

Reptile at Risk Conservation Project

2014 Report



Prepared for:

**Waneta Terrestrial Compensation Program, Columbia Power Corporation
Suite 200, 445 13th Ave, Castlegar, BC V1N 1G1**

**Fish & Wildlife Compensation Program-BC Hydro
601 18th St, Castlegar, BC, V1N 2N1**

Prepared by:

**Jakob Dulisse, R.P.Bio.
Jakob Dulisse Consulting
410 Second Street, Nelson, BC V1L 2L3**

**Marlene Machmer, M.Sc., R.P.Bio.
Pandion Ecological Research Ltd.
532 Park Street, Nelson, BC V1L 2G9**

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1.0 INTRODUCTION AND BACKGROUND

This report describes the results of the second season of a multi-year project designed to locate snake hibernacula and assess their relative use and importance for listed and other snake species within the Waneta Terrestrial Compensation Program area. This project is being funded by the Waneta Terrestrial Compensation Program (WTCP) and Fish and Wildlife Compensation Program (FWCP), with support from Teck Resources Ltd. (Trail Operations) on land owned by CPC, Teck, the Crown, BC Parks, and other private landowners. A number of other stakeholders are supportive of this project including the Trail Wildlife Association, Rossland Secondary School, BC Parks, and BC Environment.

Past surveys have provided good data on the distribution of listed and other reptile species in the Waneta Expansion Project area and the basin as a whole (Dulisse 2005, 2006, 2007 and 2009; Machmer 2005, 2006, 2007, 2008, 2009, 2010, 2011a, 2012a, 2013; Machmer et al. 2005). However very little data is available on actual locations of active hibernacula. This information is critical for management and conservation of these habitat features. Therefore, the ultimate goal of this project is to find, conserve and/or restore existing snake hibernacula sites, and possibly also to create new reptile hibernacula (if they are determined to be a limiting feature on the landscape). This project targets the North American racer (*Coluber constrictor*) and the northern rubber boa (*Charina bottae*).

The North American racer is provincially *blue-listed* by the BC Conservation Data Centre (CDC). Both the racer and the northern rubber boa are federally listed as species of *special concern* by the Committee on the Status of Endangered Wildlife In Canada (COSEWIC). These species have both been subject to elevated levels of road mortality associated with increased traffic due to construction of the Waneta Expansion Project (see Machmer 2011a, 2012a, 2012b, 2013, 2014c). Direct impacts to at least two previously active (2007-2010) snake hibernacula (occupied by racers and rubber boas) in the powerplant construction area have been documented during construction monitoring (Machmer 2011b). Snake hibernacula are often used by multiple species, so the project will also benefit other local reptiles including the common garter snake (*Thamnophis sirtalis*), terrestrial garter snake (*Thamnophis elegans*), the northern alligator lizard (*Elgaria coerulea*), and the western skink (*Plestiodon skiltonianus*). The latter species is *blue-listed* by CDC and listed of *special concern* by COSEWIC. All of these species have been documented using the area near the previously known active snake hibernacula (Machmer 2011b).

1.1 Project Goals and Objectives

The overall goals of this multi-year project are to: (a) determine if hibernacula sites are limiting for local populations of reptiles at risk, (b) find/protect/restore/create important local hibernacula, (c) contribute to improved restoration knowledge and practice, (d) improve habitat resiliency in light of additional disturbance and habitat impacts, and (e) promote greater awareness and stewardship of reptile species at risk.

The specific objectives of this multi-year project are to: (a) test a new method of conducting snake radio telemetry, (b) find local hibernacula and determine which species and how many individuals use them, (c) describe the habitat characteristics of the hibernacula and determine their importance to local snake populations, (d) determine potential threats to these sites, (e) protect and restore hibernacula identified, (f) potentially also create new hibernacula if these

sites are determined to be limited on the landscape, and (g) provide opportunities for outreach and stewardship regarding little-known local species.

2.0 METHODS

The 2014 field season was initiated on April 3 and continued until mid-July; it involved following the summer movement of several snakes. Late season field work was conducted from September to early November and focused on finding hibernacula.

2.1 Capture Techniques

The main capture technique used in 2013 and 2014 was non-random encounter surveys conducted on foot in appropriate habitat according to British Columbia Biodiversity Inventory Methods for snakes (Resource Inventory Committee 1998). Cover objects such as rocks, coarse woody debris, and discarded building material were turned over to look for inactive snakes. We searched for active snakes by walking through good habitat and disturbing the grass and shrub cover.

In 2013, plywood and concrete artificial cover objects (ACOs) were tested for snake capture. 16 inch square concrete patio stones (half painted black, half unpainted) and 24 inch squares of plywood (3/4 inch thickness). Paired plywood and concrete ACOs were placed at 18 sample sites (Appendix 1). These ACOs will be left in place for the habitat underneath the objects to develop over time.

Foot surveys for active snakes turned out to be the most effective method for capturing snakes, so we focused on this method in 2014.

2.2 Radio Telemetry and PIT-Tagging

Radio-tracking of local North American racers was attempted in 2006, but the relatively small body size of local individuals prohibited traditional surgical implant techniques (Dulisse 2007). For this project, we are testing a newly documented technique which involves the external attachment of transmitters using tape (Wylie et al. 2011). This simple method has been proven to be successful in similar, active snake species and has several advantages over surgical implantation including decreased invasiveness, lower risk to individual animals from surgery and infection, as well as a much lower overall cost (Wylie et al. 2011). Also, if a battery in an attached transmitter fails or the tagged animal is somehow not recaptured, the transmitter falls off the snake either during periodic skin shedding or through deterioration of the tape.

In addition to radio-tagging, most captured snakes (even those too small to radio-tag) were PIT-tagged. PIT tags were injected into the body cavity of individuals. A 12-gauge needle was used to insert the tag ventrally approximately 5 cm anterior to the cloaca. The injection site was swabbed with alcohol and the needle and PIT tags were sterilized with alcohol prior to each use. We used the smallest tags available from Biomark (8-9mm in length).

2.3 Educational Outreach

On 23 May 2013, we gave a Powerpoint presentation to a grade eight class at Rossland Secondary School. The presentation discussed the reptiles of the Columbia Basin with a narrowing focus on this project. Following the class presentation, we co-hosted a field trip to a Teck reptile conservation property near Warfield with Dave DeRosa (Teck Resources Ltd.). During this field trip, we discussed local reptile conservation (we captured a rubber boa) in relation to concerns about invasive plant encroachment and public recreation in the reptile habitat.

On January 30, 2014, we presented the results of this project at the annual general meeting of the Trail Wildlife Association. On November 12 and 24, 2014, we presented the results of this project to members of the public in Trail and to the West Kootenay Naturalists Association. A total of 110-120 people attended these events.

On June 26, 2014, we were panelists on a Kootenay Conservation Program (KCP) tour stop at Beaver Creek Provincial Park, attended by approximately 30 people. The purpose of the tour was to “Bring KCP partners together from around the Kootenays to learn about on-the-ground initiatives to conserve and steward lands and to facilitate in-depth learning regarding the most significant threats to the ecosystems in the Kootenays.” We presented the findings of the Reptile at Risk Project so far and outlined our experiences and challenges regarding conservation outreach in the area.

Information resulting from this project has been shared with other local conservation groups including KCP and West Kootenay EcoSociety which are working toward increasing the profile of lower Columbia Valley with respect to unique wildlife and habitats.

2.4 Land Management/Stewardship Activities

Stewardship activities have focused on recent land development activities occurring at the Trail Airport. Ownership of the airport was recently transferred from the Regional District of Kootenay Boundary (RDKB) to the City of Trail, which has been working to expand and upgrade all facilities including the runway, associated clearance perimeter fencing and access routes. A new terminal building is also planned at this location.

The new airport manager is very concerned about the potential for safety risks associated with wildlife species on and near the airport, and also with people trespassing from the park onto airport property (D. Goulard, pers. comm.). Construction of a new fence was initiated in May 2014 and despite our efforts to change the design and minimise ground disturbance, the fence was completed in November 2014. Although the airport manager has indicated a willingness to “work with us,” most of our verbal management suggestions have not been adopted.

A formal complaint was made to the provincial RAPP line regarding the fence construction activities to listed reptiles and plants at the airport. The local conservation officer responded and passed the file onto MFLNRO but there was no government staff with expertise on reptiles (e.g. Species at Risk biologist) to investigate the impacts (M. Knapik, pers. comm.).

We are continuing our efforts to encourage the airport authorities to implement conservation measures and we are hoping to engage local conservation groups to assist in this regard.

To assist with raising awareness in Beaver Creek Provincial Park, we provided input to BC Parks personnel in spring of 2014 regarding content for interpretive signage. The interpretive kiosk was installed at the Beaver Creek parking area and trailhead in June of 2014. It provides information on listed species, high value habitats, and a rationale for why it is critical to keep dogs on leashes at all times. Compliance has been very poor, and this continues to be a disturbance and mortality risk for listed reptiles on both BC Parks and Teck private lands (Machmer 2014a).

There is currently a very high demand for land in the Lower Columbia corridor (from Waneta to the US border) for industrial use and development (Machmer 2014; D. DeRosa, pers. comm.). This includes both Teck and other private lands that are of high habitat value to listed snakes, based on data gathered for this study. Although there is documentation regarding the critical habitat and conservation values of these lands (this study; Dulisse and Machmer 2014; Machmer 2014a, 2014b), there is a need to continue working with landowners to promote awareness and stewardship actions.

3.0 RESULTS

In 2013, we radio-tagged and followed the movements of five snakes (two rubber boas and three North American racers) between September 20 and October 17, which resulted in the discovery of four hibernacula (Dulisse and Machmer 2014).

In 2014, we radio-tagged and followed the movements of 11 snakes (all North American racers) between May 6 and November 8. Four snakes were captured and followed in May to July in order to determine summer habitat use and movements (Table 1). An additional seven racers were captured in September and October, resulting in the discovery of four new hibernacula (Table). All captures were made during foot-based encounter surveys.

Table 1. 2014 early season racer capture and telemetry summary.

PIT tag no. Radio Freq Sex	TL/SVL(cm)	Wt (g)	Date	Time	Air Temp	Surface Temp	Dist fr last location (m)	Land Status/ Ownership	Comments
6239557 150.046 male	72.0/56.0	85.8	6-May-14	1247	21.0	27.0	new	Beaver Cr Park	round scar on right side of head right behind eye
			11-May-14	1421	20.2	33.5	45	Beaver Cr Park	active, didn't see transmitter
			16-May-14	1005			104	Trail Airport	no visual: on airport property--triangulation
			20-May-14				unk		no signal--underground?
			24-May-14	1905			134	Trail Airport	no visual; under rock feature on airport property right near shrub removal/habitat damage and heavy ground disturbance
			30-May-14				unk		no signal--underground?
			6-Jun-14	1135	23.7	32.4	156	Beaver Cr Park	active hunting in grass near saskatoon, choke cherry, Oregon grape and Ponderosa pine; some scarring at tape line--reattached transmitter further up body; within 30m of unleashed dogs in park
			10-Jun-14	1209	23.5	30.0	66	Beaver Cr Park	active in rocks with native grass and shrubs (choke cherry and poison ivy)
			16-Jun-14		12.0		3	Teck Metals	3m from last location; no visual; under rocks
			20-Jun-14	1219			0	Teck Metals	same spot; no visual
			23-Jun-14	1555			0	Teck Metals	transmitter off with complete skin shed; found in grass with Oregon grape and choke cherry
6239572 150.852 female	83.0/67.0	159.8	30-May-14	1144	14.5		new	Teck Metals	active in grass 3m fr choke cherry; healthy, fat uniform belly (gravid?); broken tail tip; scarring on back of head; some missing scales; calm disposition
			3-Jun-14		17.9	23.0	5	Teck Metals	no visual; snake underground at slope break adjacent to road shoulder
			6-Jun-14	950	16.2	23.0	0	Teck Metals	basking in grass, same location; transmitter looks good
			10-Jun-14	1234			0	Teck Metals	transmitter off with complete skin shed; in grass/rocks approx 4m from edge of road
6239579 150.871 male	88.5/71.5	161.8	30-May-14	1153	16.5		new	Teck Metals	active in grass on shoulder of road next to mock orange and beaked hazelnut; popping cloaca; nearing ecdysis; feisty; broken tail tip
			3-Jun-14	1554	17.9	24.0	0	Teck Metals	can just see snake's head in hole under rock; unsure if it was basking when I arrived; appears sluggish
			6-Jun-14	955	16.2	22.5	0	Teck Metals	basking in grass under hazelnut; same location as capture site; racer shed also found here
			10-Jun-14				0	Teck Metals	transmitter off with complete skin shed at capture location; CWD/grass at base of hazelnut

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PIT tag no. Radio Freq Sex	TL/SVL(cm)	Wt (g)	Date	Time	Air Temp	Surface Temp	Dist fr last location (m)	Land Status/ Ownership	Comments
no PIT tag 150.852 male	75.0/57.5	78.3	26-Jun-14				new	Teck Metals	attached 150.852 to a new snake (55 days left on battery)
			1-Jul-14	1500	32.4	28.0	83	Teck Metals	snake looks good; hiding in kinnickinnik/saskatoon/vetch/bracken fern/Oregon grape cover
			4-Jul-14	1010	24.2	35.9	60	Teck Metals	basking on ground at base of hazelnut; escaped into hazelnut
			10-Jul-14	1730	33.3	55.0	138	Teck Metals	no visual; under some rocky areas/grass 4m from road surface
			16-Jul-14	715	20.0	21.0	0	Teck Metals	same place; no visual
			18-Jul-14	2050			0	Teck Metals	transmitter off with partial shed in rocks

Table 2. 2014 late season racer capture and telemetry summary.

PIT tag no. Radio Freq Sex	TL/SVL(cm)	Wt (g)	Date	Time	Air Temp	Surface Temp	Dist fr last location (m)	Land Status/ Ownership	Comments
63610810 150.871 male	73.0/55.5	75.8	9-Sep-14	1200	23.0	38.0	new	Teck Metals Ltd	attached 150.871 to a new snake;
			15-Sep-14		21.0	38.0	0	Teck Metals Ltd	visual; looks healthy
			16-Sep-14		17.0	27.0	0	Teck Metals Ltd	basking in protected spot next to fallen fence post
			22-Sep-14	1350			unk		no signal; failed transmitter?
63610985 151.851 female	73.0/63.0	130.3	9-Sep-14	1421	20.0	21.0	new	Beaver Cr Park	along airport fence; active but sluggish; missing tail tip; digesting large prey item
			16-Sep-14	1323	22.0	37.0	62	Beaver Cr Park	no visual; in dense choke cherry/ceanothus/Oregon grape at airport fence line
			22-Sep-14	1545	27.0	32.0	30	Beaver Cr Park	no visual; rocks, choke cherry, hazelnut, Oregon grape, snowberry, poison ivy,
			30-Sep-14	1521	15.0	21.0	9	Beaver Cr Park	active at base of hazelnut with Oregon grape and grass; transmitter looks good
			5-Oct-14	1450	22.0	38.0	0	Beaver Cr Park	no visual; underground; one nice looking hole
			6-Oct-14	1500	19.0	24.0	0	Beaver Cr Park	visual; basking on dead leaves under Oregon grape, choke cherry; looks good
			8-Oct-14	1440			0	Beaver Cr Park	no visual; same place
			17-Oct-14	1448			0	Beaver Cr Park	no visual; same place; unlikely looking spot; no obvious entrance but there are buried rocks; at base of hazelnut with Oregon grape, choke cherry, poison ivy; slope orientation 273, slope 37 degrees
			24-Oct-14	1349	12.8	17.0	0	Beaver Cr Park	same place
			8-Nov-14				unk		no signal; battery likely dead
62395597 151.911 female	88.0/70.0	142.9	15-Sep-14	1223	21.0	38.0	new	Teck Metals Ltd	active in ferns and rocks; broken tail tip
			22-Sep-14	1350	25.0	27.0	0	Teck Metals Ltd	no visual; 1m from capture location in rocks
			30-Sep-14		15.0	19.0	0	Teck Metals Ltd	visual; looks good; within 2m of last location; under Oregon grape at base of dense hazelnut
			5-Oct-14	1528	21.0	37.0	5	Teck Metals Ltd	approx 5 m upslope; entrance underground through cobble below?
			6-Oct-14				0	Teck Metals Ltd	no visual; same place

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PIT tag no. Radio Freq Sex	TL/SVL(cm)	Wt (g)	Date	Time	Air Temp	Surface Temp	Dist fr last location (m)	Land Status/ Ownership	Comments
			8-Oct-14				0	Teck Metals Ltd	no visual; underground same place
			17-Oct-14	1415	11.0	13.5	0		all three snakes in same place (62395597, 63610844, 63610830); no visual; location just up from likely entrance through cobble rocks; rocks dumped here from agricultural area; snowberry, hazelnut, Oregon grape; marked with WT ribbon; slope orientation 265, slope 25 degrees
			24-Oct-14	1254	11.0	13.5	0		same place
			8-Nov-14	935	4.7	7.4	unk		no signal
63610844 151.951 female	80.0/61.0	107.8	30-Sep-14	1148	15.0	19.0	new	Teck Metals Ltd	
			6-Oct-14	1527	20.0	26.0	5	Teck Metals Ltd	basking 1m off ground in snowberry bush; escaped into bush; tag looks good;
			8-Oct-14				0	Teck Metals Ltd	active at same place at base of old fence post
			17-Oct-14	1415	11.0	13.5	5		all three snakes in same place (62395597, 63610844, 63610830); no visual; location just up from likely entrance through cobble rocks; rocks dumped here from agricultural area; snowberry, hazelnut, Oregon grape; marked with WT ribbon; slope orientation 265, slope 25 degrees
			24-Oct-14	1254	11.0	13.5	0		same place
			8-Nov-14	935	4.7	7.4	0		same place
63610867 151.970 male	62.0/52.0	60.8	1-Oct-14	1330	15.0	19.0	new		active in snowberry, Oregon grape, rocks; under transmission line; broken tail tip
			5-Oct-14	1210	15.0	29.0	70		no visual; dense grass, knapweed and St John's wort at base of dead mallow ninebark, but mostly invasives
			6-Oct-14	1342	23.0	37.0	27		no visual; under rocks with dense ninebark, snowberry cover
			8-Oct-14	1255	15.0	25.0	8		no visual; approx 3m upslope; several good rock openings with mock orange cover and CWD
			17-Oct-14	1330	10.0	13.5	0		no visual; same place; marked with WT ribbon; bedrock feature with nice looking entrance; native grasses, Saskatoon, mock orange (aspect of 251° and slope of 45°)
			24-Oct-14	1233	11.0	16.0	0		same place
			8-Nov-14	1103	4.2	7.0	0		same place

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PIT tag no. Radio Freq Sex	TL/SVL(cm)	Wt (g)	Date	Time	Air Temp	Surface Temp	Dist fr last location (m)	Land Status/ Ownership	Comments
63610831 151.831 female	80.0/61.0	89.5	6-Oct-14	1300	22.0	27.0	new		basking on side of transmission access road; cold, sluggish snake; under snowberry, mock orange; broken tail tip
			8-Oct-14	1105	17.0	35.0	49		travelled approx 70m upslope; no visual; underground in rock feature under mock orange, choke cherry 5m from new transmission pole installation
			17-Oct-14	1305	10.0	13.5	5		no visual; signal approx 4m upslope from last site; just up hill from rocky complex with mock orange, oceanspray, choke cherry, saskatoon, native grass; marked with WT ribbon; possible entrance below; orientation: 175; slope 23 degrees
			24-Oct-14	1218	11.0	16.0	1.5		same place but signal moved approx 1.5m east underground
			8-Nov-14	1047	4.2	7.0	0		same place
63610830 151.710 male	82.0/65.0	118.5	8-Oct-14	1400	17.0	26.0	new	Teck Metals Ltd	under same hazelnut bush; basking; broken tail tip
			17-Oct-14	1415	11.0	13.5	5	Teck Metals Ltd	all three snakes in same place (62395597, 63610844, 63610830); no visual; location just up from likely entrance through cobble rocks; rocks dumped here from agricultural area; snowberry, hazelnut, Oregon grape; marked with WT ribbon; slope orientation 265, slope 25 degrees
			24-Oct-14	1254	11.0	13.5	0	Teck Metals Ltd	same place
			8-Nov-14	935	4.7	7.4	0	Teck Metals Ltd	same place

3.1 Early Season Snake Capture and Radio Telemetry

Between May 6 and July 18, we captured and radio-tagged four North American racers (Table 1). These snakes were followed for 11 to 49 days before individual snakes shed their skin (and the radio transmitter).

One snake was showing signs of minor skin injury at the radio attachment site (Table 1), so we reattached the transmitter further up the body of the snake; this snake shed its skin 13 days later (Table 1).

Distances from one telemetry location to the next ranged from 0 to 156 m (Table 1) and several snakes were observed active and moving, seemingly unaffected by their transmitters.

3.2 Late Season Snake Capture and Radio Telemetry

Between September 9 and October 8, seven North American racers were radio-tagged. Movements of these individuals were tracked over 13 to 60 days, resulting in the discovery of four hibernacula (Table).

Racers did not move as much at this time of year and the distances from one telemetry location to the next ranged from 0 to 62 m (Table 2). The transmitter on the one snake that was followed for only 13 days (#63610810) likely failed and the remaining six snakes were followed to four different hibernacula by October 8 (Table 2). No skin shedding events were recorded during this season.

3.3 Snake Hibernacula

One North American racer female (#63610985) was captured within Beaver Creek Provincial Park, adjacent to the Trail Airport and confirmed hibernating nearby on a rocky slope 88 m from her capture site (Table). Although we could not find an obvious entrance, there are numerous piles of rounded river rock cobble along this slope (aspect of 273° and slope of 37°). This snake was always found in association with suitable native shrub cover, including species such as choke cherry (*Prunus virginiana*), snowbrush (*Ceanothus velutinus*), tall Oregon-grape (*Mahonia aquifolium*), common snowberry (*Symphoricarpos albus*), beaked hazelnut (*Corylus cornuta*) and poison ivy (*Toxicodendron rydbergii*). The latest date on which this snake was found active was October 6.

Three racers (#62395597, 63610844 and 63610830) were captured near and followed to a communal hibernaculum (Table). All three snakes were captured within 10 m of the hibernaculum and did not move very much at all (less than 10 m) from when the first snake was captured (September 15) until the last snake was seen above ground (October 8). There are numerous possible entrances to this hibernaculum which consists of partially and fully embedded piles of rounded river rock, likely deposited artificially over the last 75-100 years as a result agricultural activities above the road. The slope (aspect of 175° and slope of 23°) is

located just below the road with within a Fortis BC power line right-of-way beside Teck land. This site is likely very important for racers; numerous other individuals of all age classes and shed skins were observed over the field season in the immediate area. Tall Oregon-grape, common snowberry and beaked hazelnut are the dominant shrub cover at this site. Rocky Mountain Douglas-fir (*Pseudotsuga menziesii*) ingrowth is occurring here and the hibernaculum is located within a popular dog walking area.

An adult male racer (#63610867) was captured on October 1; this snake was in its hibernaculum by October 8 (Table), located 86 m downslope of the capture site. During the seven days of tracking, this snake was found associated with native shrub cover including common snowberry, tall Oregon-grape, mallow ninebark (*Physocarpus malvaceus*) and dense, non-native plant cover including common St. John's-wort (*Hypericum perforatum*) and spotted knapweed (*Centaurea stoebe* subsp. *micranthos*). The hibernaculum is located at the top of a very steep, open slope (aspect of 251° and slope of 45°). It is a rock feature with obvious openings/fissures. Cover vegetation is dominated by mock-orange (*Philadelphus lewissii*), saskatoon (*Amelanchier alnifolia*) and native grasses.

The last racer was captured on October 6. This adult female (#63610831) was basking on the side of the transmission line access road (Table 2) under common snowberry and mock-orange. By October 8, she was located 49 m upslope within 5 m of her hibernation site, a large, prominent rock feature with mock-orange, oceanspray (*Holodiscus discolor*), choke cherry, Saskatoon and native grass cover. A likely entrance was visible and the snake apparently moved underground approximately 1.5 m eastward between October 17-24. The hibernaculum (aspect=175° and slope= 23°) is located immediately below a newly constructed transmission line tower and fresh rubble covers the upper portion of this feature.

Although several snakes were found in the same areas as in 2013, no individuals were found using the same hibernacula in both years.

3.4 Incidental Observations

In addition to the radio telemetry efforts on larger adult snakes, we recorded observations of snakes that escaped, snakes that were too small to radio tag, shed snake skins and non-target reptile and amphibian species including the western skink, northern alligator lizard, Pacific treefrog (*Pseudacris regilla*) and long-toed salamander (*Ambystoma macrodactylum*).

Of note is the exceptionally high density of shed racer skins adjacent to Columbia Gardens Road. This site had the highest overall racer activity within the study area with numerous snakes of all age classes observed, numerous shed skins and two known hibernacula so far. Also relevant is the high density of shed skins on the west side of the Trail airport property, in the same area where persistent disturbance (excavation, vegetation clearing, machinery and vehicles driving over native shrubs, etc.) was observed in 2014.

4.0 DISCUSSION

All four early season (May, June and July) telemetry attempts ended when the radio-tagged snakes shed their skins and radio transmitters. It is possible that transmitter attachment using

our methods at this time of year may induce shedding (ecdysis) as snakes may shed in possible response to skin parasites. However it is also possible that many snakes shed naturally or more frequently during this time of year and we just happened to capture these events by tagging snakes at this time. More research is needed to determine if our efforts are actually causing the snakes to shed.

Although the early season sample size is small, the snakes in our study seem to be moving less than racers in other areas. Daily movements of different racer subspecies have been compared by Fleet et al. (2009). Mean daily movements range from 33 m for *C. constrictor mormon* (the same racer subspecies as in our area) in Utah to 104 m for *C. c. priapus* in South Carolina and the authors suggest this has to do with foraging habitat quality rather than body size: snakes living in higher quality, more homogenous habitat may require less movement to encounter prey (Fleet et al. 2009). Racers feed mainly on invertebrates (especially grasshoppers, crickets and katydids) and small vertebrates are taken opportunistically. Local racers are known to eat grasshoppers and western skinks (J. Dulisse, pers. obs.).

It is possible that our early season tracking efforts happened to coincide with ecdysis, when snakes are known to be inactive (Fleet et al. 2009). We recommend additional spring and summer tracking to better understand local racer movement patterns.

Much more snake movement was noted during the early season telemetry (May to July) than the late season telemetry (September to October). Three of the racers radio tagged in September moved less than 10 m over the approximately one month period from capture to hibernation in October (Table 2). The three snakes followed to hibernacula in other areas moved a maximum of 88 m from their capture site to hibernation locations.

We recommend continuing the early season portion of this project to determine if this method is practical for following snakes in the summer. This is valuable information because our results show North American racers have different movement patterns throughout the season.

Our methods have been successful in following the movements and finding hibernacula of eleven individual snakes at risk in the Waneta area. Minor skin injury due to the tape attachment was noted on one of the northern rubber boas in 2013 (the transmitter was removed at that time) and one North American racer in 2014 (the transmitter was reattached further up the snake's body). In general, this method seems much less invasive and risky than the alternatives (surgical implantation or force feeding). It is possible/likely that injury is more likely during the most active seasons and when the snakes are underground passing through narrow rock openings (northern rubber boas spend more time doing this). We recommend testing the attachment technique on 1-2 more northern rubber boas before abandoning its use on this species.

Foot surveys were most effective in capturing adult snakes, so we focused less effort on checking under natural and artificial cover objects. This shift in methodology resulted in no northern rubber boa captures this season, however the tradeoff is deemed worth it, based on the increased number of racers captured over this season. Also, northern rubber boas likely use some of the same hibernacula as racers (Dulisse and Machmer 2014), so their habitat needs may well be captured with a focus on North American racers.

None of the radio tagged snakes were observed on a road surface or observed to have crossed a road surface. However, several radio tagged snakes basked and spent considerable time

immediately adjacent to road surfaces and several non-tagged racers were observed on paved and non-paved road surfaces during the field season.

There are a number of areas that were not efficient or practical to survey in 2013-2014, due to logistical/budget constraints and/or nearby disturbance (even though they were being used by snakes prior to the Waneta Expansion Project. These include sites within the fenced Trail Airport perimeter and Teck Reload Facility property, areas closer to the Waneta Dam construction footprint and/or close to the busy Highway 22A, or nearby private lands (where permission from each landowner must be sought prior to entering). It is recommended that some of these more challenging areas be included next year, to broaden the survey scope and gain a better understanding of the relative importance of impacted/disturbed habitats by the listed snakes.

Finally, this project has contributed to an important “on-the-ground” presence in an area that has traditionally been under-represented with respect to wildlife stewardship and conservation efforts. Local land managers, operators and members of the general public are now more aware of the habitat needs of local reptiles and other listed wildlife in this area. There is a need to further educate and empower local government, agencies and NGO groups to promote greater stewardship of this area, and we see this project as a catalyst for such efforts to continue.

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6.0 APPENDIX 1. Photographs



Juvenile North American racer. This snake is too small to radio-tag but is large enough for PIT-tagging.



Adult North American racer with radio transmitter attached.



Side view of radio transmitter taped to ventral surface of adult North American racer.



Bottom view of radio transmitter taped to ventral surface of adult North American racer.



Racer habitat in Beaver Creek Park.



Hibernation site of North American racer #63610985 at base of beaked hazelnut in Beaver Creek Park.



Group hibernation site of North American racers (#62395597, 63610844 and 63610830).



Likely entrance to group hibernation site of North American racers (#62395597, 63610844 and 63610830).



Hibernation site of North American racer #63610867.



Likely entrance to hibernation site of North American racer #63610867.



Hibernation site of North American racer #63610831.



Recent ground disturbance at Trail Airport along border with Beaver Creek Park.



Recent ground disturbance at Trail Airport along border with Beaver Creek Park.



Important cobble habitat within Beaver Creek Park.



Typical racer escape habitat. Radio-tagged individual is down a hole under a rock (arrow).



Typical racer escape habitat. Radio-tagged individual is at base of beaked hazelnut under tall Oregon-grape.



Complete shed skin of untagged North American racer.



Complete shed skin, including radio transmitter.