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(E74-10137) IDENTIFICATION, DEFINITION AND MAPPING OF TERRESTRIAL ECOSYSTEMS IN INTERIOR ALASKA Bimonthly Progress Report (Alaska Univ., Fairbanks.) 16 p HC $3.00 CSCL 08B G3/13 Unclas 00137

EIGHTH BI-MONTHLY PROGRESS REPORT
University of Alaska
ERTS-1 Project 110-3
November 30, 1973

TITLE OF INVESTIGATION: Identification, definition and mapping of terrestrial ecosystems in interior Alaska.

PRINCIPAL INVESTIGATOR: J. H. Anderson. UN 592

PROBLEMS IMPEDING INVESTIGATION: None

PROGRESS REPORT:

1. Accomplishments during the reporting period:

a. The vegetation map in preparation at the time of the seventh bi-monthly report (September 30, 1973), described therein under 1.a. on page 1, was refined and labeled. This is presented now (Fig. 1), somewhat reduced in scale.

b. Using this map, areas covered by the several vegetation types characterized by white spruce as the leading component were determined by planimetry (Table 1).

c. A 15-page manuscript was finished for the Proceedings of the 24th Alaska Science Conference, dealing with preparation of a 1:250,000 scale vegetation map of the same area. Although an earlier version of this map was presented in an earlier report, the version incorporated in this manuscript is presented here for the first time (Fig. 2).

d. A 1:63,360 scale land-use map of the Juneau area, using the Juneau B-2 quadrangle as a base map, was drawn. It is presented here (Fig. 3) in reduced and somewhat degraded form. This map incorporates the land-use classification system now under development by the U.S. Geological Survey (Table 2).

e. As a small extra exercise, the ERTS images used in making the Juneau area map were used to determine changes in surface area of the terminal zones of advancing and receding glaciers. Three prominent glaciers were measured (Table 3).

f. A new 1:63,360 scale land-use map of the Bonanza Creek Experimental Forest and vicinity (Test Area 5) was produced, using U.S. Geological Survey quadrangles as base maps. Whereas its professional drafting and labelling is yet to be done (scheduled for the week of December 17), the map's penultimate form is presented (Fig. 4), in reduced and degraded form. This map uses the same classification system as the Juneau area map.

g. Several excellent new scenes of test areas were received from NASA in color-infrared format. These are being used for making photographic prints for analysis and mapping according to the procedure outlined below.

2. Plans for the next reporting period:

a. It is intended to work toward production of land-use maps of several areas, utilizing the following U.S. Geological Survey quadrangles as base maps:

(1) Fairbanks (1:250,000)

(2) Fairbanks D-2 (1:63,360)

(3) Wiseman, east approximate 1/4, and Chandalar, west c 1/4 (1:250,000)

(4) Philip Smith Mountains, west c 1/3 (1:250,000)

(5) Saganavirktok (1:250,000)

(6) Saganavirktok A-4 (1:63,360)

(7) Beechy Point (1:250,000)

(8) Beechy Point B-2 (Prudhoe Bay) (1:63,360)

In addition, mapping at a scale of 1:1,000,000 will be pursued further (cf page 3, 7th Bi-monthly Report) using the CC-9 and CD-11 World Aeronautical Charts.

b. It has been decided by the Project 110-2 and 110-3 investigators that the two different approaches they have somewhat separately developed need now to be amalgamated into a single, optimal method. Project 110-2 has emphasized digital data-based procedures and Project 110-3, a photographic products-based procedure. In the time remaining on ERTS-1 contracts, comparisons and testing of each procedure against the other will be made, and the synthesis and definition of this method will be attempted.

SIGNIFICANT RESULTS:

1. The vegetation map in preparation at the time of the Seventh Bi-monthly Progress Report (September 30, 1973, page 2), was redrawn and labeled (Fig. 1).

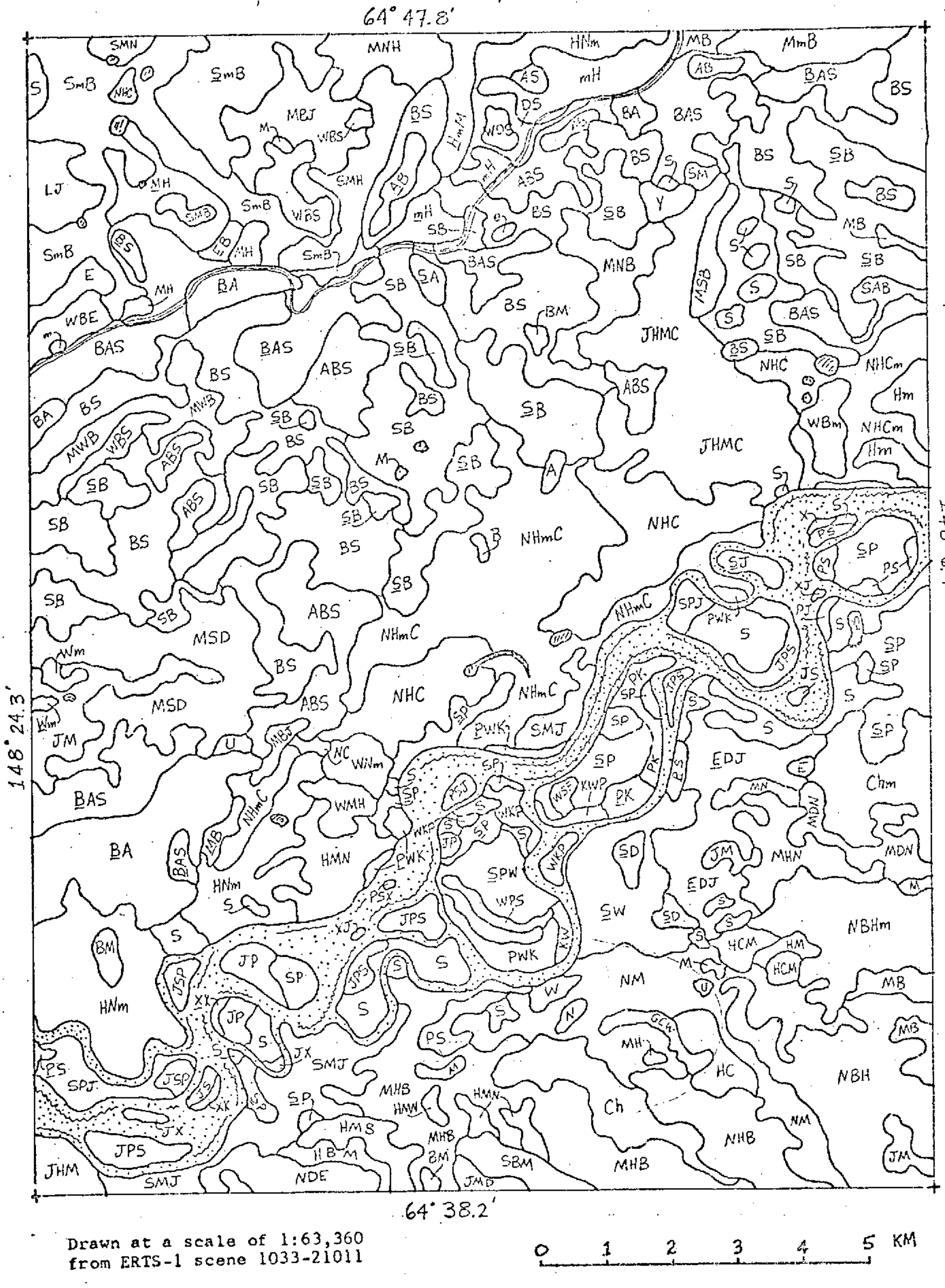
This map is quite tentative. It was drawn while the investigator's ability to recognize on ERTS imagery real stands of vegetation was even less perfect than now, and some of the vegetation type identifications, particularly outside the area covered by aerial photographs, are uncertain. It is not considered as useful a map as if it had been fitted to a base map, such as the U.S. Geological Survey 1:63,360 quadrangles for the area (cf 6, below). The vegetation classification is an experimental one and quite unrefined. Therefore it is not intended to present this map beyond the present report. Its chief value is in suggesting the level of vegetation spatial and classificatory detail that may be shown on a map of this scale drawn from an ERTS image enlarged to the same scale.

2. Using this map, the total areas of the vegetation types in which white spruce is the most important component were measured by planimetry. The results are given in Table 1. The vegetation type symbols in the table are the same as on the map and may be interpreted by referring to the map legend on the page following Figure 1. There are a number of other vegetation types in the map area which contain white spruce as a secondary or lesser component.

3. A slightly revised version, which is now in press, of the 1:250,000 scale vegetation map of the Bonanza Creek Experimental Forest and vicinity is presented (Fig. 2) (cf p 12, Second Semi-annual Report, July 31, 1973). As with Figure 1, interpretation of the map should be possible with the legend provided, or by reference to the earlier discussion (ibid, pp 9-16). Although no ground checking of this map has been done (the reason being that, for the broadly defined vegetation types depicted, the aerial photos provided adequate control), first-hand information from persons who have been in the field subsequent to mapping has tended to validate interpretations in a few places. No refutation of any interpretations has come to the author's attention.

4. A 1:63,360 scale land-use map of the Juneau area, using the Juneau B-2 quadrangle as a base map, was drawn (Fig. 3), using ERTS-1 scene 1019-19430. It is shown here at a reduced scale and somewhat degraded for want of a more adequate means of reproduction than xeroxing.

The land use classification system under development by the U.S. Geological Survey (Reference: October 1973 Tentative Proposed Revision of the 1972 publication, A land-use classification system for use with remote sensor data, U.S. Geological Survey Circular 671, by J. R. Anderson) was



PRELIMINARY VEGETATION MAP OF THE BONANZA CREEK EXPERIMENTAL FOREST AND VICINITY

Figure 1

Legend for Figure 1

MAP UNIT SYMBOLS USED ON 1:63,360 SCALE VEGETATION MAP OF THE BONANZA CREEK EXPERIMENTAL FOREST AND VICINITY.

A - Populus tremuloides
  Aspen

B - Betula papyrifera
  Paper birch

C - Cyperaceae
  Sedges and cotton grasses

D - Deciduous trees, undif.

E - Evergreen trees, undif.

F - Forbs

G - Gramineae
  Grasses

H - Ericaceae
  Heath plants

J - Broadleaf shrubs, undif.

K - Alnus spp.
  Alders

L - Low vegetation, undif.

M - Picea mariana
  Black spruce

N - Betula nana and B. glandulosa
  Shrub birches

P - Populus balsamifera
  Balsam poplar

R - Recently burned area

S - Picea glauca
  White spruce

U - Unclassified

W - Salix spp.
  Willows

X - Bare ground

Y - Man-disturbed area

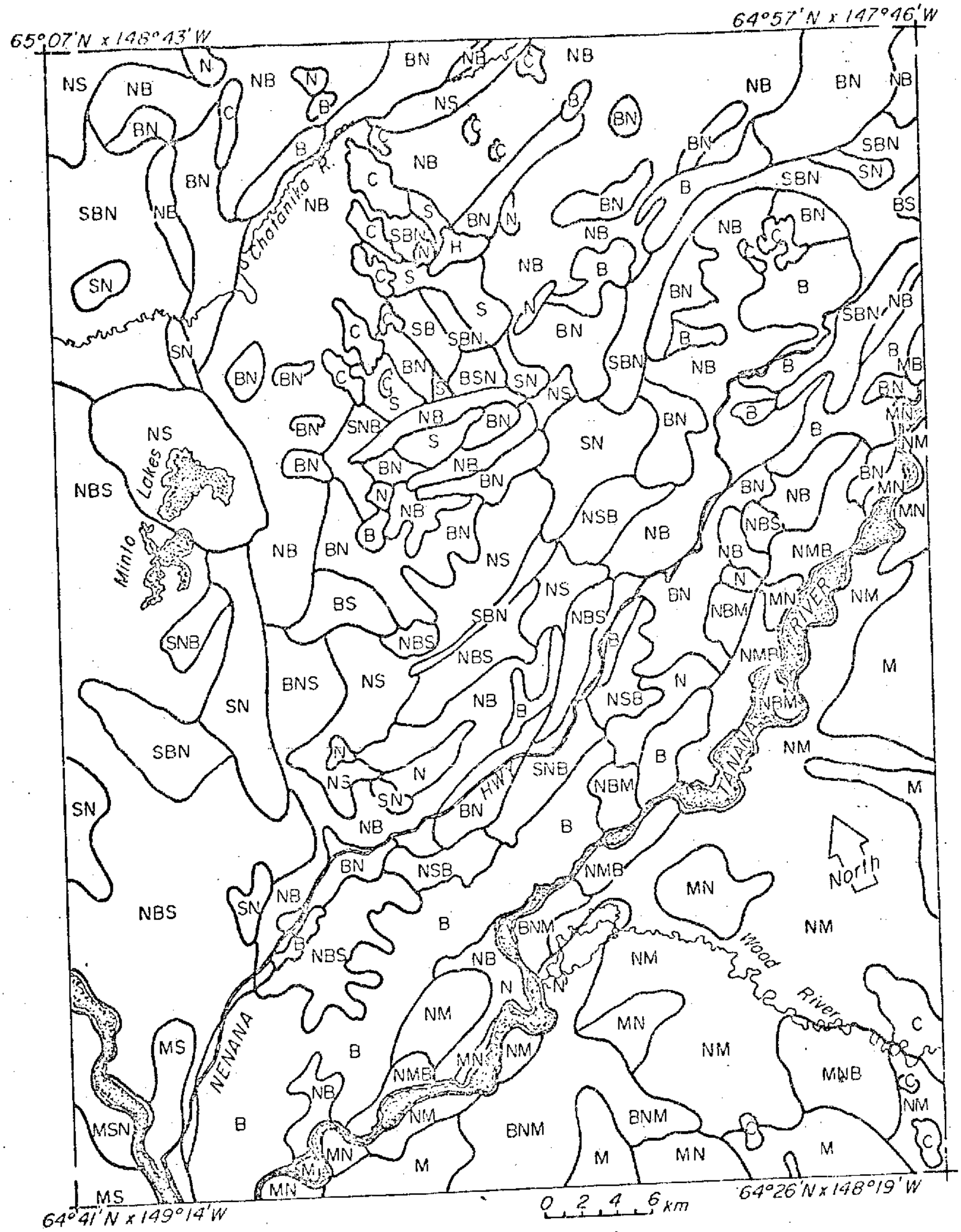
Letters arranged in order of decreasing importance in combination units.

Lower case letters for trees indicate plants less than approximately 5 m in height.

Underlined letters indicate plants of very high importance relative to others.

TABLE 1. Total areas of stands of vegetation types characterized by white spruce (Picea glauca) as the most important component, in the map area of Fig. 1.

VEGETATION TYPE	AREA km^2	AREA ha	% TOTAL MAP AREA ($257\ km^2$)
S	4.31	431	1.67
SA	0.17	17	0.07
SB	11.37	1,137	4.42
SB	8.13	813	3.16
SD	0.54	54	0.21
SJ	0.21	21	0.08
SM	0.13	13	0.05
SP	5.31	531	2.07
SP	1.93	193	0.75
SW	3.0	300	1.16
ŜBM	0.90	90	0.35
SMB	2.92	292	1.17
SMJ	2.59	259	1.01
Smb	7.18	718	2.79
SmH	1.82	182	0.71
SmN	0.23	23	0.09
SPJ	1.20	120	0.47
SPW	1.51	151	0.59
Totals	53.45	5,345	20.82



VEGETATION MAP OF THE BONANZA CREEK EXPERIMENTAL FOREST AND VICINITY, DRAWN AT A SCALE OF 1:250,000

Figure 2

B - broadleaf trees
N - needleleaf trees
M - muskeg plants
H - herbaceous plants
S - shrubs

Plant name symbols given in order of decreasing importance in combination units.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

JUNEAU (B-2) QUADRANGLE
ALASKA
1:63 360 SERIES (TOPOGRAPHIC)

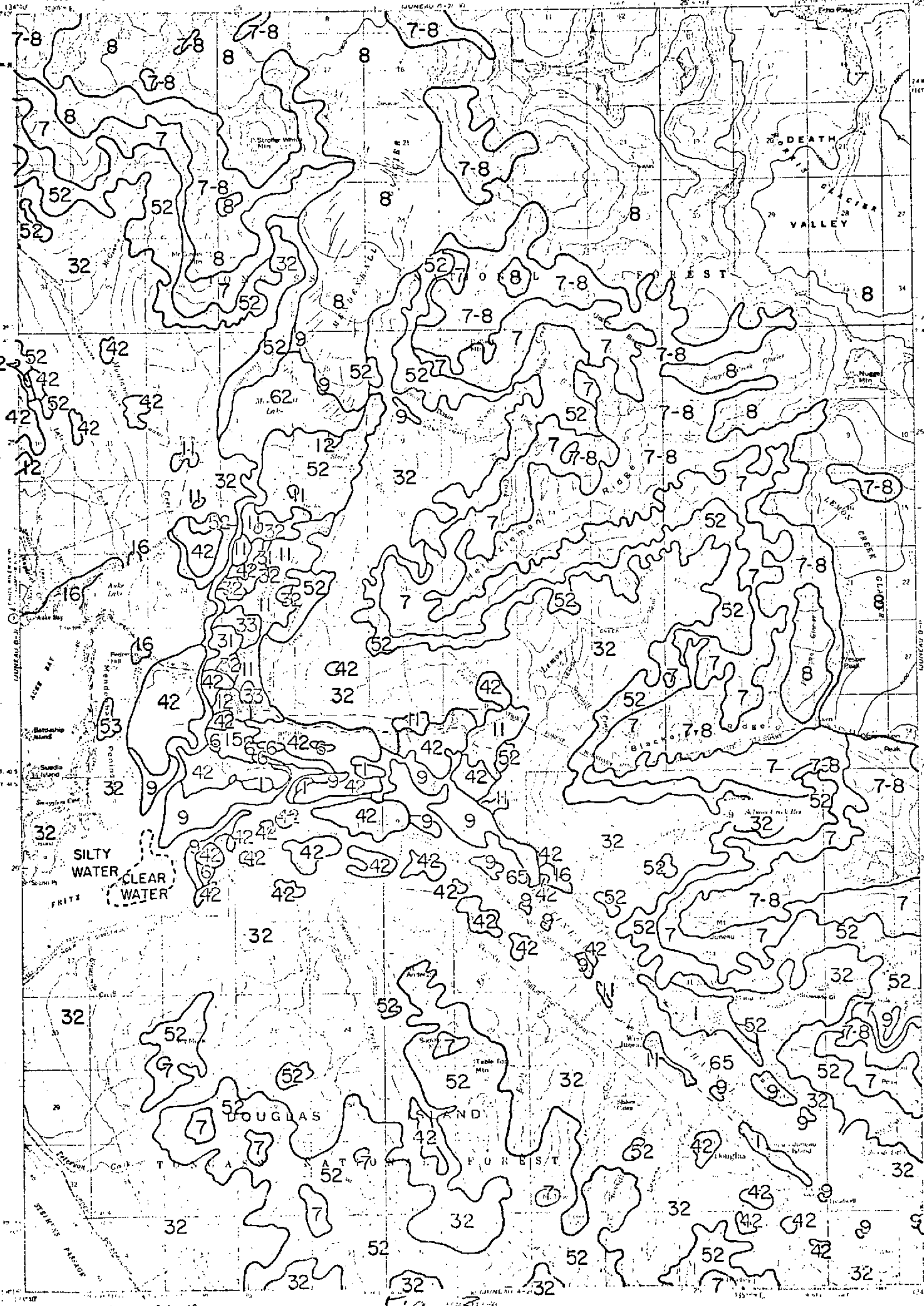


Fig. 3

Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS

TABLE 2. Symbols for vegetation types and other features depicted on land-use maps of the Juneau area (Fig. 3) and the Bonanza Creek Experimental Forest and vicinity (Fig. 4). Levels I and II are from the October 1973 Tentative Proposed Revisions of the 1972 publication A land-use classification system for use with remote sensor data, U.S. Geological Survey Circular 671, by J. R. Anderson. Level III classes are original. Only symbols for features on these maps are listed.

LEVEL I	LEVEL II	LEVEL III
1. Urban and built up land	1. Residential	
	2. Commercial and services	
	4. Extractive[1]	
	5. Transportation, communication and utilities	
	6. Mixed, including strip and other settlement	
	7. Open and other	
3. Forest land	1. Deciduous	
	2. Evergreen	
	3. Mixed	
4. Wetland	1. Forested	1. Deciduous
		2. Evergreen
		3. Mixed
	2. Non-forested	H. Dominated by herbaceous plants and low shrubs
		S. Domonated by shrubs
5. Rangeland[2]	1. Herbaceous	
	2. Shrub-brushland	
	3. Mixed	
6. Water	1. Streams	
	2. Lakes	
	3. Reservoirs	
	4. Bays and estuaries	
	5. Other	
7. Tundra		
8. Permanent snow, icefields and glaciers[3]		
9. Barren	7. Other	8. Recent severe burn

[1] Interpreted here to include logging.

[2] Applied here to upland shrub-dominated vegetation types, including the extensive subalpine scrub in the Juneau area.

[3] May also include nunataks and lesser bedrock outcrops.

Hyphenated symbols, e.g. 7-8; 42-411, designate mosaics of two classes of map units too small to map individually. The apparently more important class is placed first.

applied here for the first time by this investigator. It seems suitable and relatively straightforward in application, at least at levels I and II. It was also used for the next map (Fig. 4), and may be used in much if not all subsequent mapping on this project. Discussion with other investigators who have attempted to apply it is desired, however. Table 2 lists the classes depicted on these maps. Level III classes are original, established to accommodate map units for which a finer interpretation seemed possible.

The procedure for producing this and the next map, under development for some time, is as follows:

a. Obtain 9 1/2-inch color-infrared transparencies (Product Type B) of the scene covering the area of interest (from NASA or the Sioux Falls EROS Data Center, or have it reconstituted locally). Of the several possible scenes, the best should be selected for mapping, and others may be obtained, particularly those showing different seasonal aspects, as aids in interpretation.

b. Mark the area to be enlarged and submit the transparency to the photo lab for color printing at the specified scale.

An enlargement to 1:63,360 to encompass the area of a standard U.S. Geological Survey quadrangle in Alaska, say 14" x 18" (they vary), may be made from an approximately 1" x 1 1/4" portion of the 1:1,000,000 ERTS scene.

c. Provide the photo processor with the quadrangle or other item to be used as the base map. He may use this on the enlarger easel to obtain the best possible fit of the image by matching landmarks such as lakes, roads and other easily detected features not likely to have changed, or whose change would be known, between map preparation and ERTS data acquisition.

d. Cut a clear, transparent sheet of some material suitable for drawing on to fit the map area. Place this over the base map and trace several widely spaced landmarks easily seen on both the map and the ERTS photo image.

e. Place the transparent sheet over the ERTS image on the drawing board, match the landmarks, and fasten it in place. Proceed with delineating vegetation stands and other landscape features according to the classification system being applied.

f. When the base map and the ERTS image cannot be matched over the entire area, subdivide the transparent sheet into blocks by drawing lines across it. Nine blocks (three across and vertically) may be sufficient for all but the worst of fits, when a zoom transfer scope might better be used (i.e. trace all units onto the transparent sheet and use this in the scope, not the ERTS picture, which would be difficult adequately to interpret without the strong, direct light and unobstructed view possible over the drawing board).

With the Juneau map, the B-2 quadrangle and the enlarged ERTS photo matched almost perfectly throughout, even though the technique of step c was omitted. (The photo processor applied a calculated enlargement factor instead. This may be risky because of possible, though slight deviations from the nominal scale of the 9 1/2" ERTS scenes and other obvious sources of error.) With the next map, the fit was off by an estimated one-half km at farthest removed points in the map area. Here the nine block technique was applied. Using landmarks within a block, the best possible fit here was obtained. The block area was mapped, and then the transparent sheet was shifted slightly for aligning landmarks in the next block. Only slight fudging of lines across block boundaries was necessary.

g. Using all available materials, information and powers of ecological judgement, interpret the map units as they are delineated from the ERTS image and mark the appropriate symbols on the transparent sheet. Do not simply outline colors, patterns or textures with the hope of indentifying them later. Colors (spectral signatures) tend to vary across the larger stands of vegetation, particularly at the broader levels of classification, e.g. levels I and II of the system used here. Most notably, there is a uniform darkening and possibly a shift toward the blue across all signatures with decrease in sun angle, as on north slopes in contrast to south slopes. There is, of course, often a vegetation change with slope change, but there often is not such a change as to result in a significant change in spectral reflectance were the lighting more uniform.

Physiographic position is therefore of major importance for evaluating spectral characteristics and ecological conditions. This can be determined by referring constantly to the topographic map. In addition, all available aerial photographs should be spread out close at hand and part of the scene covered by these mapped first. All units delineated here can be checked against the photos, and these units may then serve as the basis of identifications across the rest of the map area.

Where the new signature is found outside the area covered by the air photos or other information, a field trip may be necessary.

h. When the map units have been traced onto the transparent sheet and labeled, place this on a light table and position the base map over it, using the common landmarks delineated earlier. Trace the map units onto the base map. This should also be done by the investigator, as the finished transparent sheet may be rather messy, and interpretations have still to be made. Symbols may be hand lettered. The map in Figure 4 is at this stage.

This map and a clean copy of the base map may then be given to a professional draftsman who may trace the final version over a light table and do the lettering.

With the block technique, shifting is necessary only with the transparent sheet over the ERTS image. Because reference landmarks were selected off the map in the first place, the finished transparent sheet will fit the map directly.

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5. As a small, extramural exercise, the ERTS images used in making the Juneau area map were applied to the problem of determining changes in the surface areas of the terminal zones of advancing and receding glaciers. Three prominent glaciers, the Mendenhall, Taku and Norris, were measured by planimetry on the topographic maps of 1952 and 1962 and the 1972 ERTS scene. The results are given in Table 3.

It would be impossible to measure the surface area of an entire glacier, at least on the complex Juneau Icefield, because of blending with late lying and perennial snow at higher elevations and the many joinings with tributary and distributary glaciers and other ice bodies. Only the spatially distinct terminal zone can accurately be delineated. In this exercise, the upper limit of this zone was set by drawing a line across the glacier between two stationary points, such as peaks and small lakes, that could be discerned on the map and the image. Hence the actual surface measurements given here have little meaning, but the changes may be of some interest. However, these may be hard to interpret relative to overall glacier activity and the activity of other glaciers.

Nevertheless, this exercise indicates a potential for the useful study of glacier terminus changes through use of ERTS imagery. The enlarged and thereby easily measured photograph is a key feature of the technique. Such prints (black and white would do as well) could readily be obtained for most glaciated places, as throughout south-east and south-central coastal Alaska, the Alaska Range, etc. With future satellite imagery, glacier fluctuations could be inventoried periodically. The somewhat arbitrary line across a glacier defining the terminal, measured zone would then be more meaningful as a permanent reference.

6. A new 1:63,360 scale land-use map of the Bonanza Creek Experimental Forest and vicinity (Test Area 5) was produced, using U.S. Geological Survey quadrangles as base maps. Whereas its professional drafting and labeling is yet to be done (scheduled for the week of December 17), the map's penultimate form is presented (Fig. 4) in reduced and degraded form. This map employs the same classification system as the Juneau area map (Fig. 3).

The method of producing this map was described under 4, above, and the map units may be understood through reference to Table 2.

TABLE 3. Glacier terminal zone surface areas measured on earlier U.S. Geological Survey topographic maps (Juneau B-1 and B-2 quadrangles) and the 1972 ERTS scene, 1019-19430, enlarged to map scale, 1:63,360. Data are averages of several planimeter measurements selected from a larger number for negligible deviation. The upper limit of the measured zone is explained in the text.

GLACIER	AREA, km^2		
	1962 Map	1972 ERTS	Change
Mendenhall	9.45	7.90	-1.55
	1952 Map		
Taku	15.55	24.94	+9.39
Norris	7.11	6.68	-0.43

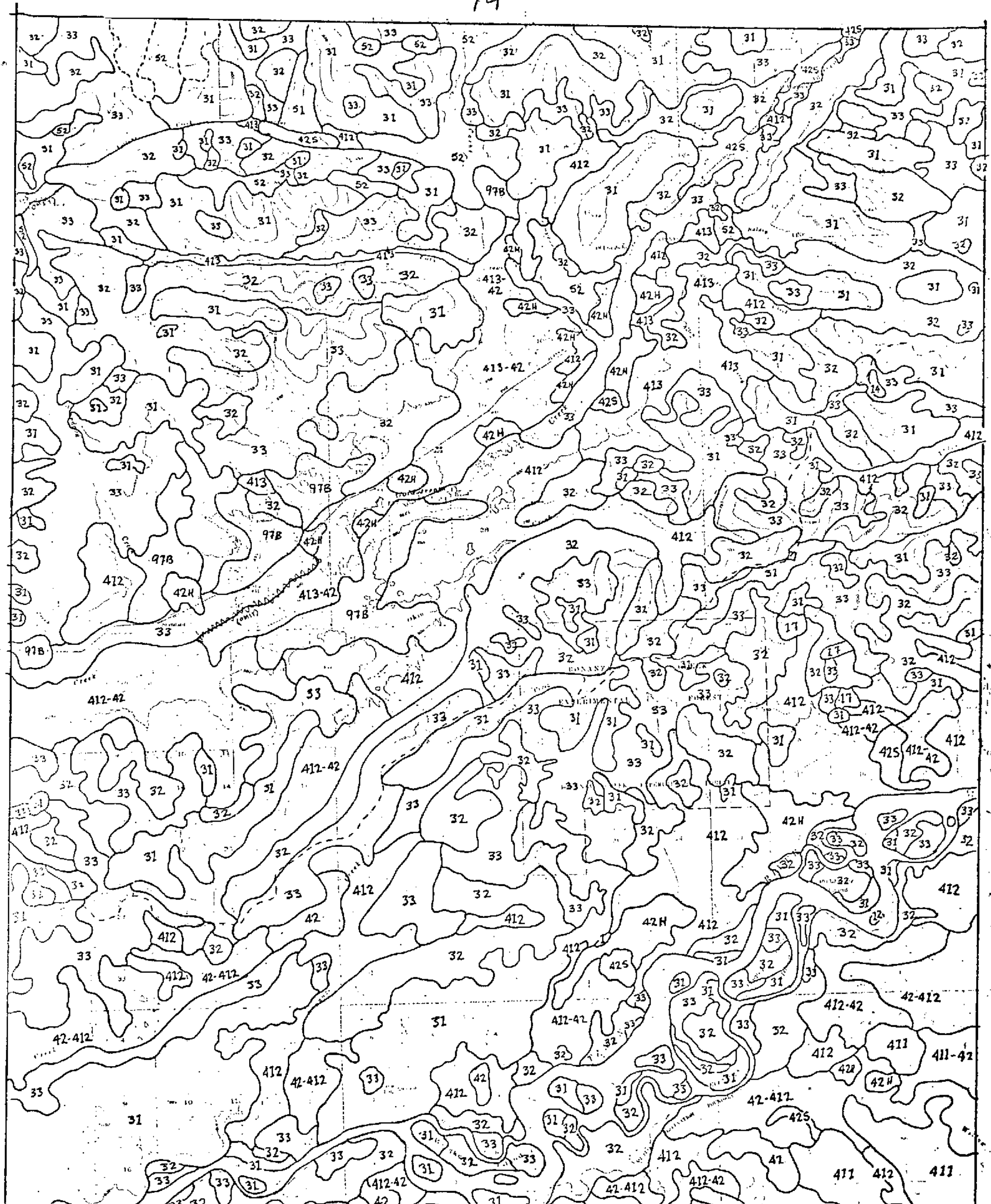

Fig. 4

7. Several excellent new scenes of test areas were received from NASA in color-infrared format. These are being used for making photographic prints for analysis and mapping according to the procedure outline under 4, above. As of this writing, the following 16 x 20" color photo prints have been produced through the photographic services coordinated by Project 110-1:

Fairbanks D-2 map area, Test Area 5, 1:63,360;
ERTS scene 1374-20552

Wiseman area, Test Area 8, 1:250,000:
ERTS scene 1017-21115

Galbraith Lake area, Test Area 10, 1:63,360 and 1:250,000;
ERTS scene 1376-21060

Soon to be finished are:

Fairbanks area, 1:250,000

Prudhoe Bay area, Test Area 12, 1:63,360 and 1:250,000;
ERTS scene 1344-21283

PUBLICATIONS:

In press:

Anderson, J. H. 1973. A vegetation map of an area near Fairbanks, Alaska, based on an ERTS-1 image. Proceedings of the 24th Alaska Science Conference.

In preparations:

Anderson, J. H. Vegetation types of the Fairbanks, Alaska area as identified on ERTS imagery. For Photo-Interpretation.

RECOMMENDATIONS: None.

Note: The quick service, one month, on a recent order for color products is greatly appreciated.

REVISED STANDING ORDERS: None.

IMAGE DESCRIPTOR FORMS: None.

With the termination of our standing order, no new scenes have been received.

DATA REQUESTS: October 1, 1973 - Received.

November 1, 1973 - Received.

EIGHTH BI-MONTHLY PROGRESS REPORT
University of Alaska
ERTS-1 Project 110-3
November 30, 1973

TITLE OF INVESTIGATION: Identification, definition and mapping of terrestrial ecosystems in interior Alaska

PRINCIPAL INVESTIGATOR: J. H. Anderson. UN 592

DISCIPLINE: Environment

SUBDISCIPLINE: Other: Vegetation analysis, mapping and phenology

SUMMARY OF SIGNIFICANT RESULTS:

The vegetation map in preparation at the time of the last report (Seventh Bi-Monthly Progress Report, September 30, 1973, p 1-2) was refined and labeled. This map, though not professionally finished, is presented (Fig. 1) as an indication of the spatial and classificatory detail possible from interpretations of enlarged ERTS color photographs.

Using this map, areas covered by the several vegetation types characterized by white spruce as the leading component were determined by planimetry (Table 1).

A 15-page paper dealing with preparation of a 1:250,000 scale vegetation map of the same area was submitted for publication, including the map shown here in reduced and degraded form.(Fig. 2) (cf p 12, Second Semiannual Report, July 31, 1973).

A 1:63,360 scale land-use map of the Juneau area was drawn, using the Juneau B-2 quadrangle as a base map. It is presented here in reduced and degraded form (Fig. 3). This map incorporates the land-use classification system now under development by the U.S. Geological Survey (Table 2).

The ERTS images used in making the Juneau area map were used to determine changes in surface area of the terminal zones of advancing and receding glaciers, the Taku, Norris and Mendenhall (Table 3).

A new 1:63,360 scale land-use map of the Bonanza Creek Experimental Forest and vicinity was drawn, using U.S. Geological Survey quadrangles as base maps. Whereas its professional drafting and labeling is yet to be done, the map's penultimate form is presented (Fig. 4), again in reduced and degraded form for want of a better means of reproduction than Xeroxing. This map uses the same classification system as the Juneau area map.

Several excellent new scenes of test areas were received from NASA in color-infrared transparency format. These are being used for making photographic prints for analysis and mapping according to the procedure outlined in detail in this report on pages 10-12.