Western yellow-bellied Racer (*Coluber constrictor mormon*) Inventory in Southeastern British Columbia 2006

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EXECUTIVE SUMMARY

This report summarises three seasons (2004-2006) of inventory efforts for the blue-listed racer (*Coluber constrictor mormon*) in Southeastern British Columbia. This project resulted in a total of 92 new racer observations at 82 locations, including 19 suspected den sites. In the Pend d'Oreille Valley, the racer range was extended approximately 9.5 km eastward from Four Mile Creek to a site just west of Tillicum Creek, which now represents the easternmost record for the species in British Columbia. The Warfield and Sunningdale observations represent a 12 km range extension northwest from the nearest, pre-2004 confirmed location at Beaver Creek Provincial Park.

All racer detections were located in dry, open grassland and mixed shrub habitat. Loose rock was an important habitat feature at all den locations.

Including racer observations, we recorded a total of 763 reptile and amphibian individuals belonging to eight species (five reptiles and three amphibians) in the Columbia Basin Fish and Wildlife Compensation Program (CBFWCP) area. Two of these species (the racer and western skink) are provincially blue-listed by the Conservation Data Centre (CDC), and three (the racer, western skink and rubber boa) are federally listed as Special Concern by the Committee On the Status of Wildlife In Canada (COSEWIC).

Despite habitat alterations and loss, the racer persists over a relatively small area in the south Columbia. Potential threats facing the species here include continuing habitat loss through development activities, lack of conservation management on private lands, forest encroachment, road mortality, invasive plant proliferation and local heavy metal contamination. To address these threats, recommended actions include continued distribution surveys, habitat restoration, demographic and population studies, toxicology assessments, radio telemetry research and ongoing stewardship and education programs.

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1.0 Introduction

The western yellow-bellied racer (*Coluber constrictor mormon*) is a large, fast snake typically associated with dry, open grassland habitat and sparse tree cover. This subspecies occurs throughout much of California, several other western states and into south and central British Columbia.

The racer is provincially blue-listed (S3S4 rank) by the British Columbia CDC (BC Species and Ecosystems Explorer 2006) because it is restricted to the dry grasslands of the southern interior and this preferred habitat is suffering loss and degradation (Cannings et al. 1999). The subspecies is also designated as Special Concern by the Committee On the Status of Wildlife In Canada (COSEWIC) because it is thought to be particularly susceptible to impacts from urban development, road proliferation, increased traffic, and pesticide use (COSEWIC 2004).

Racers are diurnal and forage within warm, sunny, well-drained open habitat such as sagebrush and ponderosa pine parkland. This agile species is thought to be the most heat-tolerant snake in B.C. Foraging occurs primarily on the ground, although they are capable of climbing and individuals are often found in bushes or trees (Gregory and Campbell 1987). They feed on insects, amphibians, lizards, snakes and small mammals. Racers are the only egg-laying snake in the Kootenays, laying approximately six eggs, often in communal nests located on sandy slopes, abandoned mammal dens or on stable talus slopes. The young hatch in late August to early September (Cannings et al. 1999). They hibernate through the winter in south-facing dens which are often shared with other snake species (Shewchuck and Waye 1995). Racers show den-site fidelity, returning to the same hibernaculum every year during October (Cannings et al. 1999).

In BC, five discrete populations occur in the following areas: the south Columbia, Kettle, Okanagan, and Similkameen, Nicola and Thompson drainages (COSEWIC 2004) (Figure 1). The 'Thompson/Fraser and 'Okanagan/Similkameen' populations are the largest and form the core of racer distribution in the province. The 'Midway,' 'Grand Forks,' and 'Trail' populations are much smaller in area (Figure 1) with the latter (our local population) being the smallest.

The species was recently confirmed in the West Kootenay following observations along the Columbia River Valley south of Trail, including Beaver Creek Provincial Park (Dulisse 1999), the Waneta Dam area (Norbert Kondla, pers. obs.), Fort Shepherd (Schaeffer et al. 2002), Moris Creek (Maryann McDonaugh, pers. obs.) and the Pend d'Oreille Valley (John Gwilliam and Ted Antifeau, pers. obs.). Inventory projects in 2004 (Dulisse 2004) and 2005 (Dulisse 2006) resulted in a total of 33 new racer observations at 28 locations within the Pend d'Oreille and lower Columbia Valley.

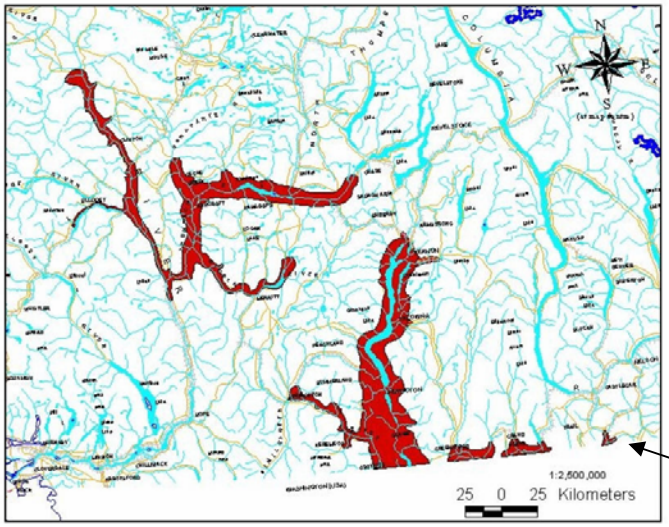

Figure 1. Racer Distribution in British Columbia.

The objectives of this project were to expand on the 2004 and 2005 surveys to determine the distribution and habitat use of racers and to identify potential denning and nesting sites within the CBFWCP area. We were also attempting to find and capture a snake large enough to implant with a radio transmitter. This report presents the 2006 survey results and summarises the 2004-2006 survey results.

2.0 Methods

2.1 Project Area

This project focussed on lower elevation, open, south-facing slopes within the CBFWCP area with potentially suitable racer habitat. In 2006, surveys were conducted near Trail, Warfield, Sunningdale, Montrose, Waneta, Fort Shepherd, and the Pend d'Oreille Valley. Sites were selected at the north, west and east edges of the racers range in the West Kootenay (Dulisse 2006) to refine these range limits. The Fort Shepherd area was also a focus of 2006 inventories because of the high conservation values of this undeveloped habitat and the efforts to protect the area (this area has since been protected).

In the Columbia Basin, the racer is associated with dry biogeoclimatic ecosystem classification (BEC) subzones (especially the ICHxw--Very Dry Warm Interior Cedar-Hemlock), so these habitat types were targeted for surveys (Dulisse 2004 & 2006). Refer to Braumandl & Curran (1992) for a detailed description of BEC subzones in the West Kootenay.

2.2 Surveys

Stratified, non-random encounter surveys were conducted on foot in appropriate habitat according to British Columbia Biodiversity Inventory Methods for snakes (Resource

Inventory Committee 1998). The protocol effort was to determine presence/not detected. Evidence of snake presence included direct sightings, shed skins (exuvia) and mortalities. Cover objects such as rocks, coarse woody debris, and discarded building material were turned over to look for inactive snakes. All potential cover objects were returned to their original position to reduce the impact of the survey on important habitat features. We searched for active snakes by walking through good habitat and disturbing the grass and shrub cover. Potential den sites were identified based on clusters of snake and shed skin observations adjacent to specific habitat features such as vertical rock fissures, stacked rock, rubble, etc. located on open, warm, upslope habitat. The presence of snakes very early and very late in the season near these features also indicated a probable den site.

Approximately 66 sites were surveyed over 26 days between 20 April and 24 August, 2006 (Figure 2). A total of 156 sites were surveyed over 49 survey days from 2004-2006. Incidental racer observations made by other biologists and naturalists are also included in this report. Surveys were generally conducted between the hours of 08:00 and 17:30 PST. During cooler mornings, we focussed our efforts on flipping cover objects and as the temperature rose throughout the day, we shifted our efforts toward finding active snakes. One of our objectives was to find racers large enough to implant with radio transmitters so we sometimes revisited known occupied sites from 2004 and 2005. Snakes of all species were opportunistically captured weighed, measured, sexed and classified to age category.

3.0 Results

3.1 Distribution

2006

During 2006 surveys, a total of 59 racer detections were made at 49 locations (Figures 2 & 3). Locations are not independent as some sightings are quite closely clustered. Thirteen potential denning sites were located in 2006 (Appendices 1-3).

2004-2006

2004-2006 inventories resulted in a total of 92 racer detections including 46 exuvia, 40 adults, three subadults, two carcasses and one juvenile. A total of 19 suspected racer den sites were located (Appendices 1-3). An additional four potential dens of rubber boas and/or garter snakes were also documented and are included in this report because different reptile species often share den sites, so they may be used by racers. Suspected den sites were located in the Warfield area (eight sites), Sunningdale (one site), Waneta (two sites), Fort Shepherd (two sites) and the Pend d'Oreille Valley (10 sites) east of Four Mile Creek (Appendix 2).

The Warfield (2005 & 2006) and Sunningdale (2006) observations represent a 12 km range extension northwest from the nearest, pre-2004 confirmed location at Beaver Creek

Provincial Park (Dulisse 2004). In the Pend d'Oreille Valley, the racer range was extended approximately 9.5 km eastward from Four Mile Creek to a site just west of Tillicum Creek (2006 observation) (Figures 2 & 3). Figure 3 shows changes in known racer distribution resulting from the 2004-2006 inventories.

3.2 Habitat

All racer observations within the Pend d'Oreille were located within the ICHxw and the sites near Montrose, Trail and Warfield were located within the ICHdw (Dry Warm Interior Cedar-Hemlock) BEC subzone.

Detailed habitat descriptions were not completed in 2005-2006 to maximise inventory efforts. Racer habitat characteristics were very similar in all survey years and consisted primarily of dry, open grassland/shrub habitat with sparse tree cover. All detection sites were located on warm aspects and most were near loose surface rocks and/or exposed bedrock outcrops. Many of the detection areas had exposed bedrock with deep vertical fissures—suitable for snake hibernacula sites (see Appendices 1-3 for more detail).

Many racer detections were in artificially open areas, where trees have been or continue to be removed by human activities. For example, racers were found in areas cleared for historic agricultural and farming activities (many sites in the Pend d'Oreille), continual brushing of power transmission corridors (Pend d'Oreille), and through loss of tree cover likely resulting from historic Teck Cominco smelter emissions (Warfield and Montrose areas).

Habitat at not detected sites appeared to be suitable and comparable to sites were racers were detected. For example, areas north of the Warfield site looked particularly good for racers, yet none were found here.

3.3 Land Status

Although a detailed land status check of occupied racer sites was not conducted, many racer occurrences outside of the Pend d'Oreille Valley are likely located on private land.

3.4 Radio Telemetry

Radio-telemetry was not carried out in 2005, as the the largest snake we captured (Table 1) was not wide enough in girth to accommodate an implanted a radio transmitter (Holohil BD-2) (Dulisse 2006). In 2006, a similarly sized racer was captured but implantation was not attempted as it was a gravid female.

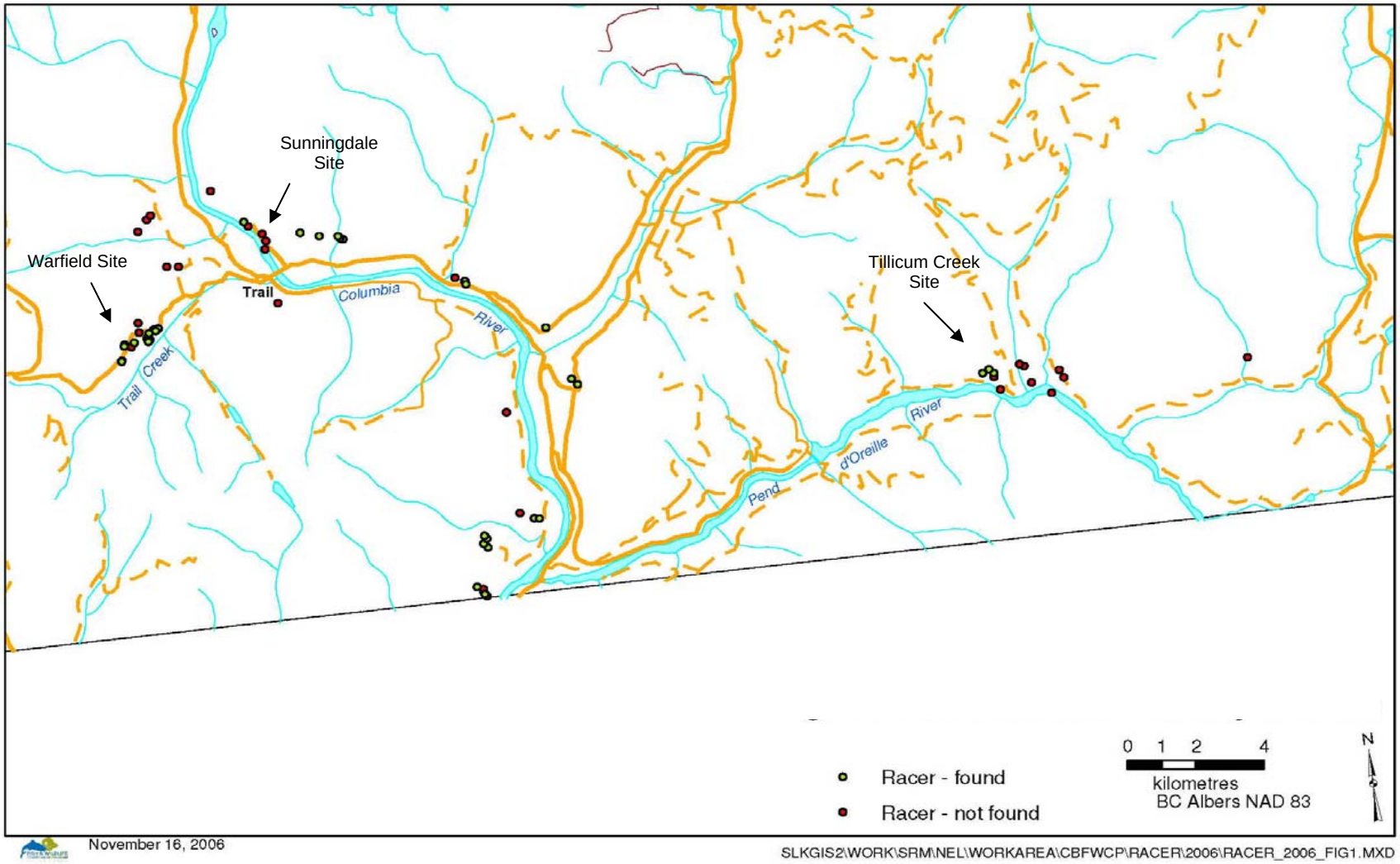

Figure 2. 2006 racer surveys, South Columbia and Pend d'Oreille Valleys.

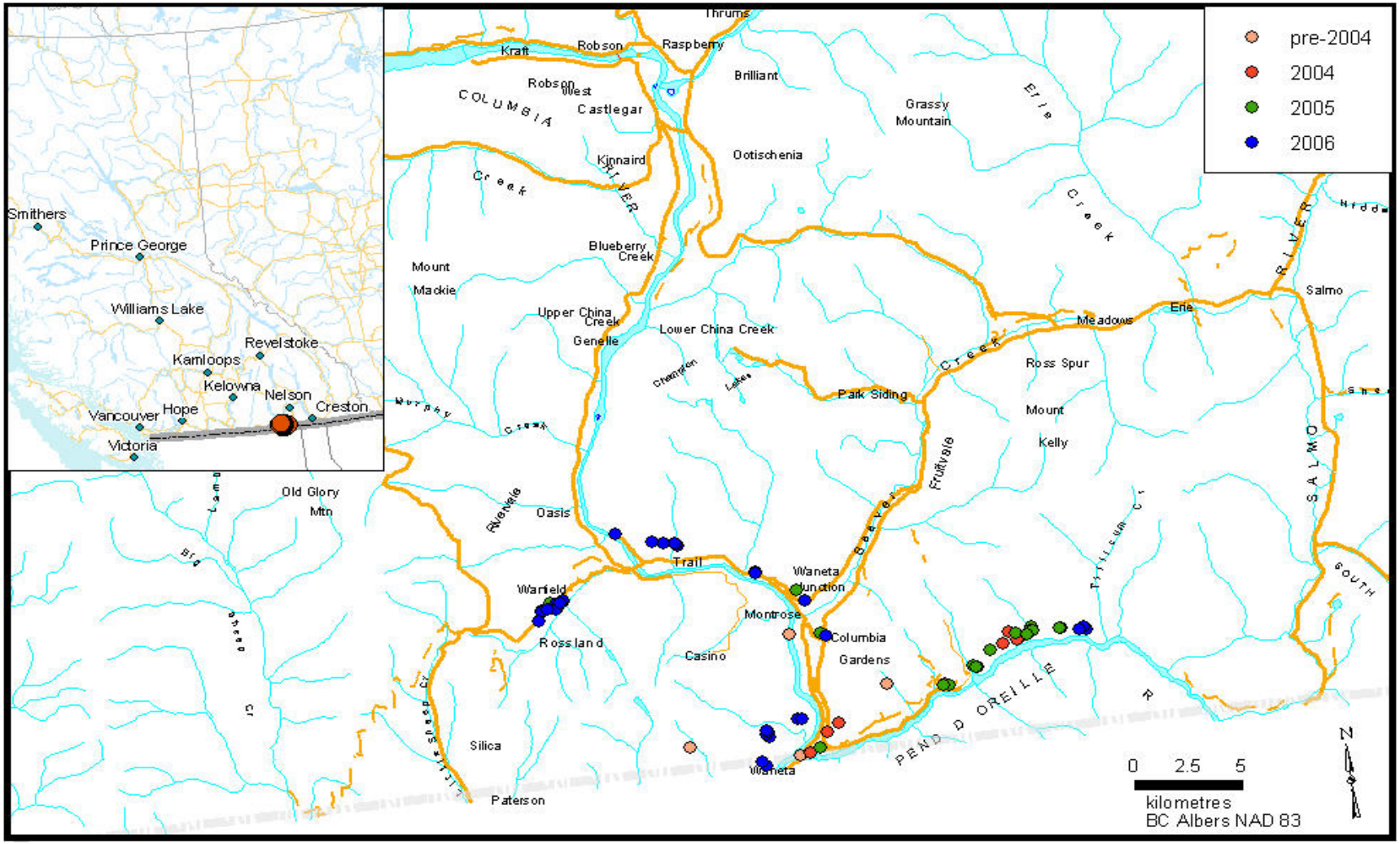

Figure 3. Recent changes in known racer distribution.

Table 1. Snake body size data, 2005-2006.

Date	Species	Wt (g)	SVL[1] (mm)	Notes
28Jul2005	*Racer	84.5	580	Determined to be too small prior to surgery
29Ju2005	*Racer	105.5	630	Determined to be too small during to surgery-not implanted
26Jul2005	Racer	12.5	270	juvenile
16Sept2005	Racer		480	Adult female dead on road
03May2006	Racer	58.5	480	Adult male
10May2006	Racer	19.0	300	Subadult under rock; slow moving
10May2006	Racer	57.0	500	Adult male; exhibited tail rattle behaviour
23May2006	Racer	80.5	580	Adult female; basking
23May2006	Racer	28.5	350	Female; active or basking
23May2006	Racer	>100	640	Gravid female; actively basking
23May2006	Racer	66.0	580	Male; active
11Aug2006	Racer	33.0	380	Small female; active; western skink scales in scat
11Aug2006	Racer	96.0	600	Female basking in shrubs next to rock.
28Jul2005	*Rubber Boa[3]	99.5[3]	440	Determined to be too small during to surgery-not implanted
21Jul2005	Rubber Boa	38.5	380	Adult male
19May2006	Rubber Boa	9.0	110	Male; under rock; tail and body scarred
23May2006	Rubber Boa	23.5	230	Male with spurs
24May2006	Rubber Boa	92.0	428	Gravid female; 4 bumps in body; scarred tail; three rubber boas under same rock
24May2006	Rubber Boa	97.0	400	Gravid female; 3 bumps in body; scarred tail; three rubber boas under same rock
24May2006	Rubber Boa	31.0	365	Male; three rubber boas under same rock
30May2006	Rubber Boa	32.5	3550	Male
06Jun2006	Rubber Boa	37.5	330	Female under rock
28Jul2005	*Common Garter Snake	94.5	510	Adult female
03Aug2005	Common Garter Snake	62.5	520	
03Aug2005	Common Garter Snake	31.5	430	Adult female

*These individuals were considered for transmitter implantation.
[1]SVL=snout-vent length
[3]This snake had recently ingested a very large food item.

3.5 Non-target Reptile and Amphibian Observations

In addition to the racer, at least four other reptiles and three amphibian species were observed during our surveys, including three other species at risk, the rubber boa (COSEWIC: *Special Concern*), western skink (CDC: *Blue*; COSEWIC: *Special Concern*) and western toad (COSEWIC: *Special Concern*) (Table 2).

The western skink was the most commonly encountered reptile during these surveys, occurring at 29 percent of racer sites. (Western skink scales were observed in the scat of

a captured adult racer.) Rubber boas, garter snakes and northern alligator lizards were detected at much lower rates (5-7 %) at racer sites.

Table 2. Total reptile and amphibian observations, 2004-2006.

Common Name	Scientific Name	Total Detections	Number of Sites with Racer	Percent Occurrence at Racer Sites
Racer	*Coluber constrictor*	92	82	-
Rubber Boa	*Charina bottae*	56	6	7
Garter Snake sp.*	*Thamnophis* sp.	47	4	5
Western Skink	*Eumeces skiltonianus*	470	24	29
Northern Alligator Lizard	*Elgaria coerulea*	87	5	6
Long-toed Salamander	*Ambystoma macrodactylum*	1	0	0
Pacific Treefrog	*Pseudacris regilla*	9	0	0
Western Toad	*Bufo boreas*	1	0	0
Total		**763**		

*It was not always possible to identify garter snake exuvia to the species level.

4.0 Discussion

The Pend d'Oreille and lower Columbia River Valleys have the highest snake diversity within the CBFWCP project area with four species occurring. Despite habitat alterations and loss, the racer persists over a relatively small area in the south Columbia. Many occurrences are on private land which presents conservation challenges, but the presence of additional reptile species at risk at many of the sites provides an opportunity to manage for several species at once.

The 2006 discovery of populations near the relatively densely populated areas of Montrose, Trail, and Waneta shows that this snake can easily go un-noticed and presently persists at these locations despite habitat fragmentation and road proliferation. However the viability of these sub-urban populations is unknown. Additional information on denning and nesting sites, seasonal habitat use and population dynamics are needed to determine if these populations are likely to persist.

4.1 Potential Threats

4.1.1 Loss of Low Elevation Habitat

The creation of the Waneta and Seven Mile reservoirs resulted in the loss of valley-bottom grassland habitat and hibernacula sites, likely displacing racer populations up the slopes—perhaps into marginal habitat. It is unknown if this loss of habitat had an impact on overall snake populations and if it continues to affect snake movement and landscape use. Urban development results in additional habitat loss and fragmentation.

4.1.2 Forest Encroachment

The racer appears to require open grassland habitat, which is declining in the Pend d'Oreille and other areas partially due to forest ingrowth. Historically, climax forests were rare within the ICHxw because of frequent natural fire cycles but fire suppression has greatly increased the wildfire interval which has consequently changed the vegetation cover of the area. Without intensive management, grassland and shrub ecosystems are converting to forests. It is unknown exactly how forest encroachment affects racers, but it is likely to be negative if overall grassland area decreases. CBFWCP addresses encroachment through burning in some areas of the Pend d'Oreille and ongoing efforts are planned (Machmer et al. 2006). As mentioned, power transmission corridors may provide valuable grassland habitat for racers in areas where forest encroachment is an issue.

4.1.3 Smelter Effects

In the Trial, Warfield and Montrose areas smelter emissions resulted in reduced forest cover and may have created favourable grass/shrub habitats for racers and other reptiles. Conversely, non-native vegetation may have proliferated, possibly impacting reptile populations and it is unknown if accumulations of heavy metals in the soil and litter (John et al. 2005) are impacting reptiles through bioaccumulation.

4.1.4 Invasive Plants

Vegetation cover is very important to racers in order to avoid predation, so invasive plants may have reduced the habitat quality for racers in the Pend d'Oreille. When dense native vegetation such as pinegrass (*Calamagrostis rubescens)* is displaced by non-native species such as spotted knapweed (*Centaurea maculosa*) and Dalmatian toadflax (*Linaria dalmatica*), the ground cover is significantly decreased (E. McKenzie, Evan McKenzie Ecological Research, pers. comm.) which likely affects racer movement and habitat use in the valley.

Abandoned agricultural land and power transmission corridors in the Pend d'Oreille appear to provide important habitat for the racer. These areas are susceptible to spotted knapweed (and other invasive species) invasion which may reduce the habitat quality for the snakes.

4.1.5 Road Mortality

Snakes are attracted to road surfaces to bask, where they become vulnerable to encounters with vehicles. During this inventory several racers and garter snakes were found dead on local roads. Road mortality is a difficult problem to address but it seems likely roads have impacted distribution patterns in the south Columbia, particularly when roads have fragment denning, nesting and summer habitat. Paved roads are more of a concern because they store heat longer and snakes are attracted to them, especially during cooler nights. Paved roads also tend to have more traffic, increasing the probability of mortality.

Road mortality is known to be an important conservation issue in the following areas:

Warfield
At least one den site is located across a busy highway from much of the summer habitat and it is likely that frequent mortalities occur here. A road killed adult racer was found on Shutek Road, which bisects the same habitat area.

Montrose
Although road mortality has not been observed here, Highways 3B and 22A fragment racer habitat and likely impact racer populations north of Beaver Creek.

Waneta-Pend d'Oreille
Road killed racers have been observed along Highway 3B near Beaver Creek Provincial Park and along Columbia Gardens Road, Seven Mile Dam Road in the south Columbia Valley. In the Pend d'Oreille Valley, mortalities have been recorded along the Seven Mile Dam Waneta-Nelway Roads as far east as the Seven Mile Dam. In 2006, at least four racers were found dead on the road in this area (M. Machmer, Pandion Ecological Research Ltd., pers. comm.).

4.2 Future Directions

4.2.1 Habitat Restoration

NDT4 ecosystem restoration methods outlined in the Wildlife Management Plan for the Pend d'Oreille Valley (Machmer et al. 2006) would likely benefit the racer. Forest encroachment is likely impacting racer habitat in many areas.

Actions
-pursue a combination of thinning, selective logging, and prescribed burning in appropriate habitat
-minimise ground disturbance to protect important habitat features such as rock and talus

4.2.2 Distribution

Continue efforts to determine extent of species' range in the South Columbia, particularly between Trail and Castlegar. Areas east of Tillicum Creek in Pend d'Oreille Valley should also be sampled further to determine the species' absence here.

Actions
-survey appropriate habitat
-use cover objects to sample open grassland habitat east of Tillicum Creek in the Pend d'Oreille Valley

4.2.3 Demographics

This project increased our knowledge regarding the current distribution limits of the racer within the CBFWCP area. It would be interesting to expand on this work by conducting population studies such as mark/recapture and genetic analysis to determine if there are demographic challenges facing the species, especially at isolated sites like Warfield (Appendix 4). Other detection sites may also represent isolated populations and demographic studies would help to determine this. Shed skins can be used for analysis so the collection of genetic samples would be relatively easy.

Actions

-conduct mark/recapture studies within confined populations (e.g. Warfield site)
-collect exuvia and analyse genetic data from throughout study area

4.2.4 Toxicology/Contaminants

As mentioned, heavy metal contamination may be impacting racers and other local reptile species. The diverse carnivorous diet and habitat use of the racer (and other reptile species) make them ideal model organisms to study the uptake and effects of mine pollution (Fletcher et al. 2006).

Actions

-analyse racer (and other reptile species) tissue for the presence of heavy metal accumulations
-compare results to known soil and litter contamination distribution patterns

4.2.5 Invasive Plants

Due to the prevalence of invasive plants within racer habitat, it would be valuable to learn if these plants are affecting racer and other reptile habitat. Currently, there is very little information on how non-native plants impact species at risk in B.C. (J. Craig, Silverwing Ecological Consulting, pers. comm.).

Actions

-develop a research plan to determine if invasive plant species are impacting racer (and other reptile) habitat

4.2.6 Road Mortality

Local development projects are increasing local traffic which will likely impact racers and other wildlife species. Baseline road mortality data has already been collected in the vicinity of the Waneta Dam expansion project (M. Machmer, pers. comm.) and more intense and widespread surveys should be conducted throughout the South Columbia range of the racer.

Actions

-perform road mortality surveys following local baseline monitoring methods already established (M. Machmer, pers. comm.) to determine road mortality 'hotspots'
-use radio telemetry and/or mark recapture studies to determine effects of roads on local racer habitat use
-pursue fencing and underpass mitigation strategies at road mortality hotspots

4.2.7 Radio Telemetry

Due to cumulative habitat alterations, it is unknown to what extent the racers are using the forest and other habitats in the Pend d'Oreille. To determine specific habitat use and locate critical habitat features such as hibernacula and nesting sites, radio telemetry should be attempted again.

Radio transmitter size presents a major challenge when working with the racer. Transmitter volume in relation to snake size should be carefully considered when considering the implantation of narrow-bodied, active snake species. Larger individuals are known to occur (pers. obs.), although catching one has proved difficult. Smaller transmitters are available but shorter battery life makes surgical implantation unpractical. Ongoing advances in radio transmitter technology may make implantation of this species easier in the near future.

Actions

-monitor developments in radio transmitter technology to determine if radio telemetry efforts should be attempted in the future

4.2.8 Stewardship & Education

The land status of occupied sites, especially with suspected hibernacula, should be investigated to direct conservation activities such as stewardship, WHA establishment and potential land acquisitions. Efforts are already underway to map known racer locations and incorporate this information into an ecological management plan for Teck Cominco properties.

On 20 November, 2006, a Powerpoint presentation describing this project was attended by approximately 35 members of the public in Trail. Two more presentations are planned for the spring of 2007 in Kaslo and South Slocan.

Actions

-determine land status of every racer observation
-liaise with land owners regarding the importance of their holdings to reptile species at risk
-continue local public education efforts with regard to local reptile species at risk

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