

Yellowstone Elk: Some Thoughts On Experimental Management

Editor's Note: An experimental approach to understanding and dealing with the population dynamics of large grazers and the nature of vegetation-herbivore equilibria in parks is the recommendation of Doug Houston, NPS research biologist stationed at Olympic NP in Washington. Houston, who is preparing his 13-year landmark study of the Yellowstone elk for publication, here condenses some of his findings that relate specifically to management of in-park ungulate populations, both native and exotic, with particular attention to the significant differences between ecological carrying capacity and the management implications which that difference exposes.

By Douglas B. Houston

The Elk

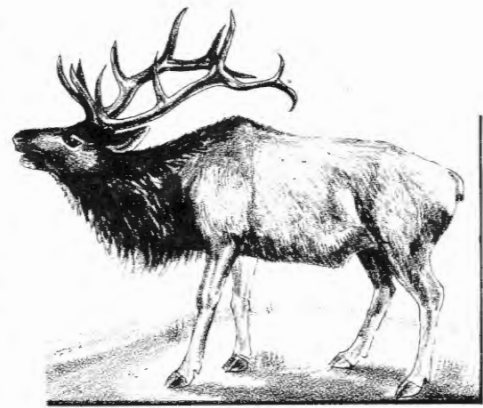
Elk are the most abundant large grazing mammals in Yellowstone National Park. Those wintering on the Yellowstone River in and adjacent to the park have become known as the northern Yellowstone herd. Management of this largest single ungulate population in the park has long been beset by controversy. Recent concerns center upon the amount of human interference required, if any, to maintain vegetation-elk equilibria in the park. One view — a laissez-faire approach to park management — counts upon natural regulatory processes to produce acceptable equilibrium states. The contrasting management view is that pristine relationships have been destabilized by modern man, and that interference now is required to impose vegetation-herbivore equilibria more in keeping with park objectives. In practice this interference has involved periodic reductions in ungulate numbers. Both approaches have been tried with the northern Yellowstone elk.

What Was Done

The nature of existing vegetation-elk relationships on the northern winter range was examined from 1970-1979, to determine if population reductions are necessary in the park (most of these elk winter in the park, but one herd segment winters outside the boundaries and is hunted. Another aspect of the study was an attempt to reconcile these two different management objectives). Our approach was to set up a series of interrelated research hypotheses subject to testing, modification and rejection. The test of whether or not progressive "range deterioration" was occurring became far more complex than imagined initially. A sound historical perspective on changes in elk numbers and in the vegetation was a necessary first step. This led to studies of climate, fire history and human activities in the park. The elk population was examined for evidence of density-

dependent negative feedback controls (described below) on population size, and for evidence of limitation through extrinsic forces such as human predation or resource levels.

Testing hypotheses in field studies is difficult at best, and doubly so in national parks where experimental manipulations usually are prohibited. Some hypotheses were tested using the method of successive approximations, where data are continuously examined for consistency with the research hypothesis.¹ Hypotheses are modified or rejected as inconsistencies appear. However, in the case of northern Yellowstone elk, hypotheses could be tested in a somewhat more experimental manner.



The west face of Mount Everts in Yellowstone Park as it appeared in 1871 (upper) and in 1971. Bighorn sheep, mule deer and elk winter on the area. The bare-appearing slopes occur in the earliest scene, are heavily grazed, and appear to be little changed during the past century.

Human predation had reduced elk numbers in the northern herd from around 12,000 to 4,000 between 1955-1968. A moratorium on reductions went into effect in the park in 1969, and numbers increased again to around 12,000. These manipulations were viewed as an experimental perturbation, useful for testing research hypotheses and for providing insight into ecosystem dynamics.

What Was Found

1. An extensive review of historical records shows, in contrast to earlier interpretations, that Yellowstone has served continuously as winter range for the northern herd since at least the 1870's. The present distribution and densities seem best interpreted as a remnant of a once far greater biomass of ungulates that occurred in the region, rather than as

an artifact created by establishment of the park.

2. Examination of the dynamics of the elk population shows strong density-dependent relationships, i.e., the percentage of mortality (particularly of young) increases, and the reproductive rate decreases as the population rises. The population is then considered to be "regulated" because natality and mortality show negative feedback from population density. The population can come into equilibrium with the park's vegetation through these density-dependent processes. The level of this equilibrium, the "ecological carrying capacity," is the appropriate carrying capacity for a native ungulate in a national park. But this is a very different, higher capacity than that for which wild and domestic ungulates are managed outside parks. Outside parks, most populations are managed for a maximum sustained yield and are maintained at an "economic carrying capacity" that is often about one-half of ecological capacity. Managers and biologists have not always recognized these different definitions of carrying capacity.

3. Studies of growth, condition and behavior suggest that the overall elk population is limited by the quality and quantity of winter forage, but that human predation outside the park modifies this resource limitation. Intraspecific competition along dominance hierarchies affected access to scarce food resources.

4. Evidence from studies of the vegetation did not support an interpretation of progressive pathological range deterioration. (The vegetation studies included rephotographing over 300 early scenes of the vegetation and analyzing 308 range plots measured over the 1930-1978 period.) Interestingly, the historic photos showed that range sites considered to be "overgrazed" by conventional criteria had the same appearance over a century ago, before the park was established. The departures from pristine conditions of vegetation on the winter range were limited and seemed to result primarily from fire suppression. In short, the elk effects on vegetation did not appear to have exceeded those expected from a population near ecological carrying capacity in a stable vegetation-ungulate system.

5. Severe inter-specific competition between elk and associated large herbivores (mule deer, bison, moose, bighorn sheep, pronghorn) could not be demonstrated. Differences in distribution and food preferences permit these less abundant species to persist in the presence of much larger numbers of elk. The management philosophy of maintaining arbitrary "balances" among ungulate species by reductions of one to favor another seems unnecessary and inappropriate in the park.

What Was Recommended

Some changes from the pristine ecological relationships have indeed occurred in Yellowstone National Park. However, the park still is remarkably intact



The major changes in the vegetation of the northern winter range appear to have resulted from a reduction in natural fires, as indicated by this scene photographed in 1885 and in 1970. Big sagebrush and Douglas fir have increased on a former bunchgrass range. Aspen (above boulder in original) has declined.

ecologically, and the potential for further restoration is very great. Management recommendations were aimed at compensating or correcting for the influence of modern man on ecosystem processes. Major recommendations include:

a. Expand the park's fire management program to include the rest of the winter range in the park and implement a limited program of experimental prescribed burns.

b. Do not reduce the numbers of elk or of any other large ungulate in the park to alter the present vegetation-ungulate equilibrium.

c. Develop innovative strategies for hunting those elk herd segments that winter outside the park. This will require close cooperation among management agencies. Even though elk hunting outside the park alters the dynamics of the hunted herd segments, it seem possible, through sensitive management, to minimize effects upon the park.

d. The gray wolf should be restored to the park.

How recommendations are to be implemented is as important as *what* was recommended. All manipulative management of park biota should be regarded as essentially *experimental*.² This means that hypotheses to be tested, procedures to be used, and criteria to reject or reformulate hypotheses, should be stated clearly in advance. The information obtained from management programs should be reviewed frequently for consistency with the hypotheses being tested.

The experimental management approach is still needed for understanding both the population dynamics of large grazers and the nature of vegetation-herbivore equilibria in parks. I generally *do not* advocate manipulating wild populations of native ungulates below ecological carrying capacity

in parks that are complete ecological units. However, if park managers have reason to suspect that ungulate numbers are "too great," and reductions are being considered, then an experimental approach is clearly indicated.

An experimental approach to management of "exotic" herbivores, e.g., goats in Hawaii, burros in wherever, mountain goats in Olympic, and wild boars in Great Smokies, also should be useful to managers. A well planned, small scale experimental reduction can provide a great deal of information about the statistics of population growth, i.e., the ability of a population to compensate for increased removals. This information is then used to determine the magnitude of the removal problem, to appraise the effectiveness of control strategies and to calculate costs.³ Beyond the immediate needs of park managers, an experimental approach to the control of exotic species could contribute substantially to our understanding of the ecology of these large mammals.

¹ Poore, M.E.D. 1962. *The method of successive approximations in descriptive ecology*. pp. 35-68 *in* J.B. Cragg, (ed.) *Advances in ecological research*, Vol. 1 Academic Press.

² Sinclair, A.R.E. 1979. *Dynamics of the Serengeti ecosystem*. pp. 1-30. *in* A.R.E. Sinclair and M. Norton-Griffiths, (eds.) *Serengeti: Dynamics of an ecosystem*. Univ. of Chicago Press.

³ Caughley, G. 1977. *Analysis of vertebrate populations*. John Wiley and Sons. 234pp.