ALASKAN RESOURCES, CURRENT DEVELOPMENT. TRADITIONAL CULTURAL VALUES, AND THE ROLE OF LANDSAT DATA IN CURRENT AND FUTURE LAND USE MANAGEMENT PLANNING

By Arthur LaPerriere, University of Alaska, Fairbanks, Alaska

ABSTRACT

Past, present, and proposed applications of LANDSAT data for renewable resource assessments in Alaska are described. Five specific projects are briefly discussed. These include a feasibility investigation applying LANDSAT data to caribou habitat mapping in northeast Alaska, analysis of a native corporate region in southwest Alaska, analysis of a game management unit in interior Alaska, and two proposed analyses in northwest Alaska. These analyses principally address range evaluations concerning caribou, moose, and Dall sheep but results have application to other renewable resource themes.

Renewable resources are the traditional basis for land-use and value in Alaska but dramatic land status changes are currently occurring. These changes along with the national demands for non-renewable resources are resulting in rapidly accelerated development. Statewide synoptic resource assessment using LANDSAT data is tenable and, in fact, occurring although not as an organized effort directed to that objective. In spite of this, LANDSAT analyses for the entire State will probably be available by 1980. These results can be utilized in development of a statewide land-use management plan.

INTRODUCTION

Alaska's 586,000 square mile landmass is about 1/5th the size of the contiguous United States. Population is roughly 300,000 and about half of these are concentrated in the greater Anchorage Area. There are only five paved highways and most of Alaska may appropriately be described as wilderness.

The concept of proprietary ownership, particularly land ownership, is foreign to the native peoples of Alaska. Until recently, most Alaskan land was administered as "public domain". Many Native people and others practiced a subsistence lifestyle, hunting, fishing, and gathering edible wild plants. Money to supplement this lifestyle could be earned by trapping, fishing, or temporary employment. Essentially, people lived on the land and used it almost wherever they chose.

Alaska is, however, about to be "owned". Under terms of the Alaska Native Claims Settlement Act, most of the public domain will be divided up: the Federal government may select 83 million acres of "national interest" lands, the native and village corporations are selecting 40 million acres, and the State will select from the remainder. Thus, clearly defined proprietary land ownership will permit rapidly accelerated development and resource utilization. Because of the energy crisis, the focus of this activity is currently directed to petroleum related development. However, the tremendous renewable resources on these lands are the traditional basis for land-use and value. Timber, fisheries, and wildlife are valuable renewable resources traditionally important to Alaskans.

LANDSAT data can play a vital role in a statewide synoptic inventory of many of these resources and provide information permitting formulation of a rational long term land-use management plan. The purpose of this paper is to describe past, present, and projected applications of LANDSAT data to renewable resource assessments in Alaska.

A feasibility study titled "Application of ERTS imagery to the study of caribou movements and caribou habitat" was initiated in 1972. Techniques for mapping vegetation type using LANDSAT data were applied and evaluated. These vegetation types were

were interpreted in terms of caribou range value but similar interpretation for other resource themes such as timber and moose habitat are possible. The most promising technique for detailed analyses of large areas was found to be computerized algorithmic processing of LANDSAT digital data (Lent and LaPerriere 1974).

These results stimulated the interest of agencies involved in forthcoming land selections. As a direct consequence, a LANDSAT based analysis of an entire native corporate region encompassing 58,000 square miles was carried out. Objectives were to map the region to vegetation types which could be thematically interpreted for renewable resource values, such as timber and wildlife habitats. This analysis was principally funded by Calista corporation but subsidized by the U.S. Fish and Wildlife Service.

Currently, analysis of the 53,000 square mile Game Management Unit 20 is in progress. Objectives of this analysis are vegetation mapping and subsequent thematic analyses. The principal thematic analyses for moose habitat will permit formulation of a moose management plan. Other thematic analyses for caribou habitat and Dall sheep winter range will be completed for specific areas of current management concern. This project is jointly funded by NASA and the Alaska Department of Fish and Game.

Habitat mapping of ranges used by the Arctic caribou herd has been proposed and funded by the Sierra Foundation. The Arctic herd is the largest in Alaska, estimated at 250,000 animals. These animals range over approximately 50,000 square miles of northwest Alaska. This project will begin next month and is scheduled for completion within three years.

Analysis of the Seward peninsula for reindeer range has been proposed and will be jointly funded by the U.S. Fish and Wildlife Service and the National Park Service. The analytic area comprises approximately 10,000 square miles and contractual negotiations for the project are in progress.

The scope of this paper does not permit discussion of all LANDSAT applications currently occurring in Alaska. Only the above projects will be briefly discussed. However, several other large scale projects under proposal or in progress should at least be mentioned. These include moose habitat mapping of the Kenai peninsula, analysis of lands being considered as potential sites for the new State capitol, and application of LANDSAT data in development of a coastal zone management plan. These analyses have been or will be based in part on algorithmic processing of LANDSAT digital data.

DISCUSSION

Feasibility Study

Methods - Test sites of homogenous vegetation type were selected using low level aerial reconnaissance. These areas were systematically sampled on the ground using a modified version of a technique for characterization of wilderness vegetation (Ohmann and Ream 1970). Test sites were then identified on LANDSAT data and used interpretively.

A variety of data processing techniques were utilized and evaluated. These included visual interpretation of single band products, visual interpretation of false color composite products, density slicing of single band products, simple algorithmic classification of digital data using multiband density slicing, and data classification using a maximum likelihood algorithm.

Results - Output products included aspect-ratio corrected line printer feature maps and 1:250,000 scale color coded feature maps. More than 7,500 square miles of northeast Alaska were mapped to vegetation type which, in turn, was evaluated as caribou winter range.

Applications - Arctic National Wildlife Range personnel utilized information generated during the investigation. Much of the analytic area consisted of D-2 lands open to selection as proposed additions to the Arctic National Wildlife Range.

Native Corporate Region Analysis

In March of 1974, representatives of a native corporation became aware of the investigational results described above. They requested a comprehensive categorical analysis based on LANDSAT data for their entire corporate region. This area encompasses about 58,000 square miles and results were required by October 1, 1974 for use in first round native land selections. The U.S. Fish and Wildlife Service learned of the proposed analysis and negotiated a contract with the native corporation wherein they would receive analytic results in exchange for financial subsidies.

Methods - Ground truth techniques were similar to those utilized in the feasibility investigation. Native corporate personnel were trained in these data collection techniques and six crews departed to the field in early June.

By late August, they had obtained survey data for approximately 150 test sites. Although these data represented a remarkable field effort, they were insufficient for a comprehensive analysis of the entire region. Therefore, an alternate technique was devised to pursue the analysis beyond the limits of existing ground truth data.

This method might be descriptively termed "interactive spectral cluster analysis". Existing ground truth was utilized insofar as possible for training and feature interpretation. The analysis was then carried to completion using intuitive trial and error training on spectrally consistent cluster classes. After this opportunistic training reached a point of diminishing productivity, i.e., new cluster classes failed to emerge with continued training, CCT data was classified to feature type using a maximum likelihood algorithm.

Feature categorized data were processed through a high speed film recorder interfaced with the processing system. An inter-negative at 1:1,000,000 scale was generated and photographically processed to produce 1:250,000 scale geometrically corrected color coded feature maps.

Results - Thirty-nine feature categorized digital tapes and corresponding 1:250,000 scale color coded feature maps were delivered to the native corporation on September 29, 1974.

Application - Analytic results were utilized in first round native land selections.

Analysis of Game Management Unit 20

Methods - An unsupervised classification technique is being considered. This proposed approach utilizes a cluster analysis applied to 2% of the LANDSAT data to be analyzed. Twenty to thirty cluster classes will be generated and used as a training set basis for classification. Maximum likelihood or table look-up algorithms will be used for data classification. Initial output will consist of "feature categorized" digital tapes and line printer "feature maps". These line printer maps will be used to systematically sample and define each "feature class". It is anticipated that each classification category will correspond to specific vegetation types or subtypes providing a basis for thematic analyses.

A pilot analysis has already been carried out and ground truth data collection is in progress. If ground truth data confirms anticipated results, the remaining data will be analyzed with the same techniques next Fall. If anticipated results are not confirmed by ground truth, the ground truth collected this summer will provide a basis for an interactive supervised analysis.

Anticipated Results - Each category will be evaluated in terms of moose habitat value. These evaluations will permit formulation of a categorical synthesis for moose habitat. From the digital tapes, color coded scale maps of moose habitat will be produced. Similar categorical evaluations for caribou habitat and Dall sheep winter range will be made.

Habitat maps will be produced from digital tapes for specific areas of current management concern.

Anticipated Applications - Results will be initially utilized in game management plan for Unit 20 and to better identify critical habitat areas requiring protection. Successful results, however, will probably be subsequently utilized in a variety of other thematic analyses such as timber and waterfowl habitat.

Arctic Caribou Herd Range Analysis

Method - If techniques delineated above are successful, the same design will be applied to the proposed range analysis in northwest Alaska. This design involves four analytic phases: spectral cluster analysis, algorithmic classification of data to cluster classes, ground truth definition of analytic classes, and categorical syntheses for specific thematic analyses.

This method may prove the most suitable for Alaskan applications for a number of reasons. First, this method does not require interactive mode processing and is considerably less expensive than methods requiring use of an interactive system. These cumulative cost benefit savings are substantial in Alaskan applications requiring large volume processing.

Second, spectral categories generated in the analysis have a higher probability of correspondence to natural geobotanical assocations rather than artifacts of human disturbance. Because the analytic areas are principally undeveloped and sparsely populated, natural vegetative cover exists and atmospheric variations are much less complex than in more populated areas.

Third, this method utilized a clearly defined goal directed ground truth effort. Sampling is carried out in specific areas to define each analytic class and continues only until class variability begins to diminish asymptotically. Therefore, the field effort is reduced to the necessary minimum and, in Alaska, field operations are usually the most expensive cost item.

Fourth, results should be useful to a variety of thematic analysts. While the stated objective of this project is a caribou habitat analysis, utility of results will not be confined exclusively to this application. A number of subsequent thematic analyses may be possible.

Anticipated Results - Caribou habitat maps covering about 50,000 square miles of northwest Alaska will be produced within the next two years.

Projected Applications - The caribou habitat analysis and subsequent thematic analyses would logically be used in preparation of the environmental impact statement for proposed development of Petroleum Reserve #4. Other applications might include use in formulation of game management and land-use plans for areas such as the proposed Kobuk National Monument and Selawik National Wildlife Refuge, as well as on native corporation lands.

Seward Peninsula Analysis

Methods - Techniques similar to those described above will be utilized.

Anticipated Results - Caribou/reindeer range maps of the Seward Peninsula will be produced within the next three years.

Projected Applications - Results will be utilized by the U.S. Fish and Wildlife Service, the National Park Service, and the regional native corporation. A cooperative management plan for reindeer introductions and expansion of existing herds will be developed.

CONCLUSIONS

Alaska currently offers unique opportunities for remote sensing research and applications particulary in the fields of ecology and land-use planning. Because large relatively undisturbed areas exist in seral climax, synoptic investigations of geobotanical climatic associations are possible with LANDSAT data.

Algorithmic machine processing of LANDSAT data provides a vehicle for statewide renewable resource assessment at a critical period in Alaska's history when rational land-use planning remains a tenable alternative. Although petroleum and mineral development is occurring at a remarkably rapid pace, most of Alaska will remain undeveloped for many years. The land status changes authorized under the Native Land Claims Act will probably be argued in our judicial system for years and perhaps even decades.

During this period, statewide renewable resource assessments based on LANDSAT data are possible. This is, in fact, occurring but not as an organized effort addressing that objective. In spite of this, almost 50% of Alaskan lands will be analyzed with LANDSAT data by mid-1977. At this rate, similar analytic results may be available for the entire State by 1980. These results could be utilized in formulation and implementation of a long term land-use management plan before uncontrolled development destroys such planning options.

Whether this will or will not actually occur is difficult to predict. It seems almost a certainty that the analytic results will be available but development of a cooperative land-use management plan involving Federal agencies, the State government, and the Native corporations may be a task of great difficulty. The logical focal point for coordination of a state-wide land-use planning effort lies within the State government and the Hammond Administration has already taken steps in this direction. Therefore, if the Alaskan legislature is responsive to Governor Hammond's leadership, we can be optimistic that Alaskan resources will be considered "in toto" with long range management addressing wise use of renewable resources and orderly planned development of nonrenewable resources.

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