

IDAHO DEPARTMENT OF FISH AND GAME

Steven M. Huffaker, Director

Project W-160-R-32

Progress Report



HELLS CANYON BIGHORN SHEEP

Study I: Hells Canyon Bighorn Sheep Restoration

July 1, 2004 to June 30, 2005

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**PROGRESS REPORT
STATEWIDE WILDLIFE RESEARCH**

STATE:	<u>Idaho</u>	JOB TITLE:	<u>Hells Canyon Bighorn Sheep</u>
PROJECT:	<u>W-160-R-32</u>		
SUBPROJECT:	<u></u>	STUDY NAME:	<u>Hells Canyon Bighorn Sheep</u>
STUDY:	<u>I</u>		<u>Restoration</u>
JOB:	<u>1</u>		
PERIOD COVERED:	<u>July 1, 2004 to June 30, 2005</u>		

ABSTRACT

The Hells Canyon Initiative is a state, federal, and private partnership to restore Rocky Mountain bighorn sheep *Ovis canadensis canadensis* in the Hells Canyon area of Oregon, Idaho, and Washington. During this reporting period, 111 radio-collared bighorn sheep were monitored regularly in 10 populations. Annual survival of radio-collared ewes was 0.90 and 0.62 for rams. Adult survival varied among populations. The largest sources of mortality were trauma and other injury or infection. No pneumonia-caused adult mortality was detected. Lamb survival was also highly variable among populations. Pneumonia-caused mortality of lambs was confirmed in 4 populations and suspected in 3 others. The overall meta-population was estimated at 875 bighorn sheep, a decline of 4% from 2003-2004. Annual health testing was conducted in the Lostine, Oregon population, and 6 bighorn sheep were moved to the lower Imnaha population. These sheep subsequently moved to the Saddle Creek population. Several other movements of bighorn sheep among herds were documented.

A meeting was held among researchers working on disease in bighorn sheep to increase collaboration and communication. An interpretive display on the project was developed for the Jack O'Connor Hunting Heritage Center to be constructed in Lewiston, Idaho, in 2006. Twelve rams were harvested in Hells Canyon in 2004, including the largest ram ever taken by a hunter in Idaho.

INTRODUCTION

The Hells Canyon Initiative was started in 1995 as a program to accelerate restoration of bighorn sheep in Hells Canyon and the surrounding areas of Idaho, Oregon, and Washington and to focus research applicable to bighorn sheep restoration and management throughout the western United States and Canada. The concept was formalized in 1997 with the completion of an interagency memorandum of agreement and restoration plan (Hells Canyon Bighorn Sheep Restoration Committee 1997). The restoration plan was updated in 2004 (Hells Canyon Bighorn Sheep Restoration Committee 2004).

PROJECT AREA

The Hells Canyon Initiative project area encompasses 2,273,194 ha (5,617,062 ac) in the Snake River drainage in Oregon, Idaho, and Washington from the mouth of Clearwater River, Idaho, south to Brownlee Reservoir. It is bounded on the east by the hydrologic divide between the Salmon and Snake rivers near Riggins, Idaho, south to Brownlee Creek on the Payette National Forest, Idaho, and extends just west of the Eagle Cap Wilderness, Wallowa-Whitman National Forest, Oregon. Major drainages include the Snake, Grande Ronde, Imnaha, and lower Salmon rivers. There are currently 16 bighorn sheep populations, or herds, established in the project area (Figure 1). Over 1.3 million acres (24%) of the project area is potential bighorn sheep habitat, 68% of which is publicly-owned, primarily managed by the U.S. Forest Service (USFS). Other public land managers are the states of Oregon, Idaho, and Washington and the Bureau of Land Management (BLM).

CAPTURE, SAMPLING, AND TRANSPLANT

As part of an annual monitoring program, 15 bighorn sheep were captured in the Lostine, Oregon herd in 3 captures: 11 January, 8 February, and 9 February 2005. Six ewes (5 adults, 1 lamb) captured in January were moved to Cow Creek, a tributary of the lower Imnaha River. The adults were radio-collared and relocated at least every 2 weeks. Two 2-year-old rams captured in February were fitted with GPS collars and released on site at the Lostine winter range.

Nasal and pharyngeal swab samples were collected from the 15 sheep captured. The swabs were submitted to the University of Idaho Caine Veterinary Teaching Center for culture of *Pasteurella* and *Mannheimia* spp. bacteria. Blood serum samples were collected for testing for exposure to respiratory viruses and submitted to the Idaho State Bureau of Animal Health Laboratory. Blood and serum were also collected for evaluation of trace element levels at the University of Idaho Holm Research Laboratory. Fecal samples and ear swabs were collected and submitted to the Washington Animal Disease and Diagnostic Laboratory for analysis of internal and external parasites. Body condition was estimated through palpation at the withers, ribs, and rump on a score of 1 (emaciated) to 5 (obese).

Sampling Results

Results of health sampling in the Lostine herd (Table 1; Appendix A) were similar to those from previous years (1997-2003). During this period, no lungworm larvae have been detected in the feces of the Lostine bighorn sheep. As in previous years, average blood selenium values of 0.40 ppm (Table 2) are observed in this population when selenium-supplemented salt is available. Average body condition of the sheep as judged by palpation was fair to good (3.4). Average body condition score in January was 3.5, this declined slightly to an average of 3.3 in February.

Since the winter of 1999-2000, no titers to respiratory viruses, with the exception of *Parainfluenza-3* virus (*PI-3*), have been detected in this herd (Table 3). Prior to this time, only occasional positive titers to blue tongue virus, bovine viral diarrhea virus, and ovine progressive pneumonia were detected (1 of 10-21 individuals tested annually). The respiratory virus titer showing the most variability through time has been the proportion of the population with positive

serum neutralization titers to *PI-3*. Since 1997, this has varied from 0-90%, and in 2005 it was 87% (Table 3). The median positive titer (32; range 16-64) was at the high end of the range observed in previous years (median positive titer 4-32).

Scabies mites (*Psoroptes ovis*) were first detected in the Lostine herd in 2003-2004, and infection has apparently become endemic (53% positive in 2005). Treatment with the anthelmintic ivermectin is ongoing both through injection at capture and ad libitum oral administration in salt.

Twelve biovariants or subspecies of *Pasteurella* and *Mannheimia* were represented in 18 of 30 swab samples where *Pasteurella* or *Mannheimia* isolates were detected (Appendix A). Lack of detection of *Pasteurella* or *Mannheimia* may have been a result of sampling or handling rather than an absence of the bacteria in the sheep (Wild and Miller 1991). *Mannheimia* spp. were detected on pharyngeal swabs from a slightly higher proportion (55%) of individuals than *P. trehalosi* (45%) which is considered the normal flora in bighorn sheep (Table 4). Detection rate was higher from pharyngeal swabs (73%) than nasal swabs (46%). Species or biovariants differed between nasal and pharyngeal swabs in 4 of 7 (57%) samples where both were taken. The pharyngeal swabs likely represent bacteria that have colonized the bighorn sheep, whereas the nasal swabs may represent bacteria that are being transmitted among sheep but may never become established in the pharyngeal area.

Four *Mannheimia* isolates from 3 individuals were beta-hemolytic, indicating presence of the potentially virulent leukotoxin-A gene (Fisher et al. 1999), and *P. multocida*, also considered potentially virulent (Weiser et al. 2003), was isolated from 1 individual (Table 5). *Neisseria* spp. were isolated from pharyngeal and/or nasal swabs from 5 individuals, *Streptococcus* spp. from 3 individuals, and *Enterobacter* spp. from 1 pharyngeal swab (Appendix A).

Transplant

All 6 bighorn sheep transplanted from the Lostine herd to Cow Creek in the Innaha herd area survived through September. Four of the 5 adult ewes were seen with lambs and the lambs also survived through September. For the first 4 months following release, the sheep were usually observed together and were not observed with any of the resident Innaha sheep. Several apparently exploratory movements occurred to the south, but the sheep returned to the area near the release site until early May when they moved approximately 20 miles south to Hat Point, joined a group of about 8 sheep (the Saddle Creek herd), gave birth to their lambs, and stayed there for the rest of summer (Figure 2).

SURVIVAL AND MOVEMENTS

Adult Survival

One hundred eleven radio-collared bighorn sheep (87 ewes, 24 rams) were monitored in 10 herds, 1 June 2004 to 31 May 2005. Nineteen radio-collared adult bighorn sheep died during this period. No pneumonia-caused mortalities were documented. The most common causes of mortality were trauma or other injury (Figure 3). Radio-collared ewe survival averaged 0.90 and

ram survival averaged 0.63. Survival of ewes in 7 herds with 7-16 radio-collared animals in each herd, ranged from a low in Asotin Creek of 0.57 to 100% in the Muir Creek, Redbird, and Wenaha herds (Table 6).

Lamb Survival

Lamb survival was highly variable among herds. Eight intact dead lambs were recovered between 10 June and 4 August 2004 in the Redbird, Black Butte, Wenaha, Lower Hells Canyon, and Myers Creek herds. Six were diagnosed with pneumonia by the Washington Animal Disease and Diagnostic Laboratory, and 2 were non-diagnostic. Summer lamb survival in the 4 herds where lambs were diagnosed with pneumonia was 50% or less (Table 7) and recruitment in these herds ranged from 0-28 lambs:100 ewes (Table 8). Pneumonia-caused lamb mortality was suspected in another 3 herds where summer survival was 29% or less and recruitment was 0-4 lambs:100 ewes (Table 7), although no dead lambs were recovered.

MOVEMENTS

GPS Collars

The VHF radio batteries on both GPS collars placed on young rams in the Lostine herd failed during summer. The collars will be retrieved on winter range to download the GPS data.

Ewe and Ram Movements

Several sheep moved among herds and states during this period. In January 2005, 5 ewes from a February 2002 transplant of 20 bighorn sheep from the Missouri Breaks in Montana to the Myers Creek area in Idaho, moved across the Snake River and joined the Muir Creek, Oregon population. Two of the ewes died in June 2005 from unknown causes. At least 9 bighorn sheep from this transplant are still alive as of fall 2005. Radio-collars failed on 2 sheep and their fate is unknown. One ewe is in Sheep Creek, Idaho, 6 ewes and 1 ram are in the Muir Creek, Oregon, population and 1 ram is in the Imnaha, Oregon, population.

Black Butte ram 03BB27, radio-collared at the mouth of the Grande Ronde River in Washington as a 2-year-old in March 2003, moved among 3 herds in all 3 states during a 13-month period, July 2004-August 2005. Several months were spent in association with resident bighorn sheep in each herd. Movements among herds occurred both during breeding season and outside breeding season (Figure 4).

POPULATION MONITORING

Hells Canyon bighorn sheep were surveyed by the states of Oregon, Idaho, and Washington from a helicopter and on the ground in 2004-2005. Approximately 875 bighorns are estimated to occur in 16 herds or subpopulations within the project area (Table 8), a 4% decrease from 910 sheep in 2003-2004. Population dynamics continue to differ considerably among herds (Appendix A).

DISEASE RESEARCH AND MANAGEMENT

A meeting was held in Lewiston, Idaho, in April 2005 to increase communication and interdisciplinary collaboration among researchers investigating disease in bighorn sheep. It was the first of what is hoped to be regular meetings to share information on this topic. Attendance was by 13 researchers, managers, and veterinarians working in the northwestern U. S. (Idaho, Oregon, and Washington) representing Idaho Department of Fish and Game (IDFG), Washington Department of Fish and Wildlife (WDFW), Oregon Department of Fish and Wildlife (ODFW), University of Idaho Caine Veterinary Teaching Center, and Washington State University School of Veterinary Medicine. Follow-up meetings have been held with Washington State University and University of Idaho Caine Veterinary Teaching Center to discuss collaboration on specific research projects.

PUBLIC INFORMATION AND OUTREACH

An interpretive display on the Foundation for North American Wild Sheep (FNAWS) and the Hells Canyon Bighorn Sheep Initiative was designed by the Hells Canyon Bighorn Sheep Restoration Committee. This display will be included in Jack O'Connor Hunting Heritage Center in Lewiston, scheduled to open in June 2006.

Articles on the Hells Canyon Initiative appeared regularly in the FNAWS National and Chapter publications in 2004-2005, and the Initiative had an informational booth at the National FNAWS convention in San Antonio, Texas, and at the Idaho and Oregon FNAWS chapter banquets. In June, Washington FNAWS sponsored the third annual meeting of the Washington, Oregon, and Idaho FNAWS chapters in Hells Canyon.

HARVEST

A total of 266 rams have been harvested by 282 draw permit holders and auction or lottery tag holders in the project area since the first season in 1978 (Table 9), including 12 rams in 2004. Success rate has exceeded 90%. Hunting is by controlled permit and limited to rams only in all 3 states. Oregon and Washington permit the taking of any ram, while Idaho requires a $\frac{3}{4}$ curl or greater, or an age of at least 4 years. Washington herds must have at least 8 mature rams, of which 2 are at least 6 years old or $\frac{3}{4}$ curl (WDFW 1995). In Idaho, permits can be issued for no more than 20% of mature ($\frac{3}{4}$ curl or greater) rams (IDFG 1990). In Oregon, the number of tags authorized for a hunt is based on the number of mature rams available in the unit area and the size of the hunt area (ODFW 2003). Nez Perce tribal members have treaty rights to hunt in all 3 states within the project area. The number of bighorns harvested by tribal hunting is unknown. Over 50 rams greater than 180 Boone and Crockett points have been taken by tag holders in the Hells Canyon area. A ram scoring 196 $\frac{4}{8}$ was taken in the Redbird, Idaho, herd in 2004. This was the second largest bighorn ram ever recorded in the state. The largest ram recorded in Idaho (197 $\frac{7}{8}$) was picked up from this same population in 1996.

In 2004, Washington authorized a lottery tag for 1 bighorn sheep to be taken in the Blue Mountains, including the Black Butte, Mountain View (also called Cottonwood), Wenaha, and Tucannon herds. With the exception of the Tucannon, these herds have been closed to hunting

since 1996. Idaho increased the number of tags in the Redbird herd to 2, and under an agreement between Idaho and the Nez Perce tribe, the tribe also received a tag for the Redbird herd bringing the total tags for this herd to 4 (including the auction or lottery tag). These changes will take effect in the 2005 hunting season.

RESTORATION COMMITTEE

The Hells Canyon Bighorn Sheep Initiative is conducted by the Hells Canyon Bighorn Sheep Restoration Committee. The committee is comprised of state, federal, tribal, and private organizations, of which each provide an administrative (A) and technical (T) committee member. Organizations and committee members in 2004 are:

Idaho Department of Fish and Game

- Dale E. Towell, Wildlife Program Coordinator (A)
- Frances Cassirer, Tri-State Coordinator/Wildlife Research Biologist (T)

Oregon Department of Fish and Wildlife

- Don Whitaker, Program Coordinator (A)
- Vic Coggins, District Wildlife Biologist (T)

Washington Department of Fish and Wildlife

- Donny Martorello, Big Game Program Manager (A)
- Paul Wik, Wildlife Biologist (T)

USDA Forest Service

- Bob Rock, Natural Resources Staff, Wallowa-Whitman National Forest (A)
- Tim Schommer, Forest Biologist, Wallowa-Whitman National Forest (T)

USDI Bureau of Land Management

- John Augsburger, Wildlife Biologist, Idaho State Office(A)
- Craig Johnson, Wildlife Biologist, Salmon-Clearwater Resource Area (T)

Foundation for North American Wild Sheep

- Raymond Lee, President/CEO (A)
- Lloyd Oldenburg and Rick Brigham, Members (T)

Nez Perce Tribe

- Loren Kronemann, Wildlife Biologist (A)
- Marcie Carter, Wildlife Biologist (T)

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- WILD, M. A., AND M. W. MILLER. 1991. Detecting nonhemolytic *Pasteurella haemolytica* infections in healthy Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*): Influences of sample site and handling. *Journal of Wildlife Diseases* 27:53-60.

Hells Canyon Bighorn Sheep Project Area



Legend

- Bighorn sheep herds
- BLM
- Nez Perce Tribe
- Private
- State
- U.S. Forest Service

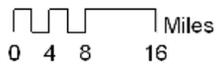
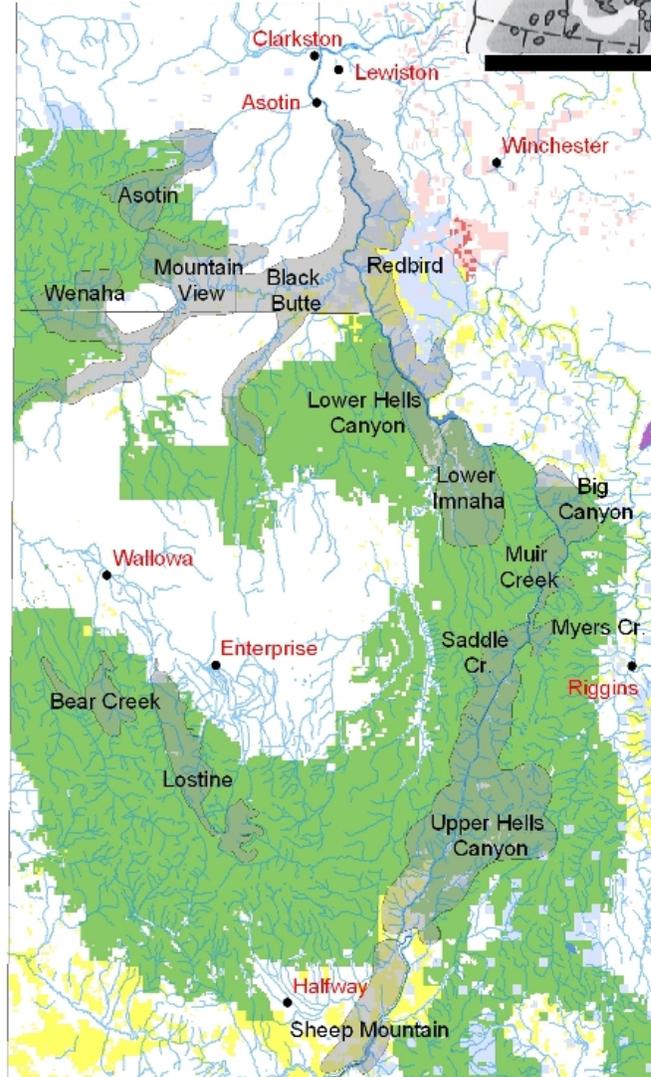


Figure 1. Hells Canyon Initiative Project Area.

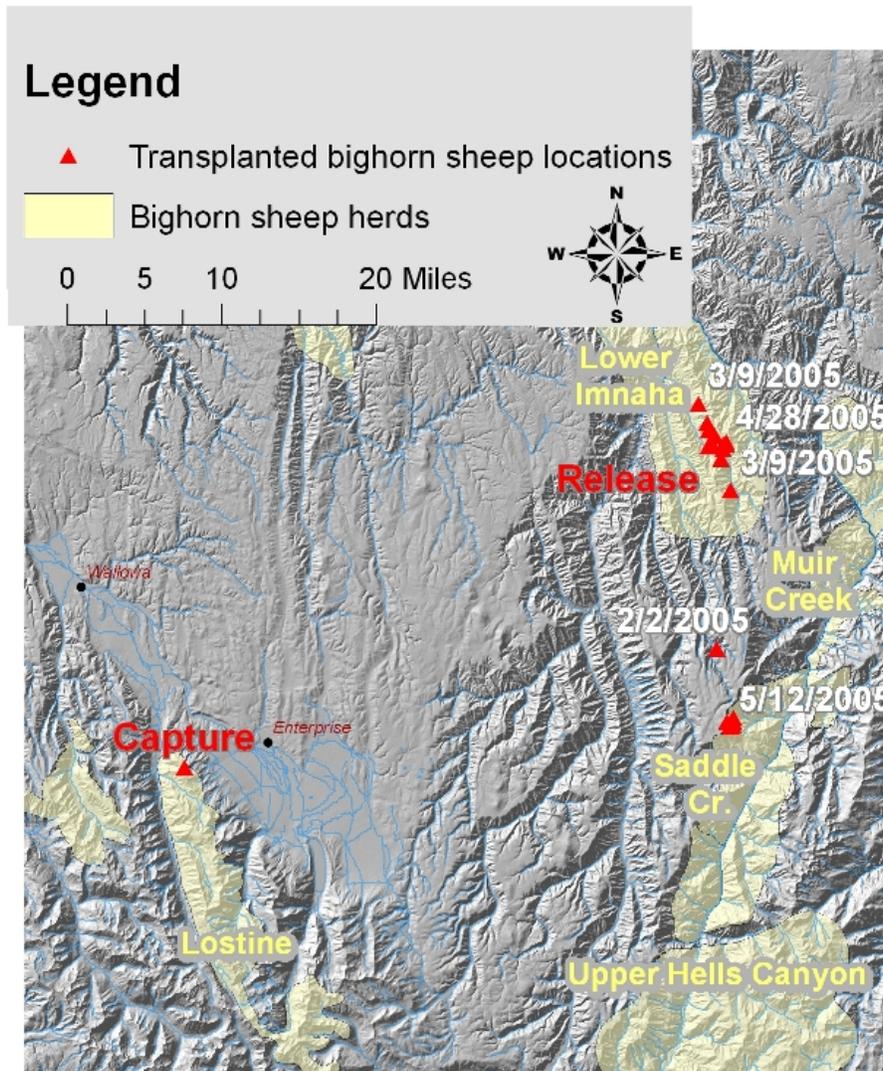


Figure 2. Movements of 6 bighorn sheep captured on the Lostine winter range, 11 January 2005 and released at Cow Creek in the Imnaha River drainage. The sheep moved in and out of Cow Creek until May 2005 when they joined some of the Saddle Creek sheep at Hat Point. Lambing occurred at Hat Point at the end of May and early June, and the transplanted sheep remained there through summer.

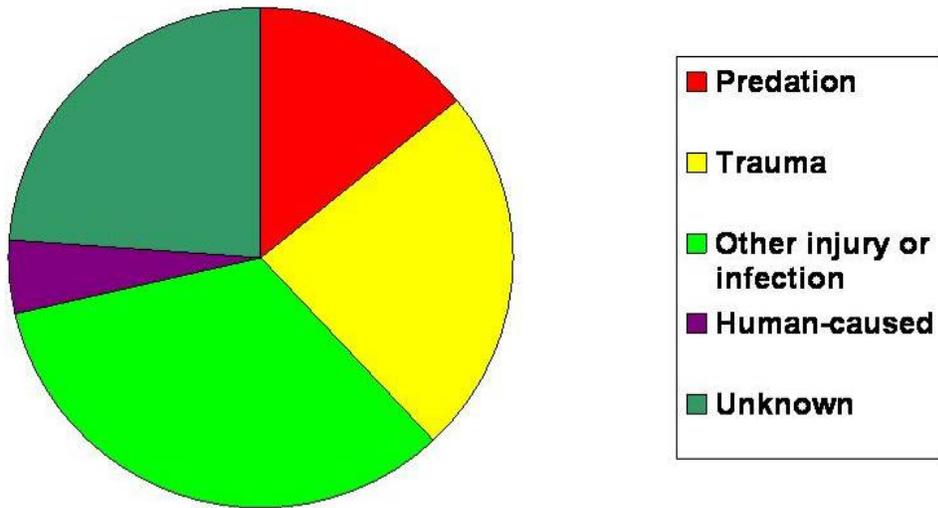


Figure 3. Causes of mortality of 19 adult radio-collared bighorn sheep in Hells Canyon, 1 June 2004 to 31 May 2005. The most frequent causes of mortality were trauma due to falls and various infections or injuries including 1 case of osteomyelitis and other ailments or injuries in intact dead sheep. Cougar predation accounted for 15% of adult mortality.

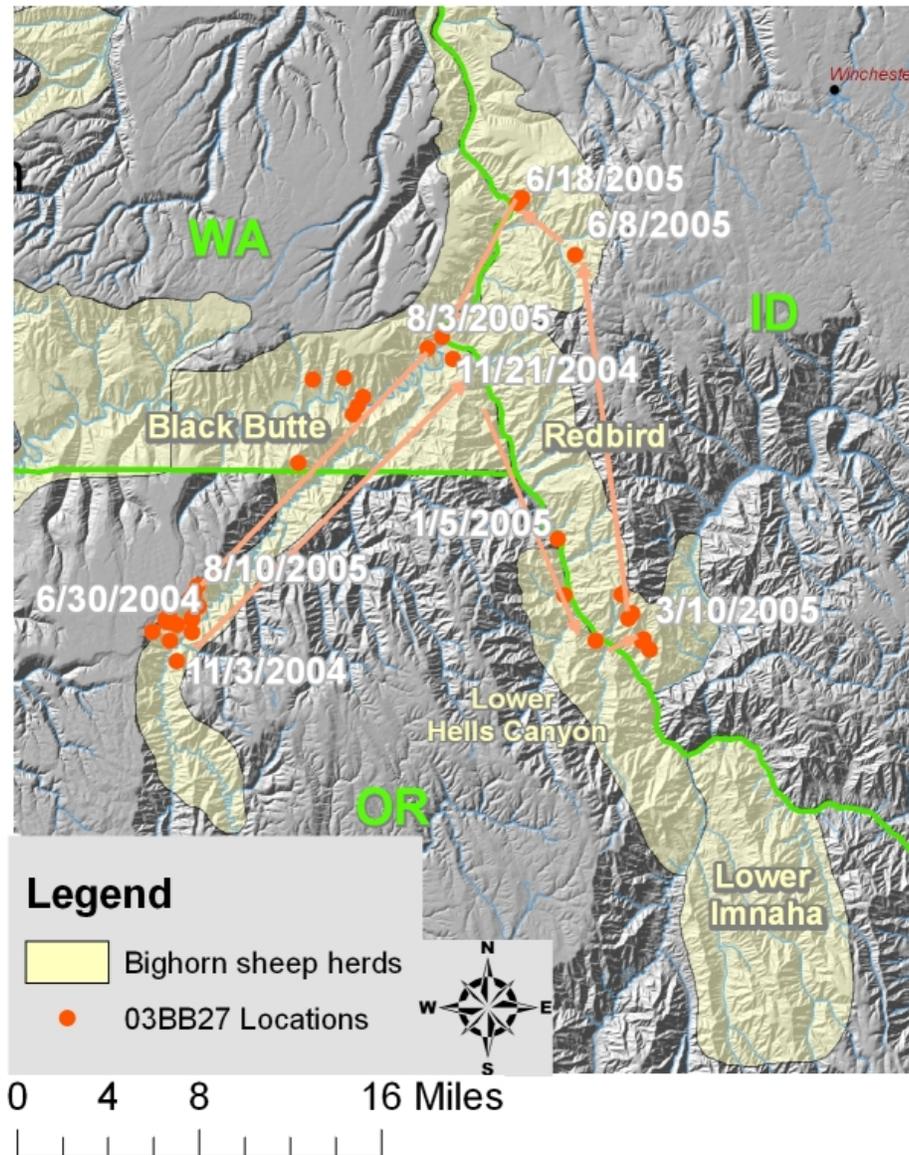


Figure 4. Movements of Black Butte, Washington, ram 03BB27, 30 June 2004 to 10 August 2005. Over the 13 month period, this ram traveled from the Black Butte/Upper Joseph Creek herd in Oregon and Washington, to the Lower Hells Canyon herd along the west side of Snake River, the Redbird herd on the east side of the Snake River, and then went back to the Black Butte/Upper Joseph Creek herd. Straight line distance traveled was approximately 75 miles and the ram crossed the Snake and Grande Ronde Rivers twice.

Table 1. Fecal lungworm (*Protostrongylus* spp.) larvae infection prevalence and intensity (larvae per gram) in 175 bighorn sheep sampled at capture in 6 populations in Hells Canyon, 1997-2005.

Population	Year	Prevalence	Mean intensity	Range
Asotin	2003	0/13	0.00	0
Black Butte	1997	10/13	20.17	6-48
	2000	6/6	24.50	6-40
	2003	8/10	5.90	2-16
Imnaha	2000	10/21	12.00	1-176
Lostine	2000	0/15	0.00	0
	2001	0/14	0.00	0
	2002	0/13	0.00	0
	2003	0/7	0.00	0
	2004	0/10	0.00	0
Redbird	2005	0/15	0.00	0
	1997	8/11	13.64	5-33
	2000	2/3	10.70	4-28
Wenaha	2003	12/12	9.30	2-22
	1997	6/12	8.00	8-30
	2000	15/15	9.80	3-22
Average		0.42	8.00	0-176

Table 2. Whole blood and liver selenium values (ppm) in 8 bighorn populations in Hells Canyon, 1997-2005. Selenium concentrations in blood and liver did not differ within populations ($p > 0.502$) except in the Lostine population ($p = 0.002$). Population means with different superscript letters are significantly different ($p < 0.05$).

Population	Blood \bar{x} (n) s.d. range	Liver \bar{x} (n) s.d. range	Mean
Asotin	0.09 (13) 0.06 0.03-0.22	NA	0.092 ^A
Big Canyon	NA	0.19 (6) 0.03 0.14-0.21	0.19 ^{AB}
Black Butte	0.19 (16) 0.09 0.06-0.38	0.16 (4) 0.08 0.04-0.22	0.18 ^{AB}
Imnaha	0.11 (27) 0.07 0.02-0.26	0.11 (7) 0.05 0.03-0.17	0.11 ^{AB}
Lostine	0.40 ^C (44) 0.15 0.12-0.65	0.14 ^{AB} (2) 0.14 0.05-0.24	
Muir	NA	0.17 (9) 0.03 0.14-0.24	0.17 ^{AB}
Redbird	0.21 (17) 0.07 0.11-0.33	0.31 (6) 0.14 0.13-0.47	0.24 ^B
Wenaha	0.11 (25) 0.08 0.02-0.33	0.09 (4) 0.03 0.066-0.12	0.11 ^{AB}

Table 3. Prevalence of titers to respiratory viruses and *Anaplasma* spp. in adult bighorn sheep in 6 Hells Canyon populations at capture, 1997-2005. Number positive in parentheses.

Population	Year ^b	n	Pathogen ^a							PI3 median + ^c	PI3 + range
			Ana	BTV	BRSV	BVDV	EHDV	OPP	PI3		
Asotin	2002-03	13	0	0.08 (1)	0	0	0.08	0.15 (2)	0.38 (5)	8	
Black Butte	1997-98	12	0	0	0	0	0	0	0.25 (3)	64	
	1999-00	6	0.16 (1)	0	0.16 (1)	0	0	ND	1.00 (6)	32	8-64
Imnaha	2002-03	10	0.50 (5)	0	0	0	2 (0.20)	0	0.9 (9)	12	
	1999-00	21	0.38 (8)	0	0	0.14 (3)	0	0	0.86 (18)	24	8-64
Lostine	2002-03	6	0	0	0	0	1 (0.17)	0	1.00 (6)	8	8-16
	1998-99	15	0.47 (7)	0.07 (1)	0	0	0	1 (0.07)	0.87 (13)	16	8-16
Redbird	1999-00	21	0.38 (8)	0	0	0.05 (1)	1 (0.05)	0	0.67 (14)	32	4-64
	2000-01	11	0	0	0	0	0	0	0.09 (1)	16	16
	2001-02	25	0	0	0	0	0	0	0	0	0
	2002-03	10	0	0	0	0	0	0	0.90 (9)	4	4
	2003-04	15	0	0	0	0	0	0	0.47 (7)	12	8-32
	2004-05	15	0	0	0	0	0	0	0.87 (13)	32	16-64
	1997-98	12	0	0	0	0.08 (1)	0	0	0.50 (6)	24	16-32
Wenaha	1999-00	6	0.17 (1)	0	0	0.33 (2)	0	0	0.83 (5)	16	8-32
	2002-03	12	0	0.17 (1)	0	0	0	0	1.00 (12)	12	4-128
	1997-98	10	0.33 (3)	0	0	0	0	0	0.10 (1)	16	16
Total	1999-00	16	0.75 (12)	0	2 (0.13)	0	0	0	0.81 (13)	32	8-64
	2002-03	8	0	0.13 (1)	0	0	0	0	0.38 (3)	16	16
Total		244	0.18 (45)	0.02 (4)	0.01 (3)	0.03 (7)	0.02 (5)	0.01 (3)	0.59 (145)		

^a Pathogens: Ana = *Anaplasma* spp.; BTV = bluetongue virus; BRSV = bovine respiratory syncytial virus; BVDV = bovine viral diarrhea virus; EHDV = epizootic hemorrhagic disease virus; OPP = ovine progressive pneumonia; PI3, parainfluenza-3 virus.

^b Year = all samples collected December-March.

^c Median value of positive titers to parainfluenza-3 virus.

Table 4. Prevalence (% of bighorn sheep) of *Pasteurella* and *Mannheimia* species isolated from pharyngeal swabs, and proportion beta-hemolytic in 6 bighorn sheep populations in Hells Canyon, 1997-2005.

Population	Date	<i>n</i> sheep	<i>n</i> isolates	<i>P.</i> <i>trehalosi</i>	<i>Mannheimia</i> spp.	<i>P.</i> <i>multocida</i>	beta- hemolytic
Asotin	Mar 2003	13	15	1.00	0.08	0.00	0.00
Black Butte	Mar 1997	7	10	0.71	0.29	0.29	0.29
	Jan 2000	7	10	0.57	0.43	0.43	0.14
	Mar 2003	2	2	1.00	0.00	0.00	0.00
Imnaha	Jan 2000	21	38	0.95	0.38	0.00	0.38
	Mar 2003	5	9	0.80	0.80	0.20	0.80
Lostine	Jan 1999	15	28	0.93	0.40	0.00	0.00
	Jan 2000	10	20	0.80	0.80	0.00	0.20
	Jan 2001	6	10	0.66	0.50	0.00	0.00
	Feb 2002	10	13	0.90	0.10	0.00	0.00
	Jan 2003	8	9	0.75	0.00	0.25	0.25
	Feb 2004	13	18	0.92	0.31	0.00	0.23
	Jan-Feb 2005	11	12	0.45	0.55	0.00	0.25
	Redbird	Mar 1997	9	14	0.67	0.56	0.11
Wenaha	Jan 2000	7	9	0.86	0.29	0.00	0.14
	Mar 2003	3	3	1.00	0.00	0.00	0.00
	Mar 1997	12	15	1.00	0.08	0.08	0.50
Wenaha	Jan 2000	10	12	1.00	0.10	0.00	0.10
	Mar 2003	5	7	1.00	0.20	0.00	0.60
	Total (prevalence)	174	254	149 (0.86)	57 (0.33)	10 (0.06)	39 (0.22)

Table 5. Comparison of prevalence (%) of *Pasteurella* and *Mannheimia* bacteria isolated from nasal and pharyngeal swabs collected from 15 sheep in the Lostine herd, 2005. Number of individuals where bacteria was isolated in parentheses. More than 1 species of bacteria was isolated from some swabs. No *Pasteurella* or *Mannheimia* bacteria were isolated from 12 swabs and these were not included in the percentages reported. All isolates were classified as nonhemolytic excepted as indicated (β).

Sample type	<i>Pasteurella trehalosi</i>	<i>Mannheimia</i> spp.	<i>Pasteurella multocida</i>
Pharyngeal <i>n</i> = 11	45% (6)	55% (6) (50% β)	0
Nasal <i>n</i> = 7	86% (6)	43% (3) (33% β)	17% (1)

Table 6. Annual adult survival in 8 Hells Canyon bighorn sheep populations, 1 June 1997 to 1 July 2005.

Gender Population	Survival ^a								\bar{x}
	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	
Ewes									
Asotin		0.88	0.86	1.00	0.83	1.00	0.83	0.57	0.85
Big Canyon		1.00	0.93	0.60	1.00	0.91	0.22	1.00	0.81
Black Butte	0.92	1.00	0.58	0.71	0.80	1.00	0.84	0.75	0.83
Imnaha	<i>0.80</i>	<i>0.74</i>	<i>0.78</i>	0.85	0.95	1.00	0.73	0.92	0.85
Lostine	<i>0.81</i>	<i>0.71</i>	<i>0.98</i>	1.00	1.00	0.94	0.93	0.88	0.91
Muir Creek	^b	1.00	0.87	0.69	1.00	0.50	1.00	0.80	0.82
Redbird	1.00	1.00	1.00	1.00	0.85	0.91	0.75	1.00	0.94
Wenaha	0.83	1.00	1.00	0.73	1.00	1.00	0.75	1.00	0.93
Average	0.87	0.92	0.88	0.81	0.93	0.91	0.76	0.89	0.87
Rams									
Asotin				<i>0.78</i>	<i>1.00</i>	<i>0.61</i>	0.80	0.75	0.79
Big Canyon		1.00	1.00	0.80	0.80	0.50	0.67		0.80
Black Butte	<i>0.46</i>	<i>0.99</i>	<i>0.73</i>	1.00	0.80	0.30	0.5		0.68
Imnaha	<i>0.68</i>	<i>0.80</i>	<i>1.00</i>	0.71	1.00	1.00			0.87
Lostine	<i>0.72</i>	<i>0.77</i>	<i>0.87</i>	0.80	1.00	0.75	0.64	0.75	0.79
Muir Creek		1.00	0.83	0.50	1.00		1.00		0.87
Redbird	<i>1.00</i>	<i>0.66</i>	<i>0.97</i>	1.00	0.80	0.75	0.83	0.60	0.83
Wenaha	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	0.67	1.00	1.00	0.86	0.86	0.92
Average	0.77	0.89	0.91	0.78	0.91	0.72	0.83	0.73	0.82

^a Survival estimated from annual counts in italics. All other survival estimates from radio-collared animals. Population-years with pneumonia-related adult mortality are in bold.

^b Insufficient data.

Table 7. Productivity and summer lamb survival in 9 herds in Hells Canyon, 2004.

Herd	No. radio-collared ewes observed with lambs (%)	Summer survival ^a
Asotin Creek, Washington	4/7 (57%)	75%
Big Canyon, Idaho	2/2 (100%)	100%
Black Butte, Washington	7/8 (88%)	29%
Imnaha, Oregon	10/12 (83%)	60%
Lostine, Oregon	14/16 (88%)	50%
Muir Creek, Oregon	7/7 (100%)	29%
Myers Creek, Idaho	6/6 (100%)	0
Redbird, Idaho	10/11 (91%)	50%
Saddle Creek, Oregon	2/3 (67%)	0
Upper Hells Canyon, Oregon	3/4 (75%)	0
Wenaha, Oregon	6/9 (67%)	50%

^a Survival from birth to 1 October. Herds in bold are those where lambs were recovered with pneumonia.

Table 8. Hells Canyon bighorn sheep herd counts, 2004-2005.

Herd	Survey date(s)	Total bighorns	Ewes	Lambs	Rams	Estimated population
Asotin, WA ^a	1-2 Apr 2005	49	26	8	15	50
Bear Creek, OR	12 Aug 2004	15	8	3	4	35
Big Canyon, ID ^a	21 Mar 2005	17	7	2	8	20
Black Butte, WA ^a	2-5 Apr 2005	48	29	5	14	55
Lower Hells Canyon, OR	17 Mar 2005	25	19	3	3	35
Lower Imnaha, OR ^a	21 Mar 2005	159	93	41	35	190
Lostine, OR ^a	Dec 04-Mar 05	74	38	13	23	80
Mountain View, WA	14 Mar 2005	25	12	4	9	35
Muir Creek, OR ^a	21 Mar 2005	35	25	1	9	35
Myers Creek, ID	16 Feb 2005	6	4	0	2	10
Redbird, ID ^a	3-4 Apr 2005	113	74	10	29	130
Saddle Creek, OR	7 Jan 2005	8	5	0	3	10
Sheep Mountain, OR	17 May 2005	19	13	6	0	25
Upper Hells Canyon, OR ^a	19-20 Apr 2005	32	17	3	12	35
Upper Hells Canyon, ID	^b					20
Upper Joseph Creek, OR ^a	5 Apr 2005	26	16	0	10	30
Wenaha, OR/WA ^a	31 Mar 2005	72	32	9	31	80
Total						875
Average						55

Table 9. Permits and harvest of bighorn sheep in Hells Canyon through 2004.

State	Herd	Total permits	Total number harvested ^a	2004 Permits	2004 Season
Washington ^b	Black Butte/ Joseph Creek	17	20	0	None
	Mountain View	8	6	0	None
	Wenaha	16	14	0	None
Idaho	Redbird	11	18	2	8/30-10/13
	Upper Hells Canyon	20	11	0	None
Oregon	Lower Imnaha	94	91	6	9/6-17, 10/18-28
	Lostine	77	71	2	9/6-17
	Black Butte/ Joseph Creek	9	7	0	None
	Bear Creek	6	5	1	9/6-17
	Lower Hells Canyon	3	3	0	None
	Wenaha	12	12	0	None
	Sheep Mountain	9	8	1	9/6-17
	Total	282	266	12	

^a Number of bighorns harvested includes auction and lottery tags.

^b No season has been authorized since 1996.

APPENDIX A
RESULTS OF CAPTURE AND HEALTH SAMPLING,
LOSTINE, OREGON BIGHORN SHEEP
JANUARY AND FEBRUARY 2005

Appendix A. Selected capture and health sampling data collected from the Lostine, Oregon, bighorn sheep herd, January and February 2005.

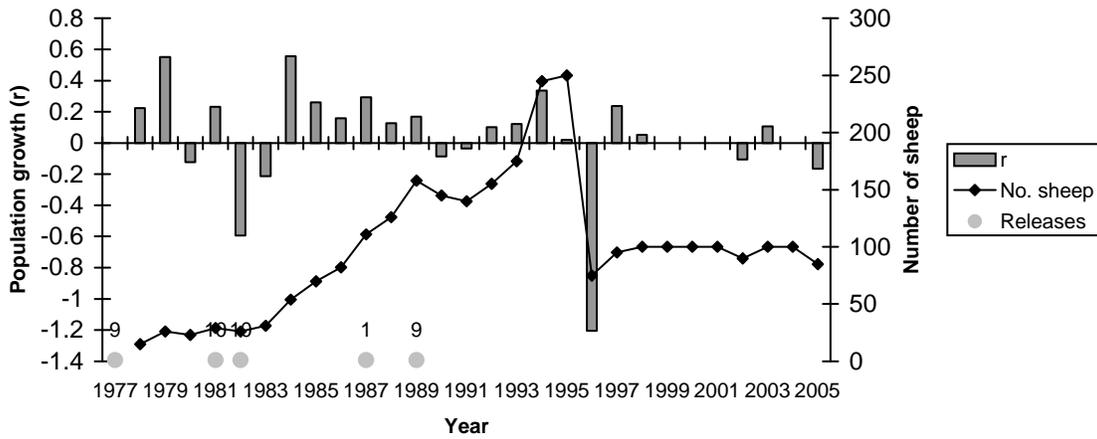
ID number	Sample date	Sex	Est. age	Body condition score	Blood selenium (ppm)	PI-3 titer	Ear swab scabies	Pharyngeal swab	Nasal swab
05L071	1/11/05	F	3.5	3	0.42	16	+	U ^{aβB}	Gram positive rods & contaminants
05L066	1/11/05	F	0.5	3.333	0.29	0	0	2 ^{BD}	Gram positive cocci
04L012	1/11/05	F	3	3	0.51	32	+	Gram positive rods & cocci U ^{aB}	Gram positive rods & cocci
05L069	1/11/05	F	3.5	4	0.46	16	0		Gram positive rods & cocci
03L026	1/11/05	F	4	4	0.78	64	+	Gram positive cocci, <i>Bacillus</i> spp. & coliforms	Gram positive cocci, <i>Bacillus</i> spp. & coliforms
05L040	1/11/05	F	4+	4	0.41	32	0	3 ^{aCD}	10 ^{aβE} , Gram positive cocci
05L050	1/11/05	F	2.5	3.5	0.42	16	0	Gram positive rods & cocci	Gram positive rods & cocci
04L022	2/8/05	M	2.5	3	0.27	32	0	8(β), <i>Neisseria</i> spp.	8(β), <i>Neisseria</i> spp.
04L017	2/8/05	M	2.5	3	0.44	0	0	2 ^B <i>Enterobacter</i> spp.	None
01L034	2/8/05	F	6.5	3		64	+	2, <i>Neisseria</i> spp.	2, <i>Neisseria</i> spp.
00L14	2/8/05	F	9.5	3	0.38	32	+	2 ^B , <i>Neisseria</i> spp. <i>Streptococcus</i> spp.	2 ^B , <i>Neisseria</i> spp. <i>P. multocida</i> b
04L074	2/8/05	F	4.5	2.5	0.42	16	+	2 ^B 9 ^{aβR} (β)	2 ^B <i>Streptococcus</i> spp. β
04L073	2/8/05	F	1.5	4	0.49	64	0	<i>Neisseria</i> spp.	None
04L065	2/8/2005	F	3.5	3	0.43	32	+	8(β), <i>Neisseria</i> spp.	2 ^E , <i>Neisseria</i> spp.
04L058	2/8/2005	F	3.5	4	0.48	64	0	2, <i>Neisseria</i> spp. 9 ^{aβB}	2, <i>Neisseria</i> spp. 9 ^{aβB}
04L038	2/9/2005	M	1.5	4	0.31	16	+	<i>Streptococcus</i> spp. β 2 ^B <i>Streptococcus</i> spp. β	<i>Streptococcus</i> spp. β 2 ^B <i>Streptococcus</i> spp. β

APPENDIX B

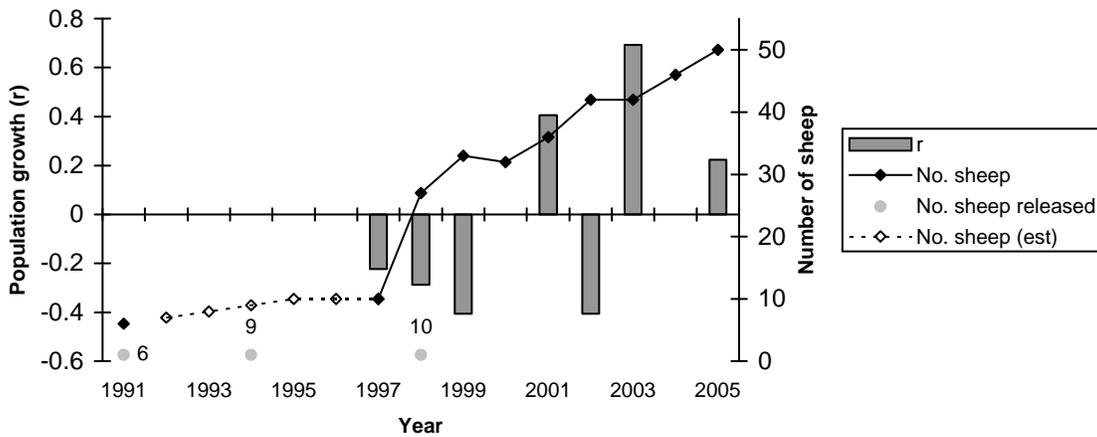
HELLS CANYON BIGHORN SHEEP POPULATION DYNAMICS 1997-2005

Appendix B.

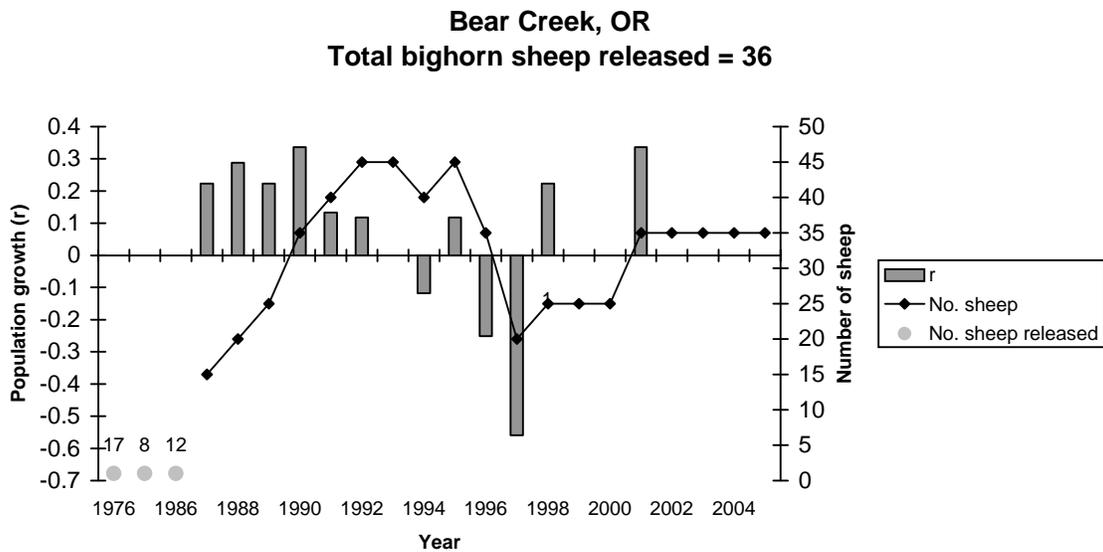
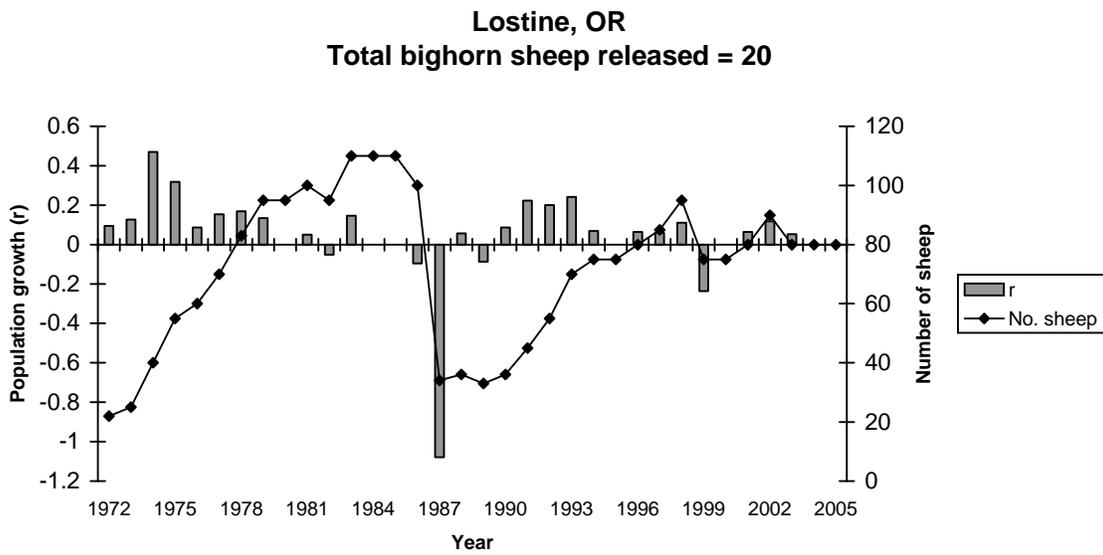
Black Butte, WA - Joseph Cr., OR
Total bighorn sheep released = 39 (in Black Butte)



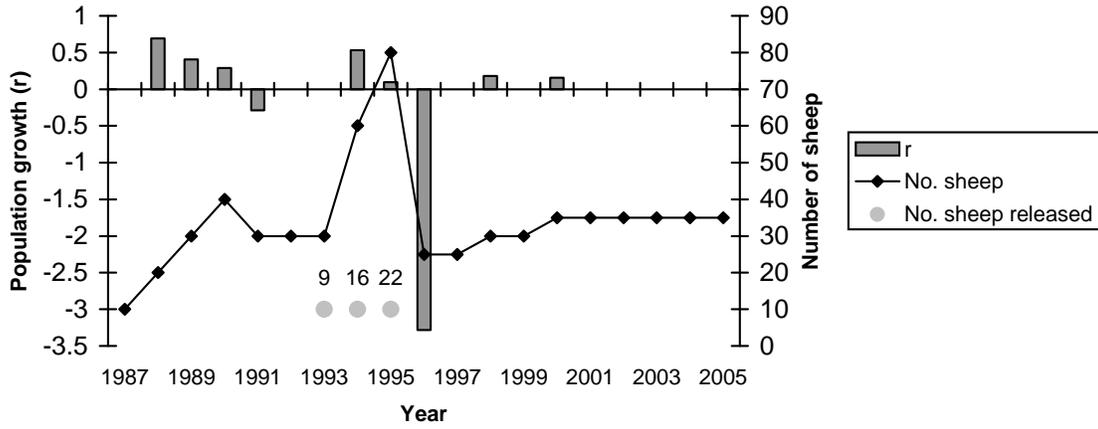
Asotin Creek, WA
Total bighorn sheep released = 25



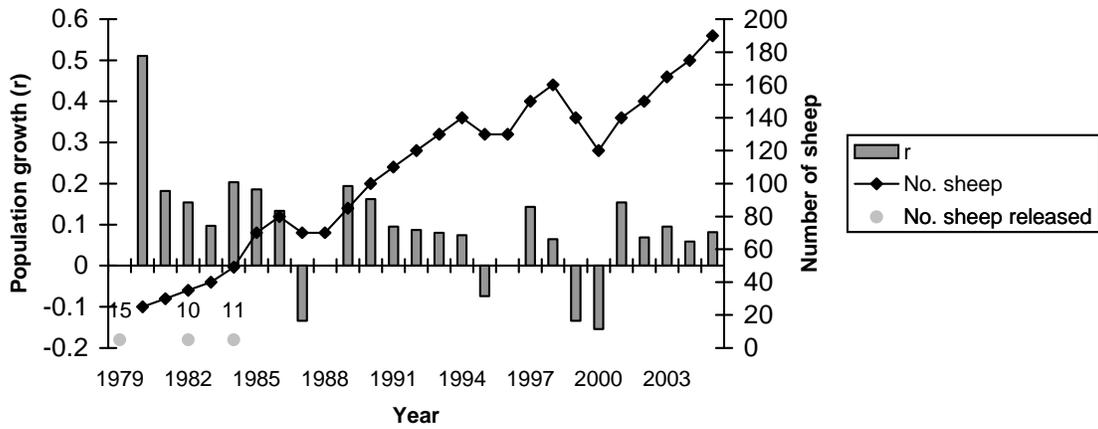
Appendix B. Continued.



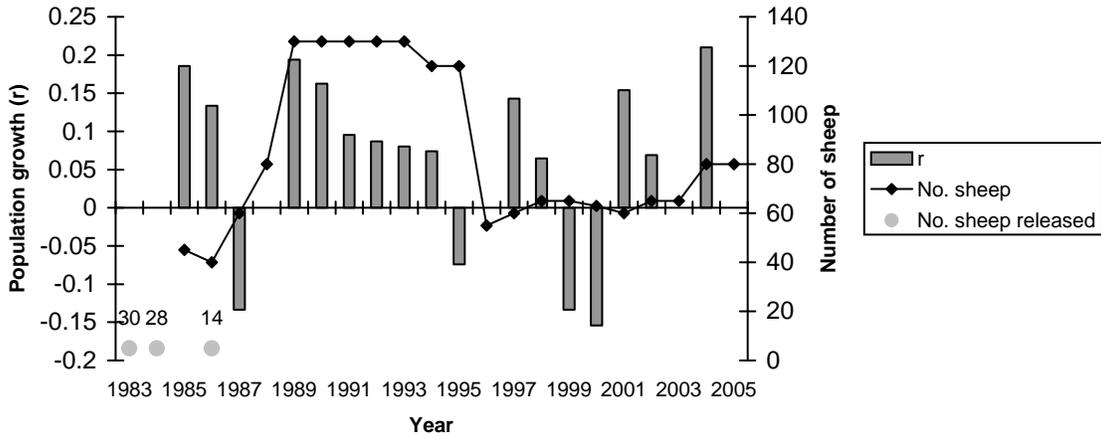
Lower Hells Canyon, OR
Total bighorn sheep released = 47



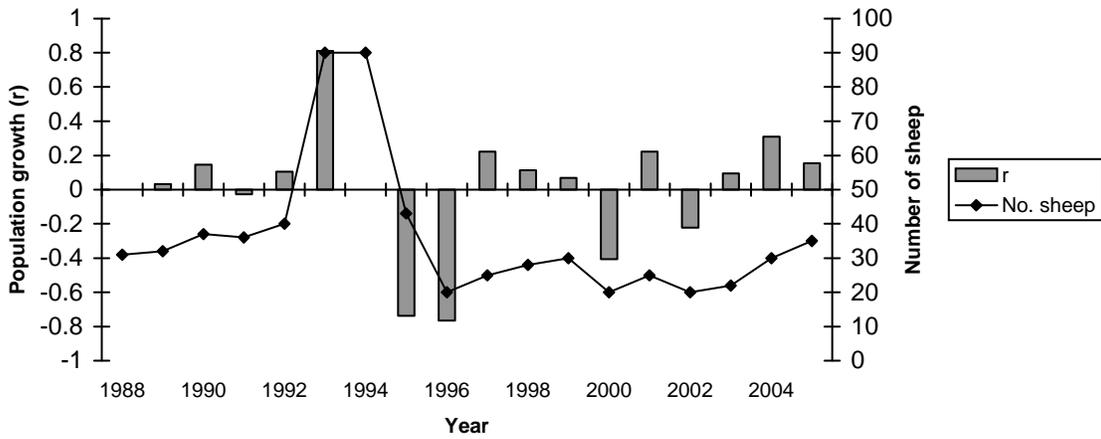
Lower Imnaha, OR
Total bighorn sheep released = 36



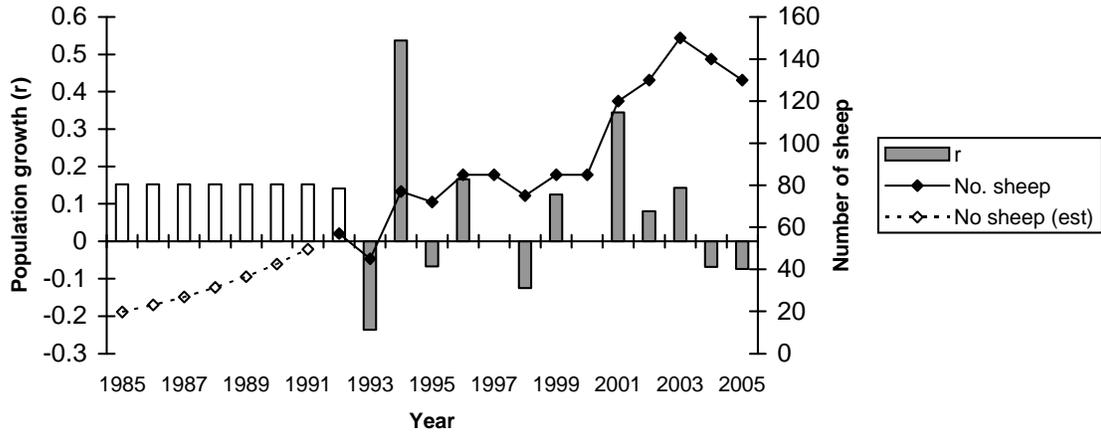
Wenaha, OR / WA
Total bighorn sheep released = 72



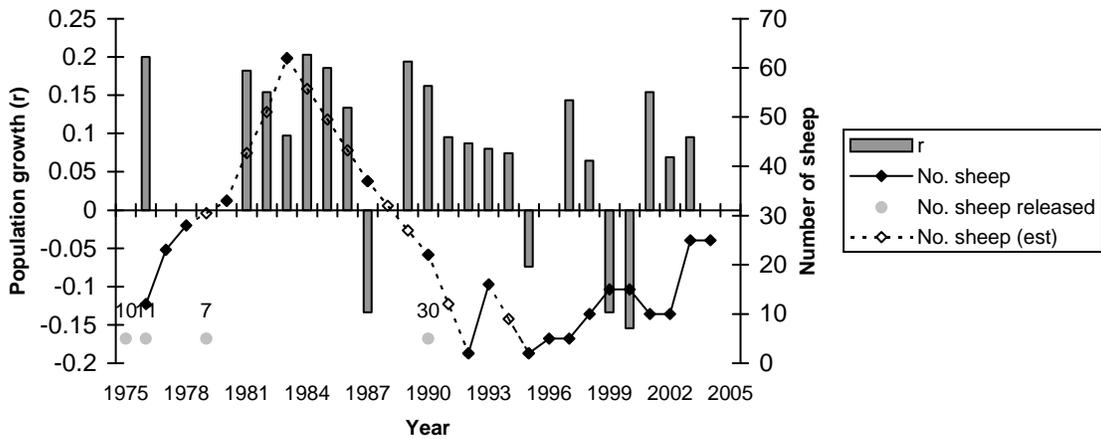
Lost Prairie and Cottonwood, OR / WA
Total bighorn sheep released = 0



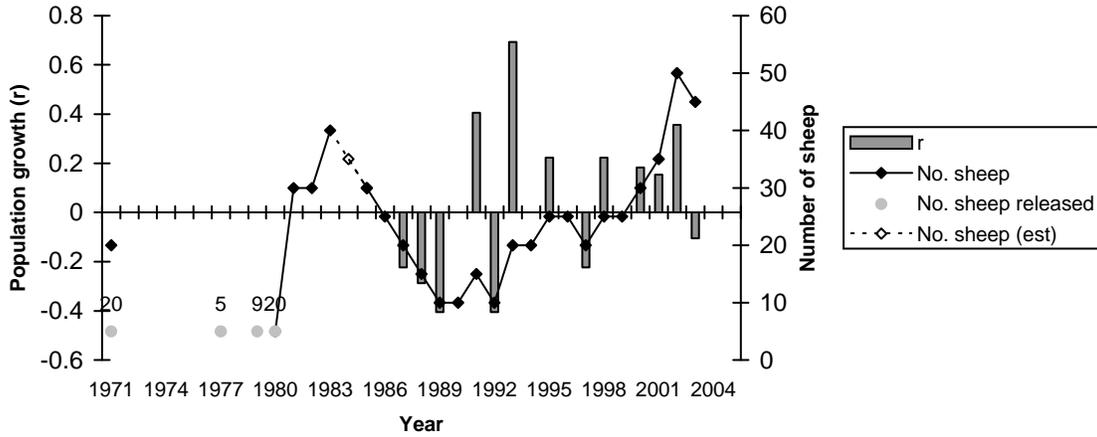
Redbird, ID
Total bighorn sheep released = 17



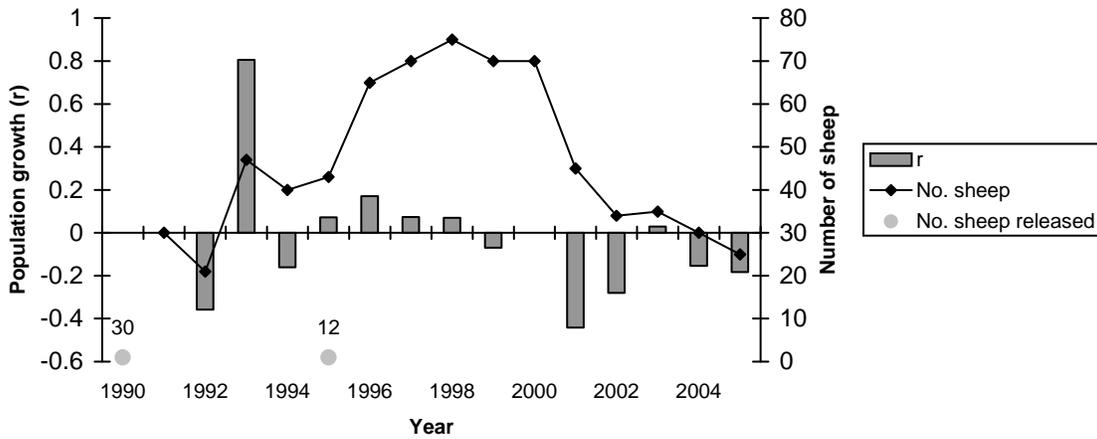
Upper Hells Canyon, ID
Total bighorn sheep released = 58



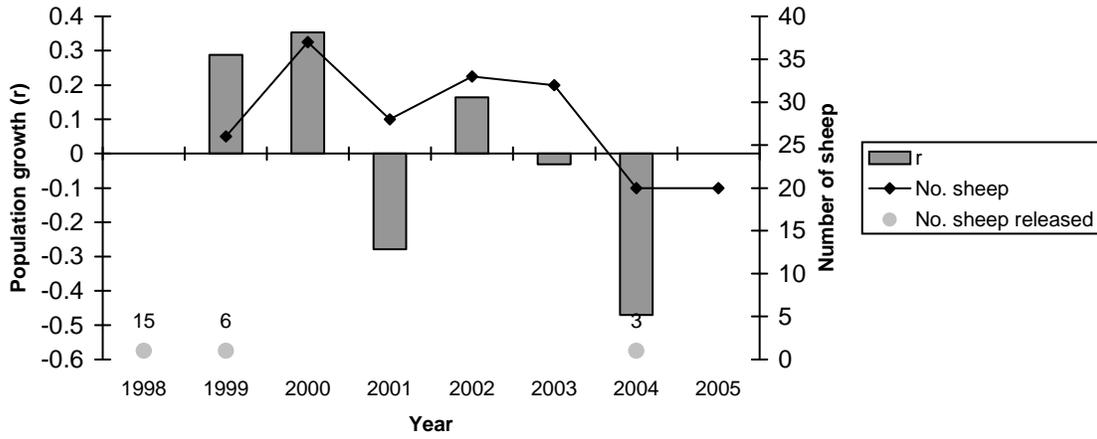
Upper Hells Canyon, OR
Total bighorn sheep released = 54



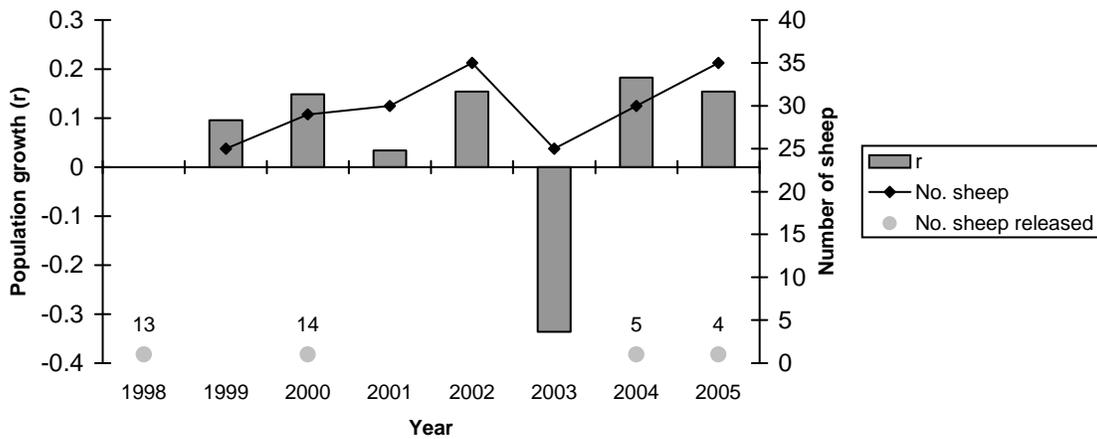
Sheep Mountain, OR
Total bighorn sheep released = 42



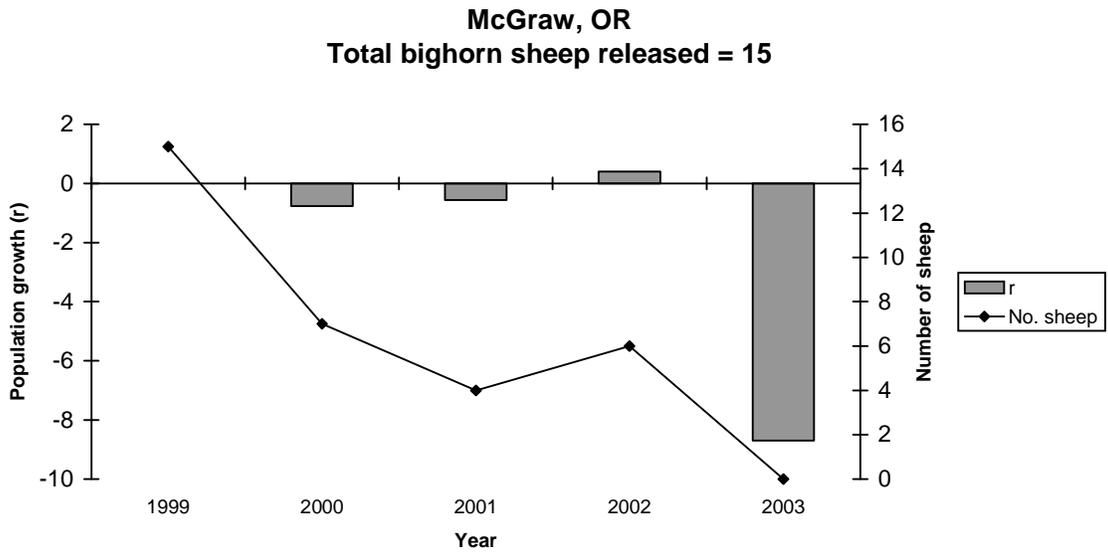
Big Canyon, ID
Total bighorn sheep released = 24



Muir Creek, OR
Total bighorn sheep released = 36



Appendix B. Continued.



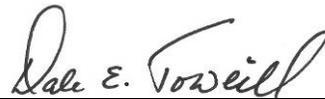
Submitted by:

Frances Cassiren

Wildlife Research Biologist

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME



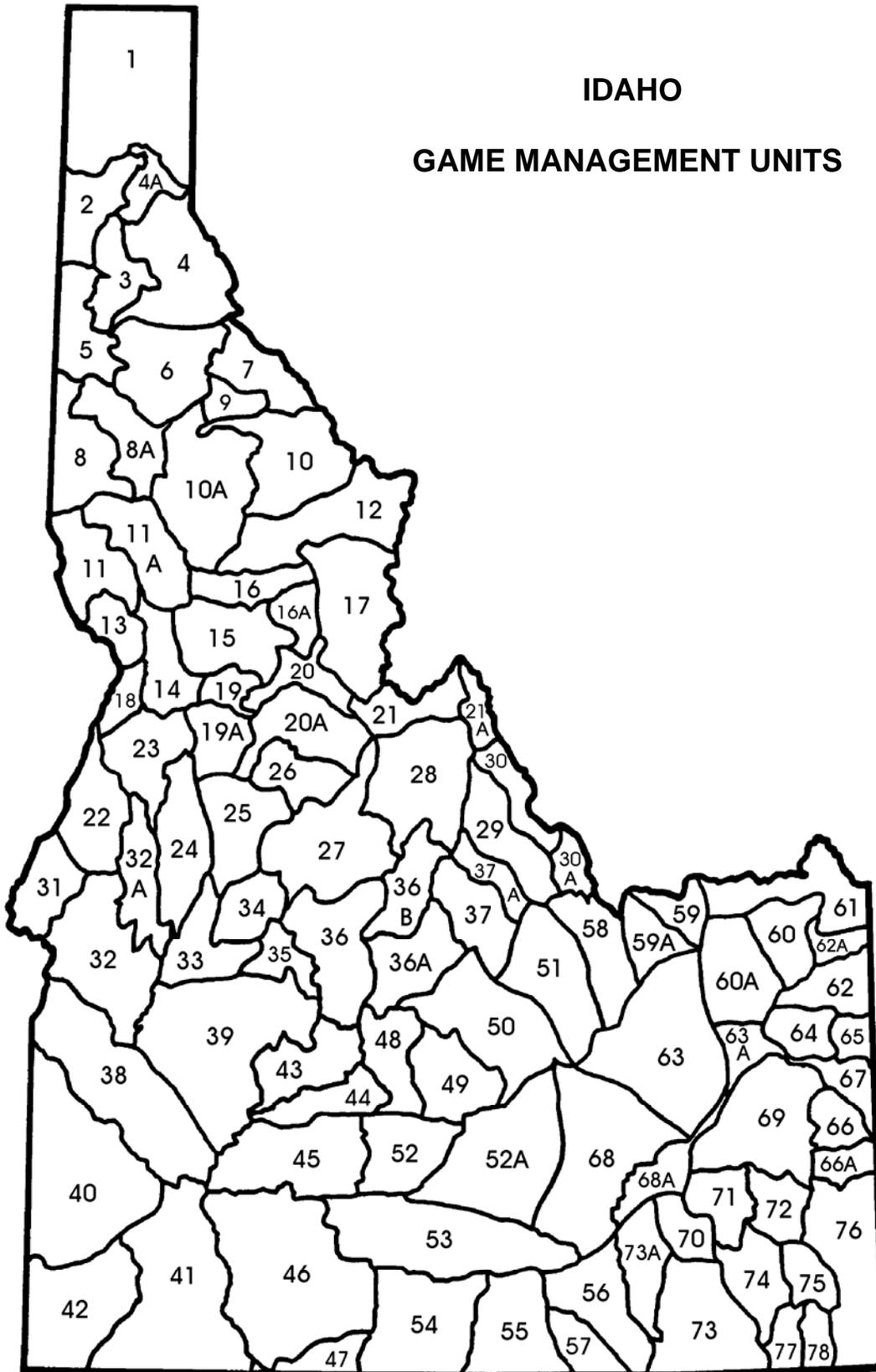
Dale E. Towell
Wildlife Program Coordinator
Federal Aid Coordinator



James W. Unsworth, Chief
Bureau of Wildlife

IDAHO

GAME MANAGEMENT UNITS



FEDERAL AID IN WILDLIFE RESTORATION

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sale of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program then allots the funds back to states through a formula based on each state's geographic area and the number of paid hunting license holders in the state. The Idaho Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be responsible, ethical hunters. Seventy-five percent of the funds for this project are from Federal Aid. The other 25% comes from license-generated funds.

