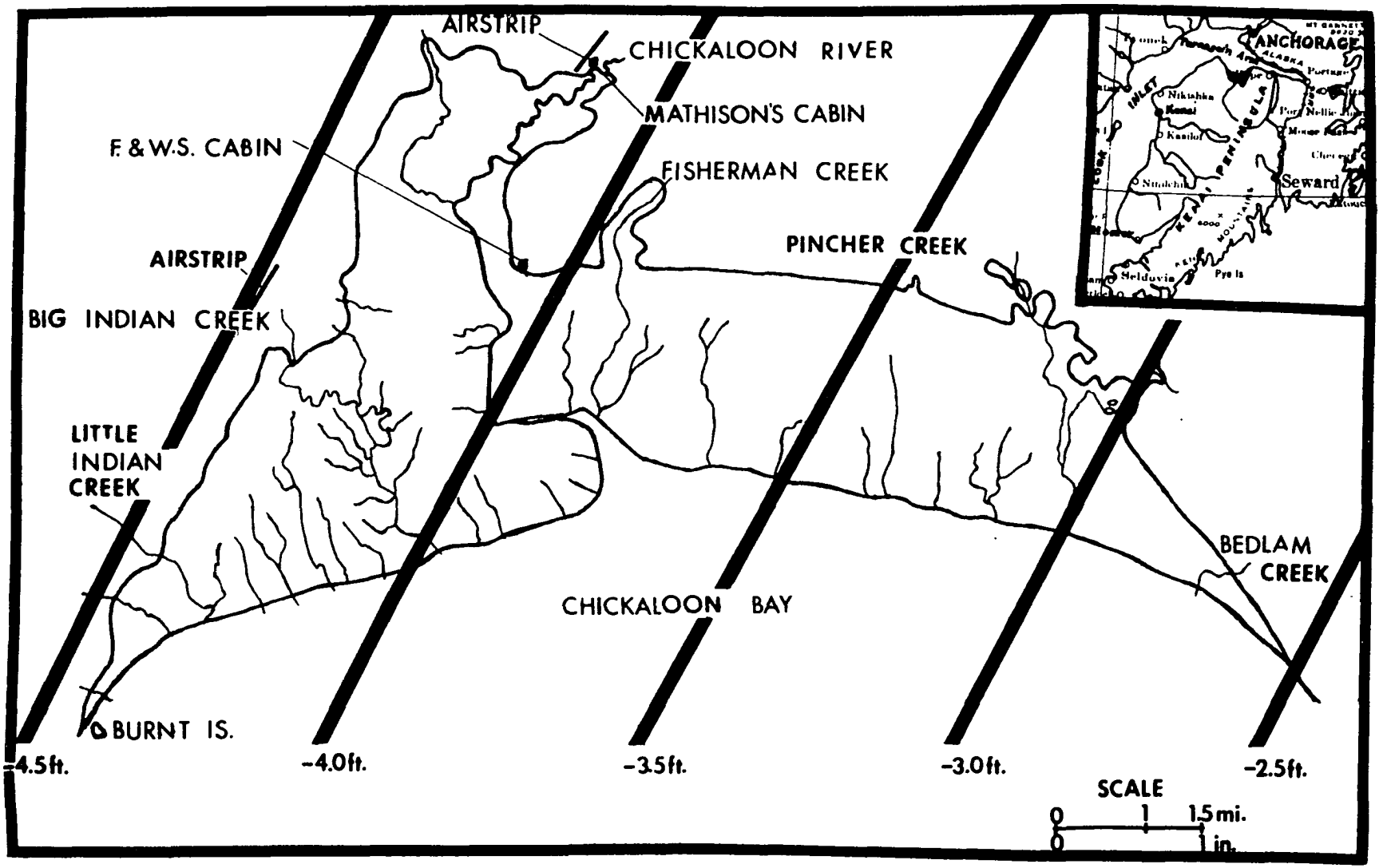

FIGURE 1. Chickaloon Flats showing gradients of subsidence following the 1964 earthquake; inset shows relative location within the Cook Inlet area.

difference of 37.5 feet. Tidal fluctuations in Cook Inlet averaged 26.1 feet.

Flooding of the Flats is cyclic, occurring during periods when tide levels reach or exceed 29.0 feet (Fig. 2 and 3). February, March, August and September are the months of peak flooding while November, December, May and June have characteristically the lowest high tides which seldom flood the Flats. The number of flooding tides for each month is shown in Fig. 4. From the U. S. Fish and Wildlife Service cabin (Fig. 1), I observed flooding a few minutes earlier east of the river than west of the river which was possibly related to a gradient caused by the subsidence.

Climate

The climate of the area is a mixture of maritime and continental influences. The winters are colder than other coastal areas further south on the Kenai Peninsula but the summers are warmer. From June to mid-July 1970, days were generally clear and warm while from mid-July to early September, the days were cooler and wetter. Anchorage (the nearest weather station) reports mean annual precipitation of 14.82 inches and mean temperature for June, July and August of approximately 55° F. Summertime temperatures at Chickaloon Flats were 4.1° warmer during the day and 3.4° colder during the night than Anchorage.

Fall was considered to be early at Chickaloon Flats in 1970. Some snow and sleet fell on September 7, and the first killing frost occurred on September 8.

FIGURE 2. High tide in July 1970. All communities were inundated. Looking northwest from U. S. Fish and Wildlife Service cabin to Kenai Mountains center and right.

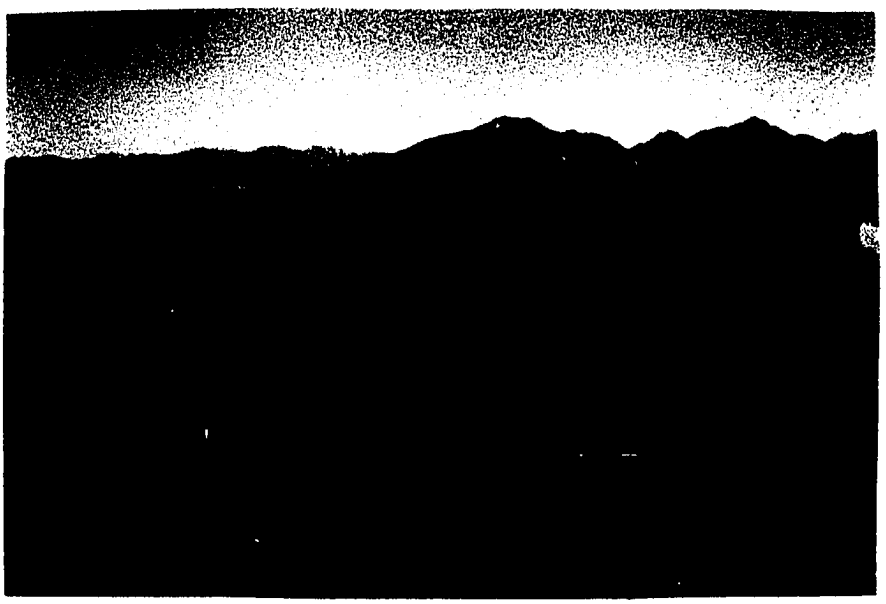

FIGURE 3. Low tide. Arrow-grass Conglomerate Community foreground and Chickaloon River in center.

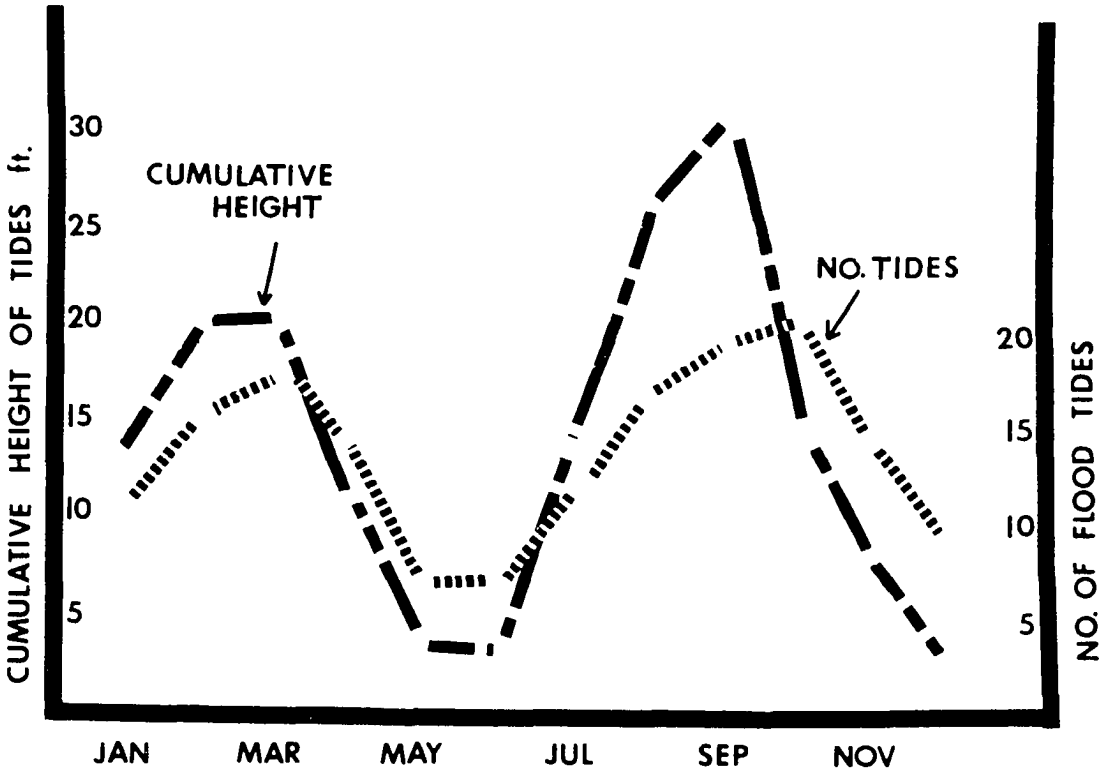

FIGURE 4. Cumulative flood depth (difference between 29.0 feet and flood crest) as measured at Anchorage and the number of flood tides at Chickaloon Flats, 1970.

PLANT COMMUNITIES

Introduction

The objectives of the plant studies were to describe vegetational patterns; to determine revegetation since the earthquake; and to relate bird use to habitat type.

Methods

Chickaloon Flats was divided into two sections for cover mapping: (1) the outer mud flats which have one plant community composed of two main species and several minor species and (2) the inner marsh and other densely vegetated communities. Communities were delineated on maps drawn from ground surveys made during the summer of 1970 and from aerial photographs of the entire area. Black and white aerial photographs taken by the Bureau of Land Management in June 1970 were used to construct the base map; and 35mm colored transparencies taken in July 1970 at 1,500 feet and 2,500 feet were used to identify plant communities. Common names follow Anderson (1959) and scientific names follow Hultén (1968). Common and scientific bird names follow Robbins, et al (1966) and other vertebrate common and scientific names follow Blair, et al (1957).

Description of Plant Communities

Ten plant communities were mapped on Chickaloon Flats and include: (1) Seaside Arrow-grass - Large Alkali-grass; (2) Ramenski Sedge; (3) Unvegetated Mud; (4) Creeping Alkali-grass; (5) Marsh; (6) Seaside

Arrow-grass Conglomerate; (7) Floating Marsh; (8) Bog; (9) Live Alder and (10) Marsh Fringe Communities. Species comprising these communities are listed in Appendix A. These communities tended to occur in the sequence just presented when crossing the Flats from Cook Inlet to the uplands, but variations existed. Fig. 5 depicts plant communities encountered along two transects traversing the Flats.

There is a circumpolar similarity of polar marshes because of extreme temperatures which only a few species can tolerate (Chapman 1960). The vegetational patterns at Goose Bay, a salt marsh on Cook Inlet, which is assumed to have had similar geologic, historic and climatic conditions as Chickaloon Flats, were described by Hanson (1951). The sequence of plant zones progressing landward were similar to those at Chickaloon Flats with two major exceptions. Stands dominated by Creeping Alkali-grass (Puccinellia phryganodes) which occured along the most seaward edge of Goose Bay and the zone of Beach Rye-grass (Elymus arenarius mollis) which occured on the estuary and higher stream banks at Goose Bay were present at Chickaloon Flats but were located further inland.

The Seaside Arrow-grass - Large Alkali-grass Community was the largest of the group and covered 46% of the Flats. Acreages and percent coverage for each community are presented in Table 1 along with comments on relative change in coverage since the 1964 earthquake.

Seaside Arrow-grass - Large Alkali-grass Community

The Seaside Arrow-grass - Large Alkali-grass Community is the largest (Table 1) and most seaward community above mean high tide which

TABLE 1. ACREAGES OF THE PLANT COMMUNITIES AT CHICKALOON FLATS WITH COMMENTS ON CHANGE SINCE THE EARTHQUAKE OF 1964.

Community	Area (acres)	%	Change since 1964
Arrow-grass - Alkali-grass	7,913	45.8	Small increase
Unvegetated Mud	3,446	19.9	Large increase
Arrow-grass Conglomerate	1,785	10.3	Large increase
Marsh	1,391	8.1	Large decrease
Floating Marsh	1,156	7.0	No change
Creeping Alkali-grass	497	2.9	Large increase
Bog	423	2.2	Large decrease
Alder	419	2.0	Small decrease
Ramenski Sedge	250	1.5	No change
Marsh Fringe	*		Large increase

* This community was not measured because of its narrow depth: however, it was believed to be comparable in area to either the Alder or Ramenski Sedge communities.

terminates inland at the heads of drainage ditches (Fig. 5 and 6). Fig. 7 depicts this community.

Seaside Arrow-grass (Triglochin maritimum) and Large Alkali-grass (Puccinellia grandis) are the dominant species in this community. Densities of plants were highest along the banks of drainage ditches and their tributaries. Areas of unvegetated mud occur interspersed within those stands (Fig. 7). These muddy areas (pans) were not well drained because they were slightly lower than the banks of the drainage ditches.

Both Seaside Arrow-grass and Large Alkali-grass were equally abundant near the heads of drainage ditches, but Seaside Arrow-grass diminished in abundance in areas closer to salt water while Large Alkali-grass remained abundant. Seaside Arrow-grass is tolerant of high salinities (Chapman 1960) and was found growing in 5 of the plant communities at Chickaloon Flats. Large Alkali-grass favored drier sites such as hummocks and other slightly elevated places.

Less abundant species occurring within this community included Beach Rye-grass (Elymus arenarius mollis), Goose-Tongue (Plantago maritima juncoides), Creeping Alkali-grass, and Pacific silverweed (Potentilla egedii grandis) which were found along the banks of rivers and drainage ditches. Slender glasswort (Salicornia europaea) was found growing along the Chickaloon River in cracks formed as the silt dried.

Of the five species, Goose-Tongue was the most widespread. It was growing along the most seaward ditches as well as far inland. Goose-Tongue frequently formed dense stands but usually grew in

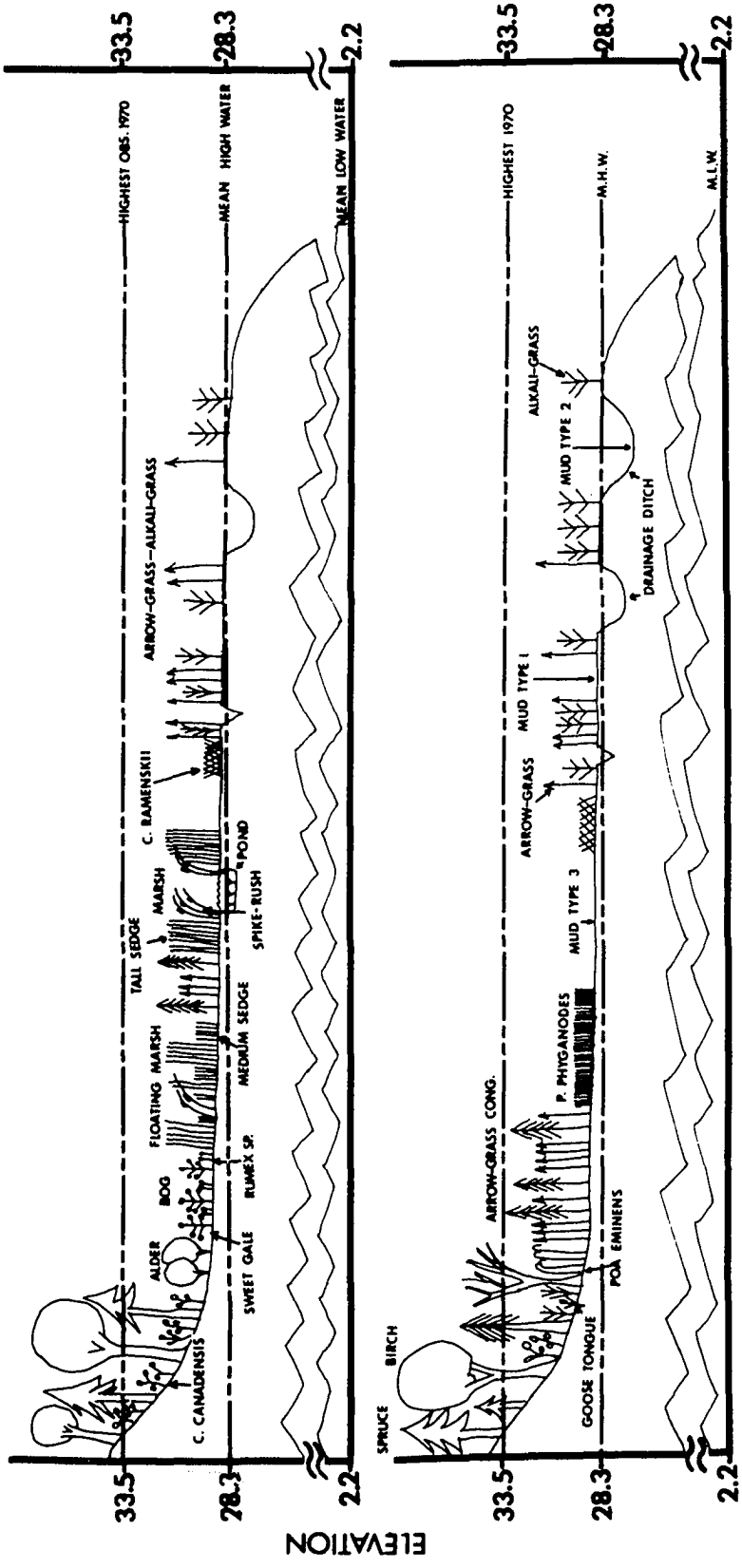

FIGURE 5. Plant communities along two typical transects.

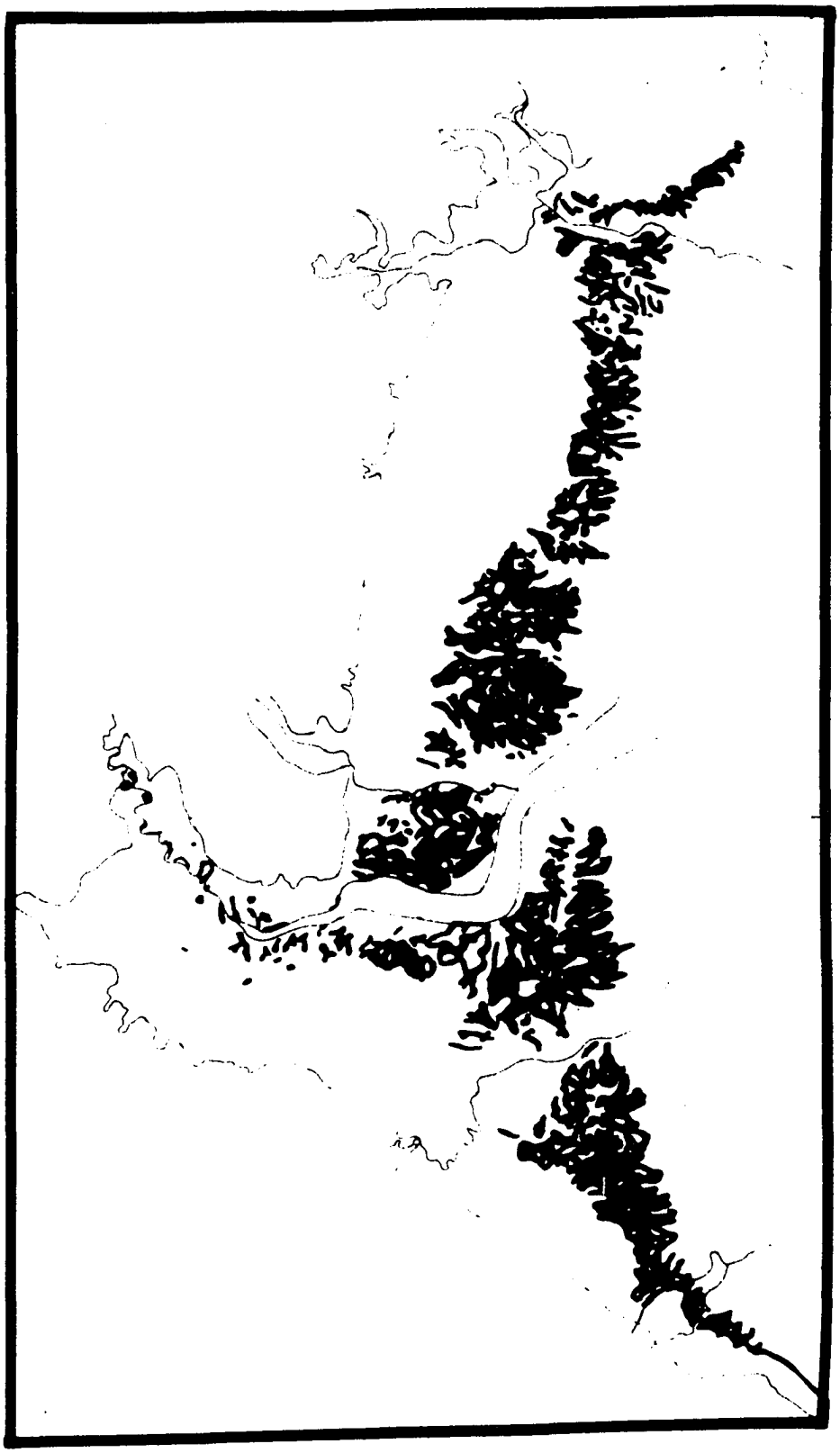

FIGURE 6. The distribution of the Seaside Arrow-grass - Large Alkali-grass Community.

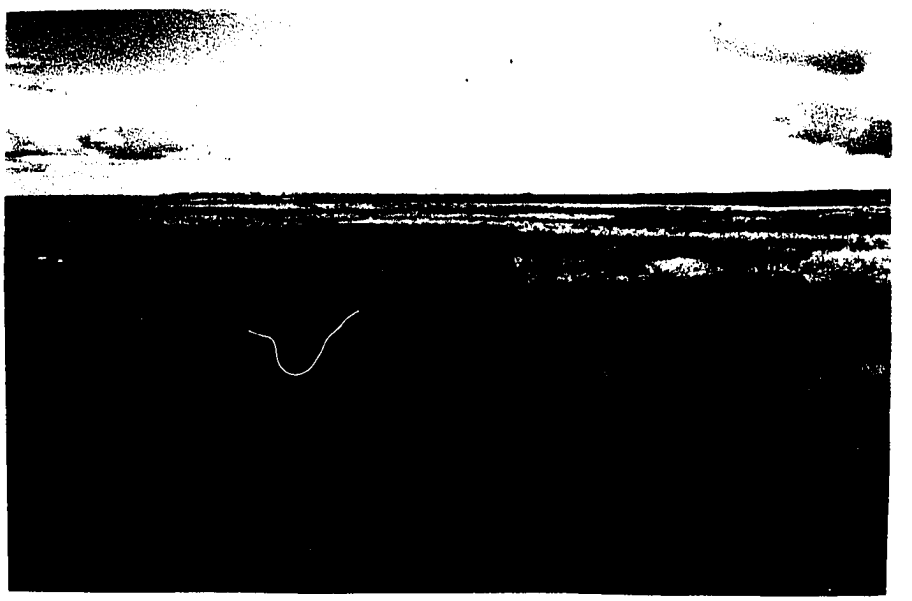

FIGURE 7. The Seaside Arrow-grass - Large Alkali-grass Community. Seaside Arrow-grass in foreground and Large Alkali-grass (yellow) in background. Areas of Unvegetated Mud Community, Type 1, scattered throughout.

scattered clumps.

This community has apparently changed little since before the earthquake. I dug up many of the Seaside Arrow-grass and Large Alkali-grass clumps and found that they had existed prior to the earthquake and had pushed shoots up through the silt. Willard Trover (pers. comm. 1970) observed that Seaside Arrow-grass plants came through the silt the summer following the earthquake.

Ramenski Sedge Community

The Ramenski Sedge Community is dominated by Ramenski Sedge (Carex Ramenski) (Fig. 8). This community was found inland from the Seaside Arrow-grass - Large Alkali-grass Community but occurred in discontinuous clumps that were seldom over 20 feet wide (Fig. 9). Stands of Ramenski Sedge were found surrounding the heads of drainage ditches and their feeder streams. According to Chapman (1960) this species is dominant in the transition to a freshwater swamp.

Scattered clumps of poorly growing Seaside Arrow-grass occurred within the narrow transition zone between this community and the Seaside Arrow-grass - Large Alkali-grass Community.

Drainage ditches were cutting through Ramenski Sedge mats in many locations. Although Ramenski Sedge constitutes a minor portion of the vegetation on the Flats, the sedge mats are resistant to erosion and have probably slowed the degrading process.

The zone of Ramenski Sedge probably moved further inland since the earthquake. Areas which were formerly occupied by tall sedges of the Marsh Community and were covered by 7 to 10 inches of silt following

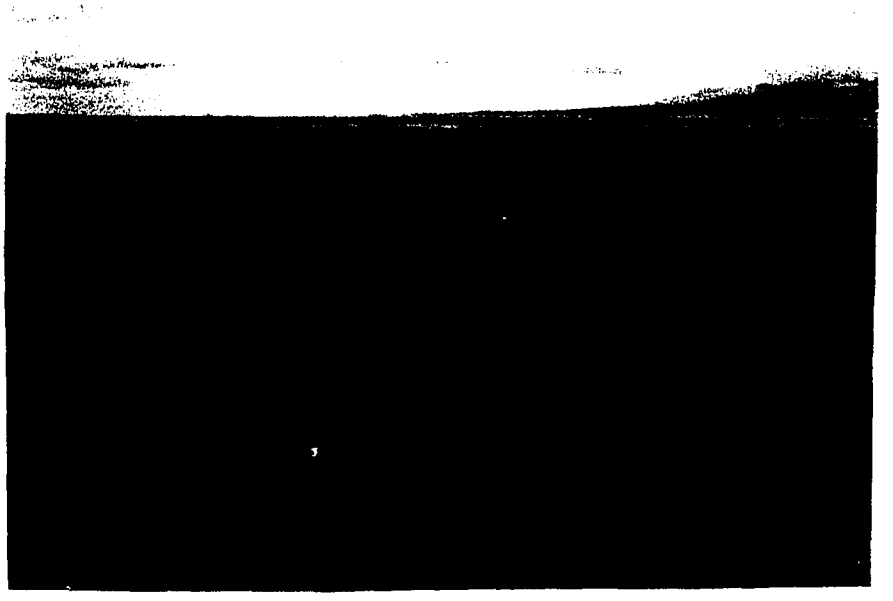

FIGURE 8. Ramenski Sedge Community with a few Seaside Arrow-grass clumps.

FIGURE 9. The distribution of the Ramenski Sedge Community.

land subsidence have been revegetated by Ramenski Sedge.

Unvegetated Mud Community

The Unvegetated Mud Community was found on the same substrate as the other plant communities, but it was devoid, with one exception, of vascular plants. This community was widely dispersed and characterized by three types. Type 1, unvegetated areas in numerous scattered locations within the Seaside Arrow-grass - Large Alkali-grass Community, as described previously (Fig. 7); Type 2, unvegetated areas in the channels of rivers and drainage ditches exposed at ebb tide (Fig. 10); and Type 3, unvegetated areas between the Ramenski Sedge Community and the Marsh Community (Fig. 11).

Type 2 areas were flooded and exposed twice daily by the tides. The upper limit of these areas was roughly the mean high tide line. From that level to a point roughly 6 feet lower in elevation was a zone of algae along the outer edge of the Flats and on the sides of the drainage ditches and rivers (Fig. 12). This zone was not conspicuous until early July when the mud became bright green with algal growth on a sunny day soon after the tide dropped. Algae did not grow near the heads of the drainage ditches where the sides had not stabilized. Banks of drainages facing north or west had a heavier coverage of algae than those facing south or east.

Distribution of only the Type 3 Unvegetated Mud Community is shown in Fig. 13 because Types 1 and 2 areas were so small and widely distributed that graphic depiction of them was too difficult. Many of the Type 3 areas were formed by siltation of previously vegetated areas while the location of the Types 1 and 2 areas have not changed since

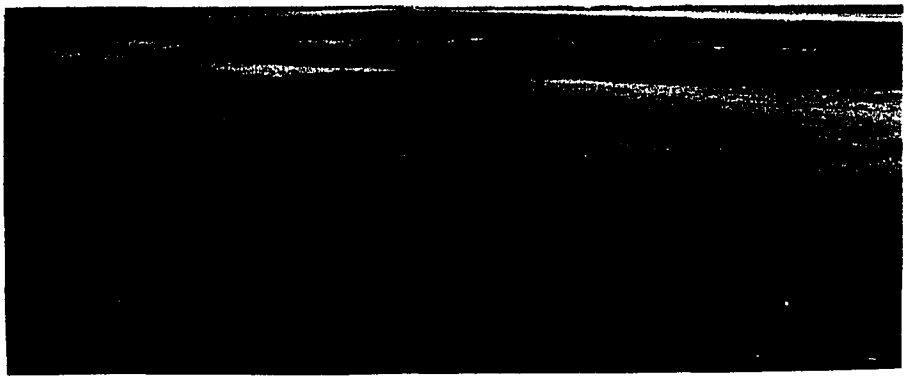

FIGURE 10. Unvegetated Mud Community, Type 2.

FIGURE 11. Unvegetated Mud Community, Type 3, with temporary ponds.

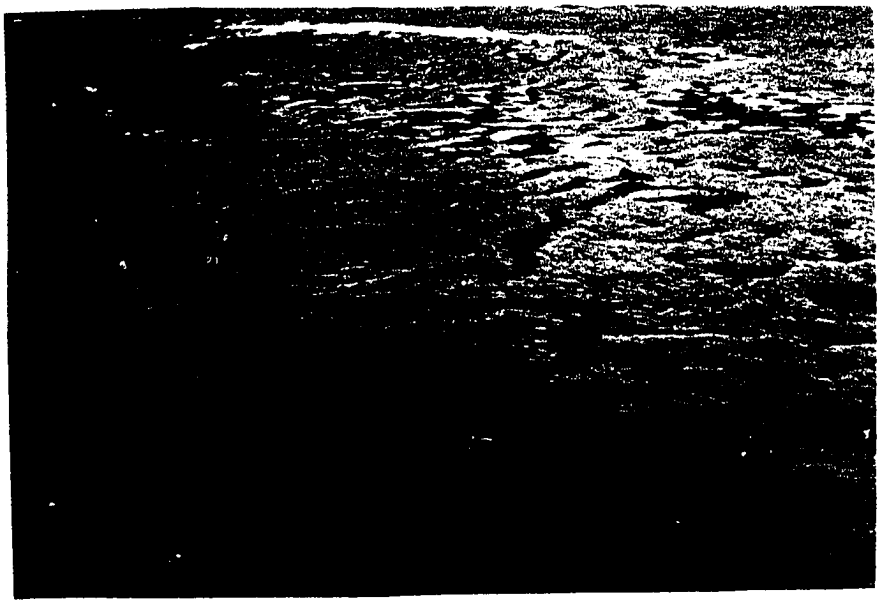

FIGURE 12. Zone of algae on Type 2 Unvegetated Mud Community.

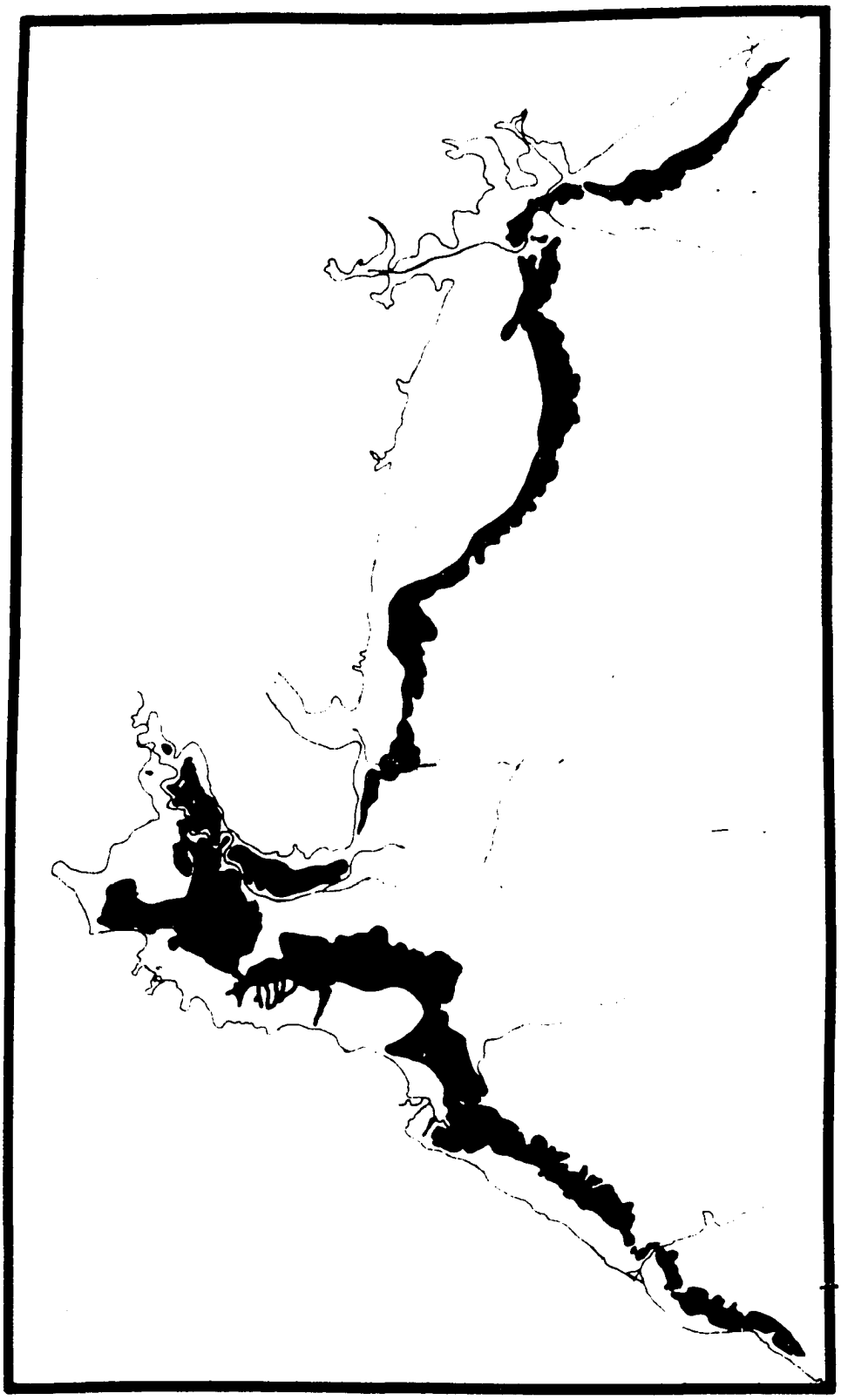

FIGURE 13. The distribution of the Type 3 Unvegetated Mud Community.

the earthquake. Some Type 3 areas were temporarily under water for a few days and others for only a few hours following periods of high tides. Some Type 3 areas that were regarded as being unvegetated during early summer sprouted shoots of Creeping Spike-rush (Scirpus paludosus) in late July and August.

Creeping Alkali-grass Community

The Creeping Alkali-grass Community occurred landward from the Type 3 Unvegetated Mud Community (Fig. 5 and 14). Creeping Alkali-grass gave this community a lawn-like appearance (Fig.15). Seaside Arrow-grass was present in scattered clumps but was not vigorous. Shoots of Creeping Spike-rush were present in many places which suggested that the present community occupied an area where a Marsh Community once existed. Large Alkali-grass occurred on raised hummocks scattered throughout this community. Short-stalk Sedge (Carex podocarpa) and Marsh Arrow-grass (Triglochin palustris) grew in various locations throughout the Creeping Alkali-grass Community.

Vegetation was not continuous in this type since there were numerous shallow ponds (pans) and scattered areas of open mud (Fig. 15). The bottoms of the shallow ponds were composed of a layer of black, odoriferous muck overlain by a layer of silt. Considerable decomposition of buried organic layers was taking place. Creeping Alkali-grass formed dense stands which stabilized the mud. This community is believed to be an early successional stage to the Marsh Community.

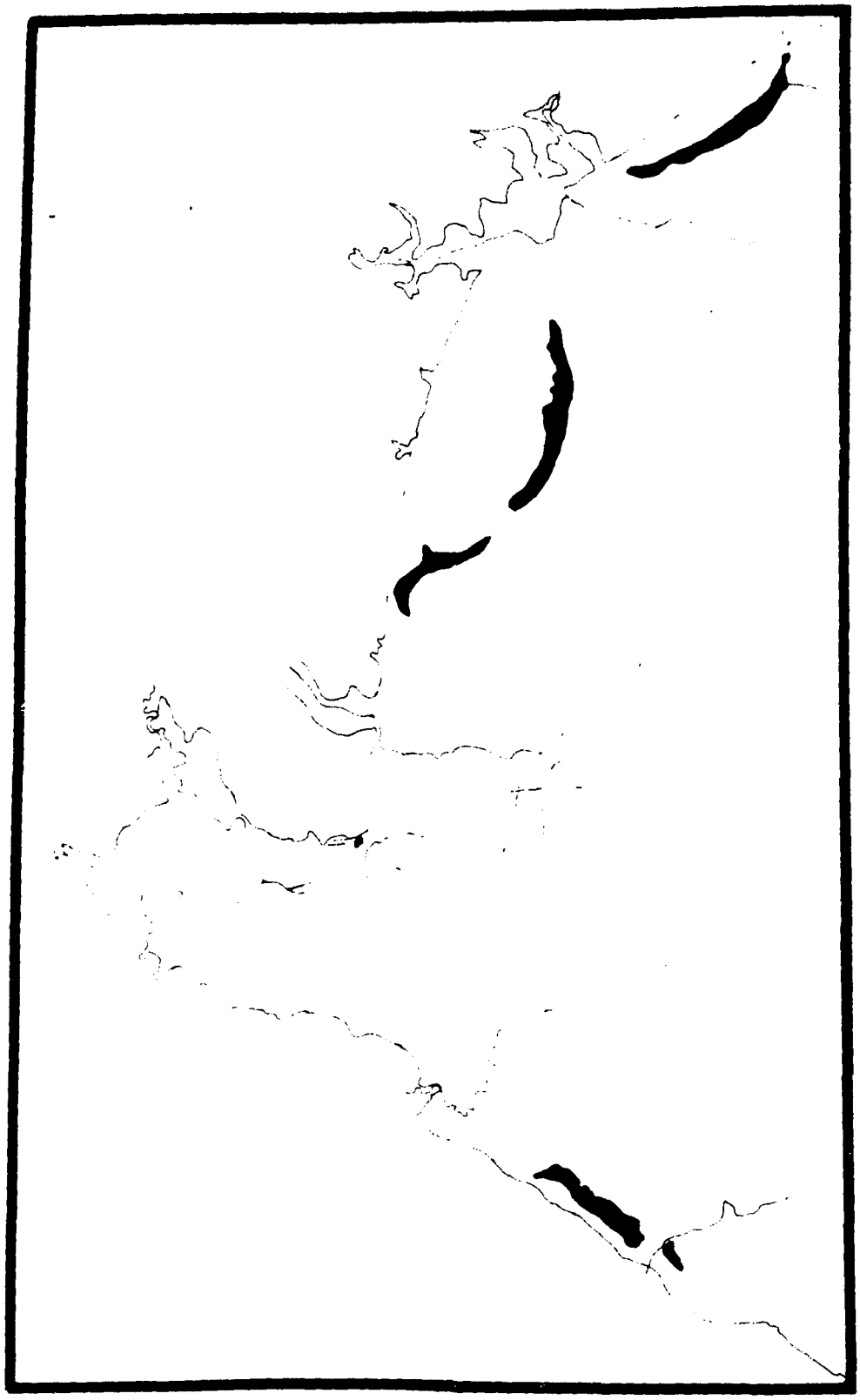

FIGURE 14. The distribution of the Creeping Alkali-grass Community.

FIGURE 15. Creeping Alkali-grass Community with scattered clumps of Seaside Arrow-grass and small shallow ponds.

I believe that the area of the Creeping Alkali-grass Community increased after the earthquake. Creeping Alkali-grass, a pioneer species on open mud flats, became established in areas formerly marsh which were silted over after land subsidence. The distribution of the community probably changed since Creeping Alkali-grass is usually dominant at the lowest levels rather than further inland.

Marsh Community

The Marsh Community is a combination of Neiland's (1971) Bulrush Community and Coarse Sedge Community. It is the most heterogenous of those described. The distribution of the Marsh Community is shown in Fig. 16.

The Marsh Community contains brackish ponds bordered by sedges and bulrushes (Fig. 17). Lyngbye sedge (Carex lyngbyaei), Sitka sedge (Carex sitchensis), and Creeping Spike-rush were the most common species. Lyngbye sedge was the most abundant species and occupied large expanses of the marsh. Clumps of Sitka sedge and Water sedge (Carex aquatilis) were found scattered within stands of Lyngbye sedge. Short-stalk sedge grew well along the edge of the Marsh Community in drier locations. Neiland (1971) found infrequently a small sedge, Carex loliaceae, in this community.

An important feature of the Marsh Community was the numerous permanent ponds, most of them less than an acre in size. The ponds varied considerably in debth with the ones nearest the Type 3 Unvegetated Mud Community generally shallower (from 6 inches to 2 feet deep) than those further within the marsh (more than 2 feet deep). This

FIGURE 16. The distribution of the Marsh Community.

FIGURE 17. Marsh Community with a stand of Creeping spike-rush in foreground and tall sedges in the background.

may be due to differences in siltation between the communities after land subsidence. Averill Thayer (pers. comm. 1970) said that he could not cross, in hipboots, a pond west of the cabin prior to the earthquake. That pond is now 12 to 18 inches deep and I could cross it anywhere in hipboots.

Several of the deeper ponds contained pondweeds (Potomageton sp.). Horned pondweed (Zannichellia palustris) grew in all of the shallower, permanent ponds, but may also have been present in the deeper ponds. Four-leaved mare's-tail (Hippuris tetraphylla) also occurred in some ponds.

The Marsh Community was more extensive before the earthquake (Table 1). Averill Thayer (pers. comm. 1970) said that areas of marsh often occurred more seaward on the Flats between drainage ditches in the present Seaside Arrow-grass - Large Alkali-grass Community and remnants of these were found east of Pincher Creek and southwest of Big Indian Creek (Fig. 1).

Seaside Arrow-grass Conglomerate Community

The Seaside Arrow-grass Conglomerate Community occupied large areas of the inner Flats, particularly along the east side (Fig. 18). Its position is usually inland from the Marsh Community (Fig. 5).

The density of Seaside Arrow-grass, the most dominant species of the community, varied considerably (Fig. 19). Some areas were almost entirely vegetated by Seaside Arrow-grass while others had only scattered Seaside Arrow-grass plants.

FIGURE 18. The distribution of the Seaside Arrow-grass Conglomerate Community.

FIGURE 19. The Seaside Arrow-grass Conglomerate Community near the U. S. Fish and Wildlife Service cabin. Dead spruce were removed.

Small, dead Black Spruce (Picea marina) were widely dispersed throughout the community. Some trees were standing while others had been uprooted by the tides and wind. Large Alkali-grass grew on the spoils from many uprooted trees.

The Geological Survey Maps, Kenai (A-1) and Seward (A-6), published before the earthquake, show 3 areas of green which were stands of Black Spruce. These have since been killed from inundation by salt water following land subsidence and are now vegetated by the Seaside Arrow-grass Conglomerate Community.

Horned pondweed and Four-leaved mare's-tail grew in the permanent ponds within this community. Pond bottoms were composed of a layer of black odoriferous muck overlain by a layer of silt.

The Seaside Arrow-grass Conglomerate Community seemed to have resulted from inundation of black spruce bog and subsequent revegetation by brackish marsh vegetation and, presumably, has greatly increased in area since the earthquake. An organic layer, containing the roots of woody plants, was present along the edges of some permanent ponds. Dead shrubs and dead trees were still present throughout the area.

Vegetational patterns in this community are complex. Almost any combination of species can be found. There are small areas of marsh scattered throughout this community. Marsh Arrow-grass was abundant throughout this community. Scattered clumps of Lyngbye sedge and Short-stalk sedge occurred throughout the area as well as clumps of Creeping Alkali-grass and Large Alkali-grass which grew around the bases of dead trees. Driftwood and other debris were present throughout this community.

Floating Marsh Community

The Floating Marsh Community differed from the Marsh Community by having fewer areas of open water, greater plant species diversity and floating mats of vegetation.

The distribution of this community is shown in Fig. 20. It was usually found adjacent to a Spruce-Birch Community, but occasionally stands were separated by a narrow band of Alder (Alnus sp.). In all cases, there is a band of dead trees between this community and the communities seaward from it. These trees possibly grew on an old beach ridge that later subsided. In all but one area the Floating Marsh Community was inland from the Seaside Arrow-grass Conglomerate Community. The largest stand of this community was located along the west central edge of the Flats (Fig. 20).

Dominant plants of this community were Sitka sedge, Lesser panicled sedge (Carex diandra), Silvery sedge (Carex canescens), Lyngbye sedge, and Creeping Spike-rush. Secondary species are listed in Appendix A.

The area of the Floating Marsh Community apparently has not changed since the earthquake. Frequent inundation by salt water has probably eliminated some plant species while favoring others which can grow under brackish conditions.

Bog Community

The Bog Community was found landward from two stands each of Floating Marsh Community and Seaside Arrow-grass Conglomerate Community (Fig. 5 and 21). Conspicuous vascular plants include Sweet

FIGURE 20. The distribution of the Floating Marsh Community.

FIGURE 21. The distribution of the Bog Community.

gale (Myrica gale), Dwarf birch (Betula nana) and two species of dwarf willows (Salix myrtillifolia and Salix sp.) (Fig. 22). Many of the sedge species found in the Floating Marsh Community are also found in the Bog Community (Appendix A).

The largest stand of Bog Community was found along the west-central edge of the Flats. From the air it appeared as a brownish, semicircular band, 1/4 to 1/3 mile across at its widest point.

There was a large decrease in the area of the Bog Community following the earthquake. Stands of Bog Community protected by stands of Floating Marsh and Marsh Communities have persisted while other stands closer to salt water were destroyed, silted over and revegetated.

Alder Community

The Alder Community, although primarily an upland community, was included in this study since it occupied places on Chickaloon Flats which were periodically flooded with salt water. This community lies inland from the Bog Community in most places (Fig. 5). Its distribution is shown in Fig. 23.

Alders (Alnus sp.) dominate the overstory, but plants found in the Floating Marsh Community and other grass species comprised the understory (Appendix A). Arctic dock (Rumex arcticus), Water hemlock (Cicuta douglasii) and Lyngbye sedge of the Floating Marsh Community, however, were not well represented.

The Alder Community had a small decrease in area since the 1964 earthquake.

FIGURE 22. A stand of Bog Community in the west-central portion of the Flats. The dark brown plant is dwarf alpine birch.

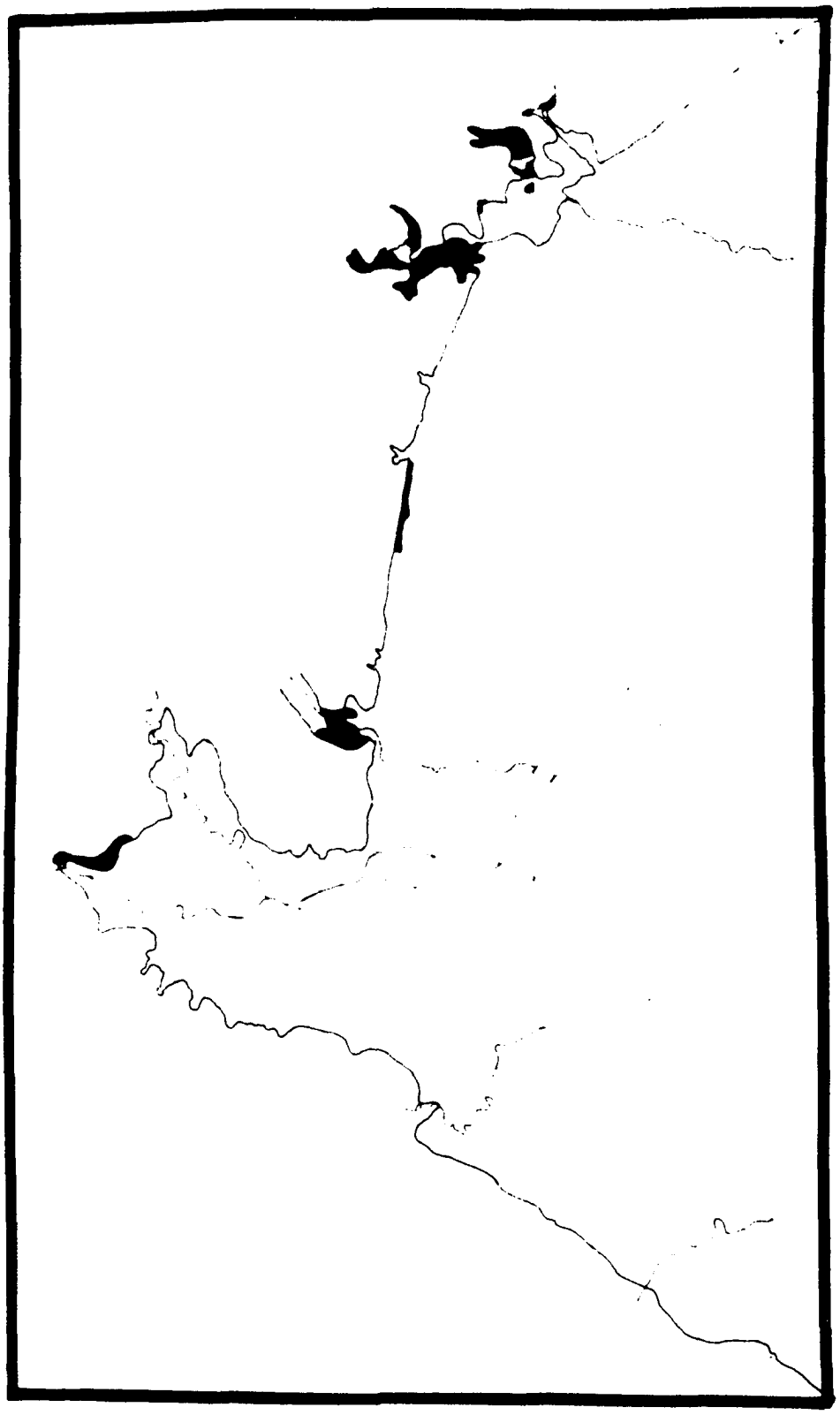

FIGURE 23. The distribution of the Alder Community.

Marsh Fringe Community

The Marsh Fringe Community was found along the edge of the Flats wherever the Alder Community was not present and usually inland from a narrow band of Seaside Arrow-grass Conglomerate Community (Fig. 5 and 24). It comprised the ground cover under the band of dead spruce and birch which were killed from the inundation by salt water after the earthquake. Plants included a mixture of marsh and upland species (Appendix A).

There is a conspicuous zonation of plant species in the Marsh Fringe Community (Fig. 25). Going inland from the seaward side of this community, there are three distinct zones of vegetation which are comprised mainly of: (1) Large-flowered Spear-grass (Poa eminens) and Beach Rye-grass, (2) Large Alkali-grass, Goose-tongue and Lyngbye sedge, and (3) an almost pure stand of Bluejoint (Calamagrostis canadensis canadensis).

The area and distribution of the Marsh Fringe Community is a result of the 1964 earthquake. The area was previously vegetated by an upland community.

Factors Affecting Vegetation

The present vegetational patterns of Chickaloon Flats are largely a result of interactions between salt water and fresh water, tides and land subsidence. For example, the "Good Friday" earthquake and subsequent changes in land level reduced the Marsh Community from an estimated 3,140 acres in 1964 to 1,390 acres in 1970, a loss of 56 percent. Changes in vegetation are affected by at least five physical

FIGURE 24. The distribution of the Marsh Fringe Community.

FIGURE 25. The Marsh Fringe Community with a stand of Marsh Community in the foreground followed by a band of large-flowered spear-grass and beach rye grass and a band of bluejoint. Zone 2 of the Marsh Fringe Community is present but not evident in the photograph.

factors (Neiland 1971): (1) the duration and number of times a given site is inundated and exposed by tidal action; (2) the amount of water retained on a given site and the duration of that retention once the tide has receded; (3) the location and rate of cutting by drainage ditches; (4) the relative amounts of salt water and fresh water that are received and retained by any site and (5) the rates of erosion and deposition of sediments. Additionally, wildlife constitutes a sixth factor.

The duration any area is inundated by salt water and subsequently exposed varies daily with changes in tidal heights. Shallow inundations of short duration occurred during May and June but became more frequent and prolonged in July and August. During June and early July the banks of the Chickaloon River and drainage ditches turned white due to evaporation and deposition of salts. Plant growth was sparse in these areas, but tufts of Large Alkali-grass were usually present.

The duration that salt water was retained on a site after the tide receded varied with elevation and drainages. Flooding occurred when tide levels reached or exceeded 29.0 feet. When flooding was shallow the water quickly drained after the tidal flow reversed. With deep flooding water was retained proportionately longer. Ponds would drain through a few shallow streams until flooded during the next tide.

I believe that frequent prolonged inundations during July and August were responsible for the partial recovery of Creeping Spike-rush within the Type 3 Unvegetated Mud Community. This plant remained dormant until conditions were favorable for growth later in the growing

season.

Drainage ditches enhanced the establishment of Seaside Arrow-grass, Large Alkali-grass and Ramenski sedge by improving drainage in areas that were formerly poorly drained.

These drainage ditches were cutting landward and affected the vegetation by undercutting the banks so that blocks of vegetation fell in and were covered with silt. Several of these ditches may eventually drain some permanent and semi-permanent ponds which are of importance to waterbirds. Between July and September 1970, I measured the advancement of the heads of eight ditches and found that three ditches showed no change while one eroded 9 feet 10 inches with the average advancement being 3 feet 2 inches. Factors contributing to the rate of erosion included: the amount of flooding and the percentage of the runoff that any one ditch receives; the extent and depth of vegetation near the heads; and the thickness and number of buried organic layers. Drainage patterns and sizes of drainage ditches changed considerably between 1963 and 1970 as shown on aerial photographs of the area.

The amounts of fresh water and salt water upon a site varies with location and time. Several small streams enter the Flats and three of them dispersed their waters within specific areas where stands of the Floating Marsh Community occur. The other streams dispersed their waters when flood tides backed them up, and these were bordered by plant species that are more tolerant to salt water. No areas of the Flats escaped inundation by sea water during high tides in July and August. Therefore, all plant communities contained plant species with

a tolerance to salinity. Areas without stream flow temporarily freshened during April and May from runoff and melt water and during June from heavy rains at a time when little salt water inundated the Flats. The relative effects of these various sources of fresh water are not known.

Sedimentation is a dynamic characteristic of the Flats importantly affecting vegetation. The amount of silt deposited in any one area is determined by at least four factors: the number and duration of times an area is inundated: the density of the vegetation; the position of the area with respect to the major drainages; and the tidal currents at ebb and flood. Miller and Egler (1950) noted that the rate of deposition of silt was highest along streams where the vegetation acted as a trap.

The greatest known rate of sedimentation on salt marshes is found on the Fundy marshes of Nova Scotia where 30 inches of silt was deposited in 122 days and as much as 1 inch may be deposited by a single tide (Chapman 1960). There appears to be a seasonal pattern of sedimentation on English salt marshes with the highest rate during the August to October quarter (Ranwell 1964). August and September are months of peak flooding at Chickaloon Flats and a considerable amount of silt was deposited during this period.

The deposition of silt between late July and late September 1970 was measured at three sites in the Unvegetated Mud Community, Type 3. Depths of silt deposited during the two month period were 5/8 inch and 1 inch for two sites in shallow depressions; and 1/4 inch for a higher site behind a clump of Ramenski sedge. Observations of

siltation of bear and moose tracks supported the above findings. Tracks in slightly higher places persisted throughout the summer while tracks in the lower places gradually filled with silt and disappeared.

Averill S. Thayer and Willard A. Troyer (pers. comm. 1970) remarked how rapidly the vegetation in an area southeast of the U. S. Fish and Wildlife Service cabin was covered with silt following the earthquake. Sedimentation was still evident during the summer of 1970 and spring of 1971 and may be preventing plant establishment by seed but probably does not hinder those species which spread by vegetative means such as Creeping Alkali-grass, Creeping Spike-rush, and the sedges in general.

Plant distribution, establishment, growth and survival are affected by the animal life of the area. During late May and June many moose (Alces alces) cows and calves grazed the fringes of the Flats feeding primarily in the Marsh and Floating Marsh Communities. Selective feeding and trampling could possibly alter the plant species composition. The moose tracks may provide microniches for some plant species. Black bears (Ursus americanus) used the Flats throughout the summer but fed primarily on dead salmon. Redbacked voles (Clethrionomys sp.) were present on the Flats but were unable to get firmly established due to periodic flooding by high tides. Bird use is discussed in the following sections.

The overall effect of the earthquake on the vegetation of Chickaloon Flats was to promote early successional plant communities while decreasing or completely destroying more stable plant communities.

WATERFOWL AND OTHER BIRDS

Introduction

Chickaloon Flats has long been recognized as an important area for waterfowl and recreational hunting; however, no quantitative information had been collected prior to the 1964 earthquake. Waterfowl inventories taken in 1965 and during the study, and personal interviews with hunters provide circumstantial evidence regarding changes in bird populations, their use of the Flats and waterfowl hunting.

Methods

All aerial surveys were made from fixed-wing aircraft, flying at low levels, generally under 300 feet. Complete counts were attempted in all surveys. However, errors in counts occurred because of differences in vision and proficiency in identification between observers, differences in visibility of waterfowl species, variations in growth of vegetation and variation in weather. These counts only represent indexes to the population and do not reflect total numbers of birds using the area. The frequency and timing of these flights perhaps were such that some populations were not counted.

Ground surveys of breeding waterfowl were made in four stands of Marsh Community in 1970 and 1971 and 10 additional stands of three other communities in 1971. Counts of birds were made both by flushing and by observing through a spotting scope.

Periodic bag checks were made of hunters who could be easily contacted. In addition to bag information, the hunters were questioned

to their knowledge of changes that might have occurred to the Flats induced by the 1964 earthquake.

Bird Populations

Nineteen species of waterfowl and 57 species of other birds were recorded on and near Chickaloon Flats during the study period (Appendix B). Other species were undoubtably present, particularly in the upland communities and during other seasons of the year.

Waterfowl population levels fluctuate widely from season to season. Peak populations usually occurred during the spring and fall migrations for ducks and geese but smaller and more stable populations were found during the summer (Fig. 26). Figure 26 does not reflect the turnover in population which may occur each day.

Figure 27 shows seasonal fluctuations in the numbers of some of the more numerous species of waterfowl using the Flats.

Aerial surveys at Chickaloon Flats often did not reflect the true population composition because they seldom coincided with peak populations or because observers did not record all species and did not distinguish between races of geese that were present at the time of surveying. For examples, the Alaska Department of Fish and Game survey of August 21, 1970 did not tally any shovelers (Spatula clypeata) which were summer residents and were present at that time, but not in large numbers and the three races of Canada geese (Branta canadensis) which utilize Chickaloon Flats during the year were not differentiated in any of the surveys in 1965, 1970 or 1971.

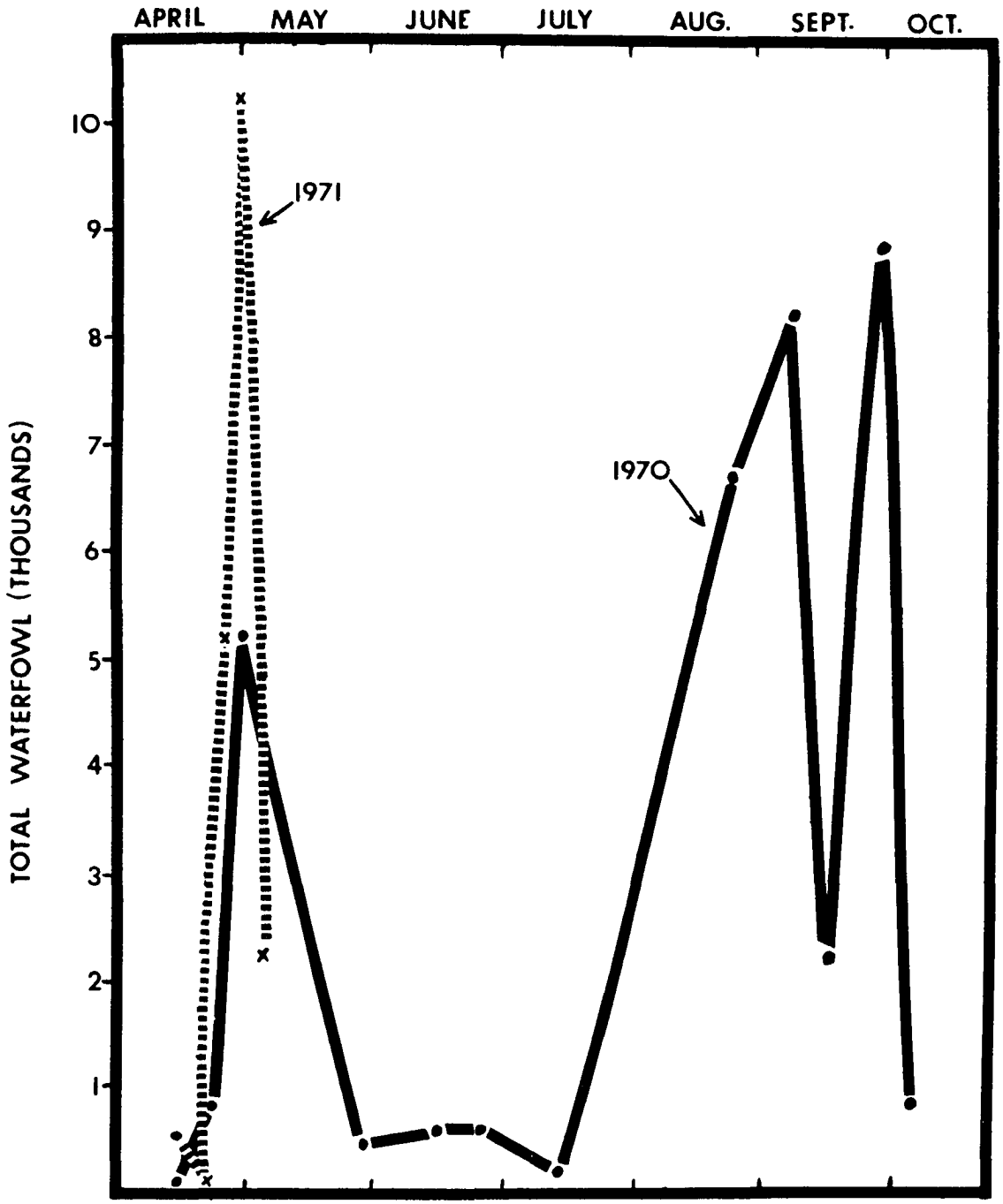

FIGURE 26. Waterfowl population levels for 1970 and part of 1971.

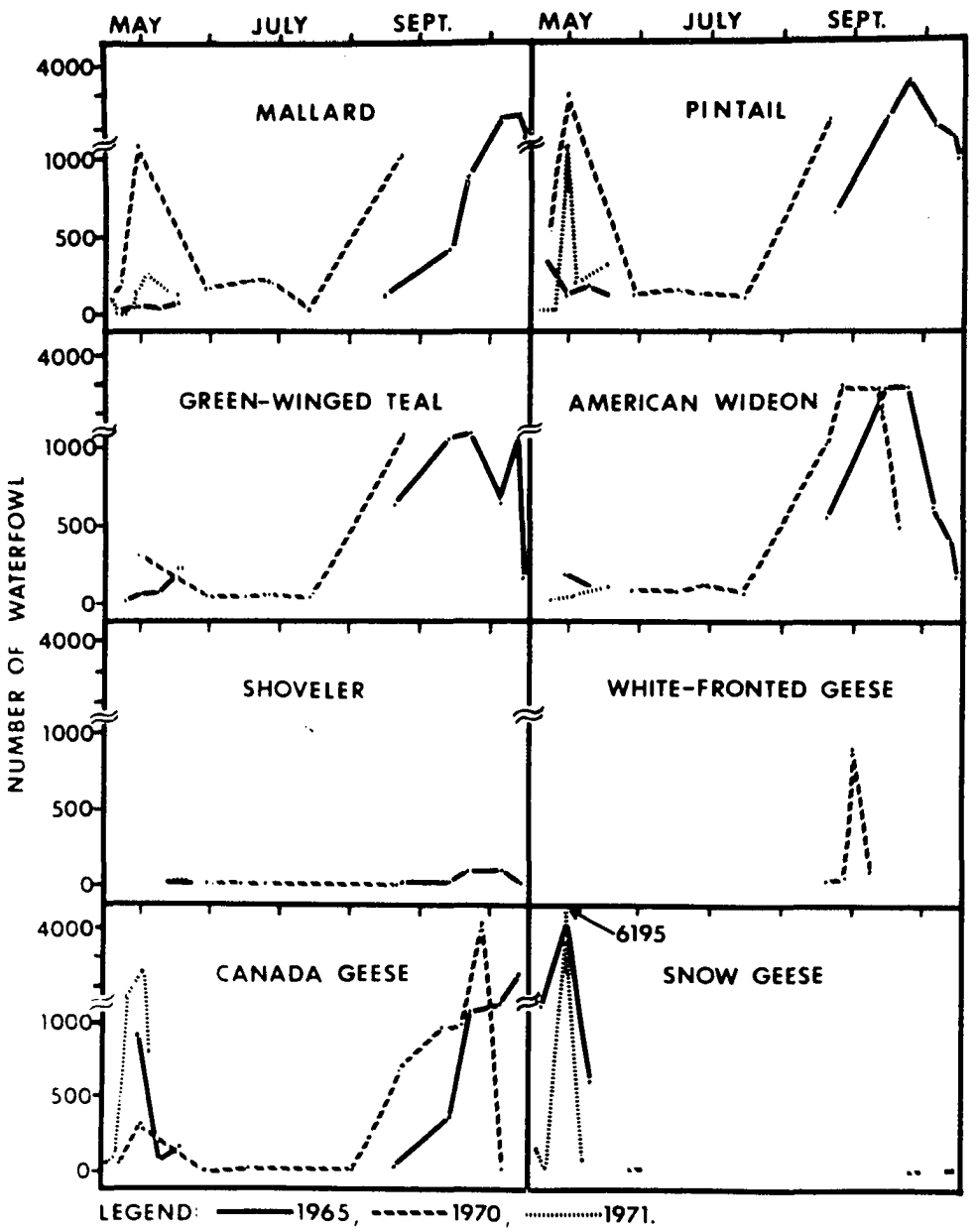

FIGURE 27. Seasonal fluctuations of the more numerous species of waterfowl, 1965, 1970 and 1971.

White-fronted geese (Anser albifrons) were not recorded during aerial surveys in 1970 although a number of these geese were present for a two-week period and reached a peak of 900 on September 1. Data on white-fronted geese in Fig. 7 come from ground observations from only one part of the Flats and, therefore, do not reflect the true population.

I believe aerial surveys did reflect the fluctuation of some of the more numerous species of ducks and geese when conducted on a regular basis. Development of better indexes to those species which are present in small numbers or for only a short period during migrations may require better timing of surveys and closer scrutiny by observers.

Mallards, pintails, green-winged teal, gadwalls (Anas strepera), American widgeon, and western Canada geese (Branta canadensis occidentalis) were present during the spring and fall migration and nested on the Flats. Shovelers were present at these times but nesting was not determined.

Snow geese (Chen hyperborea) and swans (Olor sp.) utilized the Flats mainly during the spring migration. An occasional snow goose (Fig. 26) or swan has been recorded on Chickaloon Flats during the fall migration. The largest number of swans (34) was recorded on April 30, 1970. Although trumpeter swans (Olor buccinator) nest on the Kenai National Moose Range (Hansen, et al 1971) and whistling swans (Olor columbianus) migrate through the area, I was unable to identify these swans to species.

Lesser Canada geese (Branta canadensis leucopareia) utilized the area during the spring and fall migrations while cackling Canada geese (Branta canadensis minima) and white-fronted geese were only observed during the fall migration.

There was an insufficient number of observations on canvasbacks (Aythya valisineria), greater scaup (Aythya marila), common goldeneyes (Bucephala clangula), harlequin ducks (Histrionicus histrionicus), surf scoters (Melanitla perspicillata), common mergansers (Merqus merganser), and red-breasted mergansers (M. serrator) to determine the use of the area by these species.

The frequency of occurrence of waterfowl observed during 59 days of observations between May 13 and September 25, 1970 were:

green-winged teal	73%
mallard	69%
pintail	69%
American widgeon	51%
lesser Canada geese	45%
western Canada geese	30%
shoveler	22%
white-fronted geese	10%
gadwall	7%
cackling Canada geese	7%
red breasted merganser	5%
canvasback	3%

surf scoter	3%
common merganser	3%
greater scaup	2%
common goldeneye	2%

Waterbirds which utilized Chickaloon Flats during the spring and fall migrations and also nested on the Flats during the summer include sandhill cranes (Grus canadensis), northern phalaropes (Lobipes lobatus), glaucous-winged gulls (Larus glaucensen), mew gulls (L. canus), Bonaparte's gulls (L. philadelphia) and arctic terns (Sterna paradisaea). Other species present during these seasons and suspected to nest on the Flats include common snipe (Capella gallinago), greater yellowlegs (Totanus melanoleucus), lesser yellowlegs (T. flavipes), short-billed dowitchers (Limnodromus griseus), long-billed dowitchers (L. scolopaceus), semipalmated plovers (Charadrius semipalmatus), least sandpipers (Erolia minutilla), semipalmated sandpipers (Ereunetes pusillus), western sandpipers (E. mauri), and spotted sandpipers (Actitus macularia).

Black-bellied plovers (Squatarola squatarola), whimbrels (Numenius phaeopus) and ruddy turnstones (Arenaria interpres) utilized Chickaloon Flats during the spring and summer while American golden plovers (Pluvialis dominica) were observed only during the spring and Hudsonian godwits (Limosa haemastica) only during the summer. Pectoral sandpipers (Erolia melanotos) utilized the Flats during the spring and fall migrations.

There were insufficient observations on black turnstones (Arenaria melanocephala), solitary sandpipers (Tringa solitaria) and wandering

tatlers (Heteroscelus incanum) to determine the use of the Flats by these species.

Other birds found nesting on or near Chickaloon Flats include spruce grouse (Canachites canadensis), yellow-shafted flickers (Colaptes auratus), cliff swallows (Petrochelidon pyrrhonota), rusty blackbirds (Euphagus carolinus) and white-crowned sparrows (Zonotrichia leucophrys).

Migratory Bird Hunting and Harvest

In 1970, the waterfowl hunting season began on September 1 and lasted until December 14. The hunting season for Chickaloon Flats is much shorter in reality. Hunting lasted until the third week of October 1969 because of the mild fall delaying the departure of geese, and it ended after the first week of October 1970 because of an early freezeup. Most of the hunting pressure is on ducks during September while of the geese harvested most are taken in October.

The mode of transportation for 16 groups (64%) of hunters using the Flats was an airplane on floats.

The river channels and several of the larger ponds on the Flats are used for landings. I contacted some of the hunters and found that they were able to land wheel planes on the Flats before the earthquake but these areas are now too soft. Several hunters arrived by charter aircraft which usually landed in the Chickaloon River. At this time no guides maintain cabins and the number of charter hunters is low.

Two groups (8%) of hunters arrived by boat. They probably came from Hope which is the nearest place to launch a boat.

Five groups (20%) came by 4-wheel drive vehicles along the pipeline access road. This road provides access to the south and east portions of Chickaloon Flats. There has been little maintenance of this road, and travel is difficult. The fall of 1970 was drier than normal and the road was in better condition.

Two groups (8%) of hunters reached the Flats on foot after flying to a landing strip near Big Indian Creek approximately 1/2 mile east

of the Flats.

Twenty-five groups containing 60 hunters spent 86 hunter-days on Chickaloon Flats during 24 of the first 25 days of the 1970 season. I believe that the hunting pressure was greater after than before September 25, 1970 because many geese were present which attracted the hunters. Twenty-eight charter, drive-in and boat hunters spent 44 hunter-days on the Flats while 32 float plane hunters spent 42 hunter-days. A three-day possession limit for this area may be questionable since the majority of hunters spent only one day hunting and no group was known to have spent more than two consecutive days on the Flats.

During the fall of 1970 bag checks were conducted by personnel from the Alaska Department of Fish and Game and me. The results of these bag checks are presented in Table 2. The total harvest is unknown since the total number of hunters was unknown. I believe the harvest for 1970 was probably less than 400 ducks and 200 geese. This harvest is light when considering the size of the Flats, the lenght of the season and the number of ducks and geese using Chickaloon Flats during the hunting season. This light harvest, the actual lenght of the hunting season and the relatively high cost of a hunting trip in this area would seem to be justification for increased daily bag limits on both ducks and geese.

Mallards, pintails and green-winged teal comprised 51%, 24% and 15% of the bag respectively. This differs from the most recent state-wide data (Chamberlain, et al 1971) which indicated that mallards, pintails and green-winged teal comprised 28%, 16% and

TABLE 2. WATERFOWL BAG CHECK ON CHICKALOON FLATS, FALL 1970 (AFTER P. D. HAVENS 1971).

Species	Adult		Juvenile		Total	%
	Male	Female	Male	Female		
Pintail		2	10	14	26	24
Mallard	8	10	17	21	56	51
Green-winged teal			7	9	16	15
American widgeon		1	4	3	8	7
Gadwall			1	1	2	2
Shoveler				1	1	1
Unidentified ducks					34	
Total ducks	8	13	39	49	143	100
Lesser Canadian geese	2	1	1		40	89
Snow geese					4	9
Cackling Canadian geese			1		1	2
Total Geese	2	1	2		45	100
TOTAL WATERFOWL					188	

16%, respectively, of the 1969 harvest. The differences are probably attributable to the Flats being used largely by dabbling ducks. The large percentage of mallards in the harvest may be attributable to both their tendency to sit and allow hunters to approach them and their abundance late in the season when people were actively hunting geese. Mallards, because of their size, may have been shot in preference to teal.

The common hunting method was pass shooting for a number of reasons. Walking is difficult and the hunters preferred to have the birds come to them. Also travel by aircraft did not permit the hunters to bring decoys and the materials necessary to construct a hunting blind. Some of the hunters jump-shot ducks, usually green-winged teal and mallards but this method did not work well because a considerable amount of noise is made while walking in the muck which makes it difficult to approach ducks.

Hunting in the past was probably somewhat different than it is now. There are several old cabins which were used by hunters but have been abandoned since the earthquake. Other cabins which were located out on the Flats have been destroyed by high tides following land subsidence. Three cabins are still in use by waterfowl hunters. I found some old decoys which suggested to me that these earlier hunters probably constructed blinds and hunted in a more conventional manner.

I contacted several people who were familiar with the Flats and they remarked how little hunting pressure the area gets now when

compared to that before the earthquake. The destruction of cabins, the softer walking conditions and the necessity of a float plane have all been responsible for the decrease in hunting pressure. I do not believe the availability of waterfowl has been a factor. Charles Wells, Darryl Buckmeier and Charles Pearce (pers. comm. 1971) said that the number of waterfowl using Chickaloon Flats in 1970 was the same as if not more than before the earthquake. Many of the hunters now use Susitna Flats which was not seriously altered by the earthquake.

Breeding Population

The densities of breeding pairs on the more productive areas of the Flats were one pair per 7.3 acres in 1970 and one pair per 3.8 acres in 1971. The density was one pair per 4.0 acres in 1971 for the areas censused in 1970 for an increase of 82%. Surveying began earlier and was completed sooner in 1971 than in 1970, and part of the increase may be attributable to tallying some migrating ducks which were present at this time, although I attempted to disregard these birds during surveys.

I believe that unsurveyed habitat supported a low density of breeding mallards, pintails and green-winged teal with the exception of small unsurveyed areas of Marsh Community which contained densities of dabblers comparable to those above for 1971.

Mallards, pintails, green-winged teal and American widgeon comprised 89% of the breeding population censused in selected plots for both years. Shovelers, gadwalls, greater scaup and canvasbacks accounted for the remainder (Table 3). Although common and red-breasted mergansers nested south of the Flats along the Chickaloon River, I did not consider them to be part of the breeding population.

Shovelers and greater scaup are known to nest on the Kenai National Moose Range (U. S. Department of Interior 1968) and probably nested on Chickaloon Flats in 1970 and 1971. Canvasback nesting was not substantiated but these birds are known to have nested near Anchorage and probably nest in the Cook Inlet area wherever suitable habitat occurs (Hemming 1966). I did not substantiate nesting by gadwalls although

TABLE 3. BREEDING DUCK SURVEYS IN SELECTED AREAS ON CHICKALOON FLATS, MAY 17 TO JUNE 3, 1970* AND MAY 12 TO MAY 18, 1971**.

Species	Number of Birds		Number of males per 100 females		Species Composition	
	1970	1971	1970	1971	1970%	1971%
Mallard	76	164	162	152	30	17
Pintail	62	420	158	180	25	43
Green-winged Teal	48	215	140	124	19	22
American Widgeon	38	64	153	100	15	7
Gadwall	14	49	250	123	6	5
Shoveler	8	58	167	190	3	6
Greater Scaup	3	4	-	-	1	trace
Canvasback	2	2	-	-	trace	trace
TOTAL	251	976			99%	100%

* Four census plots totaling 693 acres.

** Thirteen census plots totaling 1,448 acres.

several pairs were recorded during nesting surveys in 1970 and 1971 and two immature gadwalls were shot during the hunting season. A gadwall brood was identified during an aerial survey of the Flats by the Alaska Department of Fish and Game.

Sixteen pairs of sandhill cranes and one immature summered on Chickaloon Flats in 1970 and there were 13 pairs in 1971. A pair of sandhill cranes, using the area near the cabin, was frequently seen with two young during August and September of 1970. One dead, newly hatched, crane was found in June of 1970, possibly drowned by one of several flood tides. One crane nest was found in a stand of Marsh Community in 1971. Some cranes may have nested in a boggy area south and west of the Flats.

One pair of western Canada geese nested west of the cabin in 1970 in a stand of Floating Marsh Community and was frequently observed with two goslings. This pair was observed in the Chickaloon River with two other pairs of geese which had four and 12 goslings respectively. Some of the 12 goslings are probably the young of at least one additional pair bringing the total to at least four nesting pairs of geese. Seven pairs of geese were observed in 1971, one having a nest with six eggs located in a stand of Floating Marsh Community.

During the summer of 1970, three mallard nests containing five, six and seven eggs and one pintail nest containing five eggs were located. One unidentified duck nest was found and contained one hatched egg.

The first brood was observed on June 2,1970 and contained five Class IA mallard ducklings, and a Class IB (Gollop and Marshall 1954) green-

winged teal brood containing one duckling was observed on July 30,1970. I believe that these two broods, hatching on approximately May 29 and July 22, 1970 (Schranck 1966), were near the extremes for hatching on Chickaloon Flats. The nesting season would be approximately two months long, from May 1 to July 1.

Eight green-winged teal broods averaging 5.4 ducklings, six mallard broods averaging 4.2 ducklings, two pintail broods averaging 5.5 ducklings, and one American widgeon brood containing five ducklings were observed during the summer of 1970. One gadwall, one pintail and one American widgeon brood and two green-winged teal broods were recorded during an aerial survey on June 25, 1970 by the Alaska Department of Fish and Game. Eight broods containing approximately 60 ducklings and 40 to 50 broods containing approximately 250 ducklings were observed on two large ponds on July 11 and July 30, 1970, respectively. Although the majority of these broods were not identified to species, positive identification was made for pintails, mallards, American widgeon and green-winged teal but the number of ducklings was not determined. I believe that gadwall and shoveler broods were also present in these areas since both species were observed there during the breeding season.

The remains of six duck kills and one goose kill were found during the summer of 1970 and spring of 1971. One duck and the goose were killed by mammalian predators, probably coyotes (Canis latrans) and five ducks were killed by avian predators. I frequently observed marsh hawks (Circus cyaneus) hunting the Flats and believe they were the most important avian predator. Although ducks are not their usual

prey. individual marsh hawks may become accustomed to feeding on ducks (Mendall 1958).

Bird Use of Plant Communities

The use of plant communities for breeding, feeding and resting by various species of huntable waterbirds is depicted in Table 4 while Table 5 shows the degree of utilization of these plant communities for the more numerous species of waterbirds.

The Seaside Arrow-grass - Large Alkali-grass Community was used most intensively during the fall by migrating Canada and white-fronted geese which fed heavily on the leaves and fruits of Seaside Arrow-grass. The geese fed on the fruits by stripping them off the spike. Seaside Arrow-grass is a poisonous plant containing quantities of hydrocyanic acid (Heller 1963). Apparently, the digestive system of the geese was able to cope with the problem.

Mew gulls, glaucous-winged gulls and arctic terns used this community for breeding and resting. Most of the nests were located along the banks of the rivers and streams close to a source of permanent water. Ducks used the most seaward edge of the Seaside Arrow-grass - Large Alkali-grass Community for resting during the fall migration. Shorebird use of this community was low.

The Ramenski Sedge Community was not intensively utilized by any species. However, least sandpipers were frequently observed in this community and may have nested there and American widgeon and Canada geese were observed feeding in the community.

The Type 1 Unvegetated Mud Community was used infrequently as a resting area by gulls, terns and migrating Canada geese.

The Type 2 Unvegetated Mud Community was used intensively by

TABLE 4. USE OF PLANT COMMUNITIES AT CHICKALOON FLATS BY VARIOUS WATERBIRDS.

Community	Mallard	Pintail	Green-winged Teal	American Widgeon	Shoveler	Gadwall	Greater Scaup	Western Canada Geese	Lesser Canada Geese	Cackling Canada Geese	White-front Geese	Snow Geese	Sandhill Crane	Common Snipe
Arrow-grass - Alkali-grass	R	BR	R	FR				FR	FR	FR	FR	FR	FR	
Ramenski Sedge				F					F					
Unvegetated Mud, Type 1								R	R	R	R	R		
Unvegetated Mud, Type 2	FR	FR	FR	FR	FR	FR							F	
Unvegetated Mud, Type 3	FR	FR	FR	FR	FR			FR	FR	FR		FR		
Creeping Alkali-grass	FR	FR	FR					FR	FR			FR	F	FR
Marsh	BFR	BFR	BFR	BFR	bFR	bFR	bFR	bFR	FR		FR	FR	BF	bFR
Arrow-grass Conglomerate	bFR	bFR	bFR	bFR				FR	FR		FR	FR	F	F
Floating Marsh	BFR	BFR	BFR	BFR	bFR	bFR	bFR	BFR	FR			FR	bF	bF
Bog	bFR												F	bF
Alder														bF
Marsh Fringe														FR

LEGEND: B - known breeding; b - suspected breeding; F - feeding; R - resting

TABLE 5. USE OF PLANT COMMUNITIES AT CHICKALOON FLATS BY VARIOUS WATERBIRDS.

Community	Dabblers	Geese	Swan	Yellowleg sp.	Dowitcher sp.	Glaucous-winged Gull	Mew Gull	Bonaparte's Gull	Arctic Tern	Northern Phalarope	Least Sandpiper	West & Semipalmated Sandpipers	Semipalmated Plovers	Black-bellied Plovers	Whimbrel	Pectoral Sandpiper
Arrow-grass - Alkali-grass	X	XXX		X		XXX	XXX	X	XXX	X	X	XX	X			
Ramenski Sedge	X	X		X		X	X		X	X	XX	X				
Unvegetated Mud, Type 1		X				X	X	X	X			X				
Unvegetated Mud, Type 2	XXX	XX		X		X	XX	X	X				XX	XXX	XXX	
Unvegetated Mud, Type 3	XX	X		XXX	XXX	X	XX	XX	XX	XXX	XXX	XXX	XX		X	XX
Creeping Alkali-grass	X	XXX		XX	X	X	XX	XX	X	X	X	X				X
Marsh	XXX	XXX	XX	XX	X	X	X	X		XXX						XX
Arrow-grass Conglomerate	XX	XXX		XX	XX	XX	XX	XX	X	X	X	X				X
Floating Marsh	XXX	XXX	XX	X	XX	X	X	X		XX				X		XXX
Bog	X	X								X						
Alder																
Marsh Fringe	X			X												

LEGEND: XXX - Intensive use; XX - Moderate use; X - Infrequent use

migrating ducks during the fall which fed in the zone of algae. Black-bellied plovers and whimbrels used this community exclusively during the summer of 1970 but were observed in other communities during the spring of 1971. Semipalmated plovers and mew gulls were commonly observed in this community while many other species were observed infrequently.

The Type 3 Unvegetated Mud Community was intensively used by several species of shorebirds for feeding and resting. Mew gulls and arctic terns fed on sticklebacks (Gasterosteus aculeatus) which were present in some of the deeper ponds in this community. Ducks used this community for feeding and resting throughout the summer and fall. Sandhill cranes fed in this community on shoots of Creeping Spike-rush which grew late in the summer. The cranes would pull out the shoots and nip off the basal portion.

The Creeping Alkali-grass Community was used intensively during the spring migration by snow and Canada geese which fed heavily on Creeping Alkali-grass. Greater and lesser yellowlegs were commonly observed but other shorebird and duck use was low in this community. Mew, glaucous-winged, and Bonaparte's gulls fed on sticklebacks present in the shallow ponds.

The Marsh Community was used intensively by ducks for breeding, feeding and resting. One sandhill crane, 2 northern phalarope, and 1 mallard nests were found in stands of the Marsh Community. Common snipe were observed frequently during the fall. Other shorebird use was moderate during the spring but much lower during the summer. Canada geese, snow geese and swans used the Marsh Community for feeding and resting particularly during the spring.

The Seaside Arrow-grass Conglomerate Community was used intensively for feeding and resting during the spring migration by Canada and snow geese. Duck use was moderate during migrations and low during the summer but I believe there was some nesting by mallards, pintails, green-winged teal and American widgeon. Mew, glaucous-winged and Bonaparte's gull use was moderate in this community and these species probably nested there. Yellowleg and dowitcher use was moderate while other shorebird use was low.

The Floating Marsh Community was used intensively by migrant and resident ducks and geese and to a lesser extent by migratory swans. Two mallard nests were found in this community. Although the Floating Marsh Community provides large areas of suitable waterfowl nesting habitat, it is not as valuable as the Marsh Community since there are fewer areas of open water. Pectoral sandpipers were abundant during the spring while other shorebird use was moderate or low during the spring, summer and fall. Sandhill crane use was moderate during the summer and these birds probably nested in the Floating Marsh Community.

The Bog Community was not intensively utilized by waterfowl. Mallards were infrequently observed in a stand of this community during the spring and may have nested there. Rusty blackbirds, savana sparrows (Passerculus sandwichensis), and common snipe were the most abundant species and I believe they nested in the community.

The Alder Community was not studied intensively enough to determine the bird use.

The Marsh Fringe Community was utilized very little by waterbirds. One white-crowned sparrow and 1 yellow-shafted flicker nests were found in this community. Utilization by several species of sparrows, warblers, swallows and woodpeckers was moderate during the spring and summer and low during the fall.

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

Conclusions

An evaluation of the effects of the earthquake on the bird use of Chickaloon Flats depends on the emphasis given to short-term or long-term gains and losses; the changes in utilization of a particular plant community by the same or different group of bird species after the earthquake; and the relative value of bird species or group of species to the individual or to the public.

The earthquake reduced the area of the Marsh Community but this is a short-term loss of nesting habitat because other areas which supported few, if any, breeding waterfowl have been revegetated and now provide habitat for limited nesting and many of these areas should develop into marshes capable of supporting a much larger breeding population.

Changing vegetational patterns, such as those associated with the earthquake, affect nesting by any particular species. Some bird species have benefited while others probably have not, but it is difficult to determine which have benefited and how much. Much additional habitat has been created for shorebirds and woodpeckers and their populations are probably higher now than before the earthquake. I do not know if it is better to have live trees and their associated bird life or dead trees and woodpeckers. The problem is compounded when comparing waterfowl which have high value to certain groups of people and non-harvestable species with a lower economic value.

I believe the earthquake has benefited geese since these birds mainly utilized plant communities which have either remained the same or have increased in area after the earthquake. Several hunters remarked that the number of geese using Chickaloon Flats did not decrease after the earthquake.

Management Recommendations

The management of Chickaloon Flats depends on future developments in the area and interagency cooperation. Chickaloon Flats is used mainly by hunters who own airplanes or who can afford a charter to the area. The Alaska Department of Highways has proposed to build a road from Anchorage to the Kenai Peninsula which would provide access to the east side of Chickaloon Flats and lead to increased utilization of the area. My recommendations for management should enhance bird use of the Flats while allowing increased use by people.

Habitat manipulation on an area the size of Chickaloon Flats would be expensive and difficult because of frequent flooding by high tides. However, there are certain things which could be done which should be beneficial to waterfowl and shorebirds. The dead trees which border the Flats could be removed in order to hasten re-vegetation by perennial salt marsh plants. These dead trees could be removed during the winter by tree crushers owned by the Kenai National Moose Range. Second, more areas of permanent water could be made available by blasting potholes in the Floating Marsh and Bog Communities during late October after most birds have left but the Flats have not yet frozen solidly.

Management on an area close to a large population center should stress non-consumptive uses. The season when birds are present on the Flats is approximately 6 months long, from the middle of April until the middle of October. The waterfowl hunting season occurs during the last 6 weeks which leaves 4-1/2 months for those people who are

not primarily interested in hunting to use the Flats. Spring is important to nature photographers and bird watchers since the birds are in breeding plumage and several species can only be seen at this time.

Non-consumptive use can be encouraged by developing a system of nature trails on Chickaloon Flats. These trails should traverse all the major plant communities so that people can see most of the bird species which may be present at any one time. I would recommend building a boardwalk suspended on pilings to minimize damage by trampling. No habitat manipulation should be done in these areas. Signs which explain ecological associations, the effects of the earthquake and items of interest should be used to increase the meaningfulness of the nature walk.

The recreational use of the Flats by sport hunters will increase following the construction of the proposed highway. This should not be discouraged but may require special restrictions to maximize the value to individual hunters. The construction of private cabins by hunters should be prohibited. The construction of hunting blinds should be allowed and spaced by at least 1,000 feet and regulated by annual permit. Access roads should be developed along the east side of the Flats and to the Chickaloon River to disperse hunters.

Increased hunter utilization will affect the use of the Flats by migratory waterfowl but the total impact is not known at this time. The hunting pressure will probably be light in the west and central portions of the Flats and this should allow migrating birds time to

feed and rest before continuing south. If additional access and hunting pressure prevent the birds from obtaining their needs, part of the Flats should be closed to hunting.

Recommended future research would include studies of revegetation; the effects of goose feeding on certain species of plants; the effect of periodic flooding on the nesting success of gulls; nesting and production by both waterfowl and shorebird species; and the percentage of the duck harvest supplied by locally reared birds.

APPENDIX A. PLANT SPECIES [1] OF THE PLANT COMMUNITIES AT CHICKALOON FLATS.

Seaside Arrow-grass - Large Alkali-grass Community

Primary species:

Triglochin maritimum	Seaside Arrow-grass
Puccinellia grandis	Large Alkali-grass

Secondary species:

Puccinellia phryganodes	Creeping Alkali-grass
Elymus arenarius mollis	Beach Rye-grass
Plantago maritima juncoides	Goose-tongue
Potentilla egedii grandis	Pacific Silverweed
Salicornia europaea	Slender Glasswort

Ramenski Sedge Community

Primary species:

Carex Ramenski	Ramenski Sedge

Secondary species:

Triglochin maritimum	Seaside Arrow-grass

Unvegetated Mud Community

Primary species:

	Algae

Secondary species:

Scirpus paludosus	Creeping Spike-rush

Creeping Alkali-grass Community

Primary species:

Puccinellia phryganodes	Creeping Alkali-grass
Triglochin maritimum	Seaside Arrow-grass

Secondary species:

Puccinellia grandis	Large Alkali-grass
Triglochin palustris	Marsh Arrow-grass
Scirpus paludosus	Creeping Spike-rush
Carex podocarpa	Short-stalk Sedge

Marsh Community

Primary species:

Carex lyngbyaei	Lyngbye Sedge
Carex sitchensis	Sitka Sedge
Scirpus paludosus	Creeping Spike-rush

Secondary species:

Carex aquatilis	Water Sedge
Carex podocarpa	Short-stalk Sedge
Carex loliaceae	Sedge
Scirpus validus	Great Bulrush
Zannichellia palustris	Horned Pondweed
Potomageton sp	Pondweed
Hippuris tetraphylla	Four-leaved Mare's tail

Seaside Arrow-grass Conglomerate Community

Primary species:

Triglochin maritimum	Seaside Arrow-grass

Secondary species:

Triglochin palustris	Marsh Arrow-grass
Carex lyngbyaei	Lyngbye Sedge
Carex podocarpa	Short-stalk Sedge
Zannichellia palustris	Horned Pondweed
Hippuris tetraphylla	Four-leaved Mare's tail
Puccinellia grandis	Large Alkali-grass

Floating Marsh Community

Primary species:

Carex sitchensis	Sitka Sedge
Carex diandra	Lesser Panicled Sedge
Carex canescens	Silvery Sedge

Carex lyngbyaei	Lyngbye Sedge
Scirpus paludosus	Creeping Spike-rush

Secondary species:

Carex aquatilis	Water Sedge
Carex rariflora	Loose-flowered Alpine Sedge
Carex pluriflora	Sedge
Carex loliaceae	Sedge
Festuca rubra	Red Fescue
Calamagrostis inexpansa	Northern Reed-grass
Scirpus validus	Great Bulrush
Juncus triglumis	Three-flowered Rush
Menyanthes trifoliata	Buckbean
Caltha palustris	Yellow Marsh Marigold
Cicuta douglasii	Western Water Hemlock
Rumex arcticus	Arctic Dock
Ranunculus cymbalaria	Seaside Crowfoot
Iris setosa	Wild Iris
Epilobium sp.	Fireweed

Bog Community

Primary species:

Myrica gale	Sweet gale
Betula nana	Dwarf Alpine Birch
Salix myrtillifolia	Willow
Salix sp.	Willow
Rumex arcticus	Arctic Dock
Calamagrostis canadensis canadensis	Bluejoint
Iris setosa	Wild Iris

Secondary species [2]:

Carex lyngbyaei	Lyngbye Sedge
Carex sitchensis	Sitka Sedge
Carex aquatilis	Water Sedge
Carex rariflora	Loose-flowered Alpine Sedge
Carex pluriflora	Sedge
Festuca rubra	Red Fescue
Juncus triglumis	Three-flowered Rush
Cicuta douglasii	Western Water Hemlock

Live Alder Community

Primary species:

Alnus sp.	

Secondary species (2):

Calamagrostis inexpansa	Northern Reed-grass
Calamagrostis canadensis canadensis	Bluejoint
Carex lyngbyaei	Lyngbye Sedge
Festuca rubra	Red Fescue
Rumex arcticus	Arctic Dock
Cicuta douglasii	Western Water Hemlock

Marsh Fringe Community

Primary species:

Poa eminens	Large-flowered Spear-grass
Elymus arenarius mollis	Beach Rye-grass
Calamagrostis canadensis canadensis	Bluejoint
Puccinellia grandis	Large Alkali-grass

Secondary species:

Triglochin maritimum	Seaside Arrow-grass
Triglochin palustris	Marsh Arrow-grass
Carex lyngbyaei	Lyngbye Sedge
Plantago maritima juncoides	Goose-tongue
Potentilla egedii grandis	Pacific Silverweed
Chrysanthemum arcticum	Arctic Daisy
Puccinellia phryganodes	Creeping Alkali-grass
Hordeum jubatum	Squirrel-tail Barley
Trientalis europaea	Star Flower
Agrostis sp.	Red Top
Cornus sp.	Dogwood

(1) Scientific names after Hultén (1968), and common names after Anderson (1959).
(2) Partial list.

APPENDIX B. ANNOTATED LIST OF BIRDS ON AND NEAR CHICKALOON FLATS DURING THE SPRING (APRIL - MAY), SUMMER (JUNE - AUGUST 15), AND FALL (AUGUST 15 - OCTOBER) 1970 AND SPRING (APRIL - MAY) 1971.

Common Name	Scientific Name	Spring	Summer	Fall
Horned Grebe	Podiceps auritus	R		
Red-necked Grebe	Podiceps grisegena	U		
Swan	Olor sp	U		
Western Canada Goose *	Branta canadensis occidentalis	C	U	C
Lesser Canada Goose	Branta canadensis leucopareia	A	U	A
Cackling Canada Goose	Branta canadensis minima			C
White-fronted Goose	Anser albifrons			C
Snow Goose	Chen hyperborea	A		R
Mallard *	Anas platyrhynchos	C	C	C
Pintail *	Anas acuta	C	C	A
Gadwall #	Anas strepera	U	U	U
American Widgeon *	Mareca Americana	C	C	A
Shoveler #	Spatula clypeata	C	C	U
Green-winged Teal *	Anas carolinensis	C	C	C
Canvasback #	Aythya valisineria	R	R	
Greater Scaup #	Aythya marila	U	R	R
Common Goldeneye	Bucephala clangula	R		R
Harlequin Duck	Histrionicus histrionicus	R		
Surf Scoter	Melanitla perspicillata			U
Common Merganser *	Mergus merganser	U	U	U
Red-breasted Merganser *	Mergus serrator	U	U	U
Goshawk	Accipiter gentilis			U
Marsh Hawk #	Circus cyaneus	C	C	C
Bald Eagle #	Haliaeetus leucocephalus		C	C
Gyrfalcon	Falco rusticolus			R
Spruce Grouse *	Canachites canadensis	C	C	C

Common Name	Scientific Name
Sandhill Crane *	Grus canadensis
American Golden Plover	Pluvialis dominica
Black-bellied Plover	Squatarola squatarola
Semipalmated Plover #	Charadrius semipalmatus
Whimbrel	Numenius phaeopus
Hudsonian Godwit	Limosa haemastica
Solitary Sandpiper #	Trimga solitaria
Spotted Sandpiper #	Actitis macularia
Wandering Tattler	Heteroscelus incanum
Greater Yellowlegs #	Totanus melanoleucus
Lesser Yellowlegs #	Totanus flavipes
Short-billed Dowitcher #	Limnodromus griseus
Long-billed Dowitcher #	Limnodromus scolopaceus
Ruddy Turnstone	Arenaria interpres
Black Turnstone	Arenaria melanocephala
Pectoral Sandpiper	Erolia melanotus
Least Sandpiper #	Erolia minutilla
Semipalmated Sandpiper #	Ereunetes pusillus
Western Sandpiper #	Ereunetes mauri
Northern Phalarope *	Lobipes lobatus
Common Snipe *	Capella gallinago
Glaucous-winged Gull *	Larus glaucescens
Herring Gull #	Larus argentatus
Mew Gull *	Larus canus
Bonaparte's Gull *	Larus philadelphia
Arctic Tern *	Sterna paradisaea
Short-eared Owl	Asio flammeus
Yellow-shafted Flicker *	Colaptes auratus
Downy Woodpecker #	Dendrocopos pubescens
Northern Three-toed Woodpecker #	Picoides tridactylus
Black-backed Three-toed Woodpecker #	Picoides arcticus

Spring	Summer	Fall
C	C	C
C		
U	U	
U	C	U
R	U	
	U	
R	R	
C	C	C
	R	
C	C	C
C	C	U
C	C	U
C	C	C
U	U	
	R	
C		C
C	C	U
C	A	U
C	A	C
C	C	U
C	C	C
C	C	C
U	U	
A	A	C
C	U	U
C	C	U
	U	
U	U	
U	U	
U	U	U
R	R	

Common Name	Scientific Name	Spring	Summer	Fall
Cliff Swallow *	Petrochelidon pyrrhonota	C	C	
Violet-green Swallow	Tachycineta thalassina	U		
Tree Swallow #	Iridoprucne bicolor	C	C	
Gray Jay #	Perisoreus canadensis	C	C	C
Black-billed Magpie	Pica pica			U
Common Raven #	Coruus corax	C	C	C
Black-capped Chickadee #	Parus atricapillus	C	U	C
Robin #	Turdus migratorius	C	U	U
Yellow Warbler #	Dendroica petechia	U	U	
Myrtle Warbler #	Dendroica tigrina	U	U	
Rusty Blackbird *	Euphagus carolinus	C	C	C
Redpoll	Acanthis sp	U		
Savana Sparrow #	Passerculus sandwichensis	C	C	C
Slate-colored Junco #	Junco hyemalis	C	C	
Tree Sparrow #	Spizella arborea	C	C	
White-crowned Sparrow *	Zonotrichia leucophrys	C	C	C
Golden-crowned Sparrow #	Zonotrichia alricapilla	C	C	
Fox Sparrow #	Passerella iliaca	U	U	
Lincoln's Sparrow	Melospiza lincolnii	C	C	U
Snow Bunting	Plectruphenax nivalis	R		

LEGEND: * - Found nesting
- Suspected nesting

A - Abundant
C - Common
U - Uncommon
R - Rare

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