

LONG-TERM MONITORING OF MONTANE MEADOW BIODIVERSITY IN THE GREATER YELLOWSTONE ECOSYSTEM



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♦ ABSTRACT

This research project is part of an ongoing biodiversity inventory and monitoring effort that began in 1992. It involves using intensive, local field sampling to test for relationships between species distribution patterns and remotely sensed data. We have been using a time series of satellite multispectral imagery for monitoring the extent, condition, and spatial pattern of montane meadows on a seasonal and interannual time scale. Spectrally-based, spatially-explicit models have been developed for six meadow types along a hydrological gradient. Statistically significant relationships were found between remotely sensed data and a large number of plant and animal species in the Greater Yellowstone Ecosystem (GYE). We have shown that mesic meadows (meadows intermediate in the hydrological gradient) are the sites of highest plant species diversity and the sites of highest seasonal and interannual change. Our research during 2001 was specifically targeted to continue monitoring the plant and animal communities of the GYE with the goal of developing a list of indicator species and their present year-to-year variation. The rarity and low abundances of some of the species have limited our understanding of these patterns to the most common species. Thus, additional data will allow us to expand upon our understanding of these groups as indicators.

We believe that these communities and their associated species may be some of the best indicators of environmental change in the GYE.

♦ INTRODUCTION

In 1992, we initiated an interdisciplinary project in collaboration with geographer Mark Jakubauskas entitled "Modeling Spatial and Temporal Dynamics of Montane Meadows and Biodiversity in the Greater Yellowstone Ecosystem." Our research team has been developing predictive species assemblage models based upon landscape level habitat analysis (e.g., Debinski and Humphrey, 1997; Debinski et al., 1999; 2000; Kindscher et al., 1998; Jakubauskas et al., 1998; Jakubauskas and Debinski, 1995). The goal was to use intensive, local field sampling to extrapolate species distribution patterns within a region. The hypothesis was that plant and animal locations could be predicted by analyzing spectral reflectance characteristics as recorded by satellite multispectral scanners. This research was originally conducted in the northwest corner of the Greater Yellowstone Ecosystem (GYE) and then expanded to the Grand Teton National Park in 1996. Grants from the U.S. Forest Service, the U.S. Park Service, the U.S. Environmental Protection Agency, and three universities have supported our work.

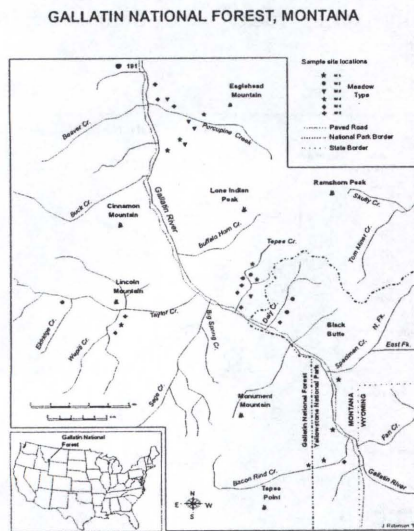


Figure 2. Core sampling sites in the Gallatin study area including the Gallatin National Forest and northwestern portion of Yellowstone National Park. Thirty core sampling sites were located in the Gallatins during 1997-2001, five of each of the six meadow types (M1-M6).

At each site plant cover data were collected by identifying each species in the field and assigning a percent cover value. For each species where identification was difficult to determine, a plant voucher was collected and brought back to the University of Kansas herbarium for help in making an accurate determination.

Abundance data were collected for butterflies and birds in each of the sampling sites. Birds were surveyed between 0530-1030 hrs using point counts in 100 m diameter circular plots. Two observers were present for each 15 min survey. One point count was conducted at each site. Butterflies were surveyed between 0930-1630 hrs by two people netting for 20 minutes in 50 x 50 m plots at each sampling site. Surveys were limited to times when temperature is above 70 degrees F, wind is less than 16 km/hr, and clouds do not obscure the sun. Each butterfly was placed in a glassine envelope with a time of capture noted on the envelope. At the end of the survey, all individuals of each species were tallied and released unless a voucher was needed to confirm species identity. Butterfly voucher specimens are archived with Dr. Debinski's entomological collection at ISU.

Research Products

- Diane Debinski and James Pritchard finished their manuscript "A Complete Guide to Butterflies of the Greater Yellowstone Ecosystem" to be published by Roberts Rinehart Publishers in 2002.
- Diane Debinski collaborated with Dr. Paul Opler, author of the Peterson's Guide to Butterflies, to create a current list of butterflies of Grand Teton National Park. This list is linked to the Northern Prairie Biological Resources database on biodiversity across North America <http://www.npwrc.usgs.gov/resource/taxa/1.htm>. Debinski's (1993), "Butterflies of Glacier National Park, Montana" is also available on that web page. The Northern Prairie Wildlife Research Center, which is part of the U.S. Geological Survey located in Jamestown, North Dakota is compiling biodiversity data nationwide for this web page.
- We are finalizing a publication that summarizes the comparison of our biodiversity assessment techniques to that of the Wyoming and Montana GAP analysis work (Su et al., unpublished manuscript).
- A paper on predicting the occurrence of plant species in montane meadows from remotely sensed data was presented at the Third International Conference on Geospatial Information in Agriculture and Forestry in Denver, Colorado, 5-7 November 2001. Citation: Peterson, D. L., Jakubauskas, M.E., Kindscher, K., and Debinski, D. 2001. Hyperspectral remote sensing of nonforested montane vegetation communities. The 3rd International Forestry and Agriculture Remote Sensing Conference and Exhibition, Denver, November 2001.

Summary & Future Directions

The goal of this research is to continue monitoring of long-term, well-established biodiversity inventory & monitoring sites in the GYE. Our research has shown that spectral reflectance patterns are a function of vegetation community type. We have also found that many animal species are statistically correlated with spectrally-based meadow habitat types. We have developed models for predicting several of the most abundant bird species relative to meadow type

(Saveraid et al., 2001). Butterfly species also show strong associations with particular meadow types, especially in the Teton region (Debinski et al., in press). Although we have found strong relationships between habitat type and species distribution, the rarity of many of the species requires long-term data collection to uncover some of the larger patterns. During 2002, we will conduct analyses of species distribution that will include four years of data for birds, butterflies, and plants in our core sampling areas. These additional data will allow us to expand upon our understanding of these groups, and the analysis of these data will allow us to refine our list of indicators.

Finally, we have noticed that the abundances of many of the willow-dependent songbirds vary significantly between the Gallatin and Teton sampling areas. During the summer of 2002, we will expand the songbird research to begin to examine potential interactive effects of habitat type, vegetation structure, and landscape context on local abundance and distribution of birds in montane meadows.

◆ ACKNOWLEDGMENTS

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