

ANALYSIS OF STATE OF VEHICULAR SCARS ON ARCTIC TUNDRA, ALASKA

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ABSTRACT

Identification on ERTS images of severe vehicular scars in the northern Alaska tundra suggests that, if such scars are of an intensity or have spread to a dimension such that they can be resolved by ERTS sensors (> 20 meters), they can be identified and their state monitored by the use of ERTS images. Field review of the state of vehicular scars in the Umiat area indicates that all are revegetating at varying rates and are approaching a stable state.

INTRODUCTION

Umiat, Alaska was the hub of intense vehicular activity during the exploration of Naval Petroleum Reserve No. 4 in the period 1945 to 1952. It has since been used, though less intensively, by private industry as a staging area for petroleum exploration of sites outside the reserve.

Much concern has been expressed over the permanency of scars to the tundra resulting from damage to insulating vegetation and disturbance of the underlying permafrost brought on by such vehicular traffic. The more extreme conjectures purport that such scars will never heal and will spread unchecked.

Preliminary examination of ERTS-1 image 1004-21395 (taken in 1972), which covers the area around Umiat (fig. 1), revealed no trace of scars resulting from this activity (W. A. Fischer, *in* Lathram, Tailleux, Patton and Fischer, 1973, p. 38). Because ERTS sensors lack the resolving power (> 20 meters) required to recognize features as narrow as these tracks were originally, Fischer observed "This does not mean that the scars are gone, for I am confident they are not wholly healed and could be observed on the ground or from a low-flying plane, but it does mean that they are not spreading like cancer, as some purport, over the northern tundra." Subsequent study of this image under the microscope at enlargements up to 1:80,000 revealed that a scar on the ridge north of Umiat can be identified on Band 5 (reflected red light) images of the area.

During the summer of 1973, Robert L. Detterman, Geologist, U.S. Geological Survey, accompanied by John Koranda, Botanist, Lawrence Livermore Laboratory, made a one-day review of the status of the scars in this area. The area surrounding Umiat, in the eastern part of image 1004-21395, and to the east beyond its borders was examined from the air and on the ground. Weather prevented observations in the western part of the image area and was generally poor, with a ceiling of 100 feet and visibility of one-fourth mile, which also reduced the quality of illustrative photography. Comments herein that refer to the surface state of scars are based on the observations of Detterman and Koranda.

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During the planning, a report of a similar field study by the Bureau of Land Management in 1969 (Hok, 1969) was utilized, and it was possible to revisit areas previously studied for comparison and recognition of changes that had occurred over the intervening four years.

DISCUSSION

All scars observed in the Umiat area are being revegetated at varying rates depending on the nature, degree and age of the disturbance or are approaching a stable state. At all places where sites studied by Hok were re-examined, revegetation had proceeded further in the intervening four years.

The extent of scarring depends, as Hok found, on the season of occurrence, substrate (particularly with respect to water content, i.e., ice-wedge occurrence), degree of vegetation removal, and slope. Trails made by small tracked vehicles such as weasels and bombardiers have left little trace. LVT trails are most intensely scarred. Cat-tracks, with little or no blading, and used only in winter, do not cause extensive scars.

The scars presently visible from the air will remain visible from the air for a few years after the physical effects of the disturbance have been healed (fig. 2). The principal indicator of trails is the presence of grasses in the tracks that are not present in surrounding terranes, giving the tracks a greener appearance. Old trails are difficult to see on the ground at present and in 5 to 10 years will probably not be visible on the ground (fig. 3).

On lightly bladed trails in which only the tops of the tussocks were removed, while the rhizomes were left intact, growth is resuming in the original tussocks, and they will attain their original size in four to five years.

Trails crossing ice-rich lowlands that have been heavily bladed are assuming the appearance of the beaded stream prevalent in the tundra, a linear vegetated depression with irregularly spaced water-filled potholes up to 6 feet where an ice wedge was exposed (fig. 4). The beaded lakes will probably enlarge to the size of the ice wedges exposed, but interlake parts of the trails are not becoming wider, and the trails are approaching a stable state.

Although vegetal damage along trails in ice-poor soils is slightly wider than the original vehicle track, this damage is not propagating, i.e., the trails are not becoming wider.

Hok noted one site near the Colorado Oil and Gas Company Gubik test well, where a bladed trail made since 1960 crossed a 10° slope in ice-poor silt. Re-examination in 1973 shows increased revegetation of the main scar (fig. 5, compare with Hok, 1969, photographs 29 and 32), increased revegetation of part of the silted area at the foot of the slope (Hok, 1969, photograph 30), and little active siltation at present, indicating a reduction and early cessation of active erosion.

The most striking example of scarring, which Hok apparently did not visit, occurs on the ridge north of Umiat. Here a heavily used cat trail, bladed bare of vegetation, leads up a 10° slope to the site of several drill holes. Not only was the trail bladed, but it was also used summer and winter during the 1945 to 1952 period and crosses the exposed area of a bentonitic shale formation. The trail has spread to a depression on the slope about 150' wide and up to 15' deep (fig. 6). This is the scar noted on Band 5 ERTS images of the Umiat area. Here, revegetation is proceeding, with felt-leaf willow, equisetum, and a grass (stipa) not noted elsewhere, indicating the onset of healing, although much more slowly than elsewhere.

Study is continuing of images of this area and that to the south and east where exploration activity has occurred since 1960. Preliminary results indicate that younger scars may be more apparent on ERTS images than the older scars in the Umiat area. To date these studies have all been visual inspection of imagery. No attempt has been made yet to employ computer enhancement techniques to identify less severe scars or changes in scars.

CONCLUSIONS

The recognition of the scar north of Umiat on ERTS images indicates that if scars are large enough, or if they spread sufficiently to be resolved by ERTS sensors they can be recognized by use of ERTS data. Preliminary results of study of other images suggest that ERTS imagery can be used to identify young severe scars and monitor their healing.

REFERENCES

- Hok, J. R., 1969, A reconnaissance of tractor trails and related phenomena on the North Slope of Alaska: U.S. Dept. of Interior - Bur. Land Management, 65 p.
- Lathram, E. H., Tailleux, I. L., Patton, W. W., Jr., and Fischer, W. A., (in press), Preliminary geologic application of ERTS imagery in Alaska, in Symposium on significant results obtained from Earth Resources Technology Satellite-1: Nat. Aeronaut. Space Adm., Spec. Pub. SP-327, v. II, p. 31-38.

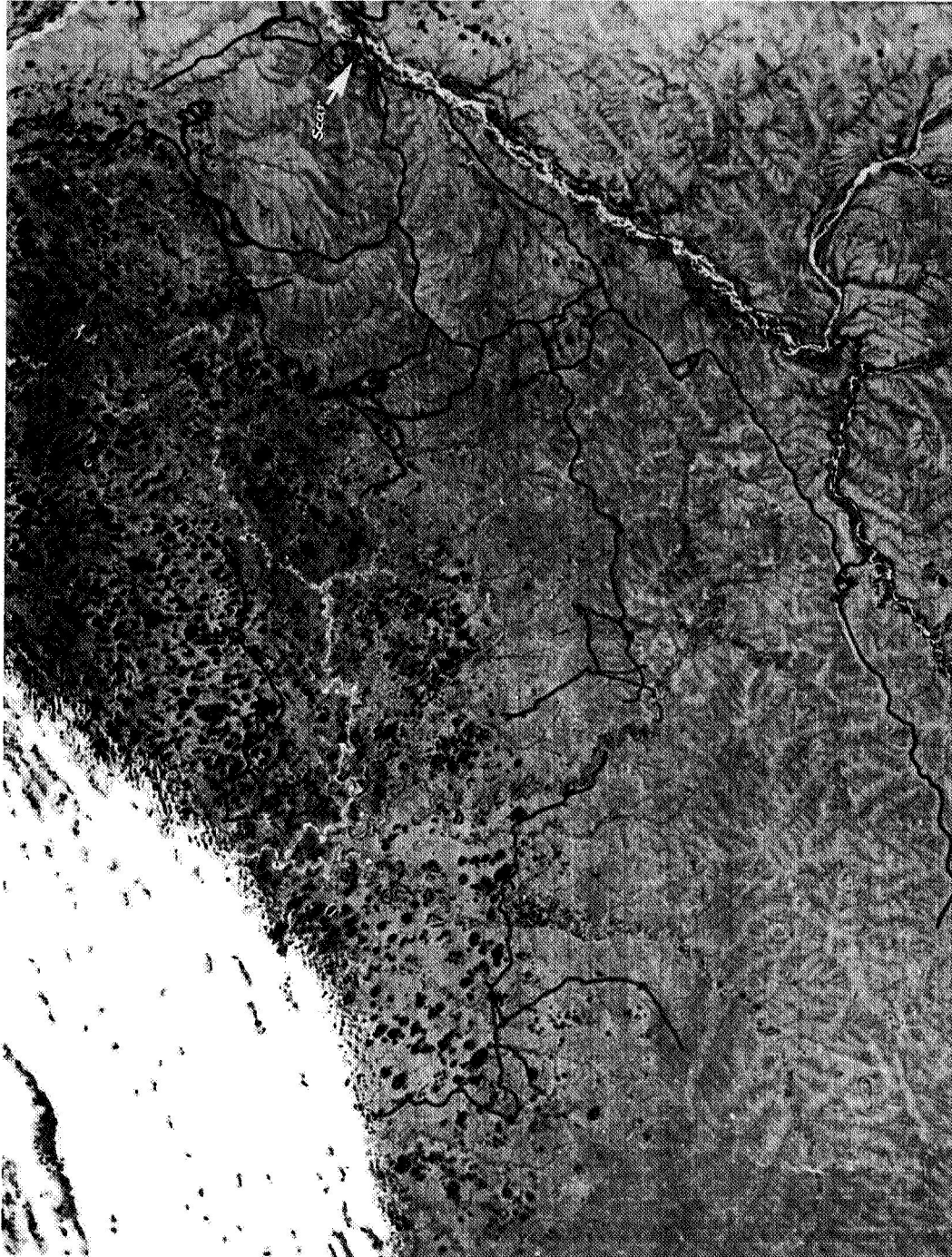


Figure 1 Known trails in the Umiat area.
Arrow shows location of scar visible on band 5 image of ERTS-1 scene 1004-21395.



Figure 2. Old trails on hills near Umiat.



Figure 3. Old trail in ice-poor soil near Umiat seen from ground.

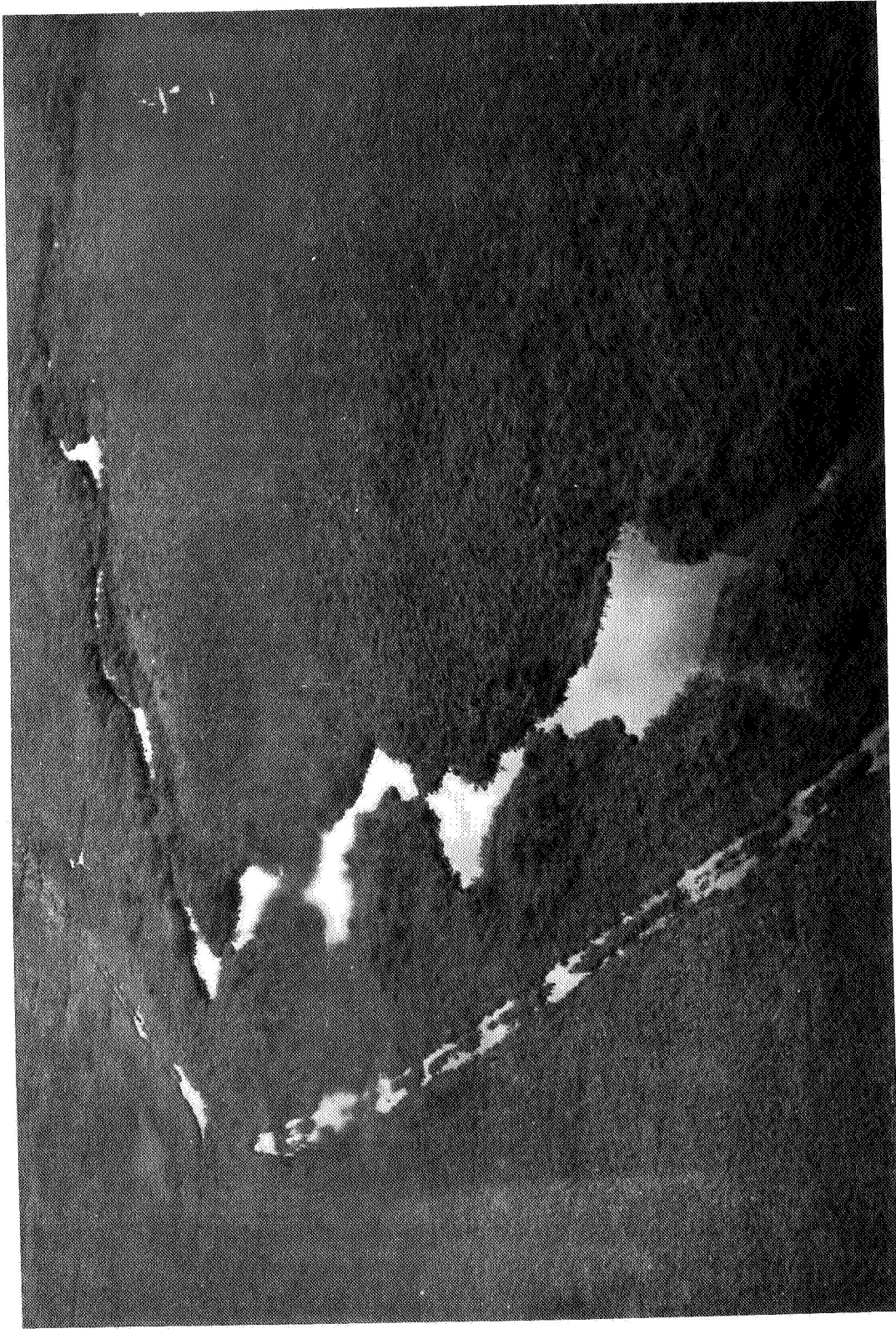


Figure 4. Trail across ice-rich lowlands assuming appearance of beaded stream on right.



Figure 5. Scar formed by more recent activity than 1952



Figure 6. Severe scar on ridge north of Umiat.