Radium - Stoddart Bighorn Sheep Habitat Use Monitoring 2002-2003

Annual Summary of Activities and Data Collection

March 31, 2003

Prepared by:

Trevor A. Kinley, R.P.Bio.
Sylvan Consulting Ltd.
RR5, 3519 Toby Creek Road
Invermere, BC V0A 1K5
sylvan@rockies.net
250-342-3205

Submitted to:

Vivian Jablanczy
Slocan Forest Products Ltd., Radium Division
Radium Hot Springs, BC

Funding for this project was provided by the Forest Investment Account through contract 03FIA03-Bighorn between Slocan Forest Products Ltd. and Sylvan Consulting Ltd.

Summary

Forest ingrowth into areas that were formerly fire-maintained grassland or open forest is a significant conservation concern for species dependent upon such habitats in the southern Rocky Mountain Trench, including bighorn sheep. There has been significant loss and isolation of natural winter range, and increasing use of human-created habitat on the valley bottom. Middle elevations between winter and summer ranges appear to be used less than in the past.

Habitat restoration within winter ranges on the Trench floor is recognized as an essential element of ecosystem health, and several projects are underway. However, mid-slope areas of the Trench's eastern edge (west flank of the Rocky Mountains) were also historically maintained in an open state by frequent fires, but restoration there is logistically and visually more challenging. Planning is further impeded by a lack of information regarding sedentary use or travel by sheep through such transitional ranges. Thus, restoration of such sites has not yet occurred. Two of the primary goals of this project are to determine whether sites at which habitat restoration is underway on winter range will be used by sheep, and what areas or habitat types sheep use when in transitional ranges, as a means of providing information for habitat restoration there.

This report covers preliminary results from the second fiscal year (first full year) of this project. From October 2002 through March 2003, we removed and downloaded GPS collar data from 7 ewes and 3 rams that had been fitted with collars in January and March, 2002. We then refurbished the collars and re-deployed them on 6 ewes and 4 rams in December 2002 and March 2003. Of these, 1 of each sex had been previously collared. Only preliminary information on general movements and collar function is presented here, as we have only 1 year of GPS collar data.

Of those collared in 2002, 1 ram was killed in a vehicle collision, bull all remaining animals survived until collar removal (9 to 14 months). Of the 10 collars, 6 functioned until removal or animal death, 1 worked until it experienced premature battery failure, and 3 stopped collecting GPS fixes early for unknown reasons. During the period in which collars were functioning properly, 84% of attempted GPS fixes were successful, and 82% of successful fixes were 3D (high probability of accuracy). Collared ewes remained in or very close to Radium Hot Springs through the winter and were in the Brisco Range during the lambing and summer seasons. Ram winter range primarily overlapped with that of ewes, but also extended southward as far as Windermere Creek. The roadkilled ram had not moved upslope beyond the Sinclair Creek/Highway 93 corridor as of 2 August. The other 2 rams did use high elevations for at least part of the summer, with 1 primarily in the Brisco Range and 1 in the Stanford Range. More complete data analysis will be conducted at the completion of the project in 2003/2004 or later.

Introduction

Problem Statement

The southern portion of the Rocky Mountain Trench has historically been a fire-maintained ecosystem (FME). Frequent, low-intensity ground fires maintained very open stands of Douglas-fir and ponderosa pine interspersed with grassland (Gayton 1996). However, fire suppression during the past century has resulted in the dramatic ingrowth of conifers into grassland and former open-forest stands (Rocky Mountain Trench Ecosystem Restoration Steering Committee 2000). Concurrently, there have been significant habitat losses, population declines and additional threats to wildlife species dependent on open habitats, including Rocky Mountain bighorn sheep. Several herds of bighorn sheep still winter in the Trench (Davidson 1994), but fragmentation of their habitat over the past century has been paralleled by isolation in their distribution and marked declines in habitat quality.

The Radium-Stoddart bighorn herd includes about 225-250 animals (A. Dibb, Parks Canada, Radium Hot Springs, B.C., unpublished data) and winters near Radium Hot Springs, British Columbia. Recently, this band has dramatically reduced its use of historic ranges and has increasingly focused on human-dominated landscapes, such as golf courses, the townsite and road margins (Figure 1; Osprey Communications 2001). This is due in part to loss of native winter range and transitional ranges, changes in migratory routes due to conifer ingrowth, habitat fragmentation and human encroachment, and probably also due to better security from predators in town. Several past projects have identified habitat issues and very broad movement patterns for this herd (Stelfox et al. 1985, Davidson 1994, Tremblay 2001). In recent years, volunteer community monitors under the “Bighorn In Our Backyard Project” have recorded the locations and behavior of wintering bighorn sheep of the Radium-Stoddart herd (Osprey Communications 2001). However, there has been no recent collection of movement/habitat use information across the full range of seasonal habitats and elevations using systematic sampling.

Ecosystem restoration is now underway through joint initiatives of government, industry and non-government organizations, including a third site within the Radium-Stoddart winter range begun in the winter of 2002/2003. These projects involve maintaining some of the oldest trees, removing smaller trees, and burning the understory. While the results of restoration are promising, several concerns remain. One is that it is unclear to what degree bighorns will use restored areas. A second issue is that there is no clear indication of whether interchange between the Radium-Stoddart herd and adjacent bands occurs. Finally and perhaps most importantly, no on-the-ground work has yet been done to maintain and restore the migratory corridors and transitional ranges that link valley-bottom winter range with alpine summer range. The extensive fire history along the western flank of the Rocky Mountains was largely a result of frequent fires in the adjacent Trench ascending into the mountain slopes (Gray 2001). Thus, fire suppression on the Trench floor has also caused dense forests to develop at mid elevations, so that the open transitional ranges to which sheep historically had access when moving between summer and winter ranges have largely disappeared. Not only has this resulted in the loss of important habitat, it now forces sheep to remain longer and to be more concentrated on winter ranges, potentially causing increased susceptibility to disease, parasites, predation, vehicle collisions and malnutrition. If we are to include migratory routes and transitional ranges in FME restoration efforts,

knowledge of route locations and habitat types is essential to guide the limited ecosystem restoration funding available. Understanding current movements through transitional ranges will also allow "before-and-after" comparisons for restoration work now planned for the face of the Rockies in Kootenay National Park.

The following progress report summarizes activities completed under contract *03FIA03-Bighorn* between Slocan Forest Products Ltd, Radium Division, and Sylvan Consulting Ltd. to March, 2003

Goals

The four goals to be addressed through the use of GPS collars are:

1. To determine both specific routes and general habitat types used by sheep in moving through transitional ranges between low-elevation winter range and summer ranges in the alpine. This will guide the locations of future ecosystem restoration projects in mid-elevation transitional ranges.
2. To determine to what extent sheep use ecosystem restoration sites before and following restoration work.
3. To document sites of concentrated sheep activity that can be correlated to lambing locations, mineral licks and other point-source habitat features, so that these sites can be considered in land-use planning decisions relating to recreation, forestry road construction, and municipal expansion.
4. To gain preliminary indications of whether there is any population exchange with nearby herds.

These goals are to be accomplished over 2 or more years of monitoring. This report briefly highlights results from the first 2 years of collaring and first year of monitoring.

Study Area

The study area includes all current seasonal ranges of the Radium-Stoddart bighorn sheep herd. Collaring occurred in and around Radium Hot Springs when sheep were on their winter range (Figure 1). The exact extent of the area over which sheep will be monitored during the following years will depend upon their movements. However, it is expected to include the Brisco Range and the northern half of the Stanford Range in the Rockies, and the Rocky Mountain Trench from about Edgewater to Windermere. The lower Sinclair Creek/Highway 93 corridor forms the boundary between the Brisco Range to the north and the Stanford Range to the south. The study area is entirely within the Southern Interior Mountains ecoprovince, and includes both the Western Continental Ranges ecoregion (Southern Park Ranges ecosection) and the Southern Rocky Mountain Trench ecoregion (East Kootenay Trench ecosection). Mountains trend northwest to southeast, so slopes facing the Trench have a general southwest aspect.

Biogeoclimatic units include the IDFun (Windermere Lake unit) and IDFdm2 at lower elevations (separated roughly by Highway 95), and the MSdk, ESSdk, and AT farther upslope (Braumandl and Curran 1992). Winter range is mainly in the IDF and lower MS. Above the level of the Columbia River floodplain on the valley floor, jurisdiction within the IDF is a mix of private, provincial Crown, Kootenay National Park, federal Crown, provincial wildlife management area and provincial park. Types of development in the IDF include urban, industrial, golf courses, rural residential and small agricultural holdings, and open forests managed at an early seral stage for Douglas-fir Christmas

trees. There are also historically open Douglas-fir dominated forests and grasslands that have experienced significant conifer ingrowth and encroachment due to fire suppression (some of which are in the process of being restored), patches of trembling aspen, and a limited amount of mature, closed-canopy Douglas-fir, lodgepole pine, aspen and hybrid white spruce forest on cool aspects. Highway 95 runs north-south through the IDF near the western edge of the study area and is joined by Highway 93 from the northeast at Radium Hot Springs. The MSdk, ESSFdk and AT are almost entirely within provincial Crown land and Kootenay National Park. Much of the MS and ESSF facing toward the Trench is on dry, rocky slopes characterized by open canopies (Douglas-fir at lower elevations grading through lodgepole pine, Engelmann spruce, subalpine fir and whitebark pine), though forest stands are shifting toward increased closure in the absence of fire. Cooler aspects within the MS and ESSF are mainly lodgepole pine at lower elevations and Engelmann spruce and subalpine fir higher up. Little of the MS and ESSF within the study area has been logged or accessed by roads due to the rugged terrain and presence of the national park.

Acknowledgements

I wish to thank the following people and organizations for their major contributions to this research: A. Dibb, Parks Canada, for project development and management, co-funding, telemetry, extensive logistical support and review of a previous draft; W. Swan, Osprey Communications, for initiating both the Bighorn in Our Backyard Project and the GPS collar research component of it; V. Jablanczy, Slocan Forest Products, for coordinating contract funding; M. Panian, MSRM, for assistance with database setup and project development; M. Oliver and S. Anning, Parks Canada, for telemetry; I. Ross, Arc Wildlife Services, for darting, sampling and collaring; Dr. T. Shury for darting and sampling; Dr. H. Schwantje, MWLAP, for animal care advice and arranging immobilization drugs; J. Dubois, Osprey Communications, for Figure 1 and assistance with other maps; L. Umsonst, MWLAP, and T. Damme and J. Niddrie, Parks Canada, for logistical support; and Forest Investment Account for funding.

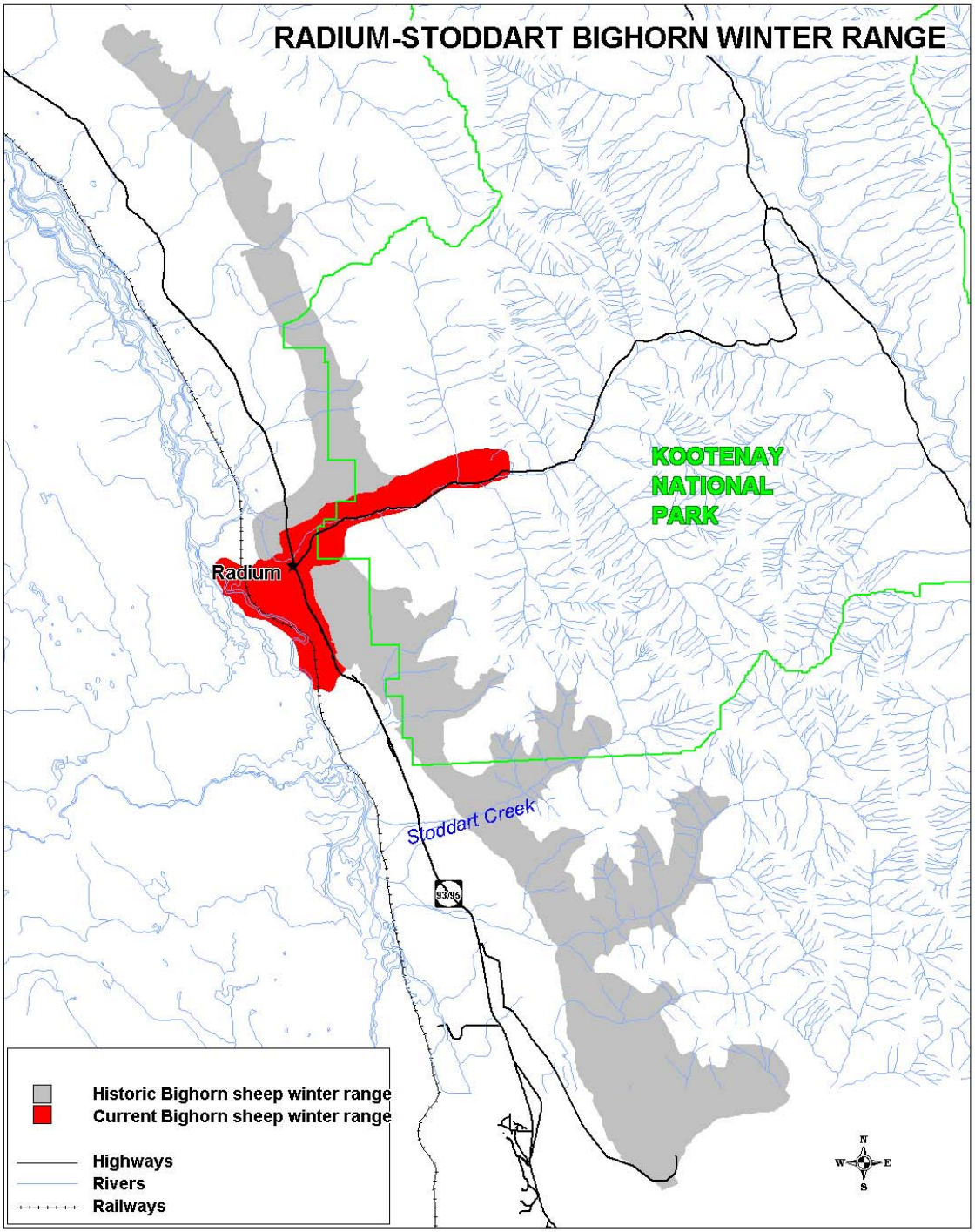

Figure 1. Winter range of bighorn sheep near Radium Hot Springs, British Columbia. Some winter activity by sheep still occurs within the grey-shaded area, but it is heavily concentrated in the red area. Transitional and summer ranges occur upslope, south and northeast of winter range. All sheep were collared within the red-shaded area. *Map courtesy of Osprey Communications.*

Methods

In January and March, 2002, we fitted 7 ewes and 3 rams with GPS collars (*GPS 2000*, Advanced Telemetry Systems, Isanti, Minnesota) as described in Kinley (2002). One ram was killed in a vehicle collision in August 2002. His collar was removed, and data downloaded. We began remotely removing the remaining collars using the manufacturer's triggering transmitter in October, 2002. Six ewe collars were removed this way, while 1 failed to drop. We attempted to remove the remaining 2 ram collars in November, 2002, of which 1 dropped and 1 failed to drop. The 2 collars that failed to drop using the remote triggering device were manually removed in December 2002 and March 2003 after darting the animals carrying them (see below). All collars were downloaded and returned to the manufacturer for refurbishment.

In the winter of 2002/2003, we equipped 10 sheep with refurbished GPS collars. In December, 2002, 3 rams and 4 ewes were darted by Ian Ross (Arc Wildlife Services, Calgary) with a Paxarms-brand dart gun, including the ewe whose collar had previously failed to detach. In March, 2003, Dr. Todd Shury darted the ram whose collar had failed to detach. We placed another collar on that ram, then darted and collared 2 more ewes. Thus, the total animal sample this year included 4 rams and 6 ewes, of which 1 of each sex had previously been collared. Immobilization was accomplished with xylazine-ketamine. All immobilization information is contained in the attached Excel file: *Radium Sheep Capture Data* and following methods described in Kinley (2002).

Based on movements of sheep in the previous year, it appeared that there was no obvious separation of animals within the herd into permanent bands. All or virtually all animals used the Radium townsite area to some extent, including those that were sometimes found in the Stoddart Creek area. Thus, we made no attempt to capture animals outside of town. All captures were made at The Springs golf course, the municipal baseball field, or on the slopes above Highway 93/95, as indicated in the attached *Radium Sheep Capture Data* file.

GPS collars were set to attempt a fix every 12 hr, 48 min continuously from May through October, and every 2 hr, 8 min between 4:00 AM and 11 PM in other months. The unusual spacing of fix attempts was intended to capture more data in periods when the first year of data indicated there was greater movement, and to allow eventual thinning of data to match the schedule used in the first year (which was every 4 hr, 15 min or 8 hr, 30 min) for some of the planned analyses. Collars are scheduled to be removed remotely with the triggering transmitter in winter, 2003/2004. At that point, data will be downloaded and further analyzed.

Sheep continue to be located approximately weekly by Parks Canada staff, using standard ground-based radiotelemetry techniques. This is done:

- as a source of backup data in the event of collar failure;
- to check collar status (a doublet every sixth beat indicates that the most recent GPS fix attempt was successful; a slow beat rate indicates low battery);
- to visually check whether collars were causing problems to the sheep; and
- to collect group composition data (sex/age classes coded according to RIC level 2 classification standards; Ministry of Environment, Lands and Parks 1998), habitat use information (using categories modified from local Terrestrial Ecosystem Mapping; Kernaghan et al. 2001) and behavior/foraging information.

A standardized field form and coding key are used to record these data (see Kinley 2002), which are then entered into an Access database.

I do not present raw sheep location data here because of the potential sensitivity of the data in relation to lambing sites and fall ram locations, but did conduct the following preliminary analyses with collar data downloaded in 2002/2003:

- Calculated successful fix rate for collars.
- Plotted home ranges of each sheep, based on 95% fixed-kernel methods, using the Animal Movement extension for ArcView (Hooge and Eichenlaub 1997).
- Plotted routes between successive locations for each sheep (Hooge and Eichenlaub 1997), then created generalized depictions of these movement routes.
- Plotted all locations of sheep falling inside of or within 100 m of the 2 habitat restoration blocks that existed at the time the sheep were collared.

Results and Discussion

Survivorship

Of the 10 study animals, 1 ram died from injuries sustained in a vehicle collision on Highway 93/95 immediately south of Radium Hot Springs. This accident occurred on the busy August Civic Holiday long-weekend of 2002, a period of very high traffic volumes. All other sheep survived at least until their collars were removed, 9 to 14 months after collaring. The sample for this year is too small to draw any conclusions about population-level survivorship.

GPS Collar Successful Fix Rate

Of the 10 collars, 6 continued to obtain GPS fixes for the entire 7 to 14 months from the date of deployment to the date of death or collar removal (Table 1). One collar experienced premature battery failure at 7 months, and ceased GPS data collection. The remaining 3 collars stopped data collection early for unknown reasons; 2 of them functioned continuously for 2 to 5 months, then intermittently for an additional 1 to 4 months before stopping data collection entirely for the final 1 to 5 months, while the other functioned for 3 months before stopping collection completely for the final 8 months. The VHF beacons and data storage systems remained operational on all 10 collars until they were retrieved.

Successful fix rates were typically high but variable between collars, with 60-94% of attempts resulting in a GPS fix (Table 1). Three-dimensional fixes (i.e. those based on 4 or more satellites, which typically have the highest probability of being accurate) were obtained on 74-96% of the successful fixes (Table 1). Thus, the dataset of sheep locations appears to have high overall reliability.

Table 1. Collar success rates for 10 GPS collars deployed on bighorn sheep, Radium Hot Springs, British Columbia, 2002.

Collar	Sheep	Days Collar Deployed	Continuous Days Collar Functioned	% Attempts Successful (When Collar Functioned Continuously)	% Successful Fixes that were 3D
12169	F/009	285	285	88.6	84.2
12170	F/004	287	142*	76.9	92.7
12171	M/002	427	427	81.7	75.3
12172	F/007	339	90	59.6	83.5
12173	F/001	288	225†	90.6	86.7
12174	M/008	322	322	76.0	73.5
12175	F/011	234	55‡	93.9	95.7
12176	F/010	284	284	85.7	80.8
12177	F/006	287	287	90.6	87.3
12178	M/005	204	204	86.8	85.0
TOTAL		**2957**	**2321**	**84.1**	**82.2**

* also functioned intermittently from 02 June through 25 September
† low-battery mode caused collar to stop GPS fix collection
‡ also functioned intermittently from 29 April through 08 June

General Movement Patterns

All 7 ewes remained in the Radium Hot Springs townsite area (lower Mile Hill, The Springs golf course, lower Sinclair canyon, and vicinity) for the entire winter. All ewes with collars functioning into spring and summer (6) then moved into the Brisco Range north of Radium, with concentrated locations being consistent with lambing and lamb rearing (Figure 2). One ewe appeared to have crossed to the Stanford Range in September, but her collar immediately stopped functioning after obtaining 1 GPS fix there, and that fix had a "positional dilution of precision" value that was in the top 2 percentiles of all fixes for her collar, indicating a possible error in the location. Thus, it is not know whether she did actually cross to the Standford Range, and if so, the extent of activity there. All ewes with functioning collars returned to Radium townsite for the late fall and winter.

Of the 3 rams, all had winter range overlapping with the ewes, but also spent varying amounts of time farther south (Stoddart through Windermere Creeks). The ram roadkilled in early August had not made an high-elevation movements at the time of death, although he had used the Sinclair canyon/Highway 93 corridor (Figure 2). This ram would presumably not have been roadkilled had he not remained in the valley bottom during summer (a pattern that apparently only began recently). This further suggests the value of restoring habitats at mid to upper elevations. Of the other 2 rams, 1 had summer locations in the Stanford Range, and the other was primarily in the Brisco Range. Those 2 rams returned to Radium townsite at that time.

Movement routes of collared sheep were, as expected, along major mountain ridges, the lower face of the Stanford Range, up the Sinclair Creek/Highway 93 corridor, and through the Radium townsite (Figure 3). No GPS-collared sheep are known to have moved northward into the Beaverfoot Range (where the Golden band occurs), southward into the southern Stanford Range (Columbia Lake band), or eastward into the Mitchell Range of the Rockies (formerly occupied by roughly 50 animals; possibly vacant now).

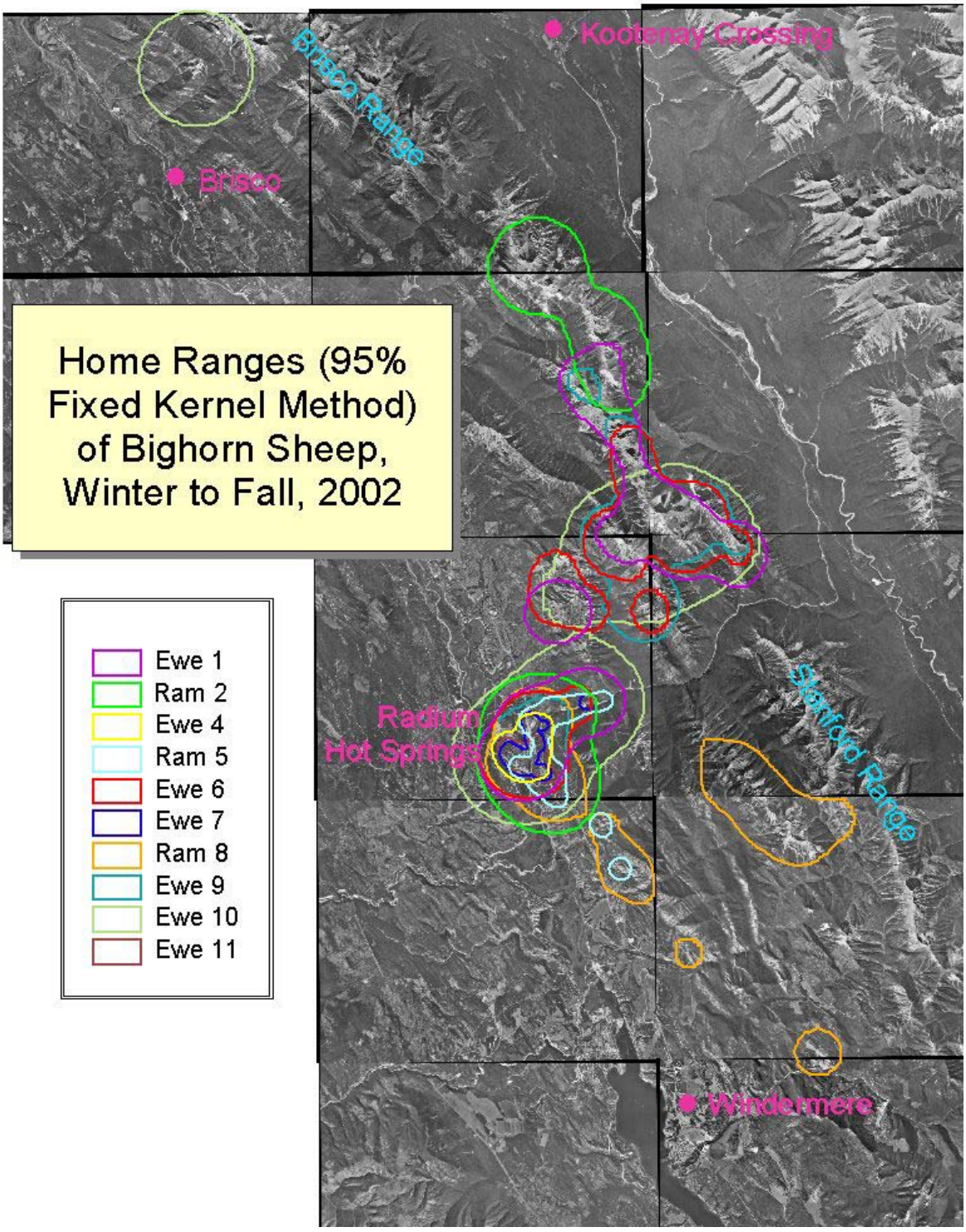

Figure 2. Home ranges (95% fixed-kernel estimates) of 10 GPS-collared sheep near Radium Hot Springs, British Columbia. Polygons based on data spanning variable periods for which collars functioned (3 to 14 months, beginning winter, 2002).

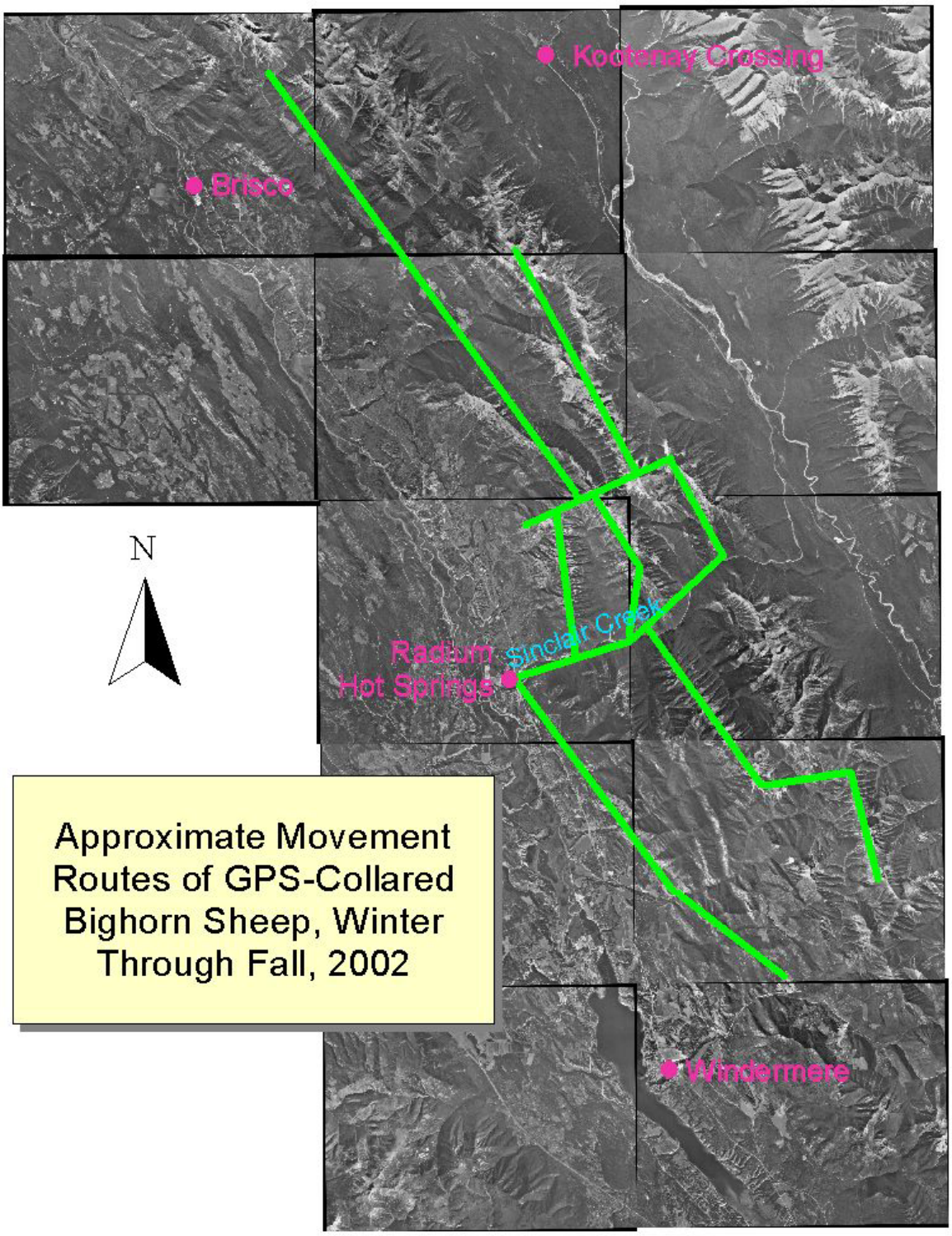

Figure 3. Major movement routes of 10 GPS-collared bighorn sheep, 2002, near Radium Hot Springs, British Columbia.

Movements Relative to Habitat Restoration Blocks

Three ram GPS locations were in open sites adjacent to the Radium provincial Crown habitat restoration block. Although no locations were recorded within this block, several movement vectors joining sequential locations from one ram passed through it, possibly indicating transient use. This block was harvested after collars were deployed, so more detailed analyses would be required to correlate harvest timing with animal movements.

There were 14 GPS-collar locations in grassland or open forest within or adjacent to the Stoddart block, the harvesting of which was being completed when collars were deployed. Again, several movement vectors passed through this block. Uncollared sheep were observed in the middle portion of it at the time collars were being deployed in January 2002 (while restoration was underway) and tracks were often evident in it during the winters of 2001/02 and 2002/03 (A. Dibb, Parks Canada, Radium Hot Springs, pers. comm.).

The sighting of uncollared animals in the Stoddart block does suggest that restoration may have some immediate effect, including allowing movement and possibly foraging. However, the low level of use by collared animals in the blocks, except in sites that were already quite open, suggests that the immediate response may be relatively small. This data provides a base from which to compare future use of restoration blocks as burning is completed and sheep potentially adapt their behavior over time.

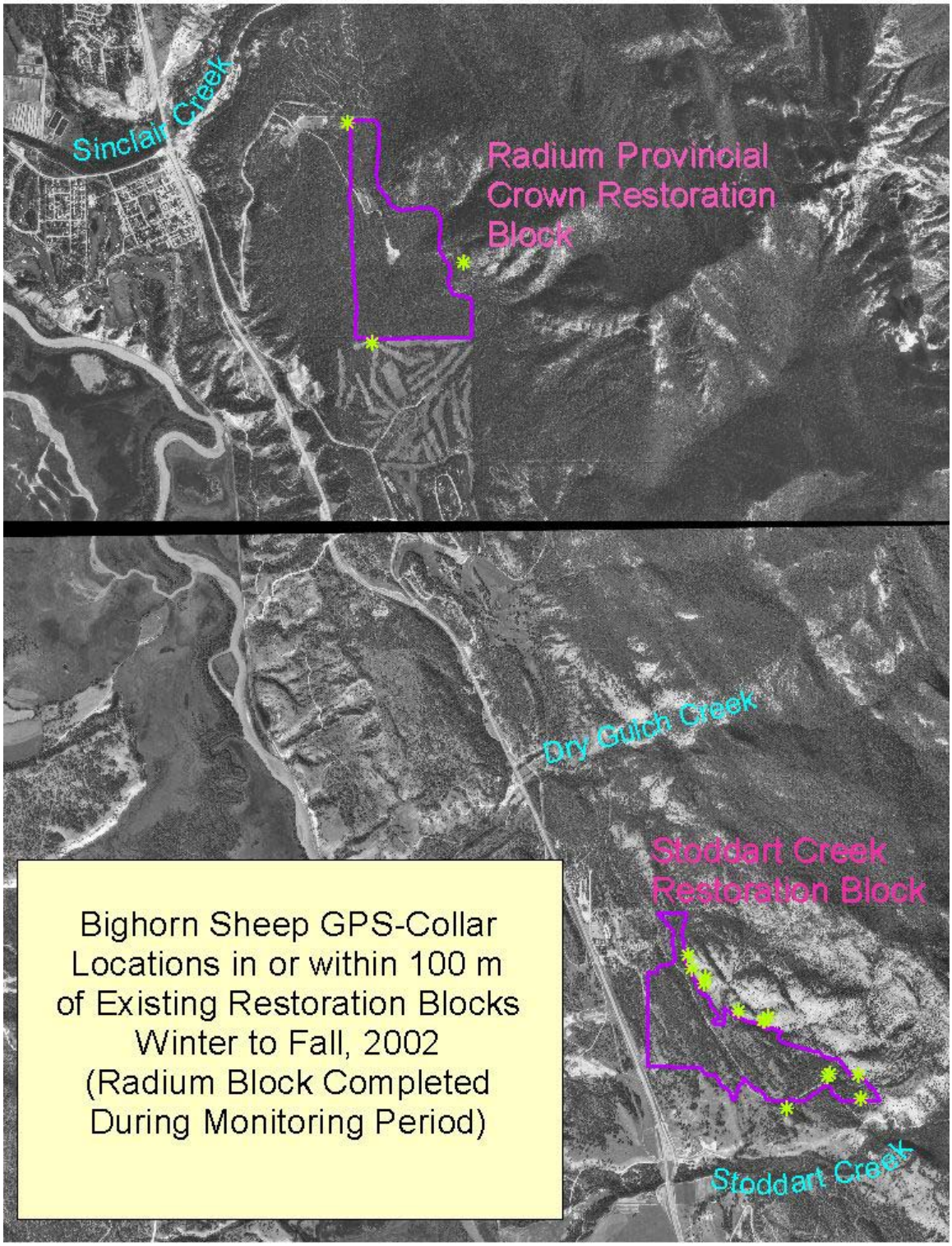

Figure 4. GPS-collar locations from 2002 that were in or within 100 m of habitat restoration blocks that had been completed or were under development during the monitoring period.

Literature Cited

Braumandl, T. F., and M. P. Curran. 1992. A field guide for site identification and interpretation for the Nelson Forest Region. Land Management Handbook Number 20, Ministry of Forests, Victoria, British Columbia.

Davidson, P. W. 1994. East Kootenay bighorn sheep enhancement project completion report. Ministry of Environment, Lands and Parks, Victoria, British Columbia.

Gayton, D. 1996. Fire-maintained ecosystems and the effects of forest ingrowth. Nelson Forest Region, Ministry of Forests, Nelson, British Columbia.

Gray, R. W. 2001. The effect of stand structure and fire regime alterations on bighorn sheep habitat. R. W. Gray Consulting Ltd., Chilliwack, British Columbia.

Hooge, P. N., and B. Eichenlaub. 1997. Animal movement extension to Arcview. Version 1.1. United States Geological Survey, Anchorage, Alaska.

Kernaghan, G., K. Lessard, B. Sinclair, R. McKay, G. Burns, and M. V. Ketcheson. 2001. Draft terrestrial ecosystem mapping (TEM) of Slocan Forest Products Ltd. (Radium Division) forest licence A18979. Volume I: expanded legend to ecosystem units. Slocan Forest Products Ltd (Radium Division), Radium Hot Springs, British Columbia.

Kinley, T. A. 2002. Radium - Stoddart bighorn sheep GPS and VHF telemetry 2001-2002. Summary of Activities and Data Collection January – March, 2002. Slocan Forest Products, Radium Hot Springs, British Columbia.

Ministry of Environment, Lands and Parks. 1998. Aerial inventory dataforms for selected ungulates: bison, mountain goat, mountain sheep, moose, elk, deer and caribou. Standards for components of British Columbia's biodiversity no. 32 (forms). Resources Inventory Committee, Victoria, British Columbia.

Osprey Communications. 2001. Radium-Stoddart bighorn winter range monitoring and restoration program results 2000-2001. Slocan Forest Products (Radium Division), Radium Hot Springs, British Columbia.

Rocky Mountain Trench Ecosystem Restoration Steering Committee. 2000. Fire-maintained ecosystem restoration in the Rocky Mountain Trench: "a blueprint for action". Ministry of Forests, Invermere, British Columbia.

Stelfox, J. G., D. M. Poll, and B. R. Sheehan. 1985. Status of the Radium bighorn sheep herd and its ranges: 1984-1985. Canadian Wildlife Service, Edmonton, Alberta, and Parks Canada, Radium Hot Springs, British Columbia.

Tremblay, M. A. 2001. Modeling and management of potential movement corridors for elk (*Cervus elaphus*), bighorn sheep (*Ovis canadensis*) and grizzly bear (*Ursus arctos*) in the Radium Hot Springs area, British Columbia. M.E.Des. thesis, University of Calgary, Calgary, Alberta.