

Bighorn In Our Backyard

Communities Working for Wildlife

Radium-Stoddart Bighorn Winter Range Monitoring and Restoration Program Results 2000 – 2001

Final Report Prepared for:

**Forest Renewal British Columbia
In partnership with
Slocan Forest Products, Radium Division
Radium Hot Springs, British Columbia**

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Executive Summary

Rocky Mountain bighorn sheep (*ovis Canadensis*) of the Radium-Stoddart herd near Radium Hot Springs, British Columbia have been the focal species of the Bighorn In Our Backyard Project (BIOB) since 1997. The BIOB Project has four primary objectives and the work conducted under contract with Forest Renewal British Columbia and Slocan Forest Products, Radium Division fall under two main categories that stem from BIOB:

1) Bighorn Community Monitoring

2) Ecosystem Restoration Research and Implementation

This report provides the methods used and the results gained from BIOB's annual Bighorn Community Monitoring program and research undertaken on two ecosystem restoration sites on critical winter range of the Radium-Stoddart bighorn herd.

Bighorn sheep of the Radium-Stoddart herd historically utilized a larger critical winter range than at present. Changes in winter range use by the herd have been primarily attributed to encroachment of closed coniferous forests on grasslands and open forest habitats and to human development of the winter range, with both of these factors intensifying in the last four decades.

The Bighorn Community Monitoring Program has assisted the BIOB Project to document physical and temporal changes in the use of winter range by the Radium-Stoddart herd. This documentation also provides a benchmark of current bighorn winter range use patterns against which future bighorn winter range use patterns can be compared. Data is collected using volunteers and BIOB staff and is primarily presence/absence data from which a UTM (NAD83) referenced database has been compiled.

Results from the data collected in 231 surveys in the 2000 – 2001 Bighorn Community Monitoring Program are very similar to previous year's data and show a continued dominant use of current vs. historic winter range areas by the herd.

In October 2000 the Radium-Stoddart Bighorn Working Group laid out a restoration plan north of Stoddart Creek. A 70hectare area was selectively harvested in December 2000/January 2001 with merchantable timber removal and veteran tree retention intended to mimic fire-maintained ecosystems typical of a Natural Disturbance Type 4 (NDT4) area.

A system used by Smith et. al., (1999) and developed by Risenhoover and Bailey (1985) to quantify habitat visibility and suitability before and after treatment of a given area was utilized in the Stoddart Creek and Radium restoration areas. UTM referenced sample plots were established at each site and a one metre square panel was used to determine horizontal visibility percentages from which we derived habitat effectiveness ratings for bighorn sheep. Sampling was completed in the pre and post-logging phases at the Stoddart site and completed in the pre-logging phase only at the Radium site.

At the Stoddart restoration site habitat effectiveness based on horizontal visibility criteria confirmed ineffective habitat for bighorn sheep before and after logging. Slashing of the Stoddart site is to commence later in 2001 and it is anticipated that habitat effectiveness based on visibility ratings for bighorn sheep will improve following slashing. Approximately 98% of the pre-logging habitat at the Radium restoration site was found to be ineffective for bighorn sheep. Logging of the Radium site is to begin early in 2002. Visibility tests will be conducted at the completion of the prescriptions on both restoration sites.

The report provides a critique of monitoring and restoration program protocols and makes recommendations for improving aspects of both programs. Ongoing work within the BIOB project will see a fire history and stand reconstruction study completed in the summer of 2001. GPS collaring of ten bighorn in the herd will be conducted in the fall of 2001. Both of these initiatives will contribute data to the ongoing formulation of a long-term ecosystem restoration plan and on-the-ground restoration of bighorn winter range. The report concludes with four recommendations. Nine figures, three tables, three photos and five appendices are included in the report.

1.0) Introduction

Bighorn In Our Backyard (BIOB) is an ongoing ecosystem-based education and research project focused on the Rocky Mountain bighorn sheep (*Ovis canadensis*) herd and its associated ecosystem in the Radium Hot Springs area of the Upper Columbia River, British Columbia. Since 1997 the project has had four primary objectives:

- Raise public awareness and motivate positive action about issues facing bighorn sheep and their associated ecosystem in the Radium winter range area;
- Involve community residents through a Bighorn Community Monitoring Program that will assist in planning and conducting ecosystem restoration and conservation initiatives;
- Prepare a multi-agency ecosystem restoration plan for the Radium-Stoddart bighorn winter range and undertake ecosystem research and restoration initiatives on this critical winter range;
- Assess and encourage potential community-based economic returns associated with the conservation of ecosystems & wildlife within and adjacent to the community of Radium.

The BIOB program has met with considerable success and is currently active in all four objective areas. (See Appendix Three for list of partners) Forest Renewal British Columbia funding in 2000 – 01 was primarily applied to the Project's second and third objectives.

The Radium-Stoddart Rocky Mountain Bighorn Sheep critical winter range historically covered a larger area than at present. Several factors account for the changes in habitat use by the herd but human use and alteration of winter range and coniferous forest ingrowth are the two dominant causal factors. Figure 1: Radium-Stoddart Bighorn Winter Range, depicts the current vs. historic winter range of the herd; a marked change over the last four to six decades. Figure 2: Project Study Area, incorporates the Bighorn In Our Backyard Project's

Bighorn Community Monitoring Program and Ecosystem Research and Restoration Initiatives.

The study area is within the Interior Douglas Fir Zone (IDF) which dominates the low-to mid-elevation landscape of south-central B.C and includes the rolling and valley terrain of the southern Rocky Mountain Trench. The IDF zone covers all of the Bighorn Community Monitoring Program study area. Two subzones of the IDF are present within the study area: the Kootenay undifferentiated subzone (IDFun) and the Kootenay Dry mild subzone (IDFdm2). The IDFun occurs elevationally from the Columbia floodplain up to the IDFdm2 at approximately 800m elevation. The (IDFdm2) is found at elevations of 800-1200 m on warm aspects and between 800 and 1100 m on cool aspects (Braumandl and Curran 1992, in Marcoux et al 1997). The study area is within the Southern Interior Mountains ecoprovince, Southern Rocky Mountain Trench ecoregion and the East Kootenay Trench ecosection.

Tremblay's (2001) Masters Degree Thesis provides a comprehensive literature overview of the status, distribution, and management of bighorn sheep. The overview also discusses bighorn sheep basic requirements, habitat use and selection, movement patterns, use of seasonal ranges, movement corridors, importance of tradition, obstacles to movement and the significance of a variety disturbances caused by humans. Tremblay's work is particularly relevant as it focuses specifically upon the Radium-Stoddart Rocky Mountain bighorn sheep herd incorporating all previous research results and contributing significant perspective and recommendations for future research and management. The paper can be viewed at www2.mtroyal.ab.ca/mtremblay.

The following summary is in part derived from Tremblay's (2001) discussion of the Status, Distribution and Management of Bighorn Sheep.

Radium Hot Springs has the distinction of being host to one of only several Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) herds in British Columbia. In the East Kootenays, bighorns have a patchy distribution along the east side of the Rocky Mountain Trench from near the Canada-U.S. border north to Edgewater (Demarchi 1967, in Poll et al. 1984). The bighorn sheep is Blue-listed in British Columbia because its winter ranges are threatened by past over-grazing, competition with domestic stock and other ungulates, land alienation and human encroachment (B.C. Min. of Forests 1997). During Bighorn In Our Backyard public extension programs, the ingrowth of coniferous forests due to fire suppression and human alteration and encroachment on the herd's critical winter range are forwarded as the dominant factors currently affecting the Radium Stoddart herd. The rates of mortality of bighorn by motor vehicles on Highway 93/95 have been rising in recent years and are also of great concern within the project.

Figure 1: Radium-Stoddart Bighorn Winter Range

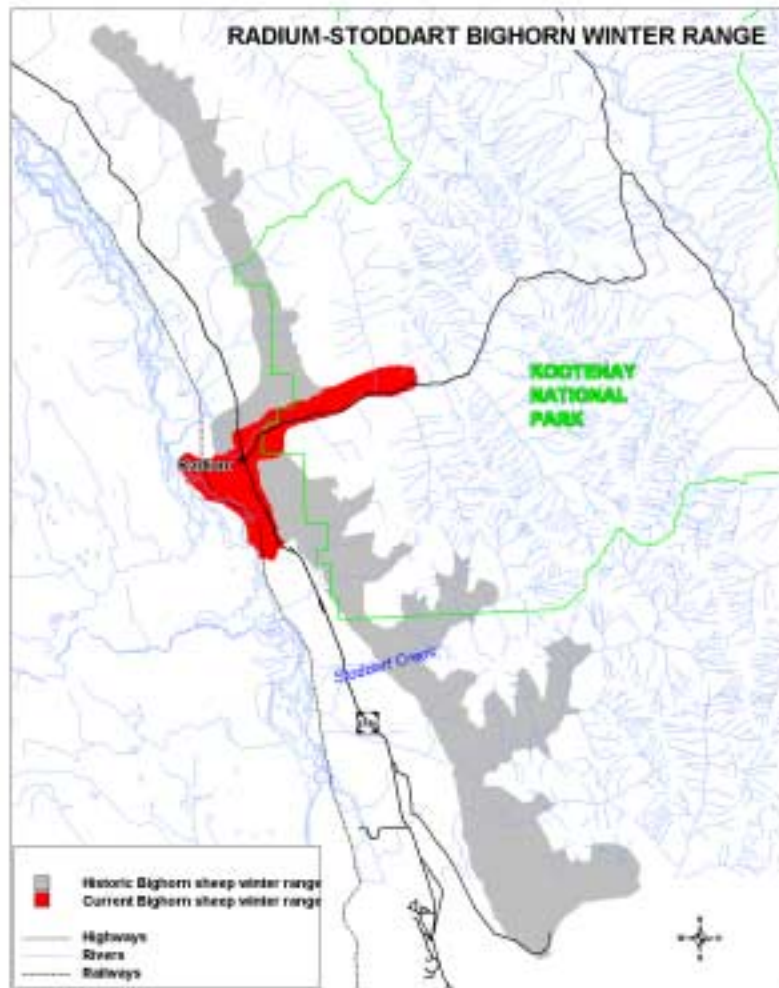
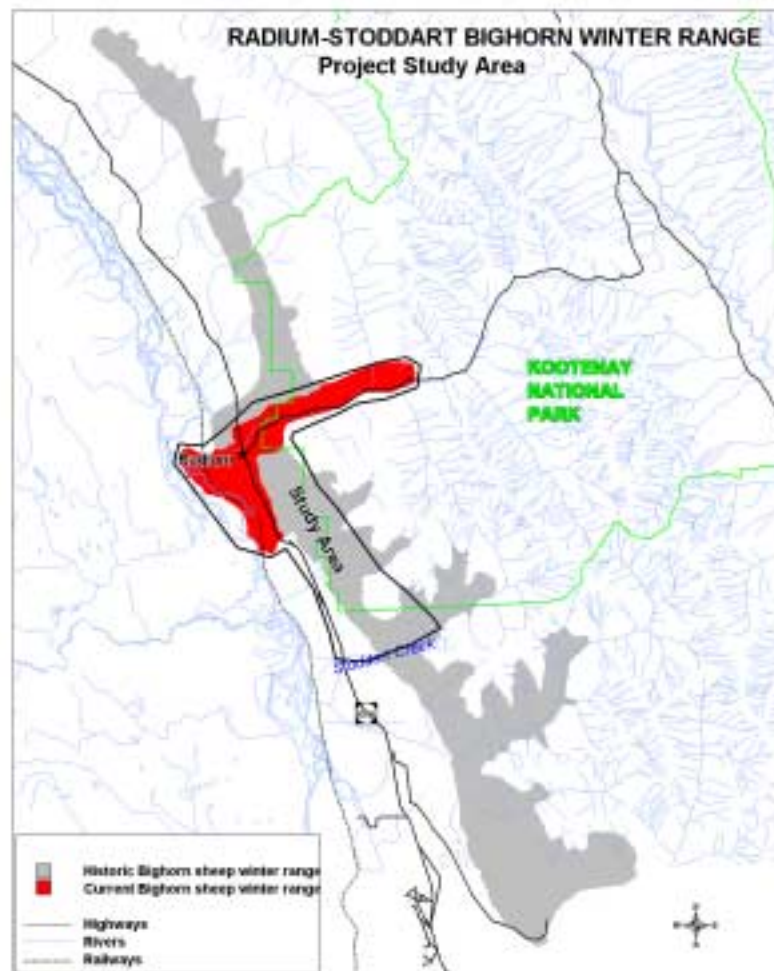


Figure 2: Project Study Area



The March 1985 ground census revealed a minimum population of 114 bighorns on the winter range between Sinclair and Stoddart Creeks (Stelfox et al. 1985). Previous counts in spring were 89 in 1984, 108 in 1983, 77 in 1982 and 109 in 1981 (Stelfox et al. 1985). At present, the population of the Radium herd is estimated at approximately 150 individuals (A. Dibb, pers. comm. October 2000), which represents roughly 8% of the total provincial population (Forbes 1999). The Radium herd is important to humans as a wildlife viewing species, as transplant animals and for a limited amount of hunting in the fall. In 1998, the hunting season for bighorn sheep in Wildlife Management Units 4-25 and 4-35 extended from September 10 to October 25 and was limited to full curl rams (B.C. Ministry of Environment, Lands and Parks 1998a). The carrying capacity of the Radium-Stoddart winter range is estimated at 150 animals (Forbes 1999). Wildlife managers attempt to keep the population below this number in order to prevent range deterioration that had been assessed in fair to poor condition by Stelfox. (Stelfox et al. 1985). Translocations have been used on occasion as a means of maintaining an optimal population size in the Radium-Stoddart herd

and for recolonization of abandoned ranges in western North America.

The increasing use of human-dominated habitats coupled with a decrease in use of traditional 'natural habitats' by bighorn sheep of the Radium-Stoddart herd is of concern within the Bighorn In Our Backyard Project, a trend that has been increasing, particularly over the past four decades. Concern over the long-term effects of this trend on the bighorn remains a large part of the impetus for the BIOB program as a whole and is a primary focal point of the ongoing Bighorn Community Monitoring program.



Photo One: Senior bighorn rams dueling during the fall rut in Radium Hot Springs, BC. Few communities in the world can claim to have this occurring in their streets and yards on a regular basis! © Bill Swan

1.1) Forest Renewal BC and BIOB

The work performed under the 2000-01 FRBC funding for the BIOB Program fall under two main categories:

- 1) Bighorn Community Monitoring**
- 2) Ecosystem Restoration Research and Implementation**

Specific objectives achieved in these categories include:

- Collection of bighorn behavioral data by project volunteers and staff Nov 2000 – April 2001.
- Mapping of the above data.
- Updating the BIOB Website to incorporate these mapping products.
- Pre and post-prescription visibility analysis based on Smith, Hardin & Flinders (1999) of proposed restoration sites with the purpose of establishing baseline habitat conditions for comparison with post-prescription conditions.

1.2) Bighorn Community Monitoring Program

The Bighorn Community Monitoring Program was initiated as part of the BIOB Project in the fall of 1997. Volunteers from the Village of Radium Hot Springs and area and university coop students with Kootenay National Park gathered weekly and monthly data on the occurrence and behavior of bighorn sheep using a monitoring protocol developed by Osprey Communications and Parks Canada (Osprey et al., 1997). The monitoring program has spanned the period of November to April each winter since 1997 with the exception of 1999 – 00 when funding for the program could not be secured.

The purpose of the monitoring is to increase knowledge of the current winter range habitat use patterns of the Radium-Stoddart herd and overlay this pattern of use with what is known of historic winter range use by the herd. The presence/absence data collected is also establishing a benchmark of current winter range use by bighorn against which future winter range use by bighorn sheep can be compared. Secondly, the Bighorn Community Monitoring Program directly involves and educates the public about bighorn sheep thereby contributing to a sense of community stewardship of wildlife and ecosystems. A fundamental premise of the BIOB Project since it began has been that ecosystem-based management decisions and actions are more successful when local communities are informed and involved.

The BIOB program's multi-agency Radium-Stoddart Bighorn Sheep Working Group (see Appendix 3) has identified the monitoring of sheep in the Radium-Stoddart herd as critical to the success of anticipated ecosystem restoration efforts planned for the winter range. Three winters of bighorn monitoring data along with previous records gathered by Kootenay

National Park and the British Columbia Ministry of Environment, all contribute benchmark data against which species and ecosystem response to restoration action can be compared in future.

1.3) Ecosystem Restoration Research and Implementation

The Radium-Stoddart Bighorn Working Group (RSB Working Group) has primarily been focused on the third objective of the Bighorn In Our Backyard Project:

Prepare a multi-agency ecosystem restoration plan for the Radium-Stoddart bighorn winter range and undertake ecosystem research and restoration initiatives on this critical winter range.

Proximity to escape terrain, open, southwest facing aspects and access to forage have historically made the Stoddart Creek area favorable to bighorn sheep. Forest encroachment in the Stoddart Creek area and over the winter range as a whole has contributed to a decline in use of the winter range by bighorn in part due to a decline in visual quality. High visibility over large distances is favored by sheep for predator detection and for visual communication of alarm postures. Wildfires historically maintained these open, high-visibility habitats by keeping forest and shrub encroachment in check. Today, decades of forest encroachment have amassed too much fuel to safely burn much of the Radium-Stoddart winter range that lies adjacent to human settlements.

In October 2000 the RSB Working Group laid out a restoration plan north of Stoddart Creek along the southern boundary of the study area shown in Figure 2. Beginning in December 2000, this seventy hectare area was selectively harvested with merchantable timber removal and veteran tree retention intended to mimic fire-maintained ecosystems typical of a Natural Disturbance Type 4 (NDT4). Slashing will be carried out to complete the restoration actions at this site sometime in 2001.

A system used by Smith et. al., (1999) and developed by Risenhoover and Bailey (1985) to quantify habitat visibility and suitability before and after treatment of a given area was utilized in the Stoddart Creek restoration area. Methods and results of this system are presented in this report.

1.4) Acknowledgements

We thank V. Jablanczy, Slocan Forest Products and Forest Renewal British Columbia for their input and administrative support of this project. A. Dibb, Parks Canada and the Wild Sheep Society of British Columbia both contributed some minor funding and we thank them both for this assistance. Additionally we thank the volunteers who have served with

the Bighorn Monitoring Program for their continued dedication, the members of the Radium-Stoddart Bighorn Working Group, D. Gilbride of Parks Canada for his GIS expertise and products, E. Jeffery, BIOB Field Assistant, M. Bowan for website design and management, and the Village of Radium Hot Springs for funding and hosting the website since 1999. We

also thank the partners and volunteers who helped plan and deliver the Wildlife Mortality Awareness Weekend. Finally, in memory we thank David White of the BC Ministry of Forests, Invermere District, and member of the Radium-Stoddart Bighorn Working Group. We will all miss his energy and passion for ecosystem restoration in the Rocky Mountain Trench. We dedicate our future efforts in the project to Dave.

2.0) Methods

2.1) Methods - Bighorn Community Monitoring Program 2000 - 2001

Each volunteer in the BIOB Project is provided with a Rocky Mountain Bighorn Sheep Community Monitoring Program Training Manual (Osprey, et. al., 1997) and is assigned an area of winter range to monitor. Seventeen volunteers and two staff participated in the monitoring program in 2000 – 01. Sixteen students and their instructors from Selkirk college also participated in the program in April 2001, during their field course in the area. Bill Swan, BIOB Coordinator and Elise Jeffery, BIOB Field Assistant managed the Bighorn Community Monitoring Program.

Program coordinators are in frequent contact with the volunteers; biweekly phone calls and monthly meetings occur during the monitoring period from November to April. Occasional field trips, presentations and updates about the BIOB program also provide the volunteers with enhanced training and an understanding of how their volunteer efforts are contributing to the success of the overall program. Media coverage of the monitoring program has been extensive since 1997 and further adds to the program's positive contributions and it's effectiveness as a stewardship tool.

All of the current and parts of the historic winter range of the Radium-Stoddart bighorn herd are delineated into twelve winter range survey units shown in Figure 3: Volunteer Monitor's Survey Areas. The emphasis for the volunteer monitors is to conduct Presence/Absence surveys and provide a geographic location by placing a dot on a topographic map on the reverse of their data sheets as shown in Appendix 1. Program coordinators determine the UTM location of this observation data once the forms are collected. Observer name, date, time, total number of sheep, age class and gender are also recorded. The observer is encouraged to record field notes on the form, e.g., feeding resting, mating, injuries, mortalities, interactions with humans/other wildlife etc.

Prominent among the trends of changing habitat use by the Radium-Stoddart Bighorn herd in recent years has been an increased use of roadsides, particularly on Highway 93/95 immediately south of the Village of Radium Hot Springs.

Figure 3: Volunteer Monitor's Survey Areas



As a result of a suggestion by a BIOB volunteer monitor, we planned and conducted a driver awareness and education event called the Wildlife Highway Mortality Awareness Weekend, February 16 –18, 2001. The event was timed to coincide with Alberta Family Day when traffic volumes are large in the region. Approximately 200 Flags marking the point of collision and death of wildlife along the sections of highway near Radium (approx. 10 km total) were inserted in the ground along the road edge based on mortality data collected over the past decade by Parks Canada and the BC Ministry of Transportation and Highways. Large highway-standard signs developed by Parks Canada indicated One Flag = One Dead Animal to passing motorists. An information table, wildlife displays and a wildlife viewing station were set up in a roadside pull out near Radium to encourage drivers to pull in and meet us.

In total we recorded contact with over 300 drivers on the Saturday of that weekend despite temperatures of -15°C to start the day. The partnership event was supported by the Insurance

Corporation of British Columbia, Sylvan Consulting, BC Ministry of Transportation and Highways, Kootenay National Park, Teachers and Students from Radium Elementary School and the Bighorn In Our Backyard volunteers and staff through the Slokan/FRBC funding. The event made front page in the local Valley Echo newspaper and was accompanied with messages about wildlife mortality issues associated with roadways in the region.



Photo 2: Ram avoiding collision with vehicle on highway 93/95 near Radium Hot Springs, BC. Thirteen bighorn of the Radium-Stoddart herd were killed by vehicles in 2000. © Bill Swan.

2.2) Methods - Ecosystem Restoration Research and Implementation

Dave White of the BC MOF, Invermere District and the RSB Working Group laid out the prescription for logging in the Stoddart Creek area in October 2000. Two areas were excluded from the restoration area, one for visual quality and one for archeology values. A motor vehicle closure under the BC Wildlife Act covers some of the restoration area.

In total, the prescription covered 70 hectares of primarily Douglas-fir (*Pseudotsuga menziesii*) forest with some lodgepole pine (*Pinus contorta*), aspen (*Populus tremuloides*) and juniper (*Juniperus* spp.) Forest cover maps of the area indicated three categories of crown closure present within the restoration area:

- open range
- 6 - 15% (inc. “non-productive”)
- 26 – 45%.

Prescription boundaries intentionally incorporated areas where escape terrain and steep slopes ran out to areas of flatter terrain within the restoration area. Logging commenced in December 2000 and was completed by the end of January 2001. Logging slash was piled on six landing sites and will be burned. Slashing and burning to remove most of the remaining sub-merchantable trees and shrubs will complete the prescription during 2001. Long-term treatments may include the use of low temperature ground fire to maintain the area in an open condition.

We wanted to assess the effectiveness of the ecosystem restoration at Stoddart Creek by quantifying habitat visibility before and after the prescription as described in Smith et. al (1999). Thirty-four stratified systematic sample plots were established over three forest cover types (open range, open forest, closed forest) within the restoration site boundaries. The samples plots were established at one per 200 m x 100 m, with 100 m offset between transects. Hand held GPS units (NAD 83) were used to locate sample plots in the field and each plot was marked with a wooden stake, flagging tape and a metal pin at ground level. Figure 4: Stoddart Restoration Site, shows the boundaries of the restoration area at Stoddart Creek with the locations of the sample plots indicated by a number and letter combination. Table 1 shows the UTM plots categorized by forest cover type for the Stoddart restoration area.

At each sample plot a one meter square yellow target board divided into 36 equal squares was used to test visibility. A wooden stake was used to keep the target upright, with the bottom of the target touching ground level or the top of the snow pack (aver. 6 – 15 cm depth). Visibility testing consisted of facing the target in each of the four cardinal directions perpendicular to the target from a distance of 40 metres. The target was viewed at an approximate height of 90cm above the ground to approximate the perspective of a bighorn sheep. A square was considered visible when >50% of the square was visible - not obscured by vegetation.

In January and February 2001, the boundaries for a proposed 110 hectare restoration area on 224 hectares of crown provincial and crown federal land adjacent to Kootenay National

Park and the Village of Radium Hot Springs was field surveyed and mapped by members of the Radium-Stoddart Bighorn Working Group. We established forty-seven stratified systematic sample plots in the Radium restoration area in March of 2001 using the same criteria and methodology as for the Stoddart site.

Figure 5: Radium Restoration Site, shows the boundaries of the restoration area at Radium with the locations of the sample plots indicated by a number and letter combination. Table 2 shows the UTM plots categorized by forest cover type for the Radium restoration area.

The Radium restoration site is also adjacent to a firebreak that Parks Canada maintains through a combination of partial and complete tree removal for public safety around Redstreak Campground in Kootenay National Park. Bighorn use this fire break opening and the logging scheduled for January of 2002 has been planned so that the break is incorporated as part of a movement corridor we hope to restore at the Radium restoration site. The overall

shape of the Radium restoration site has also been designed to create an open corridor between Highway 93/95 and the steep terrain along the western boundary of Kootenay National Park in the hope of drawing bighorn and other wildlife away from the highway margins.

Figure 4: Stoddart Restoration Site

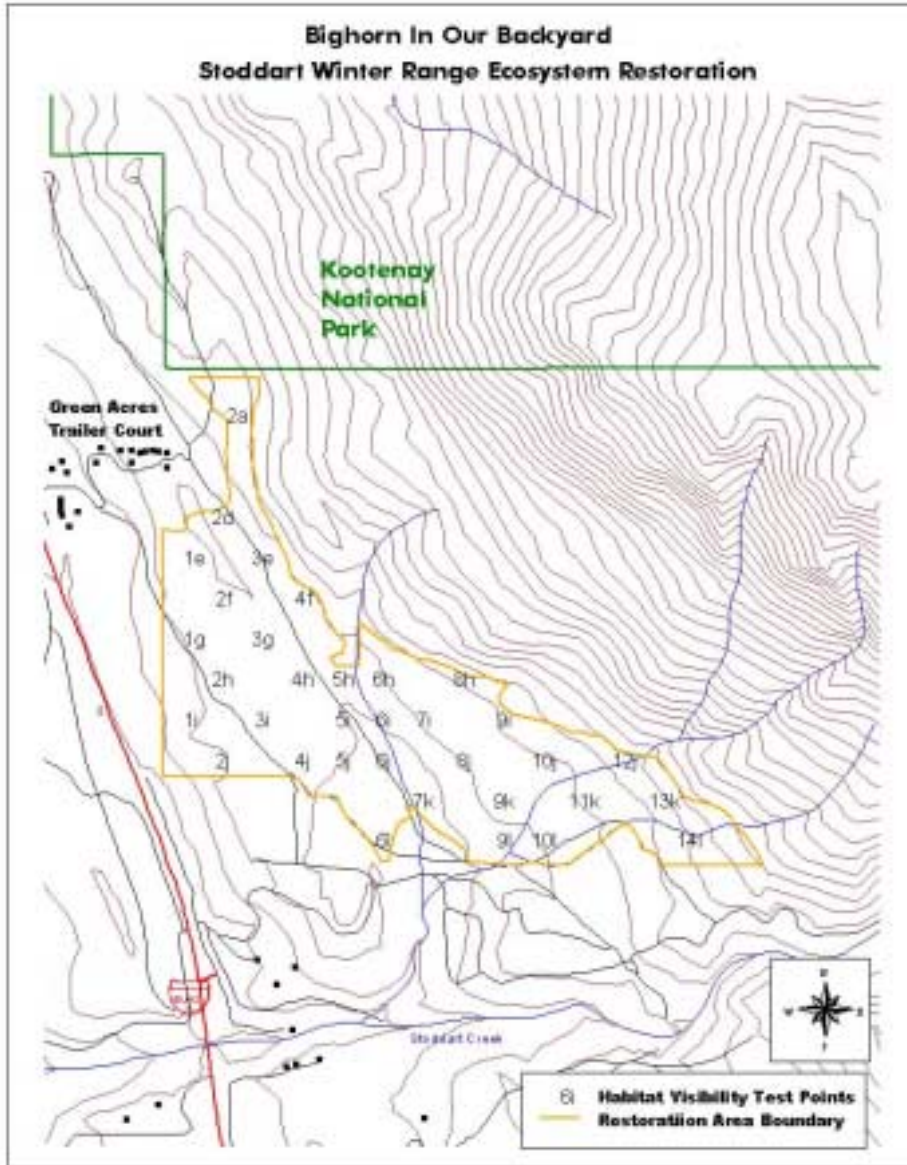
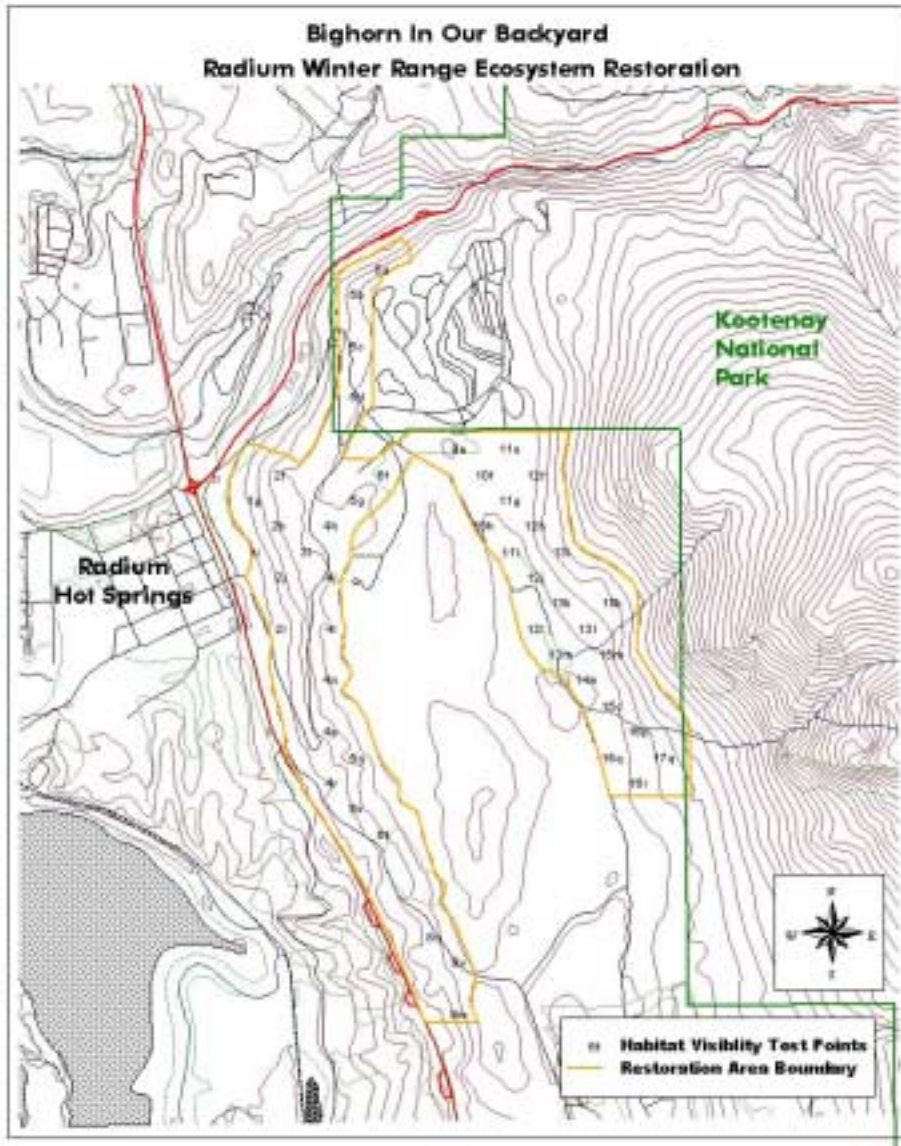
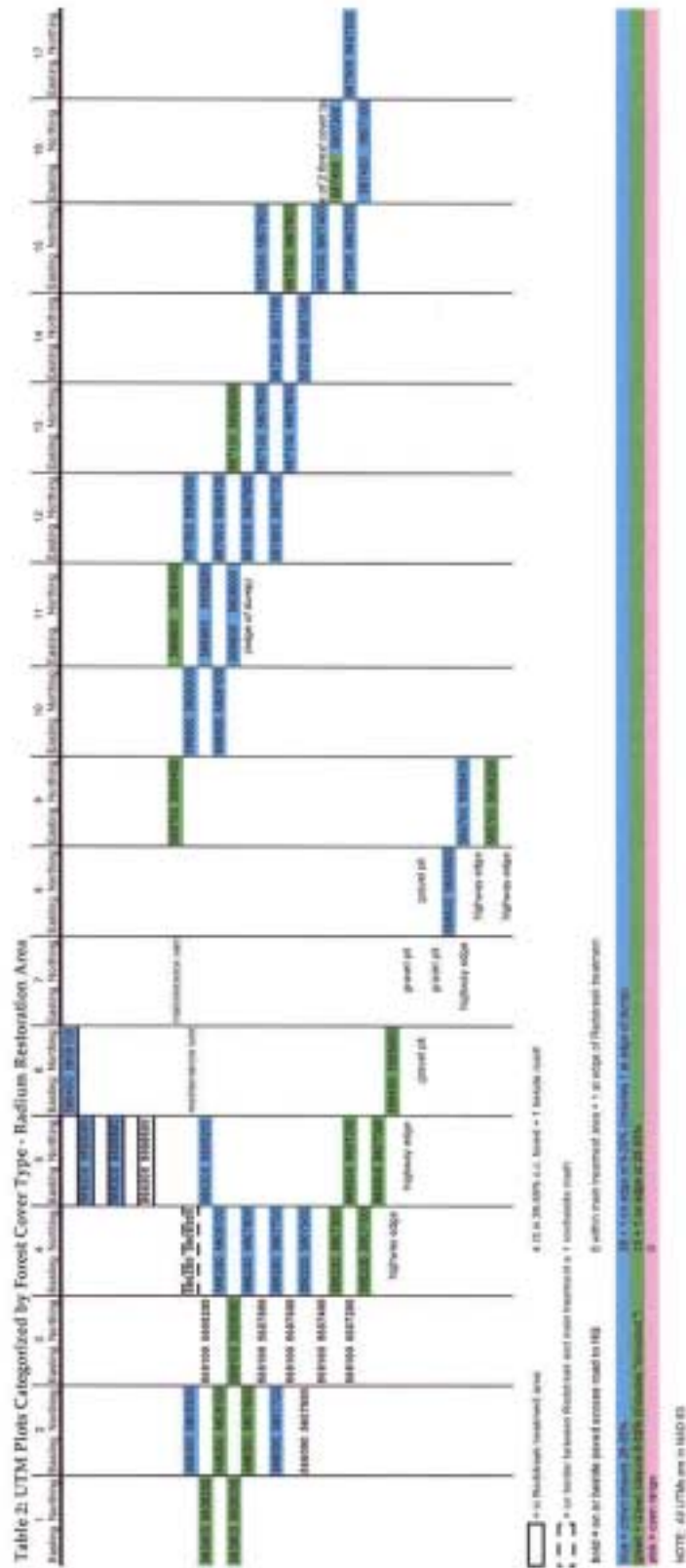


Figure 5: Radium Restoration Site





3.0) Results

3.1) Results - Bighorn Community Monitoring Program 2000 - 2001

In total 231 surveys of bighorn were submitted by the volunteer monitors in the 2000 – 2001 monitoring season. Approximately 2522 individual bighorn sheep are incorporated in these surveys and with the current estimate of the Radium-Stoddart herd size being 150 animals, each bighorn in the herd was observed an average of 17 times.

Table 3: Bighorn Community Monitoring Program

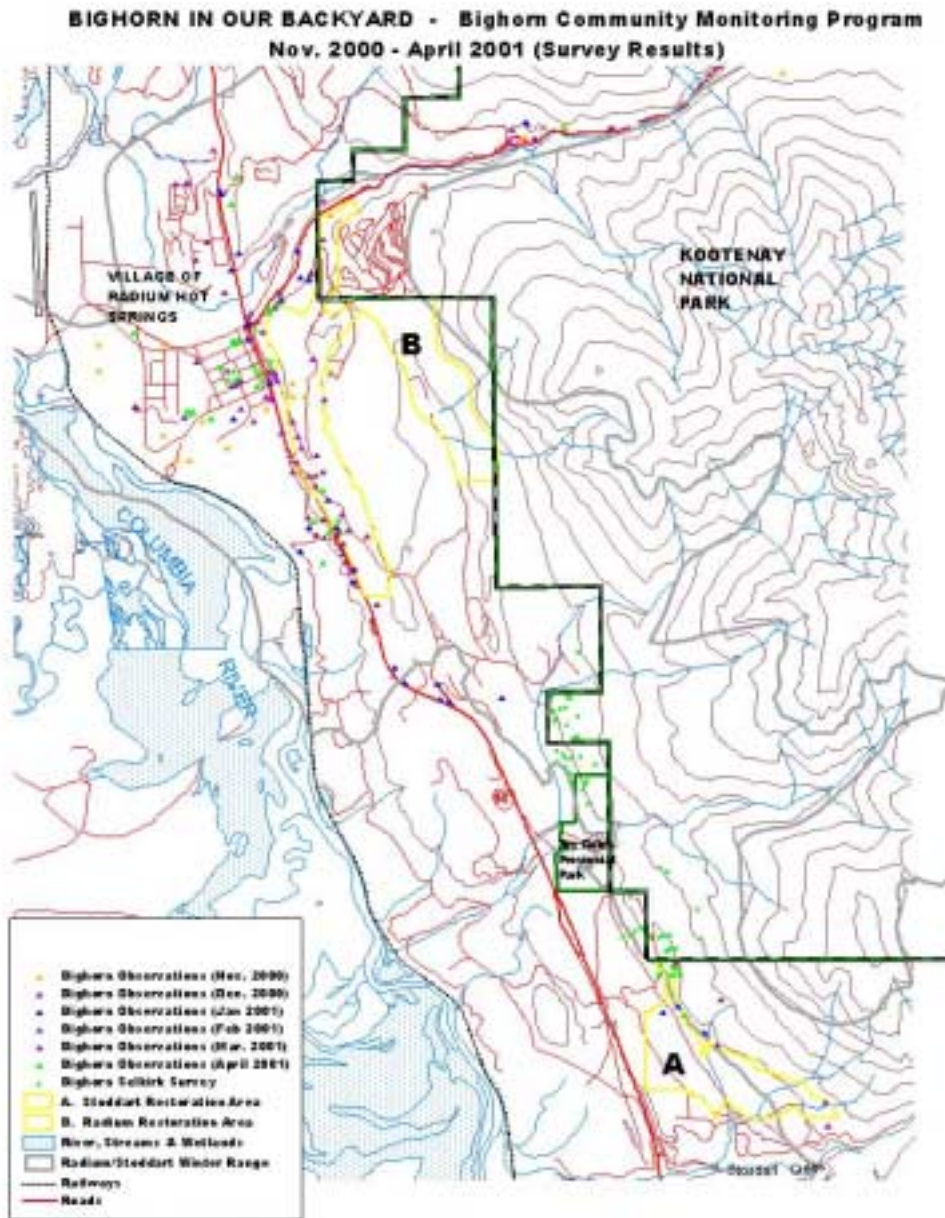
Surveys Conducted by Month Nov. 2000 – Apr. 2001

<i>Date</i>	<i>#of Bighorn Surveys Conducted</i>	<i># of Monitors Contributing Data</i>	<i>#of Bighorn Sheep Observed</i>
November 2000	19	1	340
December	17	5	100
January 2001	38	9	503
February	53	11	472
March	28	8	542
April	35	8	565
April	<u>26</u>	16 (Selkirk)	8 observations of scat 4 observations of tracks
Totals	231		2522 bighorn observed

Figure 6: Bighorn Community Monitoring Program Survey Results, provides the mapped locations of the presence of bighorn sheep during the 231 surveys conducted by volunteers and staff.

The data collected during the 2000 – 2001 Bighorn Community Monitoring Program has been entered on an Access database and submitted digitally with this report to the FRBC contract supervisor and the BC MOE. It must be emphasized that some of the data is sensitive, particularly data pertaining to locations of senior age class rams, and therefore, must be managed accordingly. Public display of the data in a manner that describes location of senior age class rams should be avoided to prevent potential poaching of these animals. The multi-agency Radium-Stoddart Bighorn Working Group supports this data management strategy.

Figure 6: Bighorn Community Monitoring Program Survey Results



3.2) Results - Ecosystem Restoration Research and Implementation

3.2.1) Results - Stoddart Restoration Site

Thirty-four sample plots on the Stoddart restoration site were established and tested using the visibility test described in the methods. Forest cover data derived from maps was also assessed in the field at each plot. Appendix 4a: Visibility Test Results for the Stoddart Restoration Area, provides the results of the pre-logging and post-logging visibility tests conducted and provides a habitat effectiveness rating for each plot based on the test results. Habitat was rated effective if it received a horizontal visibility rating $\geq 60\%$.

An early logging start-up in December 2000 resulted in two of the visibility test plots being entirely logged and three partially logged prior to our pre-logging visibility tests. Data collected at the two entirely logged test plots were excluded from pre-logging/post-logging analysis. The five affected test plots are identified with blank cells under the cardinal direction column in the spreadsheet in Appendix 4a.

At twenty-four plots the pre-logging visibility test results revealed a 0% visibility rating; in several of these tests the 1 metre sq. test panel either could not be seen at all through the vegetation or terrain aspect blocked the sight lines to the panel. Following logging, fifteen test plots showed improved visibility quality, fifteen test plots showed no change and two test plots declined in visibility quality. All of the sample plots tested at Stoddart were rated as ineffective habitat based on the visibility test results both before and after logging.

Forest cover assessments in the field confirmed forest cover map data as accurate at twenty-one plots and inaccurate at twelve plots. Of the twelve plots assessed as inaccurate, all but one showed an increase in forest cover percentage than the mapped forest cover data.

Unfortunately, the post-slashing visibility testing was not conducted due to a delay in the slashing of the Stoddart Restoration site. Post-slashing visibility tests will be conducted at all thirty-four test plots following slashing of the Stoddart restoration site in 2001.

3.2.2) Results - Radium Restoration Site

Forty-Seven sample plots on the Radium restoration site were established and tested using the visibility test described in the methods. Forest cover data derived from maps was also assessed in the field at each plot. Appendix 4b: Visibility Test Results for the Radium Restoration Area, provides the results of the pre-logging visibility tests conducted and provides a habitat effectiveness rating for each plot based on the test results. Habitat was rated effective if it received a horizontal visibility rating $\geq 60\%$.

At sixteen plots the pre-logging visibility test results revealed a 0% visibility rating; in several of these tests the 1 metre sq. test panel either could not be seen at all through the vegetation or terrain aspect blocked the sight lines to the panel. Forty-six of the test plots were rated as

ineffective habitat based on the visibility test result before logging. One test plot (5d) was rated effective habitat based on a horizontal visibility test result of 68%.

Forest cover assessments in the field confirmed forest cover map data as accurate at thirty-seven plots and inaccurate at ten plots. Of the ten plots assessed as inaccurate, seven showed an increase in forest cover and three showed a lower forest cover percentage over that of the mapped forest cover data.

A post logging/post slashing visibility test will be conducted at each plot in the Radium restoration site following the combined logging and slashing prescription planned for January 2002.

3.3) Results - Mapping the Data

Mapping of the data from the Nov. 2000 to Apr. 2001 BIOB Project's Bighorn Monitoring Program and from the Ecosystem Research and Restoration programs was completed using ArcView software. Elise Jeffery, BIOB Field Assistant and Dave Gilbride, Data Management Specialist, Parks Canada prepared the map products. We produced these maps at the conclusion of the monitoring season rather than on a monthly basis and program volunteers did not enter the data for the production of the maps as was proposed. The maps created are presented in this report and some have been used on the BIOB Website.

Monitoring forms have been upgraded for the 2001 – 02 monitoring season. In addition to "cleaning up" the maps by removing extraneous features, volunteers will be given monitoring forms that illustrate the entire study area with all survey units delineated and a monitoring form that delineates their individual survey unit(s) only. This will provide volunteers with a higher level of detail on their maps and facilitate improved data collection and mapping within the Bighorn Community Monitoring Program.

3.4) Results - Updating the BIOB Website to incorporate these mapping products.

The updated contents of the Bighorn In Our Backyard website is provided in Appendix 2. The complete website can be viewed at www.radiumhotsprings.com/village/bighorn

During April 2001, Bighorn In Our Backyard negotiated a new host site for the program website that will allow for more in-depth coverage of the BIOB Program than the Village of Radium Host website currently allows. The Village of Radium will continue to host the contents of BIOB it currently does with links to the main website of BIOB. The BIOB website will be developed on the new host site during the winter of 2001-02.

4.0) Discussion (Includes Critique of Inventory Protocols)

4.1) Discussion - Bighorn Community Monitoring Program 2000 – 2001

The BIOB Program's Bighorn Community Monitoring surveys are assisting in determining a geographic and temporal understanding of the herd's use of current and historic winter range.

The results of these surveys are assisting in the assembly of important pre-restoration, benchmark data against which post-restoration data can be compared.

Bighorn Sheep presence/absence observation data collected during the 2000 – 2001 field season displays similar distribution patterns as in previous years of the monitoring program with the majority of observations occurring in what is considered Current Winter Range for the Radium-Stoddart herd (see Figure 6). The largest concentrations of bighorn observations continues to be within and south of Radium Hot Springs along the east and west margins of highway 93/95 in winter range survey units W2, W5, W6 W7 and W9 (See Figure 6 and Figure 3). As in previous field seasons, observations of bighorn on historic areas of winter range continue to be low.

Observations of bighorn on the Springs At Radium Golf Course were lower than in previous years. Two factors may have contributed to this change in observation results. The total number of volunteer monitors surveying the golf course was lower than in previous years. Secondly, increased predator observations and occurrences have also risen in the Radium- Stoddart Bighorn winter range and we speculate that predator pressure may be contributing to increased levels of movement by bighorn. A small increase in the number of observations south of Radium Hot Springs in units W12, (Stoddart) and further south between Shuswap & Windermere Creeks was recorded in the 2000-01 field season but here again, the number of observers surveying these areas was slightly higher also.

Observer bias is a potential factor in the Monitoring Program. Observers may have a tendency to look for bighorn in their survey units where it is easiest to observe the sheep e.g. along road edges trails, openings and around buildings or travel routes the observer frequents. In addition to requesting monitors to conduct thorough surveys, two regular survey techniques have been built into the Monitoring Program to help address the issue of observer bias:

- **Monthly, all-unit surveys**
- **Strategic deployment of observers**

The coordinated, monthly, all-unit survey that we conduct sees every volunteer in the program survey their assigned unit at the same time and date followed by our monthly meeting where we tally the count. The all-unit tally provides monthly total counts and over the three seasons of surveys these monthly counts show that large numbers (usually greater than 60%) of sheep from the herd of 150 animals are being recorded in the W1 through W9 units. This result would suggest that the Bighorn are spending large amounts of time in the identified current winter range and this is why the volunteer monitors are recording them in their W1 through W9 units at other times during the field season regardless of where in each unit the observer is recording the bighorn presence/absence data.

A second factor addressing observer bias is the strategic deployment of BIOB staff and Kootenay National Park university coop students to deliberately try to find bighorn sheep in locations within the winter range that are not as easy to survey or are not surveyed on as consistent a basis as other units. These more remote and exhaustive surveys have not significantly demonstrated that bighorn are utilizing these locations.

For example, during the 2000-01 field season, Elise Jeffery, BIOB Field Assistant and Tim Harris, volunteer monitor, were assigned to regularly Survey unit W9 and W7 and conducted surveys that consistently incorporated the western areas of W7 and the eastern and southern areas of W9 away from highway 93/95 (see Figure 3). These surveys also did not produce any significant indication that bighorn are utilizing these areas. In fact Elise and Tim often recorded bighorn at the close of these surveys along the highway margins in W7 and W9.

We also applied this same strategic deployment strategy to an area of historic winter range. Winter range survey units W10 and W11 have shown repeated low records of sheep presence over the course of monitoring. A survey of these units was conducted in April deploying Selkirk College students from the Wildland Recreation Program. The observation points collected by the students are displayed on the map in Figure 6 as Bighorn Selkirk Survey. Of the 26 observations submitted by the students, four data points for sheep tracks were recorded and eight data points for sheep scat, mostly old scats, were recorded. No sheep were observed. Deer and elk scats and tracks made up the remaining fourteen data points the students recorded.

In 2001-02, we are also planning to involve secondary and post-secondary students with graduation/degree requirements in the Bighorn Community Monitoring Program. These volunteers will assist the program to extend remote survey techniques and to strategically deploy monitors to address certain questions that arise in the monitoring program.

4.2) Discussion - Ecosystem Restoration Research and Implementation

The incomplete results of the habitat visibility tests conducted at the Stoddart restoration site make it difficult to provide an interpretation of the effectiveness of the restoration prescriptions conducted to date and of the visibility test itself. However, early results at the Stoddart site do provide some insights for discussion that should be applied to the Radium and other restoration sites in the Radium-Stoddart winter range in future. At the Radium restoration site the benchmark, pre-logging visibility test sample plots have been established which was the objective at the outset.

Concern has been raised by some members of the Radium-Stoddart Working Group that the logging prescription at the Stoddart site has not removed enough of the conifer encroachment to adequately increase habitat effectiveness for bighorn based on visibility. Results of the post-logging pre-slashing visibility tests support this view as all thirty-four sample plots failed to receive an effective habitat rating of $\geq 60\%$ horizontal visibility after logging of the site.

It is important to remember that the logging of some of the merchantable timber at the Stoddart site was not intended alone to restore habitat effectiveness for bighorn sheep. Slashing of the site is a critical part of the prescription and should result in significant increases in horizontal visibility.

It is also important to emphasize that while bighorn sheep are clearly a focal species of the BIOB project, ecosystem restoration through ecosystem-based management is an underlying objective

of equal importance. The restoration of grasslands and open forest will benefit a range of plant and animal species associated with these provincially threatened ecosystems.

Photo 3 was taken at the Stoddart restoration site following logging operations.



Photo 3: View after logging and before slashing of Stoddart restoration area. Veteran trees (yellow flagging) were retained and sub-merchantable trees and dense shrub layers are to be slashed. Bighorn were observed on escape terrain in the background during and after logging operations. Larry Halverson, © 2001.

A field visit to the Stoddart site following logging by members of the Radium-Stoddart Bighorn Working Group has revealed the possibility that slashing costs may be higher than was originally intended. An option drawn from this field outing was to look at harvesting methods considered for the Radium site that would combine merchantable harvesting with slashing in the same pass when machinery and crews were already onsite. In addition to the habitat restoration and economic benefits of this approach, the need for a pre-slashing visibility test would be eliminated. Results of the Stoddart site restoration efforts to date are being incorporated in a costing and restoration effectiveness analysis at the Radium restoration site in preparation for logging in 2002.

Due to the high public profile and relatively higher levels of risk associated with ecosystem restoration in close proximity to private and public land values, the Radium-Stoddart Bighorn Working Group is stressing adaptive management principles, comprehensive restoration planning and the need for high standards of operations associated with restoration. A long-term objective is to encourage private landowners to emulate the restoration activities we are conducting on neighboring crown lands. Public field tours of the Stoddart and Radium restoration sites will be developed as part of the Bighorn In Our Backyard Education and Outreach Programs with September 2001 scheduled as a start up of these tours.

The migratory routes bighorn sheep are utilizing in the Radium-Stoddart herd are of great interest in future work in the BIOB project, particularly as it applies to the ecosystem restoration and research elements of the project. A limitation of the presence/ absence observation data collected in the Bighorn Community Monitoring Program is that it does not provide us with migrational pattern information about the Radium-Stoddart herd. In some cases, unique physical attributes of individual sheep, a broken horn, scar or injury will provide information about where sheep have been seen with time intervals calculated between these observations.

For example, on one occasion a ram with a major horn injury (broken off at the base) was observed grazing in the Windermere Creek area. One week later this same ram was observed grazing on the slopes above highway 93/95 south of Radium in survey unit W9. Approximately twenty kilometers of rugged terrain separate these two observation points.

We will be collaring ten sheep during the fall of 2001 to gather data about migration patterns, habitat use and intra-herd connections of the Radium-Stoddart bighorn herd. GPS collars will also allow us to monitor bighorn sheep use of the Stoddart Creek restoration site since logging took place and of the Radium restoration site before and after logging. Volunteer and staff monitors assigned to survey units W2, W9 and W12 covering the restoration areas at Stoddart and Radium, will also be given new monitoring forms indicating the boundaries of the restoration area and of the location of the visibility research plots, as shown in Figure 7: Example of Updated BIOB Monitors' Datasheet with Restoration Site Indicated.

Tremblay (2001) offers potential corridors for bighorn sheep in the greater Radium Hot Springs area and potential corridors for bighorn sheep in the immediate vicinity of the Village. Data from the GPS collared bighorn during 2001-02 will help to test these potential corridors and we will be working closely with Marie Tremblay during this phase of the project. Figures 8 and 9: Potential Corridors for bighorn sheep in the greater Radium Hot Springs area, B.C. are from Tremblay (2001).

Also planned for July of 2001 is a fire history and stand reconstruction study on the Radium-Stoddart bighorn winter range. Gray (2000), provides the objectives of the study that will assist the Radium-Stoddart Bighorn Working Group in the formulation of a long-term ecosystem restoration plan.

Figure 7: Example of Updated BIOB Monitors' Datasheet with Restoration Site Indicated

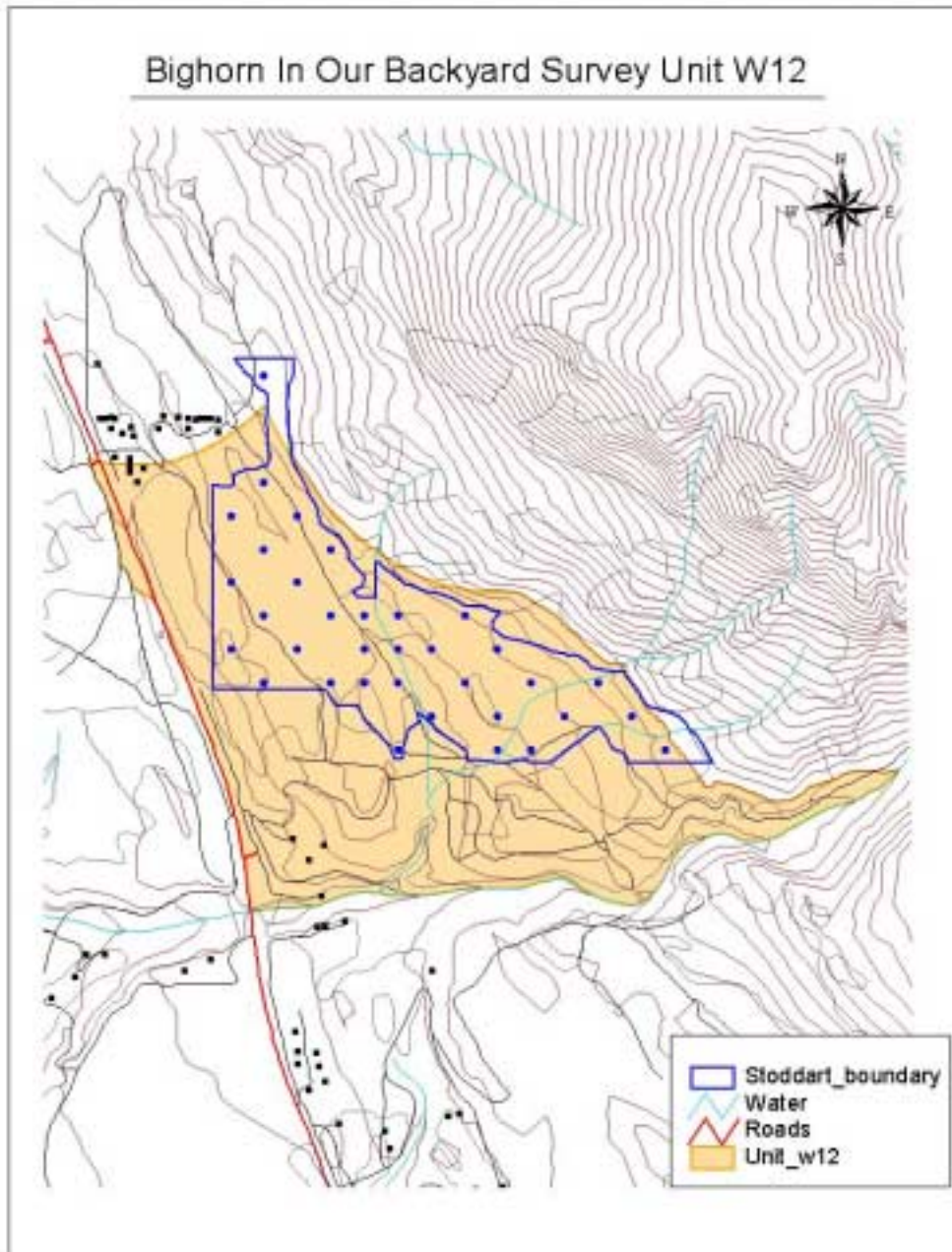
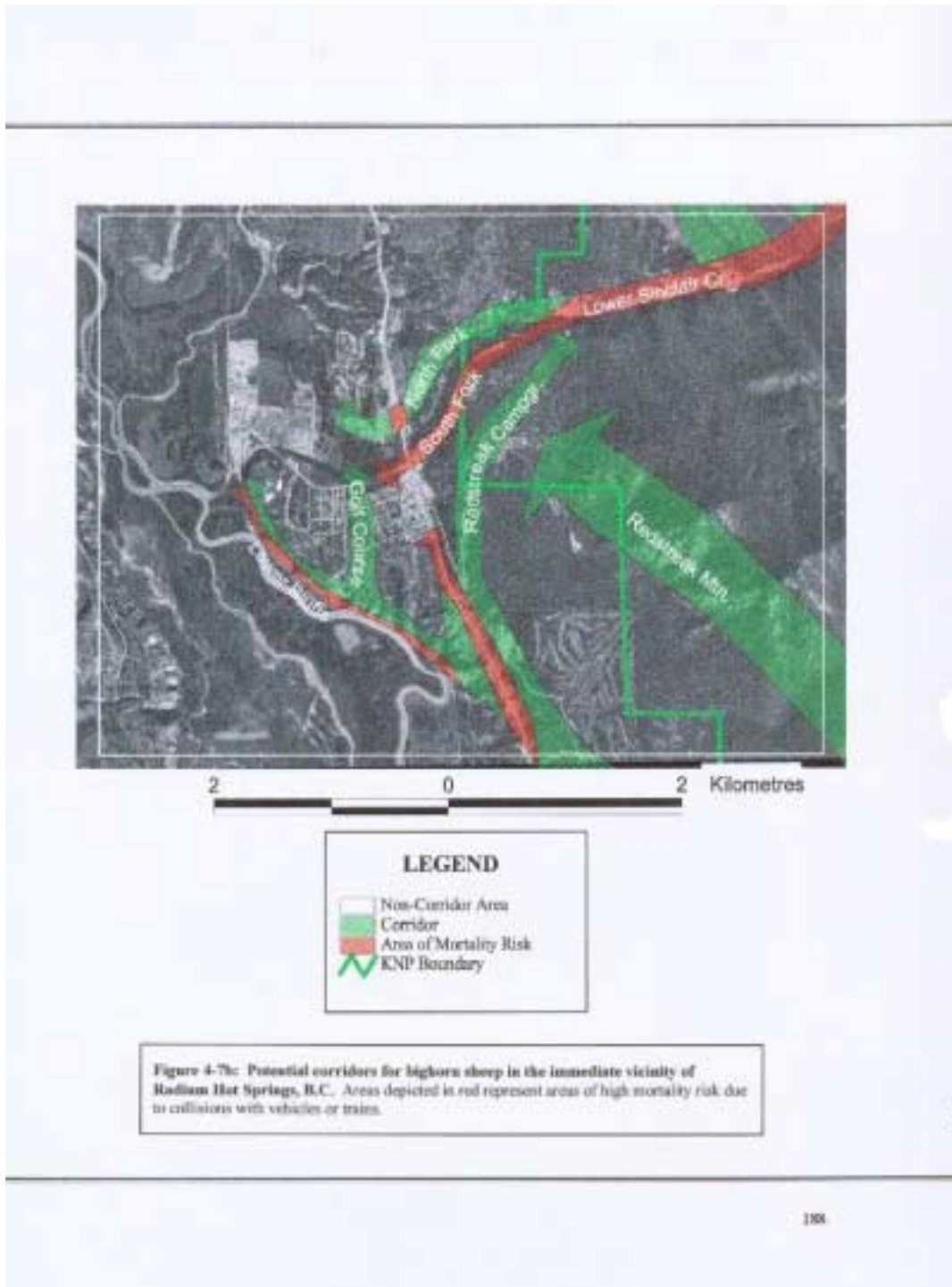


Figure 8: Potential Corridors for Bighorn in the Greater Radium Area



From: Tremblay (2001)

Figure 9: Potential Corridors for Bighorn in the Immediate Vicinity of Radium



From Tremblay, (2001)

5.0) Management Recommendations

The following recommendations are provided for consideration by Provincial, National and private agencies involved in the Radium-Stoddart Bighorn Working Group.

Recommendation One:

The Radium–Stoddart Bighorn Sheep Working Group should facilitate the continued development of a long-term ecosystem restoration plan for the Radium-Stoddart winter range.

An adaptive management approach to this planning will incorporate the following research and public outreach elements of the BIOB Project:

- Bighorn Community Monitoring Program
- Monitoring and assessments of restoration sites, e.g. - horizontal visibility testing.
- Results of the upcoming fire history and stand reconstruction study (July 2001).
- Data collected from GPS Collars on bighorn beginning fall of 2001.
- Testing of Tremblay’s (2000) potential bighorn migratory corridors.
- Public response and involvement.
- Results of other regional bighorn sheep research and restoration initiatives.

Recommendation Two:

Use the long–term ecosystem restoration plan to increase multi-agency commitments of resources to address Radium-Stoddart winter range conifer encroachment on a larger scale.

Justification:

a) Time is running out on three levels.

Ecologically – bighorn and other grassland/open forest habitat species increasingly marginalized and use of human-dominated landscapes excessive.

Politically – Winter range threatened by high and increasing rates of human infrastructure development with no regional growth management plan in place.

Socially – Public support for BIOB program is high – need action to keep it there.

b) Scale of the Radium-Stoddart winter range restoration area is large.

An Historic Lack of Inter-Agency Cooperation - Current restoration areas at Stoddart and Radium are very small in the overall winter range context while discussions and planning for this type of restoration action have taken many years to initiate and complete. Intra and inter-agency bureaucratic process has been a major stumbling block in the past. The Radium-Stoddart Bighorn Working Group provides a forum for continued improved communication and action.

Major partnership agreements required – funding must continue to come from a combination of government and non-government sources.

Recommendation Three:

Provincial Crown Land holdings in the Radium-Stoddart winter range need stronger wildlife protection designation.

Provincial lands within the current and historic Radium-Stoddart bighorn winter range (see Figure 1) should be reviewed for consideration as a Wildlife Management Area under the Wildlife Act of British Columbia.

Currently Three small provincial land holdings offer some habitat protection within the Radium-Stoddart winter range including:

- Dry Gulch Provincial Park.
- An extension of the Columbia Wetlands Wildlife Management Area along Stoddart Creek.
- A motor vehicle closure under section 109 of the Wildlife Act in the Stoddart Creek Area (frequent violations common).

In light of current development pressures on private land in the Radium-Stoddart winter range the relative ecological importance of undeveloped provincial crown lands has never been higher. Current designations of these provincial crown lands largely do not reflect critical winter range values for wildlife.

Recommendation Four:

Pertaining to restoration prescriptions and operations:

- Economic returns (stumpage) from restoration activities should not limit approval process - e.g. low stumpage rates threatened The Stoddart restoration initiative just before start up.
- Where feasible, logging and slashing should happen in one pass on future restoration sites.
- Minimal soil disturbance, minimum road construction, noxious weed prevention, full road deactivation, and the use of native grass seed/plug must remain central in the ecosystem restoration prescriptions.
- Low-intensity prescribed burns should be utilized where feasible and should remain a long-term goal throughout the winter range once fuel loads are reduced in those areas adjoining human life and property.

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APPENDIX 1:

Bighorn Community Monitoring Program

Sample Data Sheet



APPENDIX 2:

Bighorn In Our Backyard Project Website Update

Bighorn In Our Backyard Website Content – on Village of Radium Hot Springs Website

Text Block #1

Rocky Mountain Bighorn Sheep - Wildlife Residents of the Village of Radium Hot Springs, British Columbia.

Have you seen any Bighorn Sheep today? Visitors and residents of the Village of Radium Hot Springs often encounter the community's most famous wildlife species, Bighorn Sheep. For many people, these majestic animals symbolize the rugged beauty and wildlife of the Rocky Mountains. During the fall, winter and spring months, Bighorn Sheep of the Radium-Stoddart herd are frequently seen within the Village and on neighboring lands. The reason for this is that Radium Hot Springs and surrounding lands are part of a critical winter range for this band of Bighorn - habitat that Bighorn Sheep rely on for enduring the long winters when their food is scarce and their movements limited by snow.

The close proximity of people and Bighorn Sheep in the Radium area has resulted in a fascinating relationship between wildlife and humans. It is this relationship that became the catalyst for Bighorn In Our Backyard: Communities Working for Wildlife in 1997. Read on and discover more about the Radium-Stoddart Rocky Mountain bighorn sheep herd and the Bighorn In Our Backyard project!

Photos: rams butting heads in front of trailer Taylor's Heading for Radium Monument – no people

Button: Visit the Bighorn In Our Backyard Project's main page at www.BighornInOurBackyard.com

Text Block #2

Bighorn In Our Backyard (BIOB): Communities Working for Wildlife is an ongoing project initiated in 1997 by Osprey Communications of Invermere, British Columbia. The BIOB Project seeks to highlight the needs of wild bighorn sheep in the Radium-Stoddart herd and bring to light the unique challenges and opportunities that this human-wildlife relationship presents to both people and Bighorn Sheep.

Since 1997, the BIOB Project has directly contacted over 1100 people in nine communities of the region through live presentations. In addition, numerous articles have appeared in local and regional publications and radio. Television has also broadened the project's audience through news and program coverage like the Discovery Channel's, Great Canadian Parks Program about Kootenay National Park. Dedicated volunteers have participated in the project's Bighorn Community Monitoring Program that is assisting Radium's community leaders, wildlife managers and other land agencies to gain an understanding of the current winter range use and needs of this Bighorn herd. Habitat assessment and restoration projects are underway and positive economic and social benefits associated with wildlife interpretation, nature festivals, art and tourism are also successful elements of the project.

The BIOB project has benefited greatly from a broad range of [partners](#) and supporters in a magnificent example of diverse interests cooperating to achieve common goals. Community

residents, all levels of government, non-government organizations and other interest groups have worked together to make the Bighorn In Our Backyard Program an ongoing success.

Two prominent Canadian artists have supported the BIOB Project through their art. Sculptor, Rick Taylor unveiled his life-size bronze '[Heading for Radium](#)' at an unveiling ceremony in Radium Hot Springs in October 2000. The sculpture, depicting three bighorns returning to critical winter range in the Radium area, is situated on the grounds of the new Visitor Reception Centre and has become a focal point in the Village. Canadian wildlife artist Robert Bateman painted a [Bighorn Ram](#), an original painting that has helped to raise awareness and funds for BIOB.

The ongoing initiatives within the Bighorn In Our Backyard Program fall under four main objective areas and include:

A comprehensive education program about the biology and ecology of wild sheep with a case study look at the Radium-Stoddart sheep band and ecosystem issues delivered to key audiences;

Involvement of community residents through the wild sheep community monitoring program;

Assessment and restoration of the bighorn critical winter range - Emphasis on working with partners (Radium-Stoddart Bighorn Sheep Working Group) & conducting habitat restoration projects;

Promotion and demonstration of the economic and social benefits of living with wildlife for the Village of Radium Hot Springs - Visitor Centre interpretive content, interpretive trails & signs and the annual [Living With Wildlife Weekend](#) conference.

Page 1 Photos: Robert Bateman & Bateman's Ram Painting, Taylor's Monument with Rick and Bill, Bighorn Monitors & Shot of Elise doing research

Bighorn Sheep and the Village of Radium Hot Springs

There is no question that human settlements and their associated activities have impacts, both positive and negative, on wildlife. In the case of Radium Hot Springs and Bighorn, concern has been raised in regard to the effects of human settlement on bighorn habitat values including food availability, migration corridors, access to domestic food sources like golf courses, harassment by dogs & people, exposure to chemicals, altering wild sheep behavior patterns and roadway collisions with sheep.

The Village of Radium Hot Springs has demonstrated an exceptional willingness to address these challenges facing the Radium-Stoddart Bighorn herd in a number of important ways. First, by endorsing and supporting the Bighorn In Our Backyard (BIOB) project, the Village has committed to educate its leaders, citizens and general works staff about the needs of bighorn and associated ecosystem values. The Village of Radium is also backing up this commitment with action through:

- incorporating the needs of wildlife into its Official Community Plan through environmental inventories and planning;
- endorsing the principles of ecological restoration of disturbed sites and sites of development within the community to the benefit of wildlife and humans;
- showcasing to its residents and visitors the ecological, social and economic importance of conservation to the community through the development of interpretive resources at its visitor centre, the Heading for Radium Monument, streamside restoration, establishing greenways, hosting this BIOB website and partnering on other special events like the [Living With Wildlife Weekend](#);
- assisting in posting new signage warning motorists of sheep on the highways.
- providing staff time to participate in the Radium-Stoddart Bighorn Sheep Working Group

Photo: Bighorn in town

Text Block

Bighorn In Our Backyard Community Monitoring Program

Each winter since 1997 more than 30 volunteers from Radium and throughout the Radium-Stoddart bighorn sheep herd's critical winter range have been involved in a special part of the BIOB Project. Beginning in the fall when the bighorn herd concentrates on its winter range, volunteers conduct weekly and monthly inventories of the wild sheep collecting location, gender and behavioral data that is assisting land use managers and the community of Radium Hot Springs to plan habitat restoration projects, protect important habitat attributes and generally raise awareness of the needs and presence of the bighorn sheep among community residents. Working as monitors each winter from 1997 to the present, these bighorn monitors are active 'stewards' of wildlife. The growing database of their observations has exceeded 4000 observations of bighorn sheep from the Radium-Stoddart herd that totals approximately 140 animals. For a complete overview of BIOB's Bighorn Community Monitoring Program including maps and data examples please visit the Project's main website at www.BighornInOurBackyard.com

If you are interested in becoming a BIOB Volunteer Monitor please contact us by email at osprey@rockies.net

Photo: Bighorn monitors in front of Monument

Bighorn Habitat Restoration

We have begun to map the observational data of the BIOB volunteers and an interesting trend of habitat use by bighorn in this herd has emerged. This [map](#) confirms what has been suspected - a decline in use of historic winter range by the Radium-Stoddart bighorn sheep herd. It would appear that a drastic decline in the use of the critical winter range has occurred over the past 60

years or so, a trend that does not bode well for wild sheep generally. Two main causes for a geographic and qualitative decline in the bighorn's winter range are human encroachment on and forest ingrowth within the critical winter range. Other factors affecting the Radium-Stoddart herd include mortality on roads and highways, multi-jurisdictional land ownership, noxious weed growth, stray dogs and natural predation and disease levels.

Through the efforts of the BIOB Project, provincial and federal wildlife programs and the work of non-government conservation groups an emphasis is being placed on the restoration of the Radium-Stoddart herd's critical winter range. A century ago fire was the driving ecological force that maintained the open grassland ecosystem that sustained bighorn sheep and other wildlife winter ranges in the Rocky Mountain Trench. A century of fire suppression has allowed coniferous forests to reclaim these grasslands and convert them to forested habitat that is of low value to bighorn and other grassland dependent species.

The BIOB Project, through the multi-interest Radium-Stoddart Bighorn Sheep Working Group, is now focusing on the restoration and conservation of critical winter range. For a complete overview of the ecosystem restoration program associated with the BIOB Project please visit the Project's main website at www.BighornInOurBackyard.com

Map: Historic vs Current winter range use

Photos: Sheep & development sign, forest fire, Ram avoiding car, 1906/1994 comparison photo

The Future of Bighorn In the Radium Hot Springs Area

Several exciting initiatives are underway or planned in and around Radium Hot Springs that will benefit Bighorn Sheep and other wildlife. Stay tuned and/or get involved in the following:

- ⇒ Bighorn In Our Backyard Community monitoring program – volunteer with the BIOB Program and become a bighorn sheep monitor!
- ⇒ Habitat restoration initiatives are being planned and conducted in the Critical Winter Range of the Radium-Stoddart Bighorn Sheep herd.
- ⇒ First annual [Living With Wildlife Weekend](#) to be held in Radium September 27 - 30, 2001.
- ⇒ Development of the interpretive content in the new Visitor Centre.
- ⇒ Ecological restoration of Sinclair Creek.
- ⇒ Planning and establishing community greenways for conservation, education and public recreation.
- ⇒ Radium Hot Springs continues to emerge as a forward thinking and acting community that borders significant, provincial, national and internationally recognized protected areas, including the Columbia River Wetlands, Kootenay National Park and the Four Mountain Park block - support the community's positive actions in this direction.

Photo: Grassland restoration, no motorized use signage

Text Block

Viewing Bighorn Sheep in the Radium Hot Springs Area

Although the bighorn around Radium may sometimes not seem like wild animals they are wildlife species and deserve our respect and some special considerations. Whenever you encounter wildlife of any kind your objective should always be to behave in a way that reduces stress for the animal(s). Here are a few wildlife viewing tips and techniques that apply to Bighorn and other wildlife species:

Move slowly, avoid eye contact with herbivores and don't attempt to get to ground higher than bighorn sheep - they'll usually leave.

Observe and record behavior, not influence it; leave the animals doing the same thing as when you first saw or encountered them. This is particularly so during the winter months when food availability is low and energy conservation is the priority.

Avoid getting too close - use binoculars, spotting scopes or large camera lens if you have them. Photo blinds are excellent for observing & photographing some wildlife.

Dogs should always be under control around bighorn & other wildlife. Avoid wildlife viewing with your dog if possible.

Springtime and lambing season (May/June) are also critical times for bighorn, especially for the pregnant ewes. Avoid any disturbance of bighorn during these time periods.

Your appropriate behavior around the sheep provides a model for others to emulate. If the opportunity arises, inform a curious onlooker about what you are doing or diplomatically advise others when their conduct towards the sheep appears inappropriate.

Never feed wildlife - keep them wild because "fed is dead" in the long term.

Report any wildlife infractions to the following agencies:

Kootenay National Park Warden Office - For infractions within the National Park 347 9361.

Provincial Conservation Officers - For any infractions on Provincial Crown land 342 4266.

RCMP - For infractions in all other areas 347 9393 Or 342 9292

Your observations can contribute to important research on wildlife - consider becoming a volunteer community bighorn monitor in the BIOB Project or with other wildlife programs in the area!

For a complete overview of the Bighorn In Our Backyard project visit the Project's main website at www.BighornInOurBackyard.com

APPENDIX 3:

Partners in the BIOB Project

&

Radium-Stoddart Bighorn Sheep Working Group Composition.

Partners in the Bighorn In Our Backyard Project

Partnerships have been a key to the Bighorn In Our Backyard project's successes thus far. The following is a listing of the partners continuously or occasionally involved in the Bighorn In Our Backyard project since 1997:

BC Government Ministries;
 Environment*, Wildlife* and BC Parks*
 Forests, Invermere District*
 Transportation and Highways*
BC Southern Guide Outfitters Association*
Bow Valley Naturalists
Columbia Basin Fish and Wildlife Compensation Program*
Columbia Basin Trust – Columbia Kootenay Fisheries Renewal Partnership
Columbia Valley Field Naturalists Society
East Kootenay Wildlife Association*
Foundation for North American Wild Sheep
Insurance Corporation of British Columbia
Ktunaxa-Kinbasket Tribal Council*
Lake Windermere and District Rod and Gun Club
Parks Canada, Kootenay National Park*
Radium Chamber of Commerce
Rick Taylor, Bronze Sculptor. 'Heading For Radium' Monument (installed Oct 2000)
Robert Bateman, Artist. (Created an original painting of a ram for the BIOB Project)
Slocan Forest Products, Radium Division in Partnership with Forest Renewal BC*
Sylvan Consulting
Thirty+ Local Volunteers with the Bighorn In Our Backyard Community Monitoring Program
Village of Radium Hot Springs Mayor, Council and Administration*
Wild BC
Wings Over the Rockies Bird Festival
Wild Sheep Society of BC
Yellowstone to Yukon Conservation Initiative

* - Indicates member of the Radium-Stoddart Bighorn Sheep Working Group

The Radium-Stoddart Bighorn Sheep Working Group is a component of the BIOB Project and was formed in March of 1999. The Working Group meets biannually and is comprised of three levels of government, non-government, First Nations, private and public interests. The Working Group as a whole has identified its priority objectives over a mid to long-term basis and is active in all areas, particularly ecosystem restoration. Bill Swan, Osprey Communications, Chairs the Working Group and is the BIOB Project Coordinator.

The Radium-Stoddart Bighorn Working Group's mandate is to:

“Ensure Rocky Mountain Bighorn sheep and associated ecosystem processes are present in the Radium/Stoddart area in perpetuity”

APPENDIX 4a:

Visibility Test Results for the Stoddart Restoration Area

APPENDIX 4a: Habitat Visibility Test Results - Stoddart Restoration Area																	
Plot	UTM		Crown Closure		Assessment	Visibility Test (% target visible) @ 40 metres from target:										Habitat	
	Easting	Northing	Predicted	Actual		East		West		North		South		Total Sq		Effectiveness	Rating
						sq	%	sq	%	sq	%	sq	%	sq	%		
1e	568790	5602850	26-45%	26-45%	pre-logging	9.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	6.3	-	
					post-logging	18.0	50.0	0.0	0.0	0.0	0.0	14.0	38.9	32.0	22.2	-	
					post-slashing		0.0		0.0		0.0		0.0				
1g	568790	5602650	6-15%	6-15%	pre-logging	0.0	0.0	6.0	16.7	0.0	0.0	0.0	0.0	6.0	4.2	-	
					post-logging	2.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.4	-	
					post-slashing		0.0		0.0		0.0		0.0				
1i	568790	5602450	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
2a	568890	5603270	26-45%	26-45%	pre-logging			0.0	0.0			0.0	0.0	0.0	0.0	-	
					post-logging		0.0		0.0		0.0		0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
2d	568890	5602950	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	-	
					post-logging	0.0	0.0	27.0	75.0	0.0	0.0	30.0	83.3	57.0	39.6	-	
					post-slashing		0.0		0.0		0.0		0.0				
2f	568890	5602750	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	7.0	19.4	27.0	75.0	12.0	33.3	46.0	31.9	-	
					post-slashing		0.0		0.0		0.0		0.0				
2h	568890	5602550	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	6.0	16.7	0.0	0.0	6.0	4.2	-	
					post-logging	0.0	0.0	0.0	0.0	6.0	16.7	0.0	0.0	6.0	4.2	-	
					post-slashing		0.0		0.0		0.0		0.0				
2j	568890	5602350	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	24.0	66.7	0.0	0.0	0.0	0.0	24.0	16.7	-	
					post-slashing		0.0		0.0		0.0		0.0				
3e	568990	5602850	26-45%	26-45%	pre-logging									0.0		-	
					post-logging	21.0	58.3	10.0	27.8	2.0	5.6	0.0	0.0	33.0	22.9	-	
					post-slashing		0.0		0.0		0.0		0.0				
3g	568990	5602650	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
3i	568990	5602450	6-15%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	15.0	41.7	0.0	0.0	15.0	10.4	-	
					post-slashing		0.0		0.0		0.0		0.0				
4f	569090	5602750	26-45%	26-45%	pre-logging									0.0		-	
					post-logging	0.0	0.0	3.0	8.3	14.0	38.9	33.0	91.7	50.0	34.7	-	
					post-slashing		0.0		0.0		0.0		0.0				

APPENDIX 4a (Continued): Habitat Visibility Test Results - Stoddart Restoration Area																	
Plot	UTM		Crown Closure		Assessment	Visibility Test (% target visible) @ 40 metres from target:										Habitat	
	Easting	Northing	Predicted	Actual		East		West		North		South		Total Sq		Effectiveness	Rating
						sq	%	sq	%	sq	%	sq	%	sq	%		
4h	569090	5602550	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-		
					post-slashing		0.0		0.0		0.0		0.0				
4j	569090	5602350	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-		
					post-slashing		0.0		0.0		0.0		0.0				
5h	569190	5602550	OR	6-15%	pre-logging	0.0	0.0	0.0	0.0	25.0	69.4			25.0	17.4	-	
					post-logging	0.0	0.0	0.0	0.0	30.0	83.3	0.0	0.0	30.0	20.8	-	
					post-slashing		0.0		0.0		0.0		0.0				
5i	569190	5602450	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
5j	569190	5602350	OR	6-15%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
6h	569290	5602550	OR	6-15%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
6i	569290	5602450	OR	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
6j	569290	5602350	OR	6-15%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	8.0	22.2	0.0	0.0	0.0	0.0	0.0	0.0	8.0	5.6	-	
					post-slashing		0.0		0.0		0.0		0.0				
6l	569290	5602150	26-45%	6-15%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
7i	569390	5602450	OR	6-15%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
7k	569390	5602250	26-45%	26-45%	pre-logging	0.0	0.0	3.0	8.3	0.0	0.0	0.0	0.0	3.0	2.1	-	
					post-logging	0.0	0.0	1.0	2.8	0.0	0.0	0.0	0.0	1.0	0.7	-	
					post-slashing		0.0		0.0		0.0		0.0				
8h	569490	5602550	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	7.0	19.4	31.0	86.1	38.0	26.4	-	
					post-logging	0.0	0.0	27.0	75.0	6.0	16.7	36.0	100.0	69.0	47.9	-	
					post-slashing		0.0		0.0		0.0		0.0				

APPENDIX 4a (Continued): Habitat Visibility Test Results - Stoddart Restoration Area																	
Plot	UTM		Crown Closure		Assessment	Visibility Test (% target visible) @ 40 metres from target:										Habitat	
	Easting	Northing	Predicted	Actual		East		West		North		South		Total Sq		Effectiveness	Rating
						sq	%	sq	%	sq	%	sq	%	sq	%		
8j	569490	5602350	OR	6-15%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	33.0	91.7	0.0	0.0	15.0	41.7	48.0	33.3	-	
					post-slashing		0.0		0.0		0.0		0.0				
9i	569590	5602450	26-45%	26-45%	pre-logging	0.0	0.0	6.0	16.7	0.0	0.0	0.0	0.0	6.0	4.2	-	
					post-logging	33.0	91.7	5.0	13.9	0.0	0.0	30.0	83.3	68.0	47.2	-	
					post-slashing		0.0		0.0		0.0		0.0				
9k	569590	5602250	OR	6-15%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
9l	569590	5602150	OR	6-15%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	4.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	4.0	2.8	-	
					post-slashing		0.0		0.0		0.0		0.0				
10j	569690	5602350	26-45%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	2.0	5.6	8.0	22.2	10.0	6.9	-	
					post-slashing		0.0		0.0		0.0		0.0				
10l	569690	5602150	6-15%	6-15%	pre-logging	0.0	0.0	0.0	0.0	16.0	44.4	0.0	0.0	16.0	11.1	-	
					post-logging	0.0	0.0	0.0	0.0	27.0	75.0	0.0	0.0	27.0	18.8	-	
					post-slashing		0.0		0.0		0.0		0.0				
11k	569790	5602250	6-15%	26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	8.0	22.2	0.0	0.0	0.0	0.0	8.0	5.6	-	
					post-slashing		0.0		0.0		0.0		0.0				
12j	569890	5602350	6-15%	<26-45%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
13k	569990	5602250	6-15%	6-15%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-slashing		0.0		0.0		0.0		0.0				
14l	570090	5602150	6-15%	6-15%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
					post-logging	4.0	11.1	0.0	0.0	0.0	0.0	13.0	36.1	17.0	11.8	-	
					post-slashing		0.0		0.0		0.0		0.0				

APPENDIX 4b:

Visibility Test Results for the Radium Restoration Area

APPENDIX 4b: Habitat Visibility Test Results - Radium Restoration Area																
Plot	UTM		Crown Closure		Assessment	Visibility Test (% target visible) @ 40 metres from target:										Habitat Effectiv. Rating
	Easting	Northing	Predicted	Actual		East		West		North		South				
						sq	%	sq	%	sq	%	sq	%	sq	%	
1g	565900	5608200	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.8	1.0	0.7	-
					post-logging											
					post-slashing											
1i	565900	5608000	26-55%	6-25%	pre-logging	0.0	0.0	36.0	100.0	13.0	36.1	35.0	97.2	84.0	58.3	-
					post-logging											
					post-slashing											
2f	566000	5608300	6-25%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
2h	566000	5608100	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
2j	566000	5607900	26-55%	26-55%	pre-logging	3.0	8.3	9.0	25.0	0.0	0.0	10.0	27.8	22.0	15.3	-
					post-logging											
					post-slashing											
2l	566000	5607700	6-25%	26-55%	pre-logging	0.0	0.0	5.0	13.9	0.0	0.0	0.0	0.0	5.0	3.5	-
					post-logging											
					post-slashing											
3i	566100	5608000	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
4h	566200	5608100	26-55%	<26%	pre-logging	0.0	0.0	0.0	0.0	20.0	55.6	0.0	0.0	20.0	13.9	-
					post-logging											
					post-slashing											
4j	566200	5607900	6-25%	26-55%	pre-logging	0.0	0.0	3.0	8.3	0.0	0.0	0.0	0.0	3.0	2.1	-
					post-logging											
					post-slashing											
4l	566200	5607700	6-25%	26-55%	pre-logging	0.0	0.0	0.0	0.0	4.0	11.1	0.0	0.0	4.0	2.8	-
					post-logging											
					post-slashing											
4n	566200	5607500	6-25%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.8	1.0	0.7	-
					post-logging											
					post-slashing											
4p	566200	5607300	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.6	2.0	1.4	-
					post-logging											
					post-slashing											

APPENDIX 4b (Continued): Habitat Visibility Test Results - Radium Restoration Area																
Plot	UTM		Crown Closure		Assessment	Visibility Test (% target visible) @ 40 metres from target:										Habitat
	Easting	Northing	Predicted	Actual		East		West		North		South				Effectiv.
						sq	%	sq	%	sq	%	sq	%	sq	%	Rating
4r	566200	5607100	26-55%	26-55%	pre-logging	0.0	0.0	2.0	5.6	0.0	0.0	0.0	0.0	2.0	1.4	-
					post-logging											
					post-slashing											
5b	566300	5609000	26-55%	26-55%	pre-logging	18.0	50.0	14.4	40.0	0.0	0.0	0.4	1.0	32.8	22.8	-
					post-logging											
					post-slashing											
5c	566300	5608800	26-55%	26-55%	pre-logging	4.3	12.0	3.6	10.0	28.8	80.0	0.7	2.0	37.4	26.0	-
					post-logging											
					post-slashing											
5d	566300	5608600	26-55%	26-55%	pre-logging	18.0	50.0	23.4	65.0	34.2	95.0	23.4	65.0	99.0	68.8	+
					post-logging											
					post-slashing											
5g	566300	5608200	26-55%	26-55%	pre-logging	0.0	0.0	0.4	1.0	0.0	0.0	0.0	0.0	0.4	0.3	-
					post-logging											
					post-slashing											
5q	566300	5607200	26-55%	26-55%	pre-logging	7.0	19.4	0.0	0.0	0.0	0.0	15.0	41.7	22.0	15.3	-
					post-logging											
					post-slashing											
5s	566300	5607000	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
6a	566400	5609100	26-55%	26-55%	pre-logging	2.9	8.0	1.8	5.0	0.0	0.0	13.7	38.0	18.4	12.8	-
					post-logging											
					post-slashing											
6f	566400	5608300	0-6%	0-6%	pre-logging	36.0	100.0	36.0	100.0	0.0	0.0	0.0	0.0	72.0	50.0	-
					post-logging											
					post-slashing											
6t	566400	5606900	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	9.0	25.0	9.0	6.3	-
					post-logging											
					post-slashing											
8u	566600	5606500	6-25%	6-25%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
9e	566700	5608400	6-25%	6-25%	pre-logging	6.0	16.7	0.0	0.0	0.0	0.0	30.0	83.3	36.0	25.0	-
					post-logging											
					post-slashing											

APPENDIX 4b (Continued): Habitat Visibility Test Results - Radium Restoration Area																
Plot	UTM		Crown Closure		Assessment	Visibility Test (% target visible) @ 40 metres from target:										Habitat
	Easting	Northing	Predicted	Actual		East		West		North		South				Effectiv.
						sq	%	sq	%	sq	%	sq	%	sq	%	Rating
9v	566700	5606400	6-25%	6-25%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
9w	566700	5606200	26-55%	26-55%	pre-logging	0.0	0.0	1.0	2.8	13.0	36.1	0.0	0.0	14.0	9.7	-
					post-logging											
					post-slashing											
10f	566800	5608300	26-55%	>55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
10h	566800	5608100	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
11e	566900	5608400	6-25%	6-25%	pre-logging	2.0	5.6	0.0	0.0	4.0	11.1	0.0	0.0	6.0	4.2	-
					post-logging											
					post-slashing											
11g	566900	5608200	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
11i	566900	5608000	26-55%	26-55%	pre-logging	25.2	70.0	0.7	2.0	0.4	1.0	0.0	0.0	26.3	18.3	-
					post-logging											
					post-slashing											
12f	567000	5608300	26-55%	26-55%	pre-logging	4.0	11.1	0.0	0.0	0.0	0.0	0.4	1.0	4.4	3.0	-
					post-logging											
					post-slashing											
12h	567000	5608100	26-55%	26-55%	pre-logging	1.8	5.0	1.8	5.0	1.8	5.0	0.0	0.0	5.4	3.8	-
					post-logging											
					post-slashing											
12j	567000	5607900	26-55%	26-55%	pre-logging	0.0	0.0	0.7	2.0	0.0	0.0	1.8	5.0	2.5	1.8	-
					post-logging											
					post-slashing											
12l	567000	5607700	26-55%	26-55%	pre-logging	0.0	0.0	5.4	15.0	0.0	0.0	6.5	18.0	11.9	8.3	-
					post-logging											
					post-slashing											
13i	567100	5608000	6-25%	6-25%	pre-logging	0.0	0.0	3.6	10.0	0.0	0.0	0.0	0.0	3.6	2.5	-
					post-logging											
					post-slashing											

APPENDIX 4b (Continued): Habitat Visibility Test Results - Radium Restoration Area																
Plot	UTM		Crown Closure		Assessment	Visibility Test (% target visible) @ 40 metres from target:										Habitat
	Easting	Northing	Predicted	Actual		East		West		North		South				Effectiv.
						sq	%	sq	%	sq	%	sq	%	sq	%	Rating
13k	567100	5607800	26-55%	26-55%	pre-logging	0.0	0.0	1.8	5.0	0.4	1.0	3.6	10.0	5.8	4.0	-
					post-logging											
					post-slashing											
13m	567100	5607600	26-55%	6-25%	pre-logging	18.0	50.0	0.0	0.0	12.6	35.0	34.2	95.0	64.8	45.0	-
					post-logging											
					post-slashing											
14l	567200	5607700	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
14n	567200	5607500	26-55%	26-55%	pre-logging	0.0	0.0	9.0	25.0	27.0	75.0	0.0	0.0	36.0	25.0	-
					post-logging											
					post-slashing											
15k	567300	5607800	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
15m	567300	5607600	6-25%	6-25%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
15o	567300	5607400	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
15q	567300	5607200	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
					post-logging											
					post-slashing											
16p	567400	5607300	6-25% &	26-55%	pre-logging	1.8	5.0	3.6	10.0	0.0	0.0	0.7	2.0	6.1	4.3	-
					post-logging											
					post-slashing											
16r	567400	5607100	26-55%	26-55%	pre-logging	0.0	0.0	1.0	2.8	0.0	0.0	0.0	0.0	1.0	0.7	-
					post-logging											
					post-slashing											
17q	567500	5607200	26-55%	26-55%	pre-logging	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.0	0.4	0.3	-
					post-logging											
					post-slashing											