CPER

VEGETATION STRUCTURE AND DIET SELECTIVITY BY LARGE HERBIVORES

L.R. Rittenhouse, D.W. Bailey, and M.B. Coughenour

The impact of large herbivores on long-term ecological processes is poorly understood. The role of herbivory is thought to be primarily regulatory. In general, the magnitude of herbivore impact is allometrically scaled to body size, i.e., the smaller the body size of the organism, the larger the number and biomass of organisms in proportion to the involved material. Studies involving large herbivores have considered only short time scales and small spatial scales where turnover rates are fast and the impact is large. The impact of large herbivores should include longer time scales and larger spatial scales. The importance of herbivory and nutrient redistribution at long scales remains to be demonstrated.

Many terrestrial LTER sites have one thing in common--large herbivores. These animals may be indigenous or domesticated ungulates. Foraging may be an important part of long-term ecological responses. We need a uniform method to represent foraging on different time-spatial scales. The method should reproduce observed foraging behavior without conflicting with evolutionary ecological theory. Two time and spatial scales are involved, i.e., diet selection and landscape use. The approach outlined by Senft et al. (In press) will be used as the paradigm for studies. Basically, this paradigm views landscape use as an aggregate response of several foraging bouts, and diet selection as a short-term response. Herbivore diets result from decisions of forage selection.

Researchers in the Range Science Department and Natural Resources Ecology Laboratory who are associated with the shortgrass LTER site are interested in diet selection and have developed a rule-based model to represent the diet selection process. The model is based on learning psychology. Basically, the format allows the operator to create artificial communities. Using fractals, plants are distributed in space according to one of several statistical distributions. Plants have a third dimension which we call "nutrients." Actually, the third dimension can represent whatever the operator wishes or hypothesizes to be important, e.g., biomass, height, standing nutrients or available energy, etc. "Nutrients" (mean and Std. Dev.) are assigned to each cell. Each cell in the model represents the two-dimensional space from which a herbivore can take a bite. Cells are scaled according to the size and shape of a herbivore's mouth. The simulated plant community represents only the plants encountered by the herbivore while grazing in a plant community (a grazing corridor). One or several rows of cells represent a feeding station. Bite size (g/bite), time per bite, and time required to move to a new feeding station are inputs. "Grazing" follows simple rules of thumb. For example, consuming plant(s) from cells whose height is above 5 cm. Model output includes nutrient capture rate, diet composition, and relative preference of plant species. The model is general and could be used to represent any mobile herbivore.

We would like to obtain an initial indication of the usefulness of the model by cooperating with biologists and ecologists at other LTER sites. This would also give us an opportunity to improve the utility of the model for studying long-term processes impacted by herbivory.

The work would go something like this:

1. Utilize previously collected vegetative data from communities at each site to construct simulated plant communities. Communities would be selected to represent differences in plant structure. The following information would be needed:

   a. cover: bare ground and vegetation;
   b. vegetation composition by species;
   c. statistical distribution by species;
   d. height, nutrient content (nitrogen, digestible energy, etc.) and Std. Dev.;
   e. other.

2. Determine the general ranking of importance of plants by various herbivores via interviews with experts at each site. This could be supplemented by fragment analysis of fecal samples or short-term direct observation of herbivores.

3. Once simulated plant communities are generated, grazing experiments will be implemented using the computer model.

   a. The model will allow us to test the effect of vegetation structure on diet selection in various vegetation types.

   b. Interviews with project leaders at other sites would be used to pose important questions in which the grazing simulation model would be an appropriate investigative tool.

   c. A list of questions might include:

      i. Does the magnitude of variability influence species selection?

      ii. How would certain natural phenomena such as fire, drought, hail, prairie dogs, and shrub removal influence species selection?

iii. How large a successional change in composition would be required to significantly change diet selection?

iv. What happens to diet selection as the sward becomes "even?"

v. What is the effect of different distributions of plants on diet selection?

vi. How do mixes of animals (cattle and elk, bison and cattle, deer and elk, deer and desert bighorns, sheep and bighorns, etc.) impact the diets of other animals?

vii. Can the same simple rules of thumb be used to describe foraging among different animals, including specialists and generalists?

Summaries would be returned to project leaders at various sites to evaluate the model's validity.

This proposal includes only the diet selection process, but discussions would include habitat selection and use of vegetation on landscapes.

Literature Cited

Senft, R.L., M.B. Coughenour, D.W. Bailey, L.R. Rittenhouse, O.E. Sala, and D.M. Swift. 1987. Large herbivore foraging and ecological hierarchies. Bioscience (In press).

Proposal Budget

Salary	$
L.R. Rittenhouse (P.I.) 1 mo.	4288
Research assistant 2.5 mo. @ 1750/mo.	4375
Fringe benefits (PERA 18.8%)	1629
Other Direct Costs	
Travel	2000
Computer resources	1000
Supplies	250
Other	250
Total Direct Costs	$13792
Indirect Costs	
Overhead (39.9% of $13792)	$ 5503
Total	$19295

Guessing at over-head. Corrine needs to talk to you.