COLUMBIA BASIN FISH & WILDLIFE COMPENSATION PROGRAM

COLUMBIA BASIN WESTERN SKINK INVENTORY AND ASSESSMENT

2005 RESULTS

PREPARED BY:

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March 2006

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Columbia Basin Western Skink (*Eumeces skiltonianus*) Inventory and Assessment

2005 Results

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EXECUTIVE SUMMARY

This report summarises an inventory and habitat assessment for the blue-listed western skink *(Eumeces skiltonianus)* in the south-western portion of the Columbia Basin Fish and Wildlife Compensation Program (CBFWCP) project area in the summers of 2004 and 2005. Western skinks were located at 41 out of 91 sites surveyed. In addition to these surveyed locations, data compiled from other sources confirmed skinks at another 86 locations to make a total of approximately 127 known occupied sites within the CBFWCP program area. The easternmost records were for the Creston valley and skinks were confirmed at many locations northward along Kootenay Lake as far north as Pilot Bay and Ainsworth. Vallican remains the northernmost confirmed western skink location in the Slocan valley but the species may occur at New Denver and Rosebery. Western skinks are relatively common from Syringa Provincal Park, south along the Columbia River valley to the U.S. border and throughout the Pend d'Oreille River valley. At occupied sites, western skinks were the most commonly encountered reptile and they often co-occurred with northern alligator lizards (*Elgaria coerulia*) and rubber boas (*Charina botae*). Skinks were located primarily in low elevation dry forest and mixed grassland habitat. Important habitat components included sites with warm aspects, loose soil substrates, and an abundance of cover objects, such as rocks with nearby grass, shrubs or woody debris. The conservation of skink habitat is especially important considering the patchiness of suitable sites in many areas and the species' apparent lack of ability to move between habitats. Loss of habitat through development activities and forest ingrowth are probably the two main threats facing the western skink in the study area.

ACKNOWLEDGEMENTS

John Krebs and Juliet Craig administered the project and reviewed drafts of this report. The following individuals assisted with field work and reported sightings: Trevor Allegretto; Ted Antifeau; Marc-Andre Beaucher; Nico Becker; Sandra Bernier; Charmaine Campbell; Jason Carter; Anne Champagne; Ross Clarke; Stewart Clow; Tola Coopper; Gail Coopper; Juliet Craig; Lance Delport; Katherine Enns; Kent Goodwin; Alan Grant; Steve Gritchen; John Gwilliam; Brenda Herbison; Thomas Hill; Shaun Hills; Steve Hilts; Rachel Holt; Colleen Hughes; Karen Huxley; John Krebs; Susan Kurtz; Gabrielle Liddle; Rene and Marcel Linot; Heath Lockhurst; Marlene Machmer; Erica Mallam; Derek Marcoux; Liz Mayer; Loree McArthur; Maryanne McDonough; Bill Merilees; Don Miller; Steve Ogle; Penny Ohanjanian; Elaine Overton; Peter Paulson; Debbie, Brian and Jake Phelan; Adam Prisciak; Aaron Reid; Ted Ryan; Margo Saunders; Rob Serrouya; Kevin Smith; Patrick Stent; Gina Stewart; Paul Temple; Erika Tigichallr; Erik Treijs; Rebecca Whidden and; Andy Wight. GIS support was provided by Amy Waterhouse and Mark Schnider.

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1.0 Introduction

In May, 2002, the western skink was designated a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2003) because it is thought to have characteristics that make it particularly sensitive to human activities or natural events (Ovaska & Engelstoft 2002). In the spring of 2003, the species was blue-listed (vulnerable or sensitive) by the British Columbia Conservation Data Centre (2004). In the U.S., the western skink is considered vulnerable or imperilled in two (Montana and Arizona) out of eight western states where it occurs (NatureServe 2003).

In B.C., the western skink occurs in valley bottoms and dry lower slopes of south-central and east-central parts of the province (Gregory & Campbell 1984), including the Kootenay River valley (Creston and east), the Lower Arrow Lake and Columbia River valley south of Castlegar, and Okanagan-Boundary north to Salmon Arm. In 2004, an inventory was initiated to determine the distribution of western skinks, and conduct a habitat assessment in the southern portion of the CBFWCP area. The purpose of the 2005 project was to continue the inventory and habitat assessment that was begun in 2004, and to provide further recommendations for the species in the CBFWCP area including initial information for predictive mapping.

The specific objectives of this project were to:

- In conjunction with volunteers, complete a field inventory for western skink in potentially suitable and fringe habitat in the southern portion of the CBFWCP, including conservation properties.
- Document UTM coordinates, search time, habitat attributes and skink numbers at inventory sites.
- Prepare a report summarising inventory efforts, habitat associations and conservation recommendations.
- Provide preliminary information and recommendations for predictive mapping for suitable skink habitat.

2.0 Methods

2.1 Background Information

In 2004, western skinks were located at 19 out of 40 sites surveyed (Dulisse 2004a). In addition to these surveyed locations, data compiled from other herpetological surveys (Merilees 1981; Rutherford and Gregory 2001; Schaeffer et al. 2002) and public sightings confirmed skinks at another 68 locations to make a total of 87 known occupied sites within the CBFWCP program area (Dulisse 2004a). Using these results, additional survey routes were planned in what was known or suspected to be suitable habitat. This season, extra survey effort was directed toward the edges of the known range in an attempt to determine the species' range limit. For example, skink sighting reports were investigated in the following areas: New Denver, Ainsworth, and Riondel.

2.2 Study Area

Surveys were limited to drier, open forest types within the CBFWCP program area because these sites had the greatest potential skink habitat (Figures 1 & 2). Drier sites within the following Biogeoclimatic Ecosystem Classification (BEC) subzones (Braumandl & Curran 1992) were sampled: Dry Warm Interior Cedar-Hemlock (ICHdw), Very Dry Warm Interior Cedar-Hemlock (ICHxw), Moist Warm Interior Cedar-Hemlock (ICHmw2), Wet Cool Interior Cedar-Hemlock (ICHwk), Dry Mild Interior Douglas-fir (IDFdm2), Undifferentiated Interior Douglas-fir (IDFun), and Dry Hot Ponderosa Pine Variant (PPdh2). (Refer to Braumandl & Curran (1992) and Dulisse (2004a) for detailed descriptions of these forest types.) See Table 1 for a list of survey sites by BEC subzones.

2.3 Surveys

A total of 59 sites were surveyed between 22 June and 23 September, 2005. Public sightings were solicited though word of mouth and by placing "wanted posters" advertising the skink survey in target areas near the edge of the known range for the species, including Riondel, Grey Creek, Ainsworth, Balfour, Winlaw, Slocan and New Denver.

Foot surveys were conducted at each site and cover objects (rocks and woody debris) were turned over and potential escape shrubs investigated for lizard presence. Sound clues were important in this study; lizards make unique sounds as they travel through dry grass and debris. At each site, the following description data was collected: general

location and site description; date; start and end time; number of observers; cloud cover; wind; precipitation; air and ground temperature; GPS location (UTM); elevation; number of cover objects investigated; mesoslope position; slope; aspect; presence of bedrock; presence of loose surface rock; presence of woody debris; presence of invasive weeds; percent crown closure; dominant tree species; biogeoclimatic ecosystem classification zone (BEC); and habitat threats. Sites were considered independent if they were at least 200m apart.

When skinks were encountered, the following data was collected: species; activity; age; and general comments (see Dulisse 2004a for an example of the field data sheets). I tried to remain at a site for at least 30 minutes but search times ranged from 15 to 315 minutes per site depending on the size of the site, accessability and time constraints. Often, search times were limited by the size of suitable habitat at a given site. Because there have been so few herpetological studies in this area, incidental sighting information regarding other reptile and amphibian species was also gathered during this project (Table 3). This year, body size data (weight, snout-vent length and total length) were also collected opportunistically on some individual lizards and snakes. I measured survey effort by recording time (per person) spent surveying and number of cover objects flipped (Table 3) so relative abundance may be estimated in the future. Over the two seasons, a total of 7,751 person minutes were spent searching and 29,426 cover objects were investigated.

3.0 Results and Discussion

During 2004 and 2005 surveys, total of 218 western skink observations were made at 41 sites. Individual skinks observed included five eggs (all found in one active nest), 12 young of the year, 12 juveniles, 28 subadults, 44 adults (including two carcasses) and 116 exuvia (shed skins).

3.1 Distribution

The data used to map western skink distribution in the CBFWCP program area came from three sources: 1) 2004 and 2005 surveys; 2) other herpetological surveys in the area; and 3) reported sightings from members of the public, colleagues, friends etc. (Table 1). Reported sightings were accepted if they were received from a reliable source (e.g. professional biologist or naturalist) or were particularly convincing (e.g. observer saw bright blue tail of skink) and within the known range of the western skink. Unconfirmed, but convincing records outside the suspected range of the skink are included in Figures 1

& 2. Sites 1-45 were first surveyed in 2004 and Sites 47-103 were established during the 2005 field season.

Table 1. Summary of western skink records by source and BEC Zone.

	ICHdw	ICHxw	IDFun	ICHmw2	ICHwk	IDFdm2	PPdh2	Total
Number of Sites Sampled (2004-2005)	74	9	1	6	2	4	1	97
Number of Sites with Skinks								
This Survey (2004-2005)	31	9	1					41
Other Herpetological Surveys[1]	9	32	3					44
Reported Sightings[2]	24	16		1		1		42
Total	64	57	4	1	0	1	1	127

[1] Dulisse 2004b; Rutherford and Gregory 2001; Schaeffer et al. 2002, Merilees 1981.
[2] See Acknowledgements for a list of people who contributed to this survey.

Western skinks were located at 19 of 40 (47.5 %) sites visited in 2004 and 22 of 59 (37.3 %) sites visited in 2005. Overall, skinks were located at 41 of 97 (42.3 %) sites visited over the two seasons. The 59 sites surveyed in 2005 included a revisit of one site (# 45[1]) established in 2004 and site # 79 was visited twice in 2005. An additional 18 sites were gathered from a historic publication (Merilees 1981) and recent public sightings make a make total of approximately 127 known western skink locations within the CBFWCP program area (Table 1, Figure 1).

I have collected approximately eight extralimital records I consider to be reliable but was unable to confirm skinks at these locations: Shalaylee Beach (south end of Slocan Lake), New Denver, Rosebery, Halfway River, Ainsworth, Riondel and Kimberly Nature Park (Table 2).

[1] Please note: the site numbers used in this report do not correspond to the site numbers used in the 2004 report (Dulisse 2004a).

Table 2. Summary of extralimital western skink records.

	Details[1]	Source[1]	Surveyed
South Slocan Lake	Has seen many lizards with bright blue tails on property	Conrad Swanson, pers. comm.	Private land; unable to gain permission to survey here
New Denver	undetailed record	Merilees 1981	Unable to follow up due to lack of detail
New Denver	lizard with bright blue tail seen along trail	Stan Rowe via Anne Champagne, pers. comm.	Extensive surveys of area; no skinks found
New Denver	cat brought blue lizard tails into house	Erica Mallam, pers. comm.	Area not surveyed due to timing/budget constraints
Rosebery	undetailed record	Merilees 1981	Unable to follow up this record due to lack of detail. Could not survey area do to timing/budget constraints
Halfway River	Lizard with bright blue tail collected near shoreline	Don Miller, pers. comm.	Extensive surveys of the area; no skinks found
Ainsworth	Has seen lizards with bright blue tails	Kevin Smith, pers. comm.	Area not surveyed due to timing/budget constraints
Riondel	Saw one lizard with blue tail	Thomas Hill, pers. comm.	Extensive surveys of the area; no skinks found
Kimberly Nature Park	Saw one lizard with blue tail	Kent Goodwin, pers. comm.	One brief survey of area; no skinks found

[1] Further details are given in database submitted to CBFWCP.

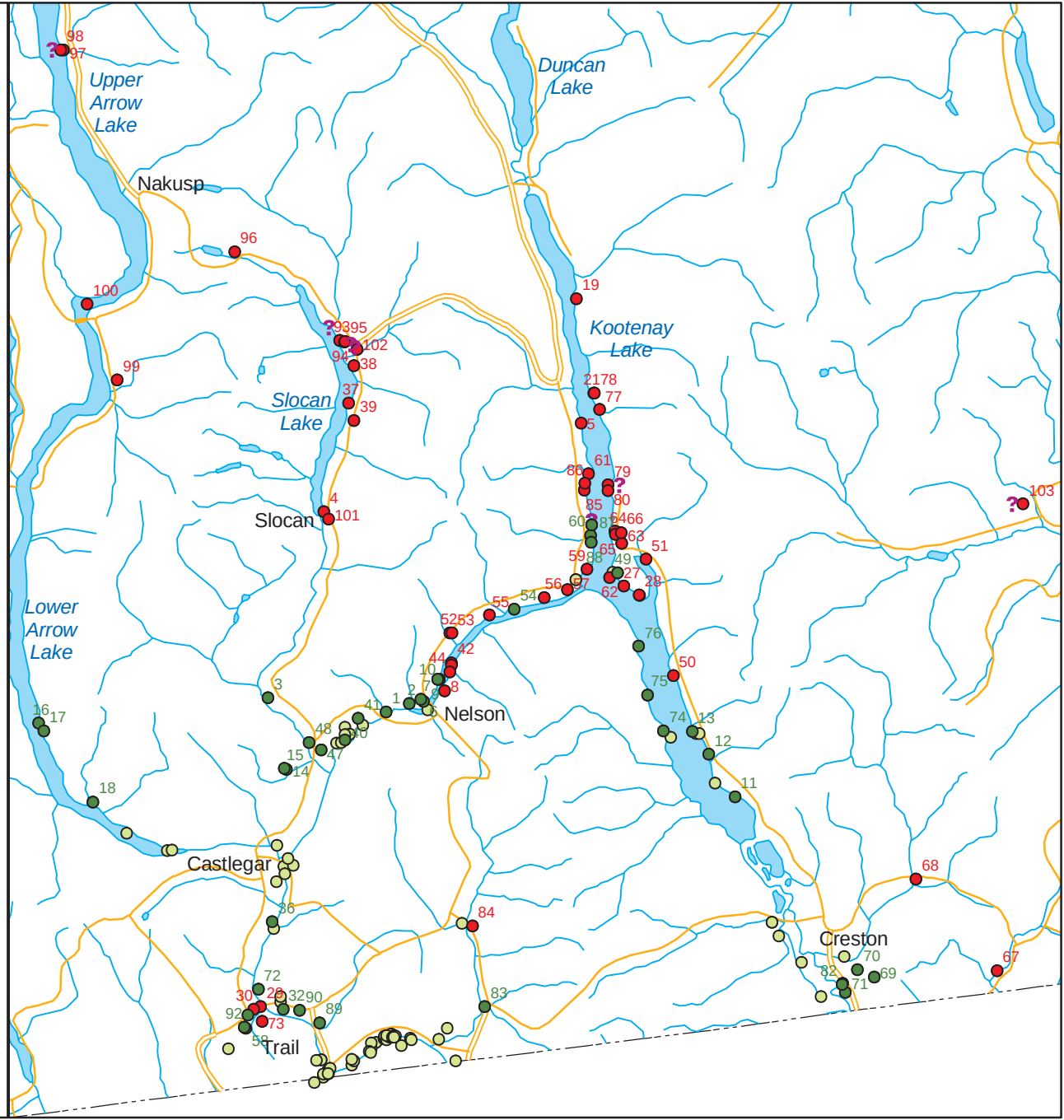
Figure 1: Skink Survey Locations 2004 & 2005 Survey Sites and other Skink Records

2004-2005 Surveys

- Skink found
- Skink not found

Skink Records from Other Sources

- Other studies and public sightings
- ? Unconfirmed outlying sightings



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BC Albers, NAD 83

March 8, 2006

Columbia Basin Fish & Wildlife Compensation Program

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Figure 2: Skink Survey Locations 2004 & 2005 Survey Sites and other Skink Records

2004-2005 Surveys

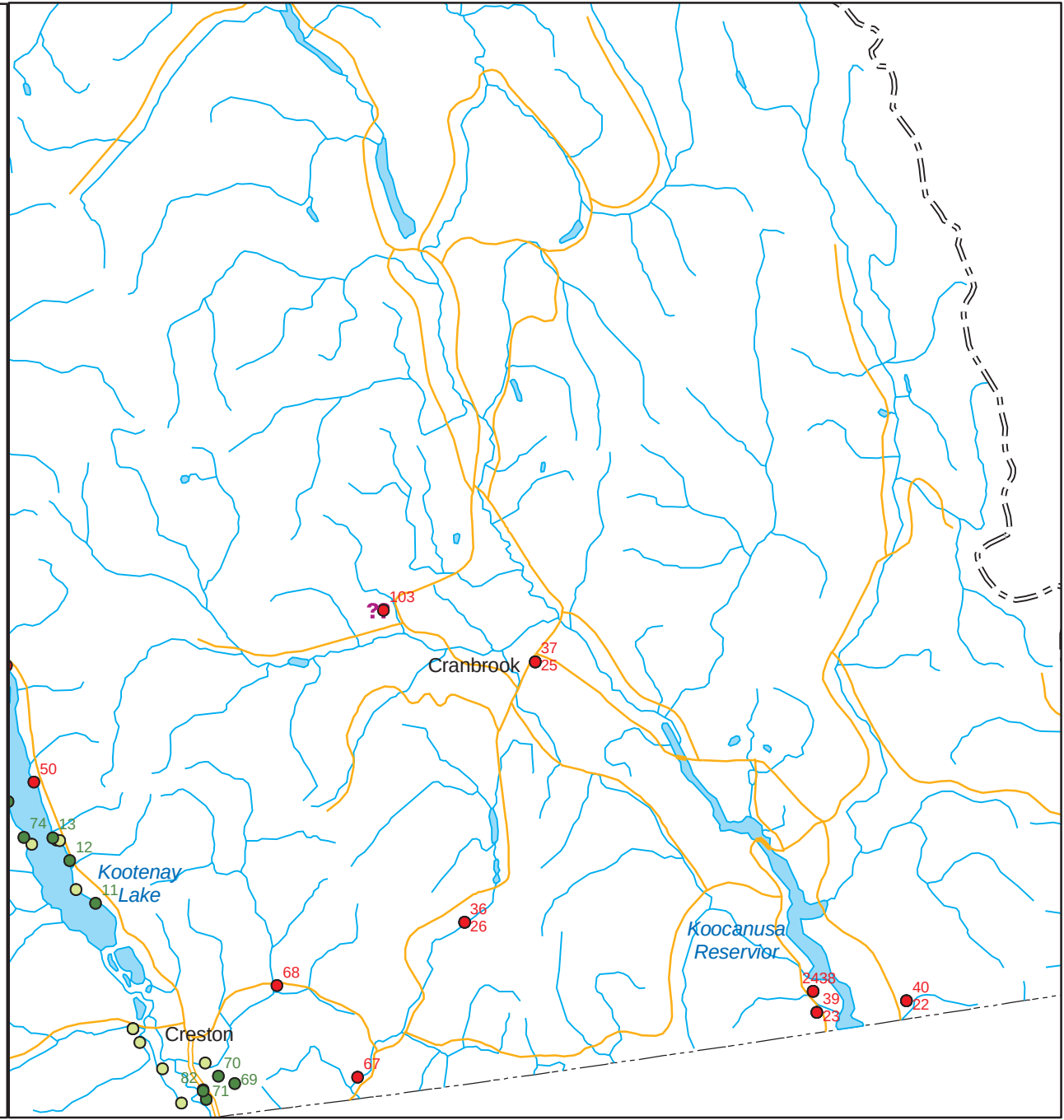
- Skink found
- Skink not found

Skink Records from Other Sources

- Other studies and public sightings
- ? Unconfirmed outlying sightings

LEGEND_LBL

- ? Reliable, unconfirmed extralimital record



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December 21, 2005

Columbia Basin Fish & Wildlife Compensation Program

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3.1.1 West Kootenays

The easternmost skink records were in east Creston and the species was confirmed north along the east shore of Kootenay Lake from Creston to Pilot Bay Provincial Park (Figure 1, Site 49). Two convincing sightings were reported in the Riondel area (Thomas Hill and Aaron Reid, pers. comm.) but western skinks were not found during extensive searches in the area or at several candidate sites between Riondel and Pilot Bay. Along the west shore of Kootenay Lake, skinks were recorded at three locations along 14 km stretch from Drewry Point Provincial Park to a site just north of Heather Creek (Sites 74-76).

Skinks were found at only two locations along the West Arm of Kootenay Lake (Sites 10 & 54) and at an additional three sites in the Coffee Creek/Ainsworth area (Sites 60, 87 & 88). Skinks were confirmed at two areas near Coffee Creek (Sites 60 & 88) and above the highway approximately 750m south of Ainsworth (Site 87), the northernmost confirmed occupied site on the west side of Kootenay Lake. I received one anecdotal report of skinks in the town of Ainsworth (Kevin Smith, pers. comm.) so it is possible that the species occurs there but skinks were not found at several sites north of Ainsworth and no convincing reports were received from this area.

Merilees (1981) reports a 1944 skink sighting from the "North Shore, Nelson B.C." and a 1945 sighting at Queen's Bay but the precise locality data has been lost. I received a convincing anecdotal report of western skink sightings during the 1950s at Queen's Bay (Aaron Reid, pers. comm.) so the species likely occurred in these areas but it is not known if these populations persist. Extensive residential development along the West Arm of Kootenay Lake may have reduced occupied skink habitat into isolated patches.

In 2004, western skinks were found only on the north side of Kootenay River from Nelson approximately 3 km east of the orange bridge (above the highway), west along the north side of the Kootenay River drainage to the Slocan River. In the Slocan valley, skinks were found during 2004 surveys as far north as Vallican, near the confluence of the Slocan and Little Slocan Rivers. Despite the investigation of convincing sighting reports from the Slocan City (Conrad Swanson, pers. comm.), New Denver (Merilees 1981; Anne Champagne and Erica Mallam pers. comm.) and Rosebery areas (Merilees 1981), I was unable to confirm the presence of the species farther north than in 2004.

Merilees (1981) reports a 1980 western skink record from Rosebery and I investigated two convincing, recent New Denver sightings from within the last four years (Anne Champagne and Erica Mallam pers. comm.). One of the observers was the late J. Stan Rowe, a noted ecologist and naturalist (Anne Champagne, pers. comm.). Although I surveyed several locations in the area without success, the species may persist here. Forest ingrowth is probably a problem for the species here and one of the recent New Denver sightings involved domestic cat depredation (Erica Mallam, pers. comm.) so this is probably an additional threat.

Skinks were reported in the Castlegar area on the north and south sides of the Columbia River, down the river valley on the north side of the river to Trail. South of Trail, there were skink records on either side of the Columbia to the US border and they were common throughout the Pend d'Oreille valley (Dulisse 2004b). These areas represent the "core" habitat of the species in the CBFWCP area and this season, many additional records were collected within these areas.

3.1.2 East Kootenays

In 2004, five East Kootenay sites were surveyed without success (Figure 2) and one site (Kimberly Nature Park) was visited this year (Site 103). A particularly convincing sighting report came from the Kimberly Nature Park (Kent Goodwin, pers. comm.) but could not be confirmed. The northern alligator lizard was found to occur at this site, which represents an extension of the known range for this species.

The southern East Kootenay Trench is not well known herpetologically and additional reptile surveys should be initiated in the area. I have received several anecdotal lizard and/or skink sighting reports for the area[2] which, if investigated and confirmed, would represent range extensions for these taxa.

3.2 Habitat Characteristics

3.2.1 Dry Forest Types

All confirmed skink sites to date are located within ICHdw, ICHun and ICHxw BEC

[2] Details in database submitted to CBFWCP.

subzones (Table 1). These subzones represent the hottest and driest forest types in our area and skinks are probably largely limited to these subzones within the CBFWCP area.

ICHdw

Most potential skink habitat in our area is within this subzone and approximately 64 western skink records have been collected within the ICHdw (Table 1). The ICHdw subzone occurs below 1200m and is characterised by very hot, moist summers and mild winters with light snowfall (Braumandl & Curran 1992). The driest sites (02 site series) within this zone have open stands of Douglas-fir (*Pseudotsuga menziesii*), and ponderosa pine (*Pinus ponderosa*) with minor components of lodgepole pine (*Pinus contorta)*. The ICHdw(02) is patchily distributed on lower slopes and valley bottoms of the West Kootenay. Few climax forests exist within the ICHdw because of frequent natural wildfire cycles and in its climax seral stage, the ICHdw(02) site series represents a provincially red-listed plant community (British Columbia Conservation Data Centre 2004).

ICHxw

Approximately 57 western skink sites have been compiled within the ICHxw. This subzone occurs below 1100m and is characterised by very hot, dry summers and mild winters with light snowfall (Braumandl & Curran 1992). Dry sites within this ecosystem have open stands of Douglas-fir and ponderosa pine. Few climax forests exist within the ICHxw because of frequent natural wildfire cycles, so open areas are often dominated by shrub and grass cover. The ICHxw ecosystem is not well represented in Canada and is limited to the Pend d'Oreille valley and south end of Kootenay Lake near Creston.

IDFun

A total of four western skink records have been collected for the IDFun. This relatively low number likely represent low survey effort within this subzone. This high quality habitat is near the centre on known skink range so was therefore not sampled heavily during our surveys. Previous research found western skinks to be quite common in this relatively small subzone (Dulisse 1999). This subzone is limited to the lowest slopes (below 1000m) on the east side of Lower Arrow Lake, near Syringa Creek Provincial Park. This subzone is characterised by frequent dry, rocky sites and open mature stands of Douglas-fir and ponderosa pine with bluebunch wheatgrass (*Pseudoroegneria spicata)*, ocean-spray (*Holodiscus discolor*), mock orange (*Philadelphus lewisii*) and mallow ninebark (*Physocarpus malvaceus*) (Braumandl & Curran 1992).

3.2.2 Key Habitat Components

Western skinks arguably have very narrow habitat requirements compared to other reptile species in our area. Skinks were found to be patchily distributed in warm, dry, open, sparsely treed habitat with high levels of solar insolation, loose soil and abundant escape cover (usually rocks lying on the substrate). These key characteristics outlined in Dulisse (2004a) were found to be important this season also.

Solar Exposure

Incident solar radiation (termed solar insolation) at a given site is correlated with and increases with southerly aspects (D'Eon & Serrouya 2005) and increasing slope (Mowat et al. 2002). Although solar insolation was not measured directly, site aspect and slope were measured. In order to benefit skinks, solar radiation must reach the ground and be reflected, so crown closure will influence reflected solar insolation (i.e. reduced crown closure will increase direct and reflected solar insolation). In general, sample sites tended to be on warm aspects, steep terrain and locations with low crown closure (Table 3).

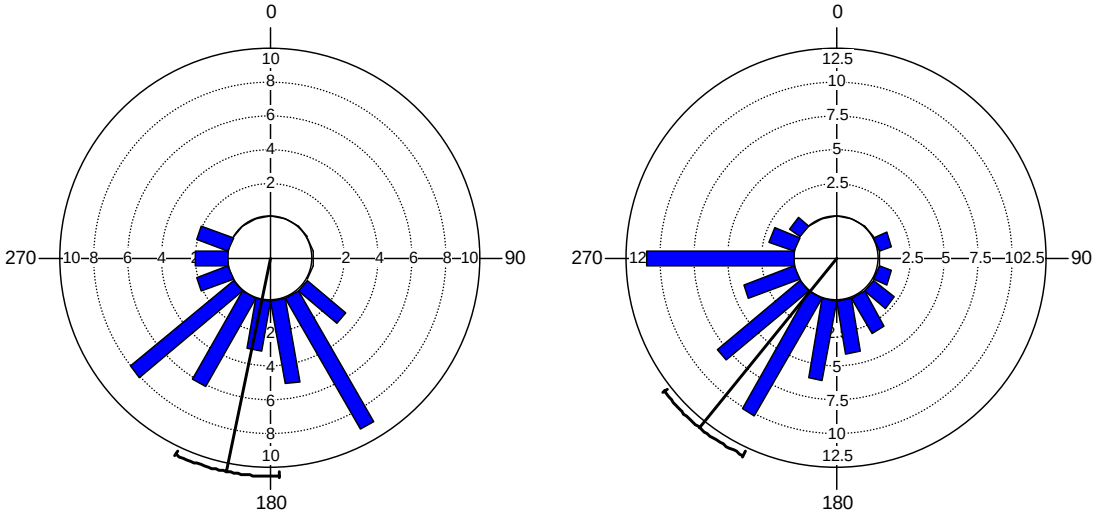
All occupied sites were located on warm aspects, ranging from 120 to 285 degrees azimuth with a mean of 190.7 degrees while the orientation of unoccupied sites had a greater range from 65 to 280 and similar mean aspect 218.0 degrees (Table 3, Figure 3). Occupied sites and unoccupied sites were similarly steep (62.1 vs 65.7 %; Table 3). Most occupied sites were located on steep terrain. The mean percent slope of occupied sites was 62.1 compared to 65.7 at sites with no skinks so the preference for steep slopes may be a sampling bias (Table 3).

Typically, crown closure on occupied sites was low, with a mean of 7 %, and did not differ significantly from crown closure at sites with no skinks, which had a mean value of 9 % (Table 3).

Table 3. Summary statistics for sites with western skinks and sites where no skinks were found (2004-2005).

	Sites with Skinks	No Skinks Found
Total Number of Sites Sampled	41	56
Number of Cover Objects Investigated	13,033	16,393
Number of Minutes Searched	3,809	3,942
Elevation Range (m)	450-1050	420-1250
Mean Percent Slope (s.d.)	62.1 (24.1)	65.7 (21.5)
Mean Aspect[1] (s.d.)	190.7 (45.4)	218.0 (49.6)
Mean Percent Crown Closure (s.d.)	7.0 (4.5)	9.0 (5.3)
Number of Sites with Bedrock Present	38	50
Number of Sites with Loose Rock Present	40	53
Number of Sites with Coarse Woody Debris Present	19	32
Number of Sites with Invasive Pants Present	31	41
Number of Western Skinks Detected	218	0
Northern Alligator Lizards Detected (no. of sites)	73 (27)	178 (36)
Garter Snakes (*Thamnophis* spp.) Detected[2] (no. of sites)	28 (12)	58 (21)
Rubber Boas Detected (no. of sites)	27 (17)	4 (3)
Racers Detected (no. of sites)	8 (3)	0

[1] Using Oriana software to analyze circular data.
[2] It was not possible to identify garter snake exuvia to the species level.



a. **b*.**

*Two sites with variable aspects were excluded from this analysis.

Figure 3. Circular plots of site aspects with mean orientation and 95% confidence intervals for sites where skinks were found (a) and sites where no skinks were found (b). 2004-2005 sites combined.

Cover Objects

The overwhelming majority (213 out of 218) western skink observations (including exuvia) were made under cover objects, usually rocks (n=212). One skink was located under a piece of bark. Only three skinks were located out in the open (active) during the surveys. This is typical of this very secretive species (Tanner 1957) and is probably in response to predation pressures.

Loose rocks were present at 98 % of occupied sites and coarse woody debris was present at 46 % of occupied sites (Table 3). The most common cover objects were rocks, especially exposed medium to large sized, flat colluvial debris lying on loose soil and frequently associated with upslope bedrock formations. Skink burrows were frequently observed directly under the rocks and in the surrounding soil. Deeply embedded rocks were not used, probably because of reduced access and excavation opportunities underneath. Also, rocks with thick layers of moss and/or lichen were not used, presumably because this affects the ability of the rock to absorb and reflect solar radiation. Many ant colonies were observed during this survey and skinks were never found under the same rock as ants. Skinks were always found singly under a cover object; they do not appear to frequently share the use of a cover rock with other skinks or other species.

3.2.3 Invasive Plants

Thirty-one out of 41 (76 %) sites occupied by western skinks had significant amounts of non-native plants present (Table 3), especially spotted knapweed (*Centaurea maculosa*). Other invasive plant species noted at survey sites included St. John's wort (*Hypericum perforatum*), Scotch broom (*Cytisus scoparius*), clover (*Melilotus* spp.), cheatgrass (*Bromus tectorum*), diffuse knapweed (*Centaurea diffusa*), Dalmatian toadflax (*Linaria dalmatica*), great mullein (*Verbascum thapsus*), sulphur cinquefoil (*Potentilla recta*) and hound's-tongue (*Cynoglossum officinale).*

3.3 Habitat Modeling

A preliminary attempt to model potential western skink habitat in our area was unsuccessful (refer to Appendix 1-3). We used forest cover and Predictive Ecosystem Mapping (PEM) data to map potential skink habitat using the following parameters.

> **Elevation**. All skink locations within B.C. have been found below 1100 m so we chose this as the upper elevation limit.

Warm Aspects. All occupied skink habitat is located on south to southwest facing slopes or on sites with flat topography. We modeled areas with no aspect (flat) and areas with aspects ranging from 140 to 245 degrees.

BEC. ICHdw, ICHun and ICHxw forests were chosen as potential skink habitat.

Crown Closure. Western skinks are found in areas with low crown closure so we chose to include areas with less than 15% crown closure.

Using known skink locations to test the 'fit' of the model, we found that the GIS layers available to us did not accurately predict the locations of known skink habitat and did not differ between sites with and without skinks (refer to Appendix 1-3). This may be partially due to the 'coarseness' of the data and lack of ground-truthing of PEM. Western skinks are often found in very small habitat patches (e.g. a 100 m^2 patch of ICHdw02) which are not always captured with larger scale PEM data (these scales of habitat use may not be well captured by ground-truthed models either). Increased sampling at sites where we do not expect to find skinks, detailed air photo interpretation and/or increased Terrestrial Ecosystem Mapping (TEM) in the area would likely result in better success at modeling the habitat of this species.

3.4 Co-occurrence with Other Reptiles

At the 41 sites where western skinks were located, they co-occurred with the northern alligator lizard at 27 (66 %) sites, the rubber boa at 17 (42 %) sites, the garter snake (*Thamnophis* spp.) at 12 (29 %), and the racer (*Coluber constrictor*) at three (7 %) (Table 3). Overall, the western skink/alligator lizard co-occurrence rate comparable to what Rutherford and Gregory (2001) found in Creston, where the two species co-occurred at 70 % (n=10) of sites they studied.

At the 41 sites were they were found, western skinks were more commonly encountered than any other reptile species at 32 (78 %) sites. Overall, the western skink was the most commonly encountered reptile during this survey: a total of 218 western skinks were observed compared to 73 northern alligator lizards, 28 garter snakes, 27 rubber boas, and eight racers (note: these observations include exuvia). This differs with the results of Rutherford & Gregory (2001), who captured western skinks more frequently than northern alligator lizards at only one out of 10 sites (The two lizard species seem to be similarly detectable and a single survey methodology is effective in detecting both species).

The racer is provincially blue-listed and often co-occurs with the western skink in the Waneta and Pend d'Oreille valley areas. The rubber boa has been down-listed from the provincial CDC blue-list but remains federally listed as Special Concern by COSEWIC. The high rate of co-occurrence of western skinks with racers (only in the areas mentioned) and rubber boas in the same areas throughout the CBFWCP area presents an opportunity to simultaneously study and address the habitat conservation needs of three reptile species at risk.

4.0 Threats and Conservation Recommendations

4.1 Direct Habitat Loss

Although the western skink is relatively tolerant of human presence, the main threat to the species province-wide is thought to be loss of habitat due to urban and agricultural development (Dupuis & Ramsay 2003), especially in the Okanagan valley. The range of the skink in B.C. overlaps with much of the densest human population in the province. Much of this habitat is privately owned and therefore subject to development pressures (Ovaska & Engelstoft 2002). Residential and industrial development within skink habitat is a problem in some areas such as Castlegar, where subdivisions constructed on the outskirts of town would have direct impacts and decrease habitat availability. Industrial developments such as the Brilliant dam expansion project have direct impacts on occupation sites. Skink habitat along the West Arm of Kootenay Lake from Nelson to Queen's Bay has almost certainly been impacted by extensive residential development along this corridor and it is likely that the species has been lost from many historically occupied sites. Removal of rock and gravel for construction may also have an impact at some sites (Ovaska & Engelstoft 2002). The most significant direct loss of habitat in our area likely resulted from the construction of local dams and associated reservoirs.

In general, pristine, low elevation protected areas are rare in the CBFWCP program area and if possible, more of this habitat should be acquired—this will benefit the western skink other species at risk such as the racer and rubber boa.

4.2 Habitat Islands

Occupied skink habitats appear to be fragmented, both naturally and due to human activities. This habitat patchiness and fragmentation probably limits lizard movements between suitable sites and may decrease or prevent the establishment of populations in

new areas or the recolonisation of previously occupied sites. These metapopulation factors may be important, especially considering the species' apparent poor dispersal ability. Global warming may also affect future metapopulation processes; the northern limit of habitat suitability may shift north with climate change. This may lead to the divergence of multiple habitat islands and population spread (but forest ingrowth may counteract this effect; see following discussion).

These factors increase the importance of occurrence sites to the skinks but makes conservation of them easier because they are smaller in area and the species does not appear to be vulnerable to mortality events often associated with seasonal migrations of reptiles and amphibians (e.g. road mortality).

4.3 Invasive Plants

Where food is plentiful, retreat site availability may limit a lizard's local abundance (Bustard 1970 *in* Gregory & Rutherford 2001). Because vegetation cover is very important for foraging skinks to avoid predation, invasive plants have likely reduced the habitat quality for skinks in many areas. This occurs when dense native vegetation such as pinegrass (*Calamagrostis rubescens*) is displaced by non-native, less densely growing species such as spotted knapweed and Dalmatian toadflax. The resulting ground cover is significantly decreased (Evan McKenzie, pers. comm.) which may affect skink movement and habitat. Weed control programs will likely enhance skink habitat but potential toxicity impacts of herbicides should be investigated.

4.4 Cover Disturbance

Because the availability of retreat sites may affect local lizard abundance, the removal of cover objects such as rocks at occupied sites probably impacts skinks at some locations near hiking trails (e.g. Pulpit Rock) and other recreation sites such as beaches or cliffs above water where loose surface rocks are often moved or removed. Also, in some areas, talus deposits are mined for highway construction and other development—if this occurs in skink habitat, it would likely affect the species.

Power line rights-of-way are periodically brushed for vegetation control which likely results in some ground disturbance but also prevents forest and shrub encroachment so there may be an overall benefit for the skinks. Large coarse woody debris (as opposed to wood chips) resulting from brushing activities should be left on site to be used as cover for skinks.

4.5 Direct Mortality

Several observers in rural/residential settings commented that pets (cats and dogs) frequently attack skinks. It is unknown to what extent this predation affects local skink populations but it may have an impact in isolated habitat patches, especially given the relatively low reproductive capacity of the species and the localised nature of its occurrence. Some observers with pets perceived a decline in skink observations over time.

Unlike many other reptile species, the western skink does not appear to be susceptible to road mortality. The extremely secretive nature and relatively short distance movements of the species ensure that it rarely ventures on to road surfaces (pers. obs.). Also, because it occurs in very open habitat (as long as cover objects are available), with ample basking opportunities, it may not be attracted to road surfaces as a heat source.

4.6 Forest Ingrowth

Fire suppression in dry forest types may be negatively impacting the western skink as open areas with high reflected solar insolation decline in area and number. Although fire probably causes some direct mortality to some skinks, it may enhance skink habitat in some areas.

ICHdw is classified as a Natural Disturbance Type 3 (NDT3) forest and ICHxw and IDFun are classified as Natural Disturbance Type 4 (NDT4) (Parminter 1995). Historically, NDT4 and dry NTD3 forests would have experienced frequent stand-initiating and stand-maintaining wildfires which would have maintained the relatively open stand structures typical of these ecosystems. Fire suppression over the last century has greatly reduced the frequency of these events, resulting in changes in forest structure (e.g. increased density of shrubs and increased crown closure) and species composition. These changes have decreased the value of these forests to wildlife adapted to live in these habitats.

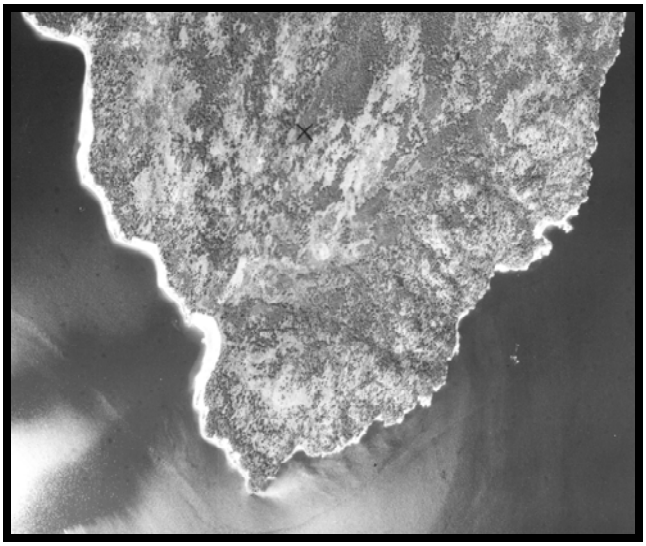
For example, near the northernmost range limit of western skinks along the east shore of Kootenay Lake, fire suppression has impacted wildlife habitat on Pilot Peninsula. The air photos in Figure 4 illustrate the dramatic increase in crown closure at the southern tip of Pilot Peninsula from 1945 through to 2004. This forest ingrowth has almost certainly decreased the habitat quality and availability for the western skink in this area. It is not known if the forest openings present in 1945 are natural or anthropogenic, but the area of

suitable skink habitat was likely much greater than it is today.

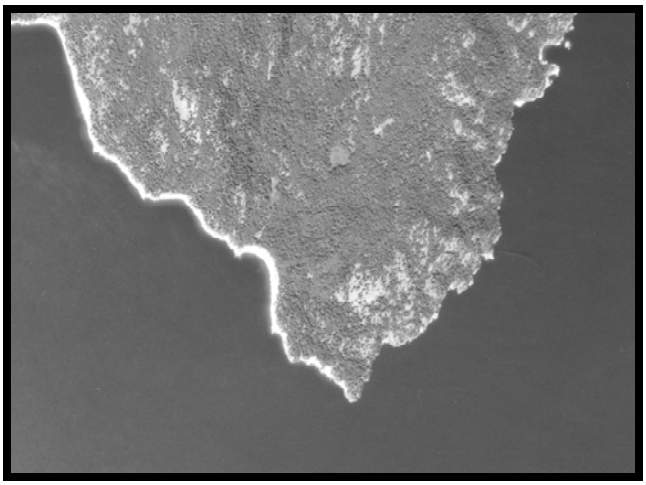
It is important to note that these changes are occurring throughout the drier forests of the CBFWCP area and are negatively impacting the habitat quality for western skinks and many other species associated with fire-maintained ecosystems. These changes in habitat may be especially important for species near their geographic range limits.

Habitat restoration through prescribed burning and/or mechanical stem removal may benefit the western skink and the species should be incorporated into future CBFWCP restoration efforts in the Creston valley (Ross Clarke, pers. comm.).

1945



1969



2004

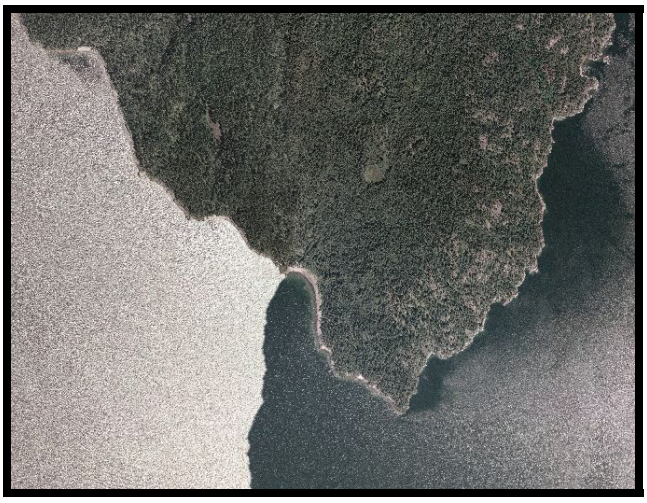


Figure 4. Forest ingrowth at Pilot Peninsula, 1945-2004.

5.0 Future Research

Unconfirmed skink sightings in the following areas should be investigated further: Riondel; Queens Bay; Slocan Lake; and New Denver. Reported East Kootenay sightings should also be investigated. Sightings were reported in several of these areas but budget limitations prevented further effort this season.

Habitat modeling efforts could be improved through further surveys (especially at sites where no skinks are predicted to occur), air photo interpretations and increased TEM of our area. As a result of increased distribution knowledge and habitat modelling, we may be able to estimate how much skink habitat is currently protected and/or under threat. This knowledge could then be incorporated into stewardship decisions made by local land managers.

DNA analysis of select populations may allow us to determine population trends in certain areas and to understand if there are isolation effects such as reduced genetic flow among populations. Results may indicate how long populations have been isolated and provide insight into habitat loss patterns.

Fire history studies of targeted habitats (e.g. Pilot Peninsula) would provide information regarding how fire patterns have changed over time and continue to impact western skink habitat. These efforts could be conducted in conjunction with habitat restoration efforts, which would benefit the western skink and other species that share its habitat.

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7.0 Photos of 2005 Survey Sites.

Skinks were found at sites captioned in green; skinks were not found at sites captioned in red.

1. Site 47.

2. Site 48.

3. Site 49.

4. Site 50.

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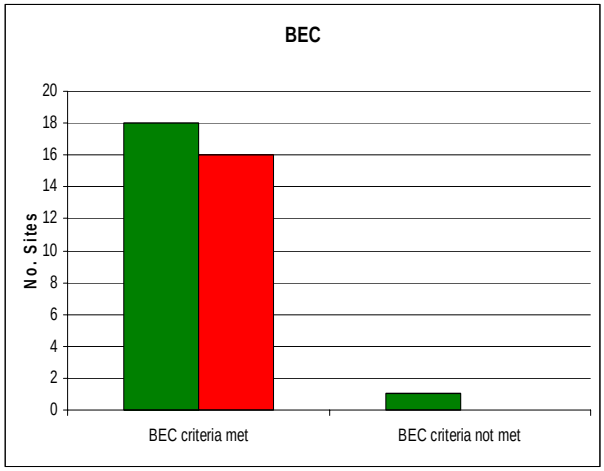
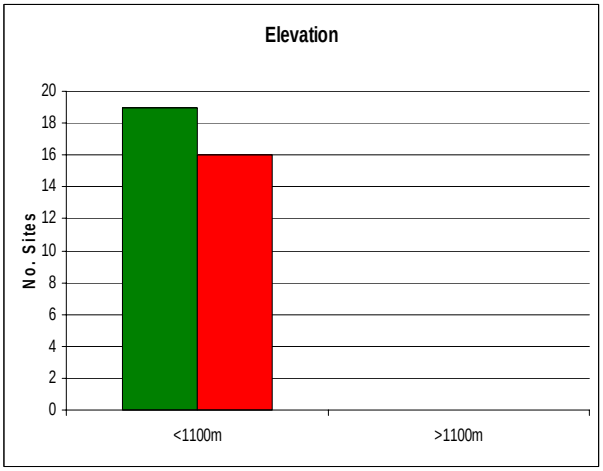
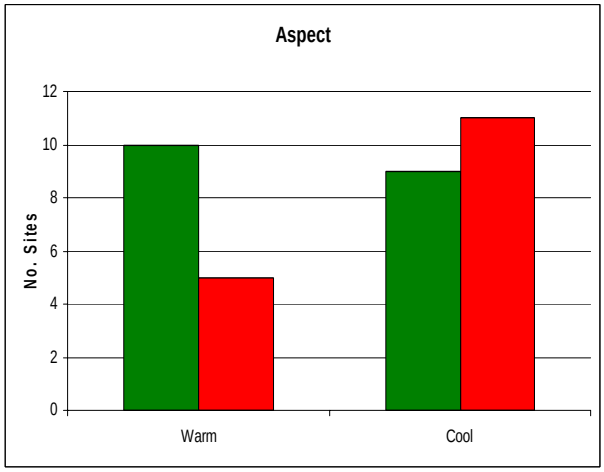
54. Site 101.

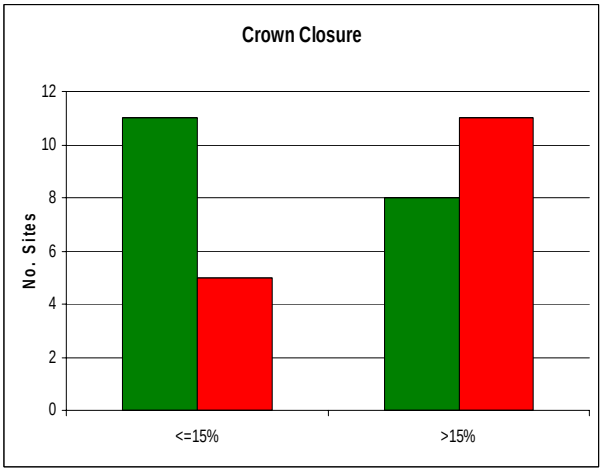
55. Site 102.

8.0 Appendix 1. Graphs Showing Fit of Habitat Modelling Criteria, 2004 Data. Sites where skinks were found are indicated in green; sites where skinks were not found are indicated in red.









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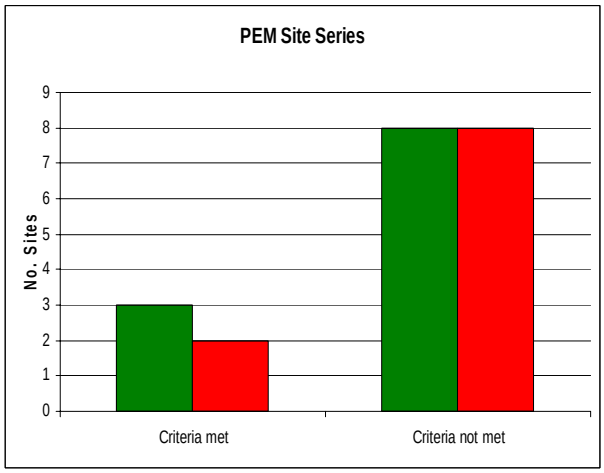

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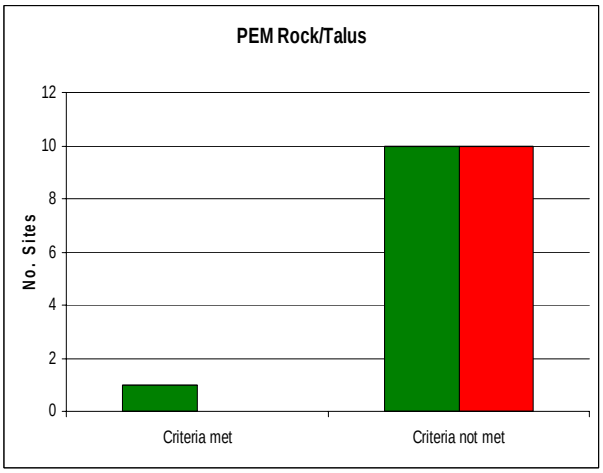
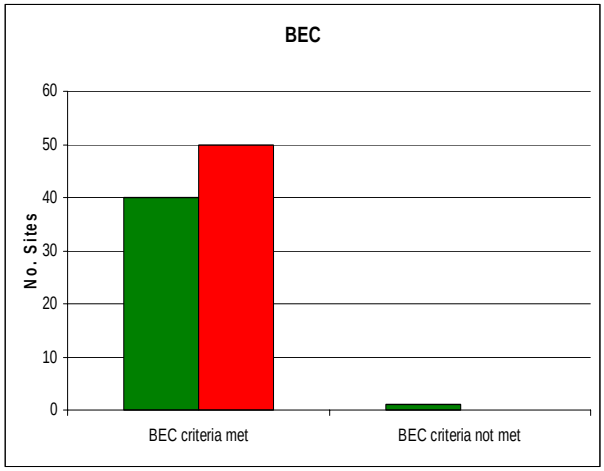
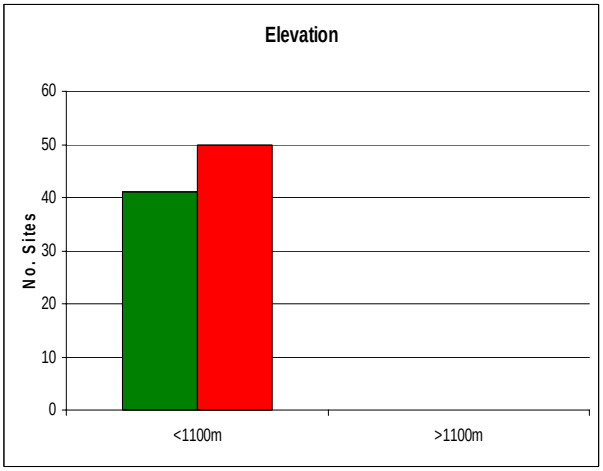
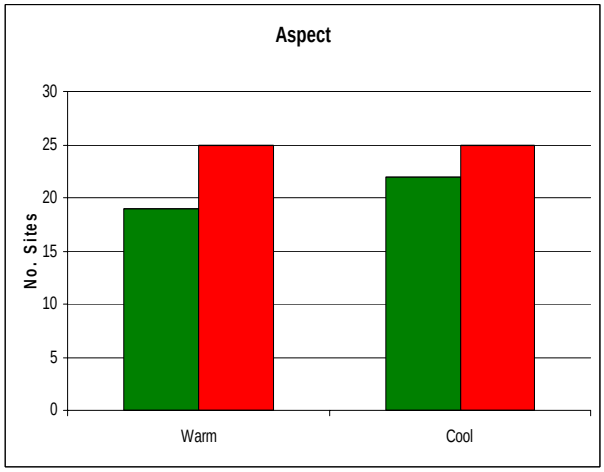


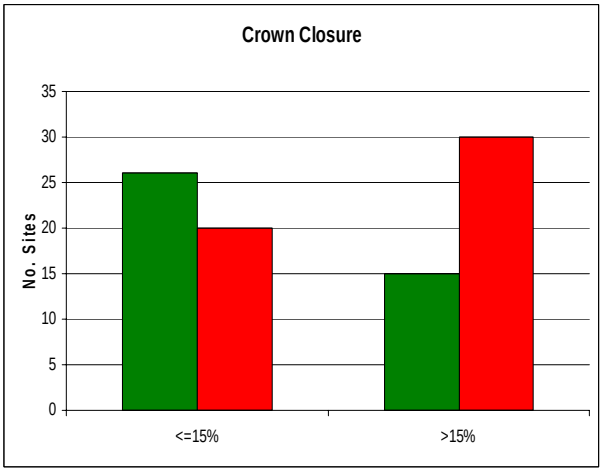
*Due to limited PEM coverage in the study area (see Appendix 3), the Site Series and Rock/Talus Criteria were tested only at sample sites within Kootenay Lake Forest District.

9.0 Appendix 2. Graphs Showing Fit of Habitat Modelling Criteria, 2004 and 2005 Data. Sites where skinks were found are indicated in green; sites where skinks were not found are indicated in red.









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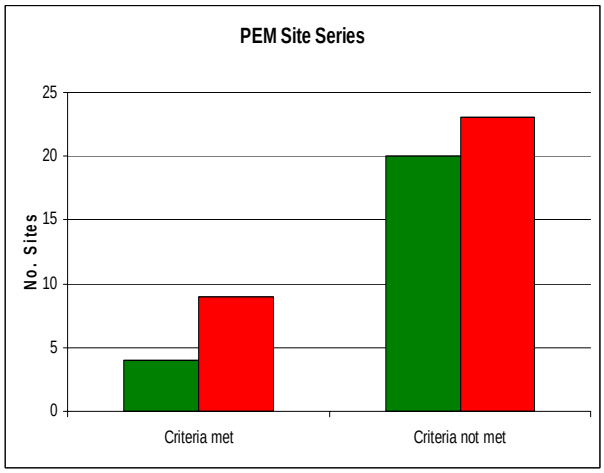

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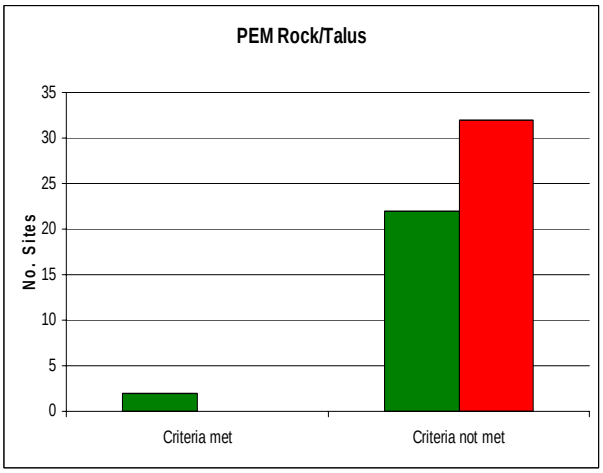

10.0 Appendix 3. PEM Availability for Pend d'Oreille Valley Region of Study Area.