Supplementation of the Ram Mountain population of bighorn sheep – Cadomin Transplant Proposal 2014/15

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The Ram Mountain population of bighorn sheep has been the subject of research on the ecology, evolution and management of this species since 1971. That research has informed the management of bighorn sheep in Alberta and elsewhere, providing insights on population dynamics, predation, population genetics, and the biological consequences of both trophy and non-trophy sport harvests. The study is recognized internationally as one of the best long-term monitoring programs of ungulates in the world (Clutton-Brock and Sheldon 2010), and the only one with repeated measurements of mass and horn growth of individuals over their lifetime.

After peaking at about 230 individuals in 1991 (Fig. 1), the Ram Mountain population underwent a steep decline, initially because of density-dependent decreases in reproduction and increases in mortality of lambs and yearlings. This decline was accelerated in 1997-2002 by intense cougar predation, when the population plummeted from 146 to 40 individuals (Festa-Bianchet et al. 2006). Despite very low density, the population then stagnated for 5 years, with very poor recruitment and showing strong evidence of Allee effects, or positive density-dependence, as reported also for the Sheep River population (Bourbeau-Lemieux et al. 2011). Part of the poor performance was explained by an increase in inbreeding, as is typical of small populations. Inbred female lambs had very low survival (Rioux-Paquette et al. 2011) and we found no evidence of inbreeding avoidance (Rioux-Paquette et al. 2010).

A translocation of 12 adult sheep from Cadomin in 2004-2005 was mostly unsuccessful, as all introduced sheep left the mountain within a year, with the exception of one yearling ewe and one yearling ram that stayed and later contributed to recruitment. A second transplant in March 2007 involved 5 ewes and 7 rams aged 10 months. These sheep remained on the mountain, but only 2 ewes and one ram survived to reproduce. Another ram remained but had no known paternities as of the 2012 rut. All transplanted ewes (n=3) that reproduced on Ram Mountain began to do so at the age of 4 years, likely because their development was slowed by the relatively poor habitat conditions of Ram Mountain compared to Cadomin.

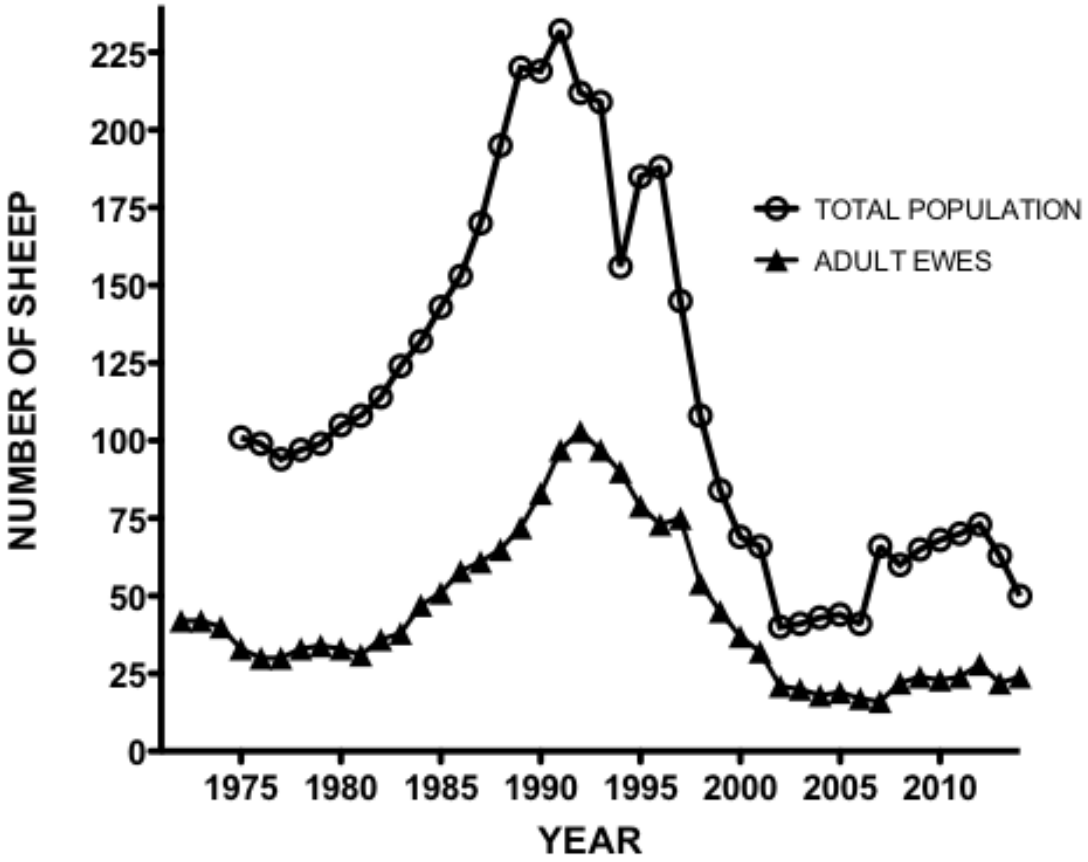

Figure 1. The total number of bighorn sheep and the number of ewes aged 2 years and older on Ram Mountain, Alberta, June 1974-2014. Supplementations from Cadomin occurred in 2005 (only 5 animals remaining by June) and 2007 (12 yearling remaining by June).

Despite the small number of transplanted sheep that contributed to reproduction (Table 1), the transplant led to a moderate degree of recovery, so that by 2012 the population had increased to 74, including 28 ewes aged 2 years and older. About a third of the population in both 2013 and 2014 had some 'Cadomin' genes. By June 2013 descendants of the transplanted sheep contributed about 10% to the overall genetic composition of the Ram Mountain population excluding surviving transplanted sheep. There is also some evidence of phenotypic recovery, as suggested by longer horns of 2-year-old rams (Fig. 2) and heavier mass of yearlings in mid-September (Fig. 3).

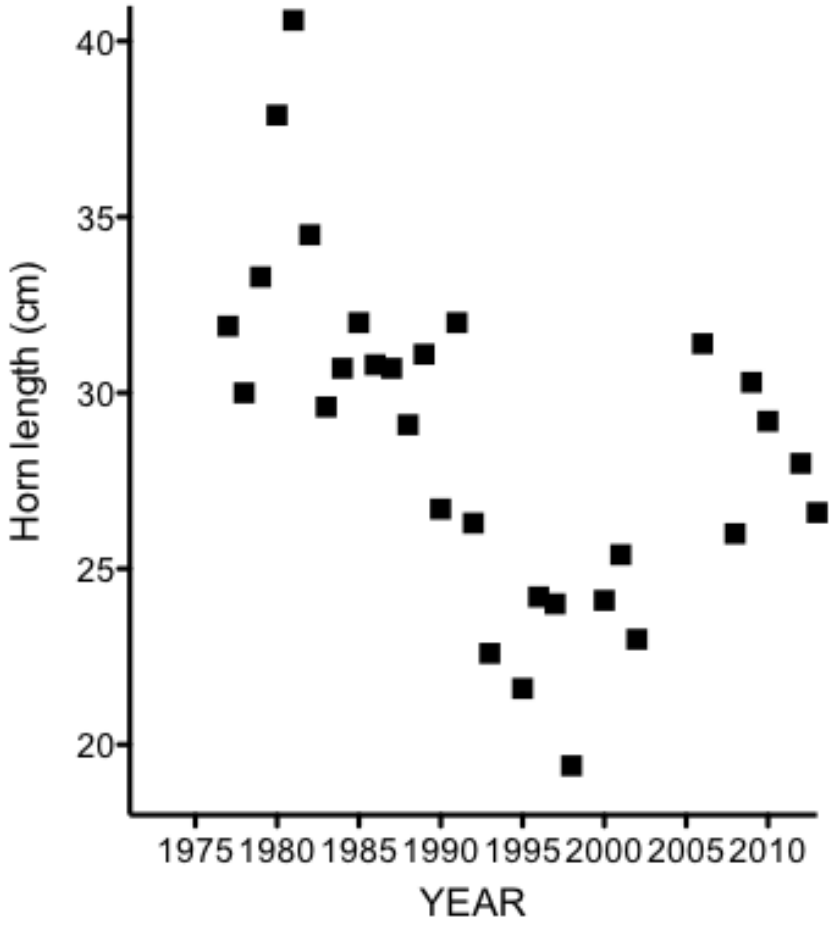

Figure 2. Average horn length of 2-year-old bighorn rams on Ram Mountain, 1976-2013, adjusted to June 5. Only years when at least 2 rams were measured are shown.

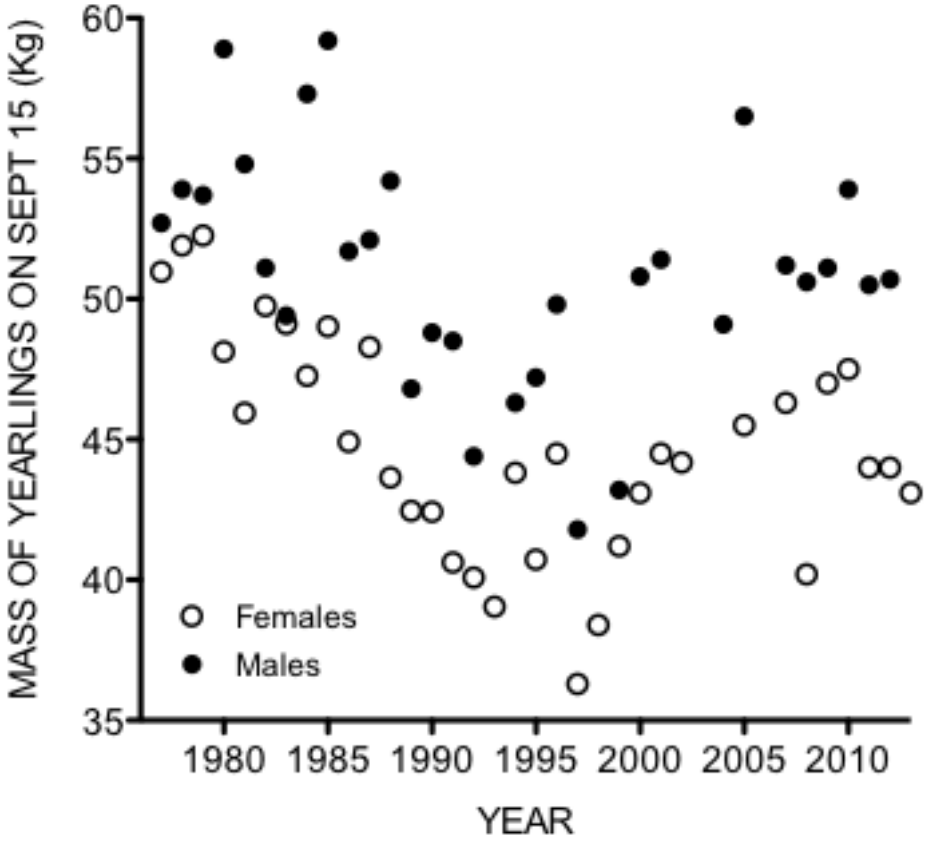

Figure 3. Average body mass of yearling bighorn sheep on Ram Mountain, 1976-2013, adjusted to September 15. Sex-specific data are shown only for years when at least 2 yearlings were weighed.

Unfortunately, the population was then reduced to 63 sheep by 2013, suspected to be the result cougar predation. That one year decline resulted in the loss of 36% of the adult ewes (one ewe was harvested by a First Nations hunter). By June 2014, the cougar predation episode appeared to be over. One adult male cougar was harvested on Ram Mountain in early December 2013, and observations by the field crew had suggested that the sheep-killing cougar was a male. All 21 adult ewes survived the winter 2013-2014 and another 3 2-year-olds were recruited, but still the population declined to about 50 sheep by June 2014, partly because of very low lamb production and survival in recent years.

Since 1996, lamb survival from birth to one year has averaged only 34%. Only 4 lambs were seen in 2014 and all were born after June 1st, suggesting that their survival will likely be poor (Feder et al. 2008). The population appears set for another decrease. Even after a 4-year moratorium, there are virtually no trophy rams in the population. As of June 2014, there are only 12 rams aged 2 years and older, and only one yearling ram.

Table 1. Population dynamics and spread of 'Cadomin genes' in bighorn sheep at Ram Mountain, 2007 to 2014

Year	Transplanted sheep surviving	Descendants of transplanted sheep	Total population	% population with 'Cadomin' genes
2007	16	1	69	24.6
2008	8	2	62	16.1
2009	6	5	65	16.9
2010	7	8	68	22.1
2011	7	10	70	24.3
2012	6	17	74	31.1
2013	4	17	63	33.3
2014	3	11	45	31.1

We have gathered substantial evidence of Allee effects in both the Ram Mountain and the Sheep River bighorn sheep populations (Bourbeau-Lemieux et al. 2011). At very low numbers, bighorn sheep populations do not show the classic density-dependence response and instead stagnate or continue to decline, partly because of predation. Therefore, small bighorn sheep populations are at risk of extinction and face a low probability of recovery, both for demographic and genetic reasons. Therefore, we are proposing a new supplementation of the Ram Mountain population with yearling sheep from Cadomin, to recover this important research population as a viable sheep herd that can produce at least 2-3 trophy rams per year.

Although translocation of adult sheep could lead to a faster contribution to population growth, previous experience revealed that adult sheep tend to leave. Lambs (10-months-old) and yearlings (22-months-old), however, appear to be more likely to remain on Ram Mountain. Because yearlings will contribute to reproduction sooner than lambs, we are requesting to transplant 8 yearling ewes and 4 yearling rams in March 2015. In March, sheep are relatively easy to capture at Cadomin, and would not face a long period of winter after release on Ram Mountain.

Based on previous experience, if 8 yearling ewes were translocated in 2015, it is predicted that 4-5 will contribute to reproduction beginning in 2017, at the age of 4 years. That will contribute to both demographic growth and genetic diversity. Rams also contribute to genetic diversity, but generally not until they reach 5-6 years of age. Because of the urgency of the situation, it is better to supplement the population with ewes than with rams, to ensure additional recruitment within a few years. This transplant will also increase our ability to evaluate how sheep transplanted from Cadomin survive, grow and reproduce in the poorer habitat of Ram Mountain. We will compare the physical development, horn growth and reproductive success of descendants with different levels of admixture of Ram Mountain and Cadomin genes.

Without this transplant, the future of the Ram Mountain population is uncertain. There are currently 24 adult ewes, but recruitment in 2014 will be minimal because of the very small number and late births of the cohort. The population has shown little recovery despite a dozen years at low density (Fig. 1). The only recovery appears to be due mostly to the contribution of the small number of translocated Cadomin sheep that contributed to local reproduction (Table 1).

The proposed translocation

Sheep for the relocation will come from Cadomin mines. We request 8 females and 4 males, all yearlings. Assuming that these animals will be captured and moved in March 2015, they will be about 22 months old at the time. It should be possible to capture all 12 animals in the same day.

Sheep would be baited to easily accessible areas and would be free ranged darted using immobilization drugs prescribed by a veterinarian experienced in capture of wild ungulates. We would propose two darting and handling crews to speed up the process and increase the chances of being able to capture all 12 sheep in one day. All sheep would be weighed, measured (horn length and base circumference, annuli) and receive a unique ear-tag combination, using Allflex tags. A tissue sample will be collected from each ear with a biopsy punch and placed in a labelled vial with alcohol for DNA analysis in Prof. Dave Coltman's lab at the University of Alberta. They would be inspected by a veterinarian, loaded into crates and the following morning moved by trailer to the base of Ram Mountain, from where they will be transported by helicopter to the trap site and released. Survival and reproduction will then be monitored on Ram Mountain beginning in late May.

Estimated Budget (some costs may vary depending on how the capture goes)

Consultant to coordinate captures with mine and assist with set-up, baiting, and capture:	$ 2015
Capture Specialists (2 darting experts plus equipment):	$ 3350
Veterinarian (Dr Owen Slater)expertise and emergency care:	$ 1300
Helicopter time (2.5 hours @ $ 1910/hr):	$ 4775
Immobilization Drugs:	$ 1525
Medatomidine	
Ketamine	
Atipamazole	
Estimated Total:	$ 12,965

In kind support from ESRD staff (capture assistance, vehicles for transport, transport crates).

Request from Wild Sheep Foundation:	**$7,965**
Other Funding Partner Contribution (University of Sherbrooke):	$5,000

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