

**Proposed sampling method to study the effects of grazing intensity on butterfly communities
in the Cascade-Siskiyou National Monument**

Investigator:

Erik Runquist

Section of Evolution and Ecology

University of California

Davis, CA 95616

ebrunquist@ucdavis.edu

Sampling Technique:

In consultation with the University of California at Davis, Bureau of Land Management, the Klamath Bird Observatory (KBO), and other interested parties, a multiple-year plan was developed to test the null hypothesis that effects of cattle grazing (if any) are compatible with butterfly species richness, diversity, and abundance in and adjacent to Cascade-Siskiyou National Monument. More specifically, variable grazing intensity levels have no effects on various measures of butterfly species richness, abundance, and diversity. Butterflies are vagile organisms and able to move between suitable habitat patches. Additionally, the CSNM is a patchy and varied environment with abrupt ecotones. Spatial scale is therefore a critical consideration, and careful selection of sampling protocols and design was required.

The most widely utilized method of monitoring butterfly diversity in a statistically meaningful sense is the use of line transects. This study will use transects in a manner similar to the method outlined in Brown and Boyce (1998), which is a derivation of the classic Pollard and Yates (1993) method. It will consist of a series of permanent transects that are walked at regular intervals throughout the season of butterfly activity (April/May to mid-September, depending on elevation, snowpack, and weather). For all butterflies observed along a transect, the perpendicular distance of the butterfly from the transect is estimated to the nearest meter and recorded. These distance estimates are used to create detectability functions for each site and species (if numerous enough) and calculate the densities of each species for each site. This compensates for structural differences between sites.

Transects will be subdivided into sections and observations that are made within each section are recorded separately. These divisions provide fine-scale information on butterfly distributions, site affinity, and usage patterns. In most cases, transect divisions are designated according to habitat differences. However, the goal of this study is to standardize habitat and

grazing intensity between each transect, so subdivisions by habitat should not be relevant. As a result, sections will be fixed at 50 meters.

The investigator has ample experience to confidently and rapidly identify the majority of the species to be encountered by sight. However, similar taxa (e.g. the fritillaries, blues, whites, etc.) often require netting for accurate identification, and questionable individuals will be netted when possible. If necessary, the sampler can stray from the transect to net/identify an individual, but no other individuals are recorded until the sampler returns to the same location. If the sampler is confident that an individual has been previously recorded, it is not counted again. The behavior of each butterfly when it is first observed will be recorded (i.e. flying, courting, mating, sitting, mudpuddling, etc.). Additional data gathered daily will include weather conditions (% sun, temperature, wind speed and direction) and time of day. Site-specific data will include elevation, slope, and aspect (to be recorded once).

Site-specific vegetation data will be gathered along each transect using a series of relevés. Intra-year grazing intensity will be assessed via comparisons of stubble height with fenced control areas, while inter-year grazing intensity history will be assessed with the Cole browse method. An index of native vs. exotic plant cover will be developed for inclusion into the ordination analysis discussed below. Site and vegetation conditions will be periodically documented with photographs.

Sampling Frequency:

Each location will be sampled every 7-14 days of acceptable weather, depending on the number of transects established and the logistics involved in accessing them. This monitoring frequency is necessary given the rapid turnover of butterfly phenologies. Because some taxa are most active at certain times of day, the order in which transects are walked will be determined randomly each day. The transects will be walked at a steady pace of 50 meters per minute during ideal butterfly weather (sunny, warm, light winds, midday).

Site Selection:

Sampling will be conducted in oak woodlands and open mixed conifer forests. Sites will primarily be selected for species richness with rare or local species a secondary consideration (to increase statistical power). Whenever possible, the sampling locations will be paired with the

monitoring sites established by the other sampling teams. Utilizing the same sites will not only allow sampling to begin soon after snowbreak, but will allow for inter-taxa comparisons.

At least 24 permanent transects will be established. At a minimum, these will cover two habitat types (oak woodland and mixed conifer) and two levels of grazing intensity, with six replicates each. Three levels of grazing intensity (low, medium, high) would be preferable. Given the desired monitoring frequency of once every 7-14 days, this will require that at least two or three transects are sampled per day.

Data Analysis:

Log densities will be calculated for each species along each transect, and multiple regressions will be used to test for variance between sites. Several ordination methods including non-metric multi-dimensional scaling and canonical correspondence analysis will also be used to search for discernable effects of cattle grazing intensity on butterfly densities and species richness while simultaneously weighing the relative effects of other factors (site specificity, vegetative composition and structure, weather, etc.). CCA was used with some success by WallisDeVries and Raemakers (2001) to separate the effects of grazing on coastal dunes butterflies in the Netherlands from other environmental variables. Collated indices of abundance for each species across all transects will also be calculated following the suggestions of Moss and Pollard (1993) for inter-year comparisons of species abundances.

References

- Brown, J.A., and M.S. Boyce. 1998. Line transect sampling of Karner blue butterflies (*Lycaeides melissa samuelis*). *Environmental and Ecological Statistics*. 5: 81-91.
- Moss, D., and E. Pollard. 1993. Calculation of collated indices of abundance based on monitored sites. *Ecological Entomology*. 18: 77-83.
- Pollard, E. and T.J. Yates. 1993. *Monitoring Butterflies for Ecology and Conservation*. Chapman & Hall, London.
- WallisDeVries, M.F., and I. Raemakers. 2001. Does extensive grazing benefit butterflies in coastal dunes? *Restoration Ecology*. 9(2): 179-188.