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LAND USE MAPS OF THE TANANA AND PURCELL MOUNTAIN AREAS, ALASKA, BASED ON EARTH RESOURCES TECHNOLOGY SATELLITE IMAGERY

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16. Abstract: ERTS imagery in photographic format was used to make land use maps of two areas of special interest to native corporations under terms of the Alaska Native Claims Settlement Act. Land selections are to be made in these areas, and the maps should facilitate decisions because of their comprehensive presentation of resource distribution information. The ERTS images enabled mapping broadly-defined land use classes in large areas in a comparatively short time. Some aerial photography was used to identify colors and shades of gray on the various images. The 14 mapped land use categories are identified according to the classification system under development by the U.S. Geological Survey. These maps exemplify a series of about a dozen of diverse Alaskan areas now in preparation. The principal resource depicted is vegetation, and clearly shown are vegetation units of special importance, including stands possibly containing trees of commercial grade and stands constituting wildlife habitat. The accompanying text covers vegetation mapping rationale, methods, and a little of the probable nature of the unit classes. More adequate copies of the maps can be obtained from the author.

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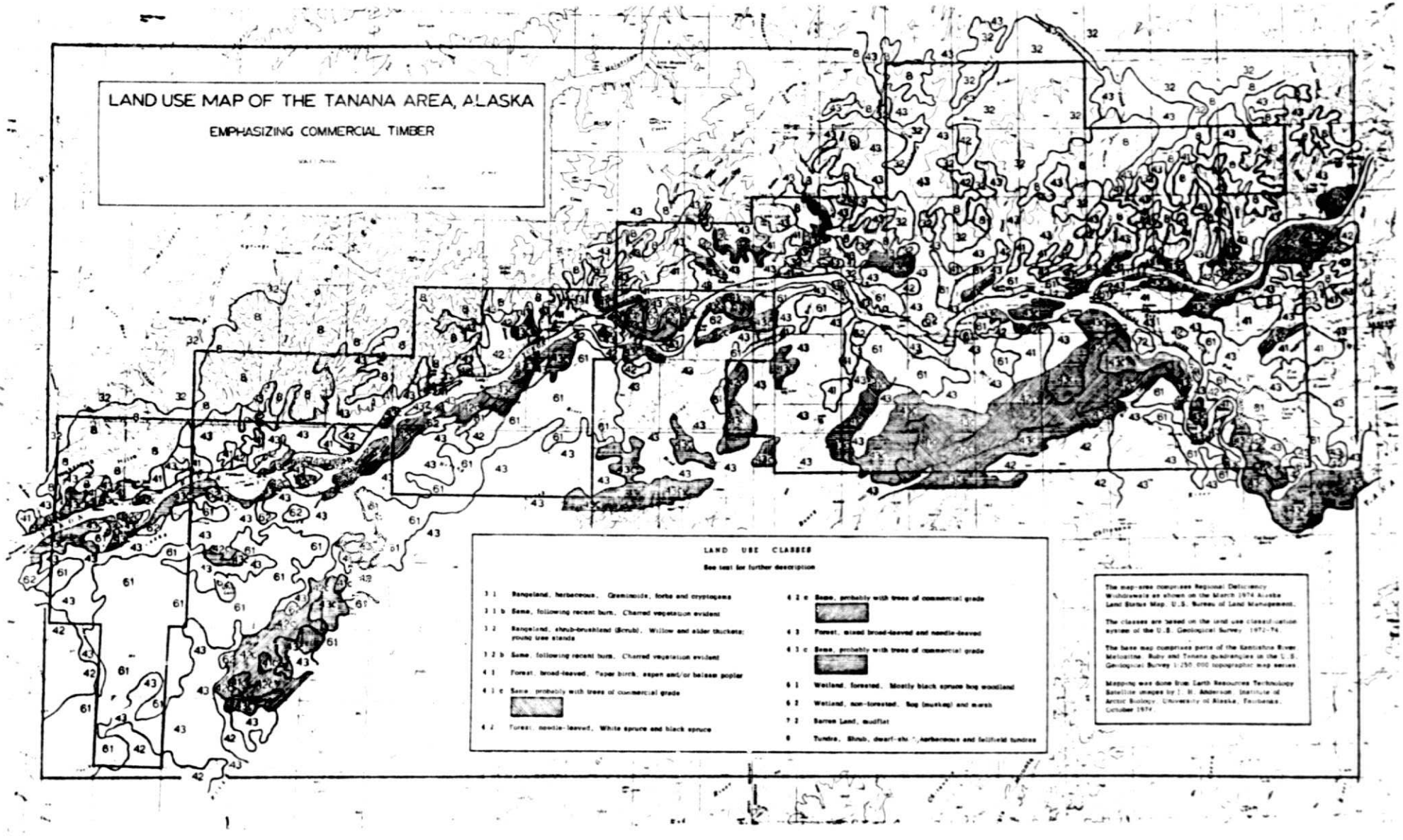
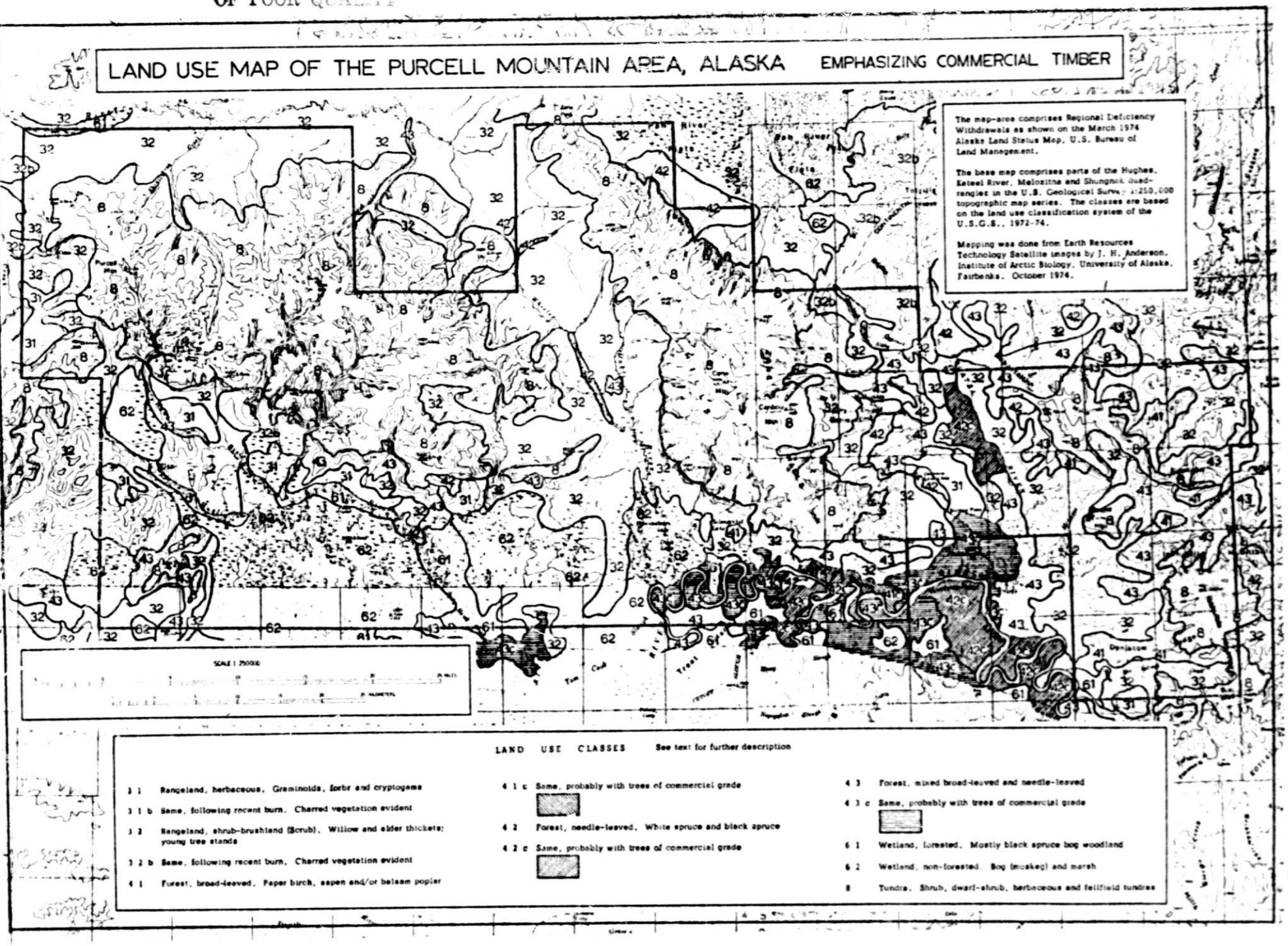


LAND USE MAP OF THE PURCELL MOUNTAIN AREA, ALASKA EMPHASIZING COMMERCIAL TIMBER



The map-area comprises Regional Deficiency Withdrawals as shown on the March 1974 Alaska Land Status Map, U.S. Bureau of Land Management.

The base map comprises parts of the Hughes, Koteel River, Meloxitna and Shungnak quadrangles in the U.S. Geological Survey 1:250,000 topographic map series. The classes are based on the land use classification system of the U.S.G.S., 1972-74.

Mapping was done from Earth Resources Technology Satellite images by J. H. Anderson, Institute of Arctic Biology, University of Alaska, Fairbanks, October 1974.

SCALE 1:250000

LAND USE CLASSES See text for further description

- 3 1 Rangeland, herbaceous. Graminoids, forbr and cryptogams
- 3 1 b Same, following recent burn. Charred vegetation evident
- 3 2 Rangeland, shrub-brushland (Scrub). Willow and alder thickets; young tree stands
- 3 2 b Same, following recent burn. Charred vegetation evident
- 4 1 Forest, broad-leaved. Paper birch, aspen and/or balsam poplar
- 4 1 c Same, probably with trees of commercial grade
- 4 2 Forest, needle-leaved. White spruce and black spruce
- 4 2 c Same, probably with trees of commercial grade
- 4 3 Forest, mixed broad-leaved and needle-leaved
- 4 3 c Same, probably with trees of commercial grade
- 6 1 Wetland, forested. Mostly black spruce bog woodland
- 6 2 Wetland, non-forested. Bog (muskeg) and marsh
- 8 Tundra. Shrub, dwarf-shrub, herbaceous and fellfield tundras

LAND USE MAPS OF THE TANANA AND PURCELL MOUNTAIN AREAS, ALASKA, BASED ON EARTH RESOURCES TECHNOLOGY SATELLITE IMAGERY

INTRODUCTION

Land use maps of Alaskan areas are of increasing importance with the current widespread rush into land disposition and resource exploitation. Such maps provide a spatial and possibly a quantitative inventory of selected resources and some basis for sensible planning. Land use maps may help in organizing activities compatible with (1) a natural environmental integrity and hence with regeneration potentials and esthetic qualitites and (2) the rational and long-range needs of the exploiter.

Land use maps where little land use by man has begun are particularly important. These tend to emphasize vegetation, the most visible and functionally important component of most ecosystems. Vegetation may provide material resources, principally food and timber; wildlife habitat; and cultural and recreational values. Vegetation is also important as an indicator: it is an integrated expression of the history of the site and the nature of soils, drainage, permafrost, topography and small and large-scale climates. It may also indicate the nature and severity of pollution and other human disturbances.

The land use maps of the Tanana and Purcell Mountain areas are part of a series of maps of Alaskan areas of particular interest to the Bureau of Indian Affairs, the agency funding the mapping, and the Doyon Native Regional Corporation, within whose jurisdiction the map-areas lie. They are essentially vegetation maps depicting broadly defined vegetation types at the relatively small scale, on the originals, of 1:250,000. Although limited

in vegetation and other detail, these maps provide more information than any previous maps of the areas and are a step toward the production of more meaningful land use maps in Alaska.

METHODS

The maps were drawn from Earth Resources Technology Satellite (ERTS) images. The reasons for this were (1) ERTS image availability, (2) the usefulness of ERTS imagery for mapping broadly defined vegetation types over large areas in a relatively short time and (3) lack of complete aerial photograph coverage. The land use classification adopted for this map series is the latest revision of a system being developed by the U. S. Geological Survey under the direction of James R. Anderson. Map units are identified at level II in this system in most cases.

The ERTS scenes used were numbers 1037-21240, 1251-21135, 1252-21193, 1341-21130 and 1613-21192 for the Tanana area and 1037-21240, 1057-21351, 1236-21303, 1273-21364 and 1345-21353 for the Purcell Mountain area. Images for mapping were photographic prints enlarged to a scale of 1:250,000.

Some of the scenes, printed in black and white, were obtained by the satellite in the late winter, when the landscape was generally snow-covered, but when plants taller than the snow pack were free of snow. In the forest zone of interior Alaska snow accumulation by late winter usually is around three feet. These scenes permitted determinations of vegetation structure, based on a gray scale continuum presumably related to plant cover. Areas of no plant cover or of vegetation too low to show above the snow appeared nearly white. Areas of some plant cover above the snow appeared

somewhat gray. Areas of intermediate plant cover appeared grayer, and areas of closed vegetation, where no snow showed, were dark gray. Nearly white was interpreted as tundra or herbaceous rangeland, intermediate gray as shrub rangeland or open forest, and dark gray or black as closed forest, the latter in some cases containing large trees of a potentially commercial grade.

Other scenes, obtained in the summer, were printed in color-infrared. These permitted several floristic distinctions, based on some knowledge of the infrared reflectance of high-cover species or species groups. For example, broad-leaved trees and shrubs reflect highly in the near-infrared and therefore appear bright red on this kind of imagery. Most needle-leaved species have low near-infrared reflectance and therefore appear dark gray. Intermediate gray colors seem to indicate ericaceous shrubs or open stands of needle-leaved species.

The winter and summer images were used together in making the vegetation and other land use distinctions expressed in the classification system. Interpretations were facilitated by physiographic information obtained from topographic maps, as there are relationships between vegetation and physiography. For example, wetlands occur in low-lying flat areas; broad-leaved forests and forest dominated by white spruce (Picea glauca) are the main forest types on east, south and west slopes; and upland bogs and black spruce (P. mariana) bog woodlands occur more frequently than the former on north slopes. All bogs except upland bogs with a major black spruce component are designated wetlands for present purposes. Flood plains in the vicinity of streams commonly are occupied by white spruce and balsam poplar (Populus balsamifera) vegetation types containing trees of commercial grade.

Initially, most of the interpretations of spectral units on the imagery were made through comparisons with aerial photographs covering parts of the map areas. Alaska Forest Inventory photographs in black and white modified infrared were obtained from the U. S. Forest Service, and some small-scale color-infrared photography was obtained from the National Aeronautics and Space Administration and its summer 1974 U-2 aerial photography mission. In general, more information is available on aerial photographs than is necessary for establishing or validating the broad land use classes distinguished at levels I and II of the classification system.

The identification of vegetation containing trees of possible commercial timber grade required the recognition of forest vegetation, then estimations of composition and stature using the kinds of spectral and physiographic information described above. A quantitative definition of commercial timber is not intended. The commercial stands depicted on the maps are those in which the occurrence of a number of larger trees suitable for lumber production is likely. White spruce, balsam poplar and paper birch (Betula papyrifera) are the potentially commercial grade species.

The mechanics of mapping involved (1) tracing streams, lakes and other prominent landmarks onto a transparent plastic overlay of the base map, a U. S. Geological Survey topographic map, (2) positioning the overlay on an ERTS image according to these landmarks, (3) tracing spectral units identified to vegetation or land use classes onto the overlay, (4) positioning the base map over the overlay on a light table and (5) tracing the unit boundaries on the overlay onto the base map and labeling them.

A preliminary map for the Tanana area was made in the laboratory by these

methods, using all available control in the form of aerial photographs and written and oral information. This map was used as a guide to a route of travel by light aircraft for field checking. Comparing the preliminary map with certain parts of the map area confirmed the interpretations of the ERTS imagery in many cases, but showed also some faulty interpretations. This field work led to the revised and more nearly accurate map presented here.

The Purcell Mountain area map was not field checked, but it is considered to be acceptably accurate because (1) high quality U-2 photography of a broad swath across the area was available for control and (2) it is the third map made in this series and therefore represents the cumulative experience of the preceding two mapping endeavors.

THE MAPS

The maps depict 14 land use classes, most of which are vegetation types of rather broad definition. The distribution of vegetation containing trees of possible commercial grade is indicated with a "c" in the label and is further emphasized by crosshatching. The general composition of the vegetation types is as follows:

3 1. Rangeland, herbaceous. This class designates areas where the vegetation is dominated by graminoids, forbs and/or cryptogams. Low-growing shrubs may be present. Unlike unforested wetlands (6 2), which are somewhat similar physiognomically, these areas are well-drained. Hence they are different floristically, and they lack peat accumulation. Major species are blue joint grass (Calamagrostis canadensis), fireweed (Epilobium angustifolium), the fescue grass Festuca altaica , squirreltail grass (Hordeum jubatum), and the wormwood Artemisia frigida . Several

species of Cladonia probably occur as dominants in lichen rangelands in the Purcell Mountain area.

This vegetation is an early post-fire successional stage in some cases. Here, the immediate evidence of fire, charred plant material, is obscured by live plant cover. In other cases, particularly in lichen dominated stands, the vegetation is much older.

3 1 b. Same, following recent burn. Whereas the vegetation of class 3 1 may or may not be an early post-fire successional stage, the vegetation designated by 3 1 b is all of this kind, as is evidenced by an abundance of charred material. This material lends a blackness to the landscape which is readily seen on summer ERTS imagery. Since the live plants colonizing the burn area are not yet sufficiently abundant to obscure this material, it is concluded that the burn was recent, probably having occurred not more than two years prior to the obtaining of the imagery. Hence the burns depicted on these maps would have occurred in 1971, 1972 or 1973.

3 2. Rangeland, shrub-brushland (Scrub), (Fig. 1). Shrub rangeland is dominated by shrubs or young, shrub-sized individuals of tree species. Much of this vegetation in the map-areas is believed to be dominated by the latter, chiefly young aspen (Populus tremuloides) and paper birch in post-fire successional stands. Closer to the larger streams, however, shrub rangeland comprises willows (Salix spp.) and alders (Alnus spp.), usually as dominants in flood plain and point bar early successional vegetation. Shrub dominated areas in bogs are included in non-forested wetlands, and high elevation shrub tundra is covered by class 8. Shrub rangeland is important for wildlife, especially large game animals, because of the high proportion in it of browse food material.

3 2 b Same, following recent burn. This class designates areas of early post-fire successional vegetation dominated by shrubs, chiefly willows or, quite frequently, broad-leaved or needle-leaved tree seedlings. Charred vegetation and downed trees are abundant. These areas should be increasingly valuable as wildlife habitat over the next few years, and most would eventually succeed back to forest vegetation.

4 1. Forest, broad-leaved. Forested areas are identified by a 4, and broad-leaved forests by a 4 1. Here the major species are paper birch, aspen and balsam poplar. Birch is the most widespread, occurring throughout the range of broad-leaved forests. Aspen is also widespread, but occurs mostly on south and near south slopes of moderate steepness. Balsam poplar is relatively limited in distribution, large trees occurring as stand dominants only on old flood plains in the vicinity of major streams. In the Tanana and Purcell Mountain map-areas most broad-leaved forests comprise trees of small to intermediate size. Some of these forests may be important as potential sources of pulp timber.

4 1 c. Broad-leaved forest, commercial. Broad-leaved forest believed to contain large trees of timber grade are designated by a "c" and by cross-hatching. These forests are mostly on the old flood plains of the Yukon, Tanana and Koyukuk Rivers, and the principal species is balsam poplar. Some commercial broad-leaved forest stands on upland sites farther from the river are dominated by paper birch and some aspen.

4 2. Forest, needle-leaved. Needle-leaved, mostly evergreen forest dominated by white spruce and/or black spruce is widely distributed in the map-areas, but is considerably less important areally than broad-leaved

forest. White spruce is the dominant needle-leaved species on upland sites of most slopes. North slope needle-leaved forests are more often characterized by black spruce in closed and open stands. Needle-leaved forests on low-lying flat areas away from major streams also are dominated more often by black spruce than white spruce, but here these forests are designated forested wetland.

4 2 c. Needle-leaved forest, commercial. White spruce is almost exclusive as the dominant in commercial needle-leaved forests. Such forests are limited to the older and larger flood plains, where white spruce forest usually follows broad-leaved forest as a late stage in vegetation succession.

White spruce of commercial size dominates in narrow gallery forests along the many smaller streams. These forests, although occurring widely, are too small areally to show on the maps. The few large trees in them and their scattered distribution and relative inaccessibility probably would preclude commercial exploitation.

4 3. Forest , mixed broad-leaved and needle-leaved. Most forest vegetation in the map-areas is characterized by mixtures of broad-leaved and needle-leaved trees in various proportions. This is a reflection of widespread heterogeneity in a number of environmental and historical factors. Mixed forests generally are dominated by trees of intermediate size or, at higher elevations, by small trees. They may be valuable sources of pulp timber in some places. Some of this forest is open in nature, with low tree densities and correspondingly high shrub densities. Therefore it is also important as wildlife habitat.

4 3 c. Mixed forest, commercial. As mixed forest is the most frequent non-commercial forest type in the map-areas, it is also the areally most important commercial forest type. Like the other two commercial types, it also is limited to lower elevation areas near the Yukon, Tanana and Koyukuk Rivers. Here the most important broad-leaved component is balsam poplar, but paper birch is widespread. Aspen is of some importance as a large tree on sites somewhat removed from the river. White spruce is the only important needle-leaved species, and in most cases this component considerably exceeds the others in frequency and volume (Fig. 2).

6 1. Wetland, forested. A "6" designates wetland, a broad class of vegetation and land use types generally having a soil water table at or near the surface most of the growing season. Wetlands in the map-areas generally are underlain by permafrost. A "6 1" designates wetland areas where the water table is just low enough and the permafrost just deep enough to allow some tree growth. This growth comprises black spruce and some paper birch. Trees are small to intermediate in size, and their density is low. Hence the vegetation is mostly open forest and, where tree density is low, woodland. Black spruce bog woodland, colloquially called muskeg, is the areally most important vegetation in this class. The bog components are shrub and dwarf-shrub layers and a thick cryptogam layer. Shrubs are several ericaceous species, shrub birch (Betula glandulosa) and some willows. The cryptogam layer is made up of several moss species, often with Sphagnum as the stratal dominant, and of lichens. Herbs are widespread but of relatively low density.

6 2. Wetland, non-forested. Some non-forested wetlands are similar

to forested wetlands except for the lack of trees. Dwarf-shrub, herbaceous and cryptogam vegetation is dominant. The most important dwarf-shrubs are dwarf birch (Betula nana), lingonberry (Vaccinium vitis-idaea), blueberry (V. uliginosum), labrador tea (Ledum decumbens), crowberry (Empetrum nigrum), and several willows. The herbaceous component usually includes much cottongrass (Eriophorum spp.) or sedge (Carex spp.). The cryptogam component features a higher proportion of Sphagnum spp. than the equivalent forested wetland component.

Non-forested wetlands with this general vegetation composition are bogs, where peat accumulation is significant and permafrost is near the surface. Bogs are important sources of wild berries.

A second kind of vegetation in this class is marsh, with a water table at or above the surface and a thoroughly wet soil. Graminoids and bryophytes are dominants, sedges and several grass species being characteristic. In the map-areas, units labeled 6 2 located near small, slow-flowing streams and near ponds and lakes in flat areas are more often marsh than bog. Marsh areas are very important as waterfowl habitat.

7 2. Barrenland, mudflat. Barrenlands are areas which, for a variety of reasons, bear very little or no vegetation. Common types in the map-areas are river bars and active flood plains, but these are too small individually to show on the maps. In the lower Tanana River, however, there is a large island composed of recently deposited silt (Fig. 3). Although scattered plants occur here, the surface is probably too unstable physiographically for vegetation development to occur.

8. Tundra. Higher elevation areas, generally above approximately

2,000 ft in the Tanana area and 1,500 ft in the Purcell Mountain area, are occupied by tundra. This is a broad landscape category characterized by at least four major physiognomic vegetation types: scrub, dwarf-scrub, meadow and fellfield. These types were not distinguished in the map-areas. Much of the tundra zone is important as habitat for caribou, moose, sheep, bear and many birds.

APPLICATION EXAMPLE

An example of a use to which maps of this kind can be put is the compilation of townships within which stands of commercial timber occur. These are listed in the following tables.

Table 1. Townships with timber of possible commercial grade in the Tanana map-area and vicinity. Reference is to the Kateel River (E) and Umiat (W) meridians and the Kateel River (S) and Fairbanks (N) base lines.

KANTISHNA RIVER QUADRANGLE

Township North	Range West
1	18
	19
2	19
	20
	22
	23
	24
	25
	26
	27

MELOZITNA QUADRANGLE

Township South	Range East
3	28
4	25
	26
	27
	28
5	23
	24
	25
	26
	28
	29

RUBY QUADRANGLE

Township South	Range East
6	21
	22
	23
	27
	28
7	18
	19

RUBY QUADRANGLE, continued

Township South	Range East
7	20
	21
8	22
	23

TANANA QUADRANGLE

Township North	Range West
2	20*
	21
	22*
	23*
	24*
	25*
3	19
	20
	21
	22
	23
	24
	25
	26
	27
4	19
	20
	21
	22
	23
	24
	27
5	23
	24
	25
	26
	27
	28

*Townships so marked are duplicates on different quadrangles.
55 townships are listed here.

Table 2. Townships with timber of possible commercial grade in the Purcell Mountain map-area and vicinity. Reference is to the Kateel River meridian and base line.

HUGHES QUADRANGLE

Township North	Range East
7	14
	15
	16
	17
8	16
	17
9	16

KATEEL RIVER QUADRANGLE

Township North	Range East
6	10
	11
	13
7	12
	13

MELOZITNA QUADRANGLE

Township North	Range East
6	14
	15
	16
	17
7	14
	15
	16*
	17*

SHUNGNAK QUADRANGLE

Township North	Range East
7	12*
	13*

*Townships so marked are duplicates on different quadrangles.
16 townships are listed here.

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The following were consulted in preparing the Tanana and Purcell Mountain area land use maps and accompanying text. They would be useful sources of further information on the vegetation and related resources of these areas and the mapping activities.

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FIGURE LEGENDS

Fig. 1. Shrub rangeland (3 2); Tozitna River in background. The vegetation in this area apparently is developing after a fire, evidence for the latter including the white standing trunks of dead birch trees. The view is NNE approximately 24 km NW of Tanana village.

Fig. 2. Mixed broad-leaved and needle-leaved forest, commercial (4 3 c). The forest in the foreground is dominated by white spruce which apparently are big enough to be of commercial value, and by paper birch, some of which also may be of commercial grade. Across the middleground is a band of shrub rangeland (3 2), comprising young tree species and, closer to the river, willows and alders. The light-colored area is a mudflat (7 2), and contiguous with it at the top of the picture is the Yukon River. The view is NNW about 5.5 km SW of Weir Island.

Fig. 3. Barrenland, mudflat (7 2). Squaw Island, in the Tanana River near its confluence with the Yukon, is made up of freshly deposited silt. Vegetation occurs only in patches. The view is NW approximately 15 km SE of Tanana Village.

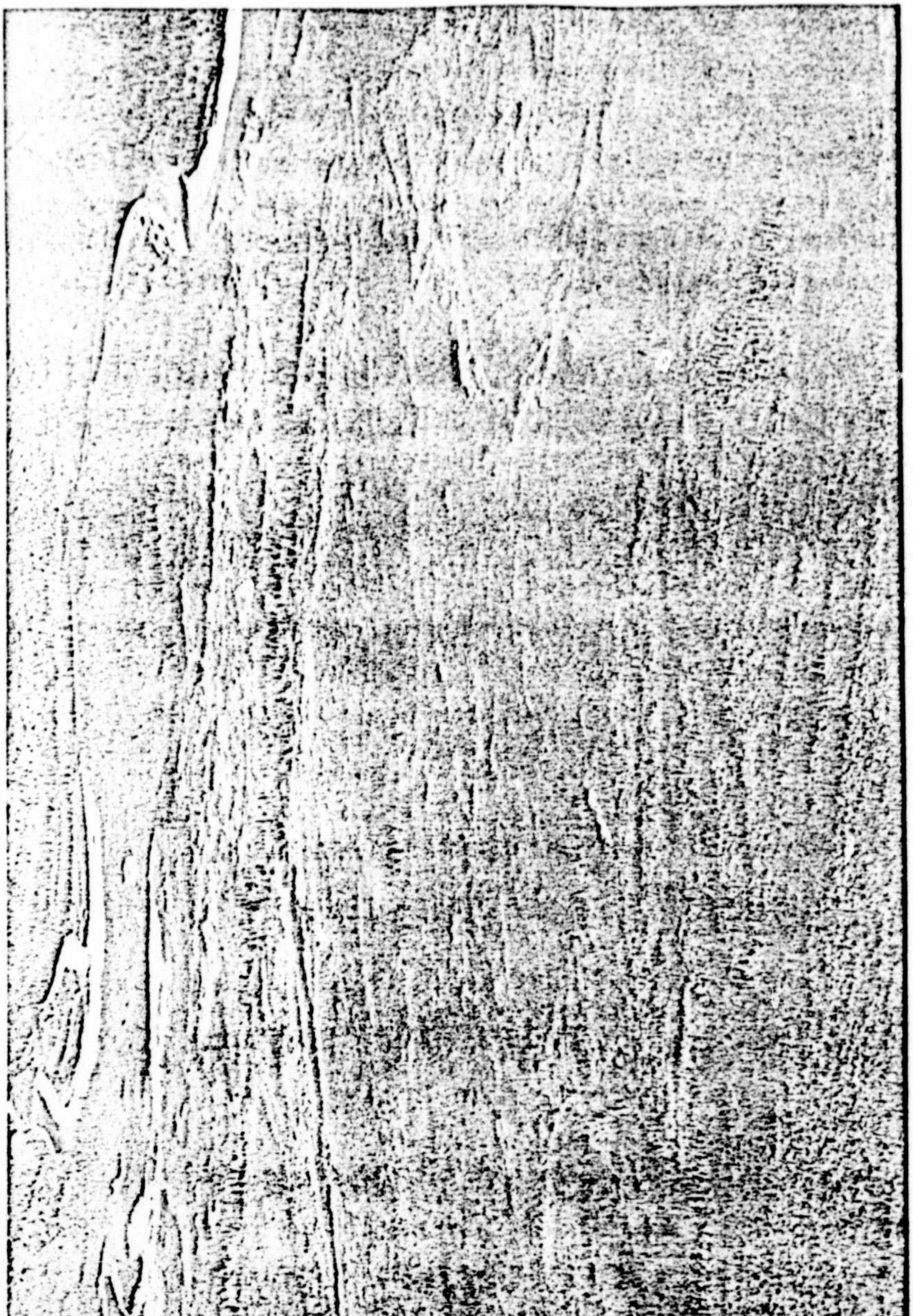

Fig. 1

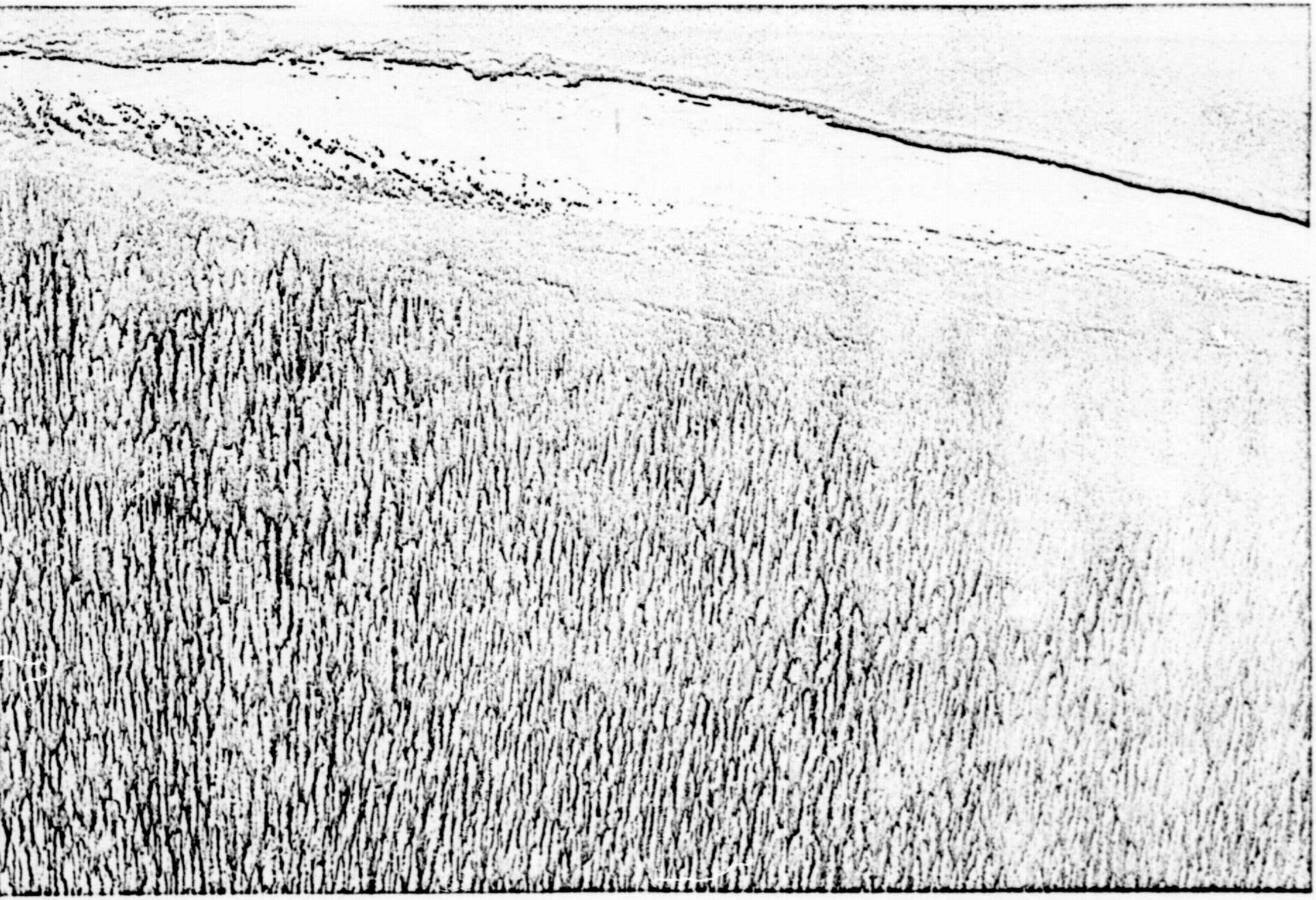

Fig. 2

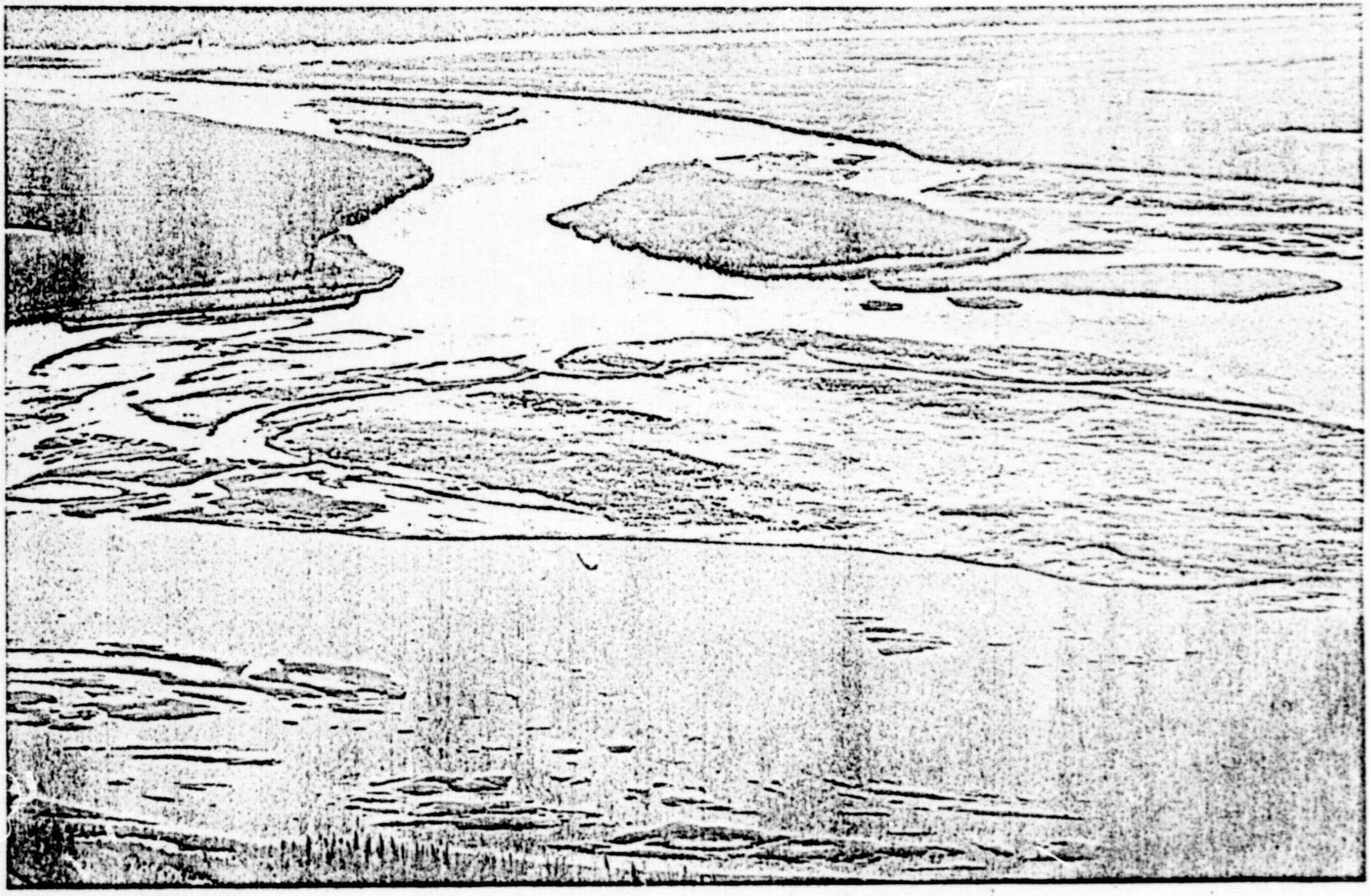

Fig. 3