HABITAT-BASED ADAPTIVE MANAGEMENT AT MOUNT HAGGIN WILDLIFE MANAGEMENT AREA

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ABSTRACT: The 22,743-hectare Mount Haggin Wildlife Management Area was purchased in 1976, in part for moose (*Alces alces*) winter range. Observed moose populations climbed from a low of 7 in 1976 to a high of 56 in 2000. A 4-step management program was initiated in 2000 consisting of definition of management objective, monitoring to determine if the objective was attained, developing a management strategy, and implementing the strategy. The management objective for browse was defined to be: browsing will not prevent young plants from attaining their potential stature, their growth being primarily limited by local environmental conditions. A survey of Geyer willow (*Salix geyeriana*) in critical moose habitat indicated that browse plants were 100% intensely browsed, suggesting that browsing could prevent willow height growth. Beginning in 2000, willow trend was monitored annually at 4 sites using an index based on the height of the tallest live stem and the height of the tallest, dead intensely browsed stem (LD Index). Low LD Index values indicated that browsing did prevent height growth. In 2000 moose harvest quotas were increased by 40%; in 2002 harvest quotas were increased an additional 7%. From 2000 to 2002, willow growth increased at all 4 locations. From 2002 to 2004, growth indicators changed relatively little at Sullivan Creek, Deep Creek, and French Creek; at these sites willow condition in 2004 had improved compared to willow condition in 2000. From 2002 to 2004, growth indicators declined markedly at American Creek; in 2004, growth indicators at American Creek were lower compared to measurements made in 2000. The improvement of willow condition at 3 sites was likely due to a combination of reduced moose numbers (due to an increase in harvest) and increased dispersal (due to low snow-cover conditions). Over the study period, the sporting public complained of reduced moose sightability; harvest quotas were lowered substantially in 2003.

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The 22,743 ha Mt. Haggin Wildlife Management Area (WMA) in southwestern Montana was purchased in 1976 and is managed by Montana Fish, Wildlife & Parks (FWP) for wildlife, public recreation, as well as controlled livestock grazing (Newell and Ellis 1982, Frisina 1992). Prior to 1976 the area was privately owned and heavily exploited for timber and minerals and by season-long livestock grazing. East of the Continental Divide moose (*Alces alces*) are the only year-round, resident ungulate species on the WMA as deep snow forces other species to migrate to lower elevations. Prior to public ownership the area supported limited numbers of moose due to livestock grazing impacts and systematic attempts to reduce or eliminate moose habitat (willows) to promote livestock forage. Observed moose populations climbed from a low of 7 in 1976 to a high of 56 in 2000 based on fixed wing census data.

During the winter, moose congregate in broad riparian areas in which grow a variety of willows including Geyer willow (*Salix geye-*

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riana), Booth willow (*S. boothii*), Drummond willow (*S. drumondiana*), planeleaf willow (*S. planifolia*), and Wolf willow (*S. wolfii*) (Fig. 1). A study initiated in 1997 indicated that browsing pressure on willow had increased. Short (young) heavily-browsed plants grew adjacent to tall (older) plants; the central stems of the tall plants had not been browsed. The age-related difference in growth forms indicated that browsing pressure must have been lower in the past as the older shrubs grew through the browse zone. Based on dendrochronologic evidence, browsing pressure was found to have increased at about 1985 from a light-to-moderate level to an intense level; over the period 1976 – 1985, moose increased from a count of 7 to a count of 23 (Keigley et al. 2003). In 1985 the number of moose counted was approximately half the number counted in 2000 (56).

At Mt. Haggin WMA, moose depend on the availability of browse that has grown above snow-cover. Intense browsing can inhibit height growth, thus reducing the amount of forage available in the winter (Keigley and Frisina 1998). The management of a viable winter range will require regulating the use of browse to a level that sustains moose while at the same time protects the habitat on which the moose depend. This paper describes a method for the habitat-based management of moose on the Mt. Haggin WMA.

METHODS

The management process was partitioned into 4 parts: (1) defining the management objective; (2) monitoring to see if the objective has been attained; (3) if necessary, developing a management strategy to attain the objective; and (4) if necessary, implementing the management strategy. The process must be repeated at regular intervals, with the management strategy being adapted to attain or maintain the management objective.

Management Objective

Given that moose require available forage during the winter, the management objective focuses on the availability of browse at diverse heights above snow-cover. Many factors influence the height to which a given plant can grow, including climate, recent weather, and browsing pressure. Among these, browsing is the factor that can be regulated by the land manager. For that reason, adaptive management was based on the following objective: browsing will not prevent young plants from attaining their potential stature, their growth being primarily limited by local environmental conditions. The monitoring program was designed to determine if this objective was being attained.

Monitoring

Geyer willow was selected as an indicator species. The effect of browsing on Geyer willow was determined in 2 steps. First, we determined if browsing was a potential factor by examining shrubs that were ≤ 150 cm tall to determine the number that were intensely browsed. A shrub was classified as intensely browsed if at some point in the life of the shrub: (1) complete annual segment was dead (causing an annual segment to develop from a segment that elongated prior to the previous year); and (2) the dead segment was browsed. A shrub was classified as light-to-moderately

Fig. 1. Overview of willow community in Sullivan Creek.

browsed if all annual segments developed from segments that elongated the previous year. An architecture-based survey was conducted in 2000 to classify key wintering areas into 2 categories: (1) areas where all plants were intensely browsed; and (2) areas where some plants were light-to-moderately browsed (Keigley et al. 2002a, b). The architectures are described in Keigley and Frisina (1998). A finding that all plants were intensely browsed would indicate that browsing was a potential factor.

If browsing was determined to be a potential factor, the second step in the monitoring process was to determine if plants were likely to attain their potential stature. The likelihood of growth to potential stature was assessed using an index based on the height of the tallest live stem measured to the base of current-year-growth (HBCYG) and the height of the tallest intensely-browsed dead stem (HD) (LD Index = HBCYG – HD; Fig. 2). An LD Index value of about zero indicates that ungulates are browsing plants down to the zone of mechanical protection. LD Index values much greater than zero indicate that stems are growing above the zone of mechanical protection (thus the plants are growing taller), while values much less than zero indicate that plants are dying back to ground level. In 2000, monitoring sites were established in Sullivan Creek, Deep Creek, French Creek, and American Creek. At each site, LD Index measurements were taken on

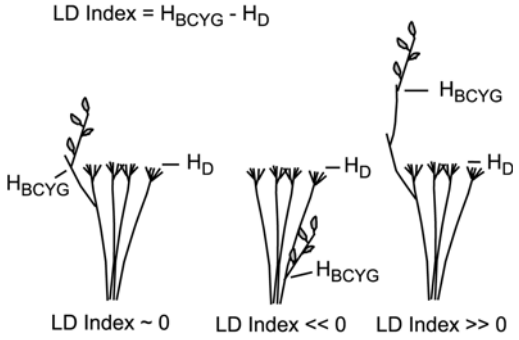

Fig. 2. LD Index is a measure of the response of a plant after intense browsing.

20 plants annually. Plants were selected for measurement by walking a set number of paces and selecting the nearest plant that met the height criterion; plants were not marked for re-measurement (Keigley et al. 2001). At each site photographs were taken down a permanently marked transect each year. Trends documented by LD Index data were compared to trends indicated by paired photographs of given shrubs.

Management Strategy

A finding that browsing prevented young plants from attaining potential stature would require a reduction in browsing pressure if the management objective was to be attained. In this case, browsing pressure was regulated by changing the moose harvest quota.

RESULTS AND DISCUSSION

The survey of critical willow habitat in 2000 found that 100% of Geyer willow was intensely browsed in all surveyed areas (Keigley et al. 2003). The widespread intense browsing indicated that browsing could potentially prevent young plants from attaining full stature. Mean LD Index values at the 4 monitoring sites in 2000 were, respectively: -12 ± 5 cm, -38 ± 10 cm, -9 ± 4 cm, and 2 ± 6 cm (± SE, n = 20). The 3 negative values and the single value near zero (2 cm) were interpreted to indicate that browsing was preventing young plants from attaining their potential stature.

Based on the initial browse survey, the moose harvest quota was increased 40% in 2000 in the 2 hunting districts encompassing the WMA (Hunting Districts 319 and 325) (Fig. 3). In 2002, harvest quotas were increased an additional 7% and Hunting District 341 was created from a portion of Hunting District 319 to distribute moose hunting pressure away from the readily accessible portion of the WMA west of the Continental Divide. Harvest quotas were lowered to slightly below pre-study levels following the 2002 hunting

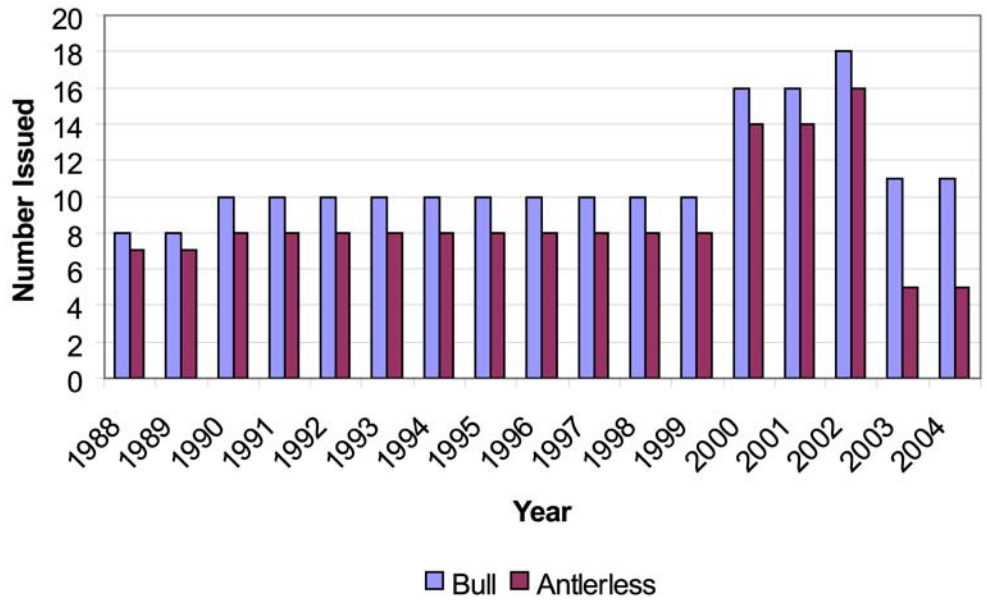

Fig. 3. Mount Haggin moose permits 1988 – 2004.

season. Percent harvest success remained above the management threshold of 80% during the period 2000-2002 (MFWP 2001, 2002, 2003). In 2003, 2 of the 3 hunting districts fell below the 80% threshold (MFWP 2004). Mild fall conditions combined with fewer moose in easily accessible areas were the likely cause of the decline in hunting success.

From 2000 to 2002 the LD Index increased at all sites, indicating that stems had grown above the height of stems previously killed by browsing (Fig. 4). From 2002 to 2004 the LD Index changed relatively little at Sullivan Creek, Deep Creek, and French Creek; at these sites, willow condition in 2004 had improved compared to willow condition in 2000. From

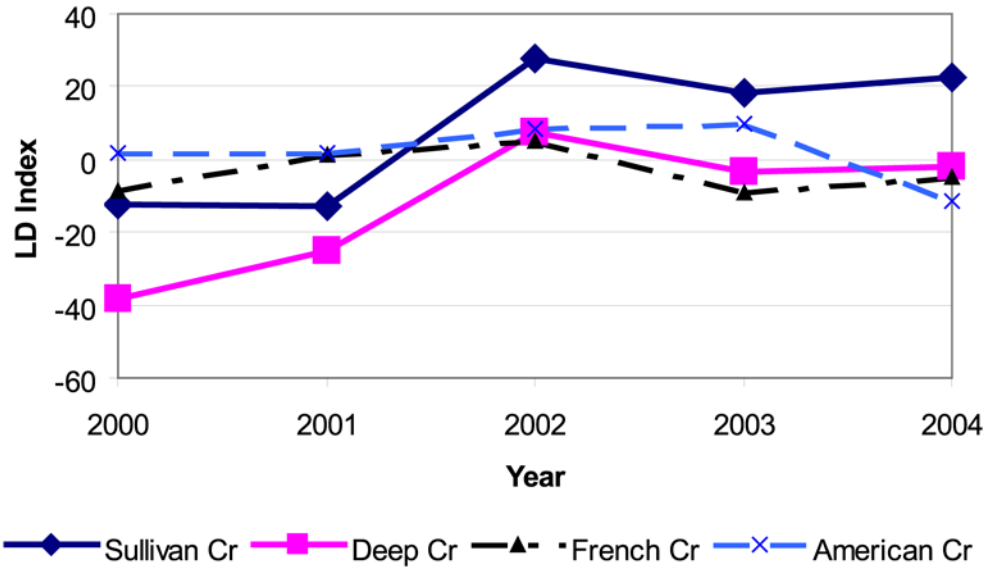

Fig. 4. LD Index values at 4 monitoring sites over the period 2000 - 2004.

Fig. 5. Paired photographs of the same shrubs at Sullivan Creek taken in 2000 and 2004. Stems are markedly taller in 2004 compared to 2000. This growth corresponds with an increase in LD Index over that period.

2002 to 2004 the LD Index declined markedly at American Creek; in 2004, the index at American Creek was lower compared to measurements made in 2000. We attribute the improvement of willow condition at 3 sites to a combination of reduced moose numbers (due to an increase in harvest) and increased dispersal (due to low snow-cover conditions).

Repeat photography corroborated the LD Index data at all sites. At Sullivan Creek, Geyer willow shrubs photographed in 2004 had extensive new growth that was not visible in the photograph taken in 2000 (Fig. 5).

Fig. 6. Paired photographs of the same shrub at American Creek taken in 2000 and 2004. Stems in 2004 are about the same height as in 2000. This lack of growth corresponds with a decline in LD Index over that period.

Similar results occurred in paired photographs of shrubs in Deep Creek and French Creek. At American Creek, new growth on shrubs photographed in 2004 was not visible (Fig. 6). Repeat photographs provide tangible visible evidence of trends, but do not provide quantitative data amenable to statistical analysis. LD Index values can be statistically compared. For example, at Deep Creek the mean LD Index measured in 2000 (-38.3 cm) statistically differed from the mean measured in 2004 (-3.3 cm) at $P = 0.0019$.

Public education on the need for moose population reductions was initiated through local newspapers, sportsman's organizations, and watershed groups. However, during the period of population reductions some individuals sought to lower the harvest based on fewer moose observations. Concern was expressed over possibly losing a lifetime opportunity to harvest a moose; Montana imposes a 7-year wait on hunters who draw a moose license, regardless of success. In response to these concerns, the harvest quota was reduced following the 2002 hunting season.

Current willow monitoring suggests the moose population rebounded within 2 years after the harvest quotas were reduced in 2002. Wildlife managers must now decide: (1) if the original objective is valid; and (2) how fast to try and effect change in the willow community with a public that demands a visible, readily accessible moose resource.

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