C REINDEER RANGES INVENTORY IN WESTERN ALASKA

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Introduction

Range surveys using Landsat data have been in progress on the tundra of Northwest Alaska since 1976. The goal of these projects, sponsored by the Soil Conservation Service (SCS), and the Bureau of Land Management (BLM), is to map the range resource and estimate plant productivity of the Seward Peninsula, an area roughly 6.5 million hectares in size.

Information derived from these surveys is needed by SCS to develop range management plans for reindeer herding and for use by BLM to evaluate potential conflicting use between reindeer and caribou.

Background

Reindeer herding has been practiced in Western Alaska since a small herd was introduced from Siberia in the late 1800s. The industry has enjoyed a colorful history involving a dramatic increase in herd size in the 1930s followed by a crash and slow recovery leading to the present population of approximately 30,000 reindeer.

Recent interest by a regional native corporation to increase herd size for commercial production has resulted in the present inventory projects, to provide information for more intensive management.

The proposed expansion of herd size has raised the possibility of conflicting range use between reindeer and the Western Artic caribou herd, which overwinters near the east edge of the Seward Peninsula. BLM is examining this potential conflict to determine appropriate management procedures of the range resources.

Inventory Process

The large size and remote location of these ranges, coupled with the lack of surface transportation for conventional range survey, caused SCS to explore the use of new tools for inventory. Consequently, the University of Alaska has participated in the inventory program to develop techniques using remote sensing data, primarily computer analysis of Landsat digital data.

As might be expected of developmental projects, the procedures have evolved through time. A brief description of the approach used during the first project and subsequent modifications should help illustrate the present situation and the problems yet to be solved to use Landsat data as a tool for range inventory on the tundra.

1976 Project

Our first project was to inventory 4 ranges on the Northern Seward Peninsula, covering approximately 1.6 million hectares. An unsupervised classification was performed on portions of three Landsat scenes using ESLs IDIMS system. The unsupervised approach was selected since we had no aerial photography or field reference data for the area. Spectral classes defined during the analysis were grouped into tentative resource categories using a COMTOL display and color products produced where each resource category was represented as a discrete color.

During the summer of 1976, a range survey crew took the color products to the field and used them to select sites for data collection on plant species, productivity and soil type. Field data was collected over a period of 4 weeks, using a helicopter for transportation.

That fall, field data was synthesized into range sites by SCS. A qualitative comparison of range sites to spectral categories led to the following conclusion; promising, but far from perfect. Discrepancies were noted in 3 categories —

- Different resource categories with the same spectral response (Eg., open spruce forest/old tundra burns)
- Terrain aspect problems in areas of moderate reflief
- Slight classification discrepancies between the 3 different Landsat images analyzed.

We concluded, that these problems were largely recognizable and could be corrected by hand-mapping the area using the Landsat color product as the base and field reference data, to correct the classification errors. Subsequently, in 1977, a hand-drawn map was produced for the 1.6 million hectare area.

1979 Project

Due to a lapse of funding, 2 years passed before the second inventory project was initiated. The 1979 project involved inventory in two areas totalling 1.4 million hectares. On the Western Seward Peninsula, some NASA high altitude color infrared aerial photography was available. Using this coverage, we interjected some supervision into the pre-field season computer analysis. During the preliminary aggregation of spectral class into resource categories, areas of confusion between upland and lowland tundra types were noted. As before, color products were produced and taken to the field for allocation of data collection sites.

After a short time in the field, we confirmed our earlier observations that a number of different resource categories were occurring in the same Landsat spectral class.

To deal with this problem, we turned to black/white winter Landsat imagery. Winter Landsat imagery shows the ranges in a snow-covered condition, with a low sun elevation angle which greatly enhances topography. We were able to photointerpret physiographic-terrain units from the winter imagery and use them to stratify the survey area. By referring to a Landsat spectral class within a specific physiographic unit, the confusion between resource categories was greatly reduced.

Following the field season, the physiographic map was digitized, superimposed on to the Landsat digital classification and used to stratify the image. Assemblages of terrain units were displayed on the TV monitor and spectral classes reassigned to resource categories. The image was then reconstructed and a new color product generated. (See Figure 1)

The new product was examined and compared to field reference data. While the product was much improved, terrain aspect differences still caused misclassification. In addition, the legend required to use the product was now in matrix form, which was felt to be too complex for use by resource managers. As a result, once again, a hand generated map was produced which simplified the legend and cleaned up aspect-related classification errors.

1980 Project

Based on the experience gained on the first two projects, some dramatic modifications in approach have been made in the current inventory project.

In Spring 1980, we acquired summer and winter Landsat imagery for the present 1.6 million hectare survey. A physiographic terrain unit map was photointerpreted, dividing the area into 27 regions. NASA high-altitude photographic coverage was acquired and sites selected for field reconnaissance within each physiographic unit.

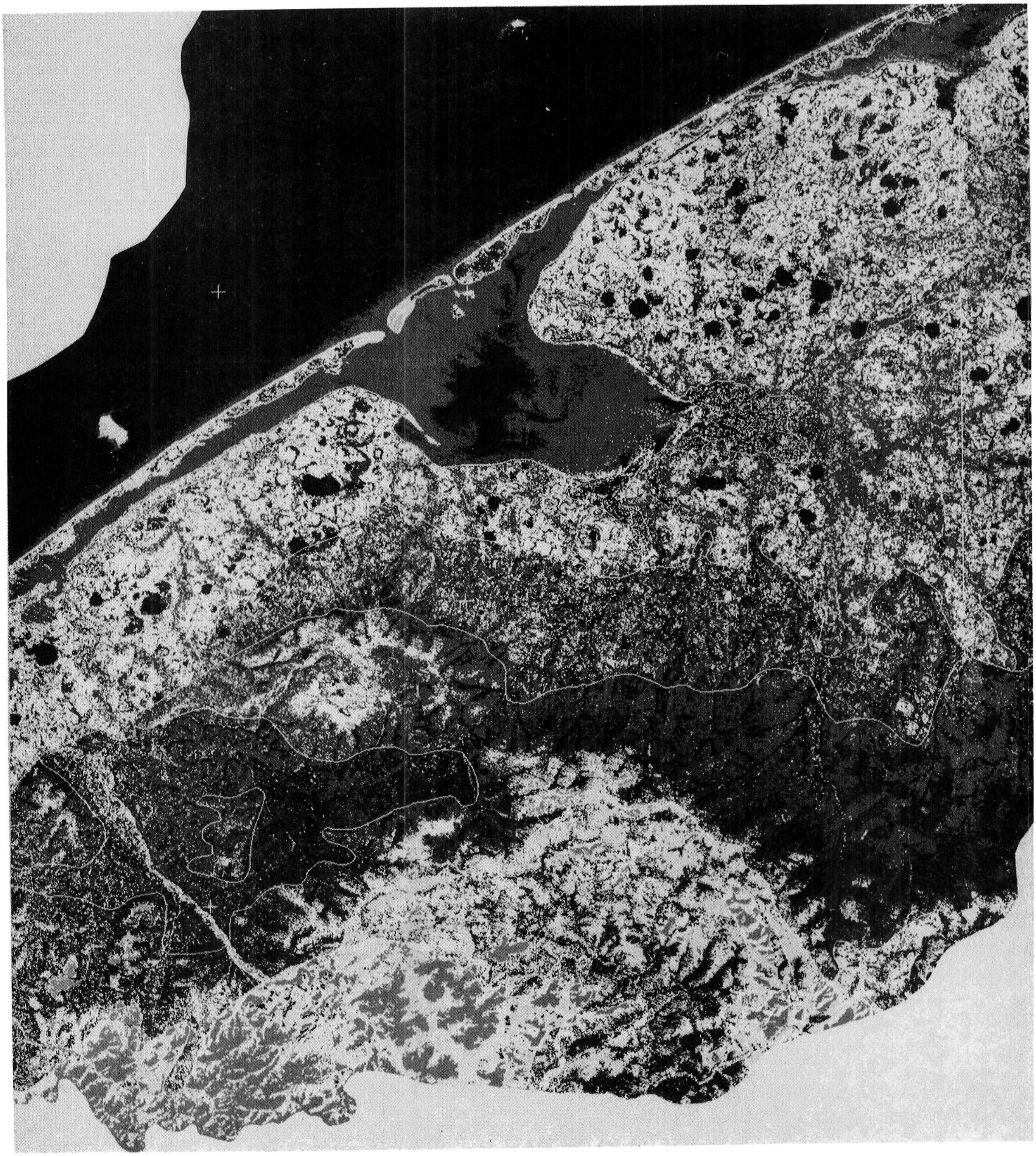

Figure 1 Classified Landsat Image Section

NOTE This product was generated for the 1979 Range Inventory Project. It shows the Landsat classification results after stratification by phsyiographic terrain unit (White Lines). The spectral classes have been combined on a unit-by-unit basis, and assigned colors (Shades of Gray), to describe resource categories on the ground. As a measure of scale, the tick marks denote corners of 1:63,360 scale USGS Topographic Map Sheets.

During the summer season, a survey crew spent approximately 2 weeks visiting the preselected sites and collecting reconnaissance data. We are now in the process of performing the computer analysis on the Landsat summer data, using a modified clustering approach. We hope to be able to use the field reference data from last summer to make the best possible image classification, and then utilize our physiographic boundaries to stratify the image as needed to separate resource classes. Our goal is to try and produce a computer generated product which is suitable for use without hand mapping. This would allow us to produce computer generated acreage summaries, more fully realizing the benefits of digital data.

Conclusion

While the results of these projects are being used in an operational context, much still needs to be done to successfully establish the use of Landsat data as a tool for tundra range inventory. Two areas that need additional research and development are —

1 Image analysis techniques — We have benefited significantly in hardware/software improvements in recent years that allow us to perform more sophisticated analysis procedures over larger sized images. We hope to experiment with the lavered classifier and the use of digital terrain data to improve computer classification results.

2 Collection of field reference data — The major expense in our inventory projects is field work. Supporting crews in the field and the use of helicopter transportation is very expensive. We need to examine closely what type and how much field data is needed for computer analysis projects. As the sophistication of analysis techniques increases, we need to know more about the relationship of slope, aspect and elevation to the cover types we are attempting to map. What is the cost of this information and can we afford it?

While progress has been slow and much remains to be done, computer analysis of Landsat data is making a positive contribution to our understanding of the tundra range resources.