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Denali Long Term Ecological Monitoring Vegetation Proposal

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To

USGS / Biological Resources Division
Alaska Biological Science Center
Anchorage, AK

From

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Denali LTEM Vegetation Scope of Work

1 INTRODUCTION

In 1992 Denali National Park and Preserve was selected as one of four prototype parks where long-term ecological monitoring (LTEM) programs would be developed. The Alaska Biological Science Center is working closely with Denali in this development phase to ensure that the LTEM program is ecologically-relevant, cost-effective, and statistically-sound. Collaborating organizations have included the University of Alaska Fairbanks, University of Rhode Island, and The Institute for Bird Populations. From 1992 through 1997 studies have been conducted in the Rock Creek watershed for hydrology (Karle), stream invertebrates (Milner), meteorology (Roush), air quality (Blakesley), vegetation (Densmore et al. 1998), soils (Ping), land bird counts (Paton), avian productivity and survival (De Sante), and small mammals (Rexstad). In order to look at ecologically-meaningful relationships, these studies must be upscaled to the level of the Park and integrated with each other as well as with large mammal studies. This must be done in a manner that could be adapted in other Alaskan parks. That is, long-term, large-scale monitoring must be based on simple, relatively inexpensive measurements, perhaps backed up by more detailed, more expensive measurements.

In addition to the LTEM data, Denali has a long history of research on vegetation and wildlife, their interactions and human impacts on vegetation (Viereck 1959; Viereck 1966; Dean and Hutson 1976; Wolff 1980; Wolff and Cowling 1981; Risenhoover 1983; Boertje 1984; Jubenville and O'Sullivan 1987; Van Ballenberghe et al. 1989; Densmore 1994; Densmore 1998?). This information will be extremely valuable in developing initial management models and possible responses to perturbations or stressors.

The vegetation component of the Long Term Ecological Monitoring (LTEM) in Denali National Park can be loosely divided into two general, overlapping sub-components: (1) developing and implementing protocol for long term monitoring and (2) developing conceptual model(s) for disturbances and management activities in Denali based on existing data and possible future monitoring. In conjunction with both of these the vegetation methods, studies, and results will be integrated with other components where feasible. The work will be divided into two phases: Phase I (through May 31, 1999) will synthesize existing information into recommendations to be tested. Phase II (beginning in approximately June 1999) will be the field test for protocols developed in Phase I and collection of data needed for developing a conceptual model of vegetation change in the Park.

2 Methods

2.1 Long Term Monitoring Methods

The primary goal of this subcomponent will be to develop a method of monitoring vegetation that could detect large-scale changes in the Park and secondarily be easy enough to apply that it can be up-scaled to other national parks in Alaska. Several scales of monitoring may be needed: something large scale and inexpensive like AVHRR or radar data combined with more intensive field work to maintain correlations between the large-scale technique and what is happening on the ground. Radar images have an advantage in not being restricted by cloud cover, a major limitation of many of the thematic mapper-type images. Literature and experts in remote sensing (US Geological Survey, Division of Geophysical and Geological Survey, Geophysical Institute, NASA) will be consulted to identify pros and cons of various techniques. One drawback of these techniques is that the products available may change over time for various reasons, one of which is advances in technology. Bandwidths may also change on existing products making it necessary to re-truth the relationship, which may not hold with a new bandwidth. Methods besides remote sensing will also be considered as an alternative technique and also for redundancy.

2.1.1 Correlating Low-Cost Method with More Detailed Data

AVHRR images use the same bandwidths as LandSat but have a scale of 1 pixel = 1 km. These images appear to be readily available both from recent years and probably will be available for the future. These images are sometimes used for mapping vegetation types but can also be used for monitoring greenup and productivity (Oesterheld et al. 1998). As an initial evaluation, the AVHRR images will be compared with the satellite imagery being used in the baseline soils and vegetation inventory. It is anticipated that there may be some tweaking needed and/or realization that interpretations dealing with 1 km pixels may be different from interpretations based on 20-m pixels. Evaluation of the imagery to use or selection of alternative low-cost, large-scale sampling technique is a prime goal of Phase I.

2.1.2 Phenology

Movements and behavior (calving, feeding habits) of wildlife within the Park may be dependent on snow depth, greenup, berry ripening, and other factors. On a broad scale, these may be highly correlated with the AVHRR data, but these relationships need to be developed. Hopefully, this could be developed by relating results from dates when phenology data were collected with AVHRR images available on the same date, approximately. Perhaps existing data can be used to establish a model, then start validating it over the next year or so.

2.1.3 Integration with other studies

Vegetation needs of other studies and/or managers will be determined. Each of the other PIs as well as wildlife habitat investigators in the Park (NPS, BRD, USFS, and anyone else) should be contacted to determine what vegetation data is most useful to them for management needs or to understand wildlife impacts on vegetation and vice versa. This will include, at a minimum, moose, bears, caribou, birds, and small mammals. Relevant literature will also be consulted (Wolff 1980; Wolff and Cowling 1981; Van Ballenberghe et al. 1989).

2.1.4 Field sampling techniques

Many vegetation studies have already taken place in the Park. Some may have resulted in permanent plots. These techniques and locations should be considered with respect to relevance for current objectives, scientific and statistical validity, and gains from using past techniques for standardization vs losses for not using a more appropriate technique. Appropriate general techniques will be selected during Phase I. Some modifications of sampling unit size may need to be based on field studies. For instance, large units take longer to measure but a greater variability is incorporated within each sampling unit. A balance appropriate to the scale of pattern of vegetation and objectives needs to be selected.

2.2 Conceptual Vegetation Model For Denali National Park (north side)

One objective of long-term monitoring is to determine changes in response to disturbances (perturbations) or stressors, either natural or anthropogenic. These disturbances may include fire, flood, glacial retreat, mining (past), visitors on trails and roads, and global change. Additionally, wildlife may impact vegetation (browsing), and vegetation may affect wildlife as more trees colonize shrub communities following fire or glacial retreat. Greening of vegetation and maturing of berries would affect animal movements. Vegetation changes would also impact aquatic habitat. The flood, glacial retreat, and past mining disturbances may follow similar pathways and will be referred to as primary successional sequences even though there may be minor amounts of seed, organic matter, or debris present initially. A successional model can help managers understand implications of certain management alternatives. This objective will also be broken down into synthesis of existing data and resources, collection of data, and construction of a model.

2.2.1 Historical Data

A number of vegetation and wildlife studies have been conducted in Denali over the decades. Some of these were one-time observations. Some involved monitoring over time. Denali has a database of these projects. This will be used to find relevant studies. Other people, such as Les Viereck (INFCRU) and Joan Foote, will be contacted for additional information. The studies dealing with fire will be addressed in the most detail initially because of this summer's potential field work.

2.2.2 Model Development

The results of this study will be synthesized into a conceptual model initially to identify various components, pathways between them, and factors affecting those changes. This will include effects of climate and seasonal weather on vegetation, vegetation parameters for birds, wildlife, and small mammals and their effects on vegetation. A frame-based model using techniques of Starfield (1997) will be developed as a learning tool to help identify gaps in our ecological understanding of biological processes in Denali National Park and Preserve. This will help determine what protocols are needed and drive the development of Phase II: the actual sampling and testing of protocols.

3 DELIVERABLES

An Annual Progress Report for the prior fiscal year suitable for NPS Annual Administrative Report is due December 15, 1998, 1999, and 2000.

Phase I report is due February 15, 1999 and will contain: analysis of existing protocol/data with recommendations, preliminary evaluation of previously studied vegetation plots, preliinary evaluation of satellite imagery options, needs of other LTEM studies fro vegetation dta and recommendations for optoins to meet those needs, and preliminary conceptual vegetation model.

Phase II study plan and budget is due April 15, 1999.

Final report on recommended vegetation protocol for Denali LTEM is due March 31, 2001.

4 Literature Cited

Boertje, R.D. 1984. Seasonal diets of the Denali caribou herd, Alaska. 37:161-165.

Dean, F.C., and E. Hutson. 1976. Effect of human trampling on vegetation in Mount McKinley National Park. p. 27 In: U.S. National Park Service (ed.). Third annual Pacific Northwest Science/Management Conference, Klamath Falls, Oregon, April 27-29, 1976. Program. Corvallis, OR, Oregon State University. Cooperative Park Studies Unit. edn.

Densmore, R.V. 1994. Succession on regraded placer mine spoil in Alaska, U.S.A., in relation to initial site characteristics. Arctic and Alpine Research 26:354-363.

Densmore, R.V. 1998? The relationship between berry production and brown bears in Denali National Park, Alaska.

Densmore, R.V., M.B. Cook, and P. Adams. 1998. Inventory and monitoring project. Vegetation Protocol. Denali National Park and Preserve. Prepared for LTEM. Prepared by Division of Biological Resources. 47 pp.

Jubenville, A., and K. O'Sullivan. 1987. Relationship of vegetation type and slope gradient to trail erosion in interior Alaska. Journal of Soil and Water Conservation 450-452.

Oesterheld, M., C.B. DiBella, and H. Kerdiles. 1998. Relation between NOAA-AVHRR satellite data and stocking rate of rangelands. Ecological Applications 8:207-212.

Risenhoover, K.L. 1983. Moose foraging and survival strategies in Denali National Park and Preserve, Alaska. Anchorage, AK, U.S. National Park Service. Alaska Region. 18 pp.

Starfield, A.M. 1997. A pragmatic approach to modeling for wildlife management. Journal of Wildlife Management 61:261-270.

Van Ballenberghe, V., D.G. Miquelle, and J.G. MacCracken. 1989. Heavy utilization of woody plants by moose during summer at Denali National Park, Alaska. Alces 25:31-35.

Viereck, E.N. 1959. Small mammal populations in Mount McKinley National Park, Alaska. Ph.D. thesis. University of Colorado. 177 pp. appendix. pp.

Viereck, L.A. 1966. Plant succession and soil development on gravel outwash of the Muldrow Glacier, Alaska. Ecological Monographs 36:181-199.

Wolff, J.O. 1980. The role of habitat patchiness in the population dynamics of snowshoe hares. Ecological Monographs 50:111-130.

Wolff, J.O., and J. Cowling. 1981. Moose browse utilization in Mount McKinley National Park, Alaska.

Category	Detail	Cost
Labor	91 days @ $395/day including benefits	$35,945
Travel[a]	Food, gas, travel to Fairbanks in winter to meet with other researchers	$575
Services	Phone, postage	$60
Supplies		$150
Total Direct		$36,730
Indirect costs	25.00% (limited by agency)	$9,183
Total Costs		$45,913

[a] Assumes Denali NP will provide space in C camp.

Canadian Field-Naturalist 95:85-88.

5 Budget for Phase I

A budget for Phase II will be developed during Phase I and is not anticipated to exceed $100,000.