



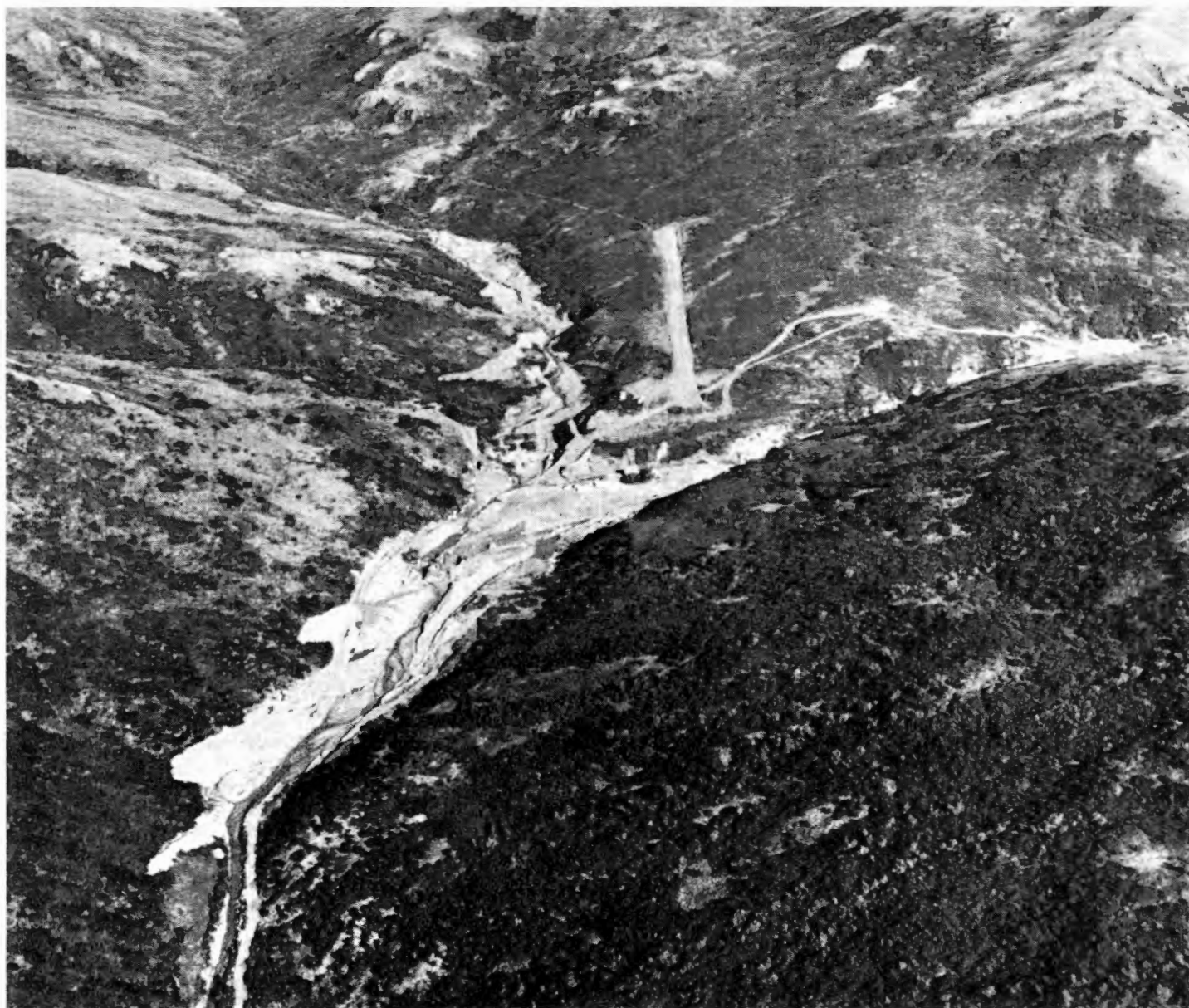
PARK SCIENCE

A RESOURCE MANAGEMENT BULLETIN

NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR

VOLUME 6 – NUMBER 2

WINTER 1986



Cover Photo:

Surface disturbance associated with placer mining in the Glen Creek mining area. Tall shrub scrub cover type adjoins areas of surface disturbance in stream drainage. (NPS photo)

Aerial Photos of Land Cover Types Aid Denali Mining Impact Analysis

By Steven Hunt, Budd Titlow, Ralph Root, John Dennis and Garry Waggoner

The Alaska National Interest Lands Conservation Act (ANILCA), enacted on Dec. 2, 1980, established new, and extended existing, conservation system units in Alaska managed by the National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management, and U.S. Forest Service. Among other provisions, the act expanded Mount McKinley National Park and redesignated it as Denali National Park and Preserve to take in the entire mountain massif and protect habitat for wildlife and fish populations on 6 million acres of federal lands.

Additionally, ANILCA withdrew federal lands within National Park System units from the U.S. mining laws, subject to valid existing rights; 317 such claims exist within the Kantishna Hills portion of Denali NP, north of the Alaska Range; another 151 claims are concentrated in the Dunkle Mine area of the park, south of the Alaska Range. ANILCA provided specific direction with respect to these claims by requiring a study of park and mineral resource values for both areas, including the environmental consequences of further mineral development.

In 1982, the Kantishna Hills Dunkle Mine study group, consisting of three state and four federal agencies, was created to prepare the required study report. This study group conducted field investigations in 1982 and 1983 on geology, mining history, mineral resources, water quality, fish populations and aquatic habitat, salmon spawning, historic resources, wilderness potential, recreational use, wildlife habitat, and large mammal populations, including the Denali caribou herd.

Due to the considerable potential for further mineral development to cause significant effects on the natural and human environment, the task assignment included preparation of a technically adequate EIS. The National Park Service was made the lead agency for preparing this EIS, and the Environmental Assessment Branch of the NPS Energy, Mining and Minerals Division was given responsibility for producing it. Preparation began in March 1983 and ended in December 1984.

This article describes a project initiated by the authors in 1983 to identify and map the vegetation and land cover types present in the two areas – Kantishna Hills and Dunkle Mine. The mapped vegetation and land cover types were analyzed relative to existing and future mining locations and the findings were used in the EIS analysis to evaluate alternative management options ranging from mineral development to park resource protection in both study areas. The overall purpose was to provide an adequate technical basis for analyzing environmental consequences and enhancing use of the EIS for informed decision-making.

The Kantishna Hills study area, 194,968 acres, lies

near Wonder Lake in the north central portion of the park in rugged, low lying hills. The Dunkle Mine study area, 22,841 acres, lies along the park's east boundary, south of the Alaska Range near Broad Pass and east of the West Fork of the Chulitna River. (Fig. 1)

Development of Vegetation Classes. The vegetation/land cover classification system adopted for the study had to reflect the following factors and constraints:

1. The purpose of the vegetation maps was to provide quantitative data on vegetation and cover types within the study areas relative to existing and future mining locations.

2. Existing aerial photographs had to be used and no on-the-ground checking of vegetation and land cover types was possible.

3. Because of gaps in coverage, both color infrared (CIR) and black-and-white (BW) photos had to be used.

4. Calculations of the aerial extent of each mapping class had to be available within 4 weeks after the project started.

5. Project team members lacked detailed on-the-ground knowledge of vegetation types at one or both study areas.

6. Choice of mapping classes had to reflect a general approach to reduce complexity, minimize the difference between interpreters, and maximize overall accuracy.

The project team considered using an existing system (*A Preliminary Classification System for Vegetation of Alaska* by Viereck and Dyrness, revised as of 1982), but inspection of this system, plus the limiting factors listed above, led the team to develop a hybridized system that contained 15 vegetation and land cover classes and included three levels of density for

forest cover and three shrub classes. After reviewing a large number of ground and low altitude 35mm color photographs and attempting to interpret them for portions of the study area, the team members found that even this system was too complex and highly detailed to permit accurate and consistent mapping. At this point the team worked out a new system with fewer classes and a more generalized approach.

The new system, with 10 classes, contained only two classes of forest, two classes of shrubs, and six other classes. These ten cover classes included:

1. **Floodplain forest:** A tall forest of both coniferous and hardwood tree species with crown cover of 25 percent or more, generally restricted to drainages within the study area.

2. **Upland forest:** A medium to low stature forest on upland sites with a total crown cover of 25 percent or more.

3. **Tall shrub scrub:** This cover type is limited to shrubs with heights exceeding 5 feet and crown cover exceeding 25 percent. It occurs from drainage bottoms to near timberline, often mixed with a lower stature, open shrubland.

4. **Low shrub scrub:** This consists primarily of low shrubs (less than 5 feet tall) and open areas covered with grasses and sedges – abundant on slopes and benches throughout the area.

5. **Alpine tundra:** This mapping unit occurs usually above 3000 feet throughout the study areas. Bare rock and soil are intermixed with a thin layer of lichens, dwarf shrubs, forbs, and grasslike plants.

6. **Floodplain barren:** Active stream floodplains where flooding occurs frequently and nonvegetated or sparsely vegetated alluvium (less than 25 percent cover) predominates.

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Table 1: Summary of Study Area Vegetation and Land Cover Types

Class	Study Area Vegetation Types (acres – percent)	
	Kantishna Hills	Dunkle Mine
Floodplain Forest	4,978 (2.6)	87 (0.4)
Upland Forest	46,792 (24.0)	1,256 (5.5)
Tall Shrub Scrub	40,500 (20.8)	11,650 (51.5)
Low Shrub Scrub	71,113 (36.5)	9,312 (40.8)
Alpine Tundra	29,752 (15.3)	57 (0.3)
Floodplain Barren	396 (0.2)	316 (1.4)
Upland Barren	158 (0.1)	—
Altered	468 (0.2)	23 (0.1)
Fire Scar	809 (0.4)	—
Water	—	139 (0.6)
Total Area	194,968 (100.0)	22,841 (100.0)

7. **Upland barren:** This includes bare rock outcrops, talus, colluvium, and bare soil (all naturally occurring) with overall cover less than 25 percent vegetation.

8. **Altered:** This mapping unit describes areas where vegetation has been stripped by human action and less than 25 percent vegetative cover is left. It is most common within floodplains along drainages where placer mining has occurred.

9. **Fire scar:** This cover type represents areas showing on the photos as recently burned, regardless of original cover types. Mapping this ephemeral type in certain locations does not imply that historic burns are limited to these areas.

This project involved three phases of data development: (1) photo interpretation, (2) transferring information to a base map, and (3) area determinations of vegetation and land cover types.

Interpretation of Aerial Photographs. Successive pairs of overlapping photos ("stereo pairs") were

set up and viewed through stereoscopes, thereby creating a three dimensional model of topography and surface throughout the study area. Cover type boundaries were drawn on one photograph "member" of each stereo pair. Each completed photograph then was matched with adjoining photos to ensure consistency of interpretation. In some cases, minor adjustments were necessary to match exactly interpretive patterns from photo to photo. This adjustment was especially important, since interpretation is a somewhat subjective procedure and, at various times, four different interpreters were working on the project. This process was repeated for successive stereo pairs and flight lines until land cover interpretation had been completed for both study areas. During the process of interpretation, each interpreter frequently compared his work with the other interpreters on the project to assure uniformity. The relative consistency between

interpreters was confirmed by the minimal amount of adjustment that was required where the work of two interpreters merged.

The Kantishna Hills area interpretation required use of three flight lines of aerial photos. Two consisted of CIR photos taken August 1981 at a scale of about 1:60,000; the third flight consisted of BW photos taken July 1951 at approximately 1:52,000. The scale variation between the flight lines required an adjustment in the size of the minimum mapping unit (which was the smallest acreage that, by common agreement, could be considered a distinct vegetation type). It also necessitated some extra work in matching sidelay interpretation. The Dunkle Mine area was covered entirely by one flight line of CIR photos (July 1980, 1:60,000).

Transferring Vegetation and Land Cover Data.

The next step involved transferring to a suitable base map the land cover information drawn on the aerial photos. In this case, the interpreted data were drawn onto a series of U.S. Geological Survey 1:63,360 quadrangle map sheets, using a Bausch and Lomb stereo zoom transfer scope. Preliminary transfer was made to paper copies and final transfer went on a stable base mylar format of the 1:63,360 quad maps.

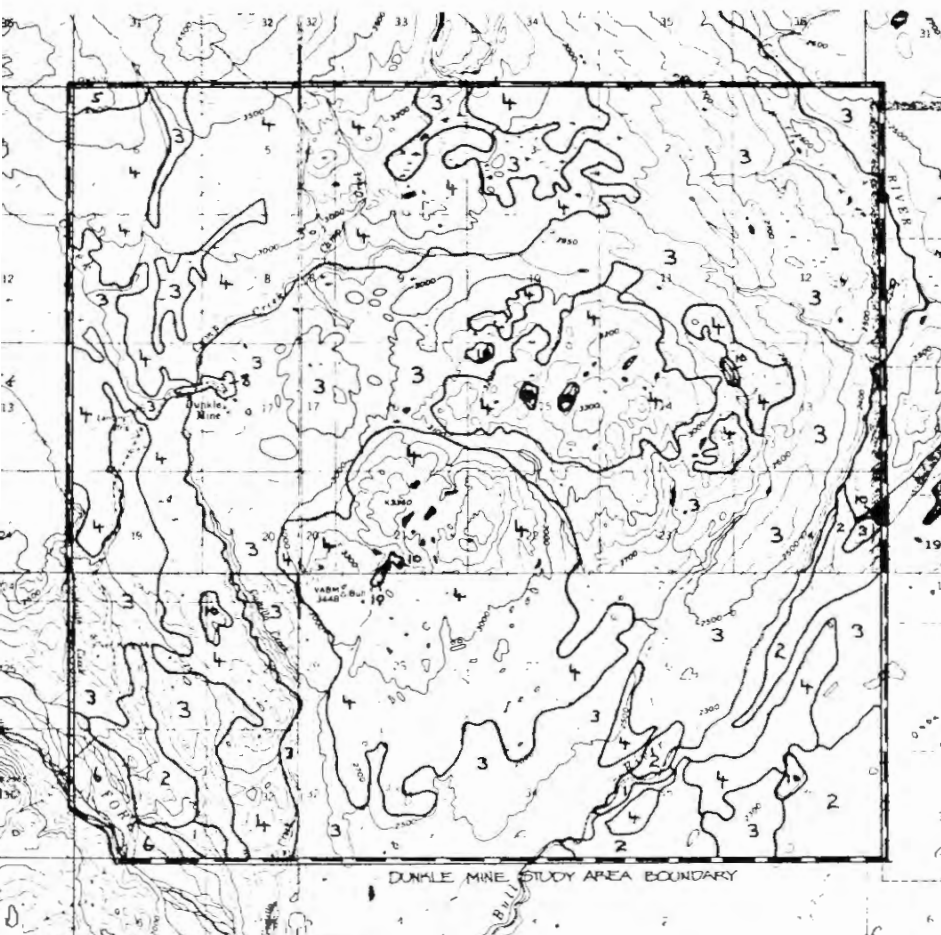
Determining the Area of Vegetation and Land Cover Types. The total acreages of all vegetation and land cover categories found in each study area were calculated using a Talos digitizing tablet coupled to a Tektronik 4054 computer terminal. The calculation results are shown in Table 1.

Results and Discussion

In the Kantishna Hill study area, the commonest cover type is low shrub scrub (Table 1). Upland forest and tall shrub scrub are prevalent too. Floodplain forest is present in smaller amounts, while remaining cover types are much less common. In the Dunkle Mine area, tall shrub scrub is most prevalent, followed by low shrub scrub; forest types are less common than in the Kantishna Hills. In both areas, altered land cover is the least common class of all surface cover types.

The vegetation and land cover classes developed for these areas are generalized, compared to other vegetation classifications used in Alaska. However, the resulting maps provide greater detail than any

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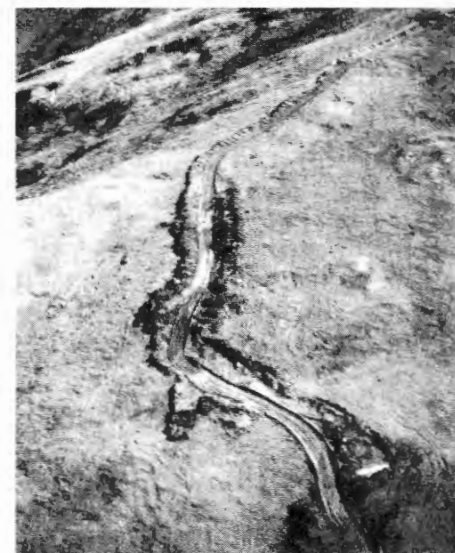
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FIGURE 2 Land Cover Types in Dunkle Mine Region

Denali National Park and Preserve
United States Department of the Interior / National Park Service

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DEC 1982

- 1 FLOODPLAIN FOREST
- 2 UPLAND FOREST
- 3 TALL SHRUB SCRUB
- 4 LOW SHRUB SCRUB
- 5 ALPINE TUNDRA
- 6 FLOODPLAIN BARREN
- 8 ALTERED
- 10 WATER



Mining Access Road developed across alpine tundra cover type is shown in this NPS aerial photograph.

(Continued)

other known maps of the study areas, and met the need for estimating quantitatively how much of each land cover type would be affected by each land use alternative considered in the EIS.

Although this approach was generalized, because of the abbreviated project deadlines and the inability of the study team to make onsite verifications, it did provide sufficient discriminative ability to show, for example, that placer mining in the Kantishna area would occur disproportionately in the floodplain forest cover type (3% of the Kantishna study area, 12% of which would be affected) and in the tall shrub scrub covering 21 percent of the Kantishna study area, 6 percent of which would be affected.

Summary

The vegetation maps produced from this study provide sufficient detail to make the general calculations and comparisons of cover types needed for quantitative evaluations of the impacts that could be expected from various mining program alternatives. However, because of the generalized nature of the cover types and the lack of ground truthing, the maps are not suitable for use in detailed wildlife habitat surveys, plant ecology studies, or other more specialized uses.

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