Addressing a recent population decline: limiting factors of Yarrow-Castle Bighorn Sheep

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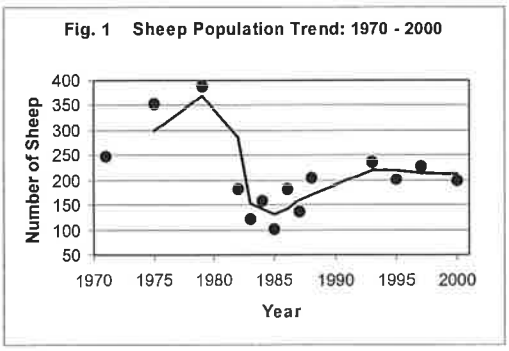
Background

Bighorn sheep are an important wildlife resource in southern Alberta. They are appreciated by a multiplicity of users of alpine environments: hunters, hikers, photographers, outfitters, local and aboriginal people. Bighorn sheep are valued trophy animals and a symbol of true wilderness, and through their use, stimulate the local economy and contribute to the enjoyment of many. Moreover, being an historical and current member of alpine ecosystems, sheep play a crucial role as a prey base for numerous alpine predators and scavengers, acting as a primary consumer of plant material and fostering a dynamic web of ecosystem interactions (Schmidt & Gilbert 1978).

Like all wildlife populations, bighorn sheep are subject to fluctuations in their population size due to a number of factors. Predation, hunting, injury, disease and natural food supply are all factors that play crucial roles in limiting the number of sheep occupying their range (Bergerud and Elliot 1998;Murphy et al. 1990; Geist 1971; Jorgenson et al. 1997; Goodson et al. 1991). The effects of disease on the southern bighorn population are perhaps particularly dramatic. Annual surveys indicate that sheep were increasing through the 1970's to a high of approximately 400 in Wildlife Management Unit (WMU) 400. Onset of pneumonia in the early 1980's, however, prompted a significant decline in this population to under 150 animals (Management Plan for Bighorn Sheep in Alberta, 1993; Fig. 1).

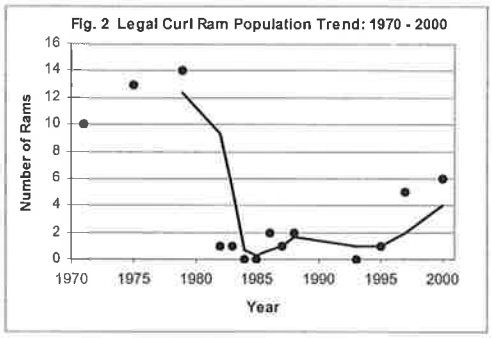


Note: All data presented in graphical form represent data gathered by Alberta Fish & Wildlife in the Table-Yarrow-Castle Mountain complexes within WMU 400.

There has been some question of the rate of recovery of this population following the disease-induced crash. For a number of years now, many have complained about the apparent lack of sheep in WMU 400, especially a lack of harvestable males. Moreover, wildlife managers continent-wide have observed that population recoveries after pneumonia epidemics have typically been slow.

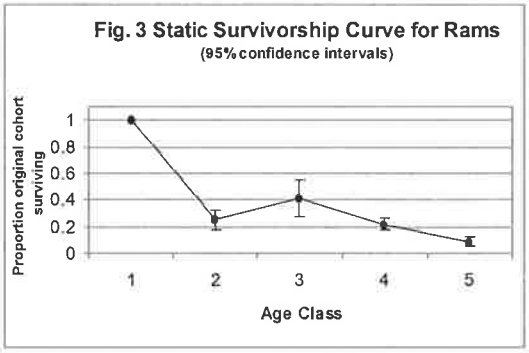
An examination of the population trend since the 1982 crash (Fig. 1), reveals that the herd grew steadily from 1985 to 1993 at roughly 10% per year. This growth rate appears not to be unusually slow for such an ungulate population, and thus warrants no special concern regarding the initial rate of recovery. However, it appears that this positive growth trend ended in the mid-1990's, leveling off to current numbers. The reasons for this are unclear due to lack of study beyond the regular population surveys.

A breakdown of this population trend into males and females reveals some curious results. As expected from local knowledge, there was an apparent lack of older rams in the population following the crash, and the recovery of this population segment did not appear to begin until over a decade later (Fig. 2). However, since 1995, the number of Class V rams have been increasing steadily in the population (note that "Class V" refers to legal rams observed during annual surveys, and that the legal designation changed from 4/5 to full curl in 1996; thus, the observed increase in legal rams is underestimated). Interestingly, the timing of this increase coincides with two significant changes in management practice. First, access into the front range canyons was restricted with the installment of gates on industrial access roads, reducing the impact of hunting in these areas. Secondly, the legal restriction for trophy rams was changed from 4/5 to full curl. Both practices were initiated in 1996, and coincide with the beginning of the increase of mature rams observed in annual surveys. It would appear at this time that these management practices are having the intended effect. For the first time in over a decade, a significant number of rams were harvested in WMU 400 this past season, bearing out the prediction from the data.

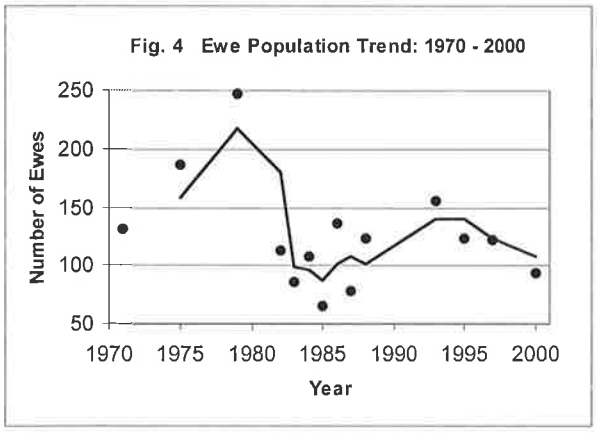


Our ability to distinguish age classes of males in the annual surveys allows us some further insight into the demographics of the male sub-population. A static survivorship curve (Krebs 1989) can be calculated from these data, whose purpose is to illustrate the proportion of males surviving into the next age class. Under the assumption that half of the observed lambs are males, our data indicate that 25% of the lambs survive to the next age class (1/4 curl; 1-2 year-olds), whereas 41% remain at 2-3 years of

age (1/2 curl), and 22% survive to 4 years (2/3 curl). In the oldest age class (5+ years; 4/5 and full curl), 9% of the original lamb cohort have survived (Fig. 3). It should be noted that the survivorship of ¼ curl rams is lower than that of the next age class, likely due to misclassification of these rams as ewes because of the difficulty in distinguishing these two classes in an aerial survey. The shape of this survivorship curve is typical of many sheep populations (Festa-Bianchet 1989; Hoefs & Bayer 1983), and while to the naïve observer 10% survival to the oldest age class may seem low, it is in fact typical of other populations. For example, in a hunted population, Jorgenson et al. (Ram Mountain Study, 1975-88) found that 10% of lambs survived to age 8 a hunted population, while just over 20% survived in an unhunted population. Again, these results raise no bells of alarm.



Of much greater concern, however, the ewe segment of this population has been in steady decline since 1993 (Fig. 4). The number of ewes currently in the population appears to be 1/3 less than that observed in 1993. The lack of scatter in the data suggests that this decline is real, rather than an effect of any bias or variability in the data. Again, the cause is unknown due to lack of study, but could result from a number of factors: spatial changes in range use, predation, reduced food quantity and/or quality, reduction in habitat quantity and/or quality, or poaching. Others have suggested that inbreeding may have reduced the vigour of the population. Effective management requires the insight to be gained from a careful study of these potential problems. We must sort out which factors are responsible for the observed demographic patterns, and use this knowledge to make informed decisions regarding the fate of the herd.



Study Area

The Yarrow-Castle Mountain complexes are located within Wildlife Management Unit (WMU) 400. This area is bounded on the west by the British Columbia border, and by Waterton Lakes National Park to the south. A narrow vegetative band of aspen lies to the east, comprising a rapid transition to prairie habitat and open grasslands. The Yarrow/Castle Bighorn Sheep Project will be entering into the first year commencing in the spring of 2002 and continuing as a multi-year project for a minimum of 3 years.

Project Objectives

The primary objective is to determine which factors may be limiting ewe numbers in the Yarrow-Castle ecosystem. Specifically, we will distinguish between the hypotheses that the observed decline is a result of predation, food quality/quantity, disease, or movement. We wish:

- to quantify the effect of predation on ewe mortality
- to determine the role that movement may play through emigration/immigration
- to examine reproductive demographic information as is relates to rates of population growth
- to examine current range condition using methods that may allow comparison to historical studies
- assess animal health through opportunistic observations and samples
- to build a predictive age-structured model of population dynamics based on demographic information gathered from marked individuals

- to measure the genetic diversity to determine whether inbreeding may be a possible factor affecting population viability (additional component that may be accomplished through collaboration with Fiesta-Bianchet study of North American sheep genetics)

Methods and Timeline

The following field activities are designed to address the specific objectives, as listed above:

YEAR 1

- capture of ewes throughout the Yarrow-Castle complex using drop nets
- application of 30 VHF radio collars to follow movements, dispersal and fate of individual ewes
- application of unique marks to an additional 20-30 individuals to provide information on survival and movement; this information will provide a base for an age-structured population model
- collection of incisor teeth to determine accurate ages of captured and marked individuals
- collection of blood samples for use in the determination of genetic diversity (possibly to be linked with another study of North American sheep genetics for large-scale data interpretation)
- ground surveys after lambing and again prior to breeding to determine reproductive success, subsequent survival of offspring and causes of mortality. High lamb mortality may warrant the marking of lambs in subsequent years to determine the cause of mortality if not readily apparent.
- survey of forage quality and quantity. Care will be taken to attempt to use methods compatible for comparison of data to historical studies to determine if food resources have changed over the years.
- sheep will be observed opportunistically for signs of pneumonia/parasite-infestation, and samples taken from animals captured and found dead (e.g. throat swabs, tissue samples, dung samples). If signs of disease are detected, it may be possible to quantify the effects of disease by comparing demographic rates among infected/non-infected animals

YEAR 2

- continuation of work started in year 1
- monitoring of collared individuals on the ground and by helicopter on a bi-weekly basis

YEAR 3

- continuation of field work
- development of an age-structured model of population dynamics (Leslie matrix method, Krebs 1994) to predict future trajectory of population

- draw conclusions to provide insight into management actions that could be taken to alter the population trajectory for desirable results

Communications Strategy

Annual reports and one final report will document progress and findings of this study. Further, progress will be detailed in local press releases, community and stakeholder presentations. Results may be presented at appropriate conferences and some data may be published in the format of peer-reviewed scientific journal articles.

Additional Comments

If the persistence of this bighorn sheep population is to be ensured, we must determine what factors are contributing to the worrisome decline of breeding individuals. Identification of these factors will allow managing agencies to make informed decisions regarding the appropriate actions to take to maintain desired population levels. Because so little is known about this population, detailed demographic and movement data are crucial to constructing a predictive model of population dynamics. Moreover, the maintenance of a large and stable population through informed actions will mean that future opportunities for both consumptive and non-consumptive uses can be assured.

Other Benefits

- Key sheep habitat areas will be identified including key movement corridors, lambing areas, summer range, rutting areas and winter range.
- Potential habitat enhancement areas will be identified. This will ensure habitat enhancement efforts are located within key sheep habitats (i.e. prescribed burn sites etc.).

The project will provide a number of recommendations to address factors that are suppressing the Yarrow/Castle bighorn sheep population. This will allow for possible management changes that could be used to benefit this population.

References

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Year 1 Budget

TOTAL PROJECT COST	MATCHING/ PARTNER FUNDS	COOPERATOR/S (Agency/Organization)
$165 189.00	$34 850.00	ACA (secured; in kind & monetary)
	$30 000.00	Shell Canada (monetary; secured)
	$15 000.00	Rocky Mountain Elk Foundation (monetary; request)
	$ 9 339.00	AB Professional Outfitters Society (monetary; request)
	$ 6 000.00	Foundation of NA Wild Sheep (monetary; request)
	$65 000.00	SRD-Fish & Wildlife (in kind)
	$ 5 000.00	WLNP (in-kind)

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Item	RMEF	FNAWS	SHELL	APOS	ACA	WLNP	F&W
Staff					$24 864.00	$5000.00	$55000.00
Helicopter/ Fuel	$5050.00		$26,336.00	$9339.00			
Vehicles/ATV's					$5,650.00		$10 000
Supplies (Collars, ear tags, traps,etc.)	$9950.00	$6,000.00					
Telemetry equipment			$3,664.00		$2,236.00		
Miscellaneous					$2,100.00		
TOTALS	$15 000	$6 000	$30 000	$9 339	$34 850	$5 000	$65 000

Note: The Alberta Conservation Association and Shell Canada have confirmed their contribution towards the project.