



Canadian Herpetological Society
Société d'Herpétologie du Canada

Important Amphibian and Reptile Areas

CENTRAL OKANAGAN (Penticton to Kelowna)

Nominator Information

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Name: Christine Bishop
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Location

Site names: Central Okanagan (Penticton to Kelowna)
Province/Territory: BC.
County/Region/District(s): part of Okanagan Similkameen Regional District, part of Central Okanagan Regional District
Closest City/Town: Kelowna
UTM/Geographical Coordinates: The Okanagan Valley between Penticton and Kelowna, below 1430 m elevation. Minor valleys extending out of the Okanagan Valley are truncated as follows: the Trout Creek / Empress Creek valley is truncated at a line between 120°10'26"W, 49°42'27"N and 120°8'2"W, 49°48'14"N; the Mission Creek Valley is truncated at a line between the east end of the Highway 97 bridge over Okanagan Lake and 119°21'45"W, 49°47'7"N.
Approximate Coordinates for site corners:
NW: 49.905225°N, -119.956504°W
NE: 49.847019°N, -119.305491°W
SE: 49.493515°N, -119.261096°W
SW: 49.471461°N, -119.895345°W

Directions to Site: From Vancouver to Kelowna: Take Hwy BC-1E, continue onto BC-3 near Hope, head north on BC-5N, turn East on BC-5A/BC-97C, merge onto BC-97 N.

Maps (please attach): See Figure 1.

Other:

Physical Description

Area: The Okanagan Lake Basin, from Penticton to Kelowna, up to 1430 m elevation. 162,645 ha.

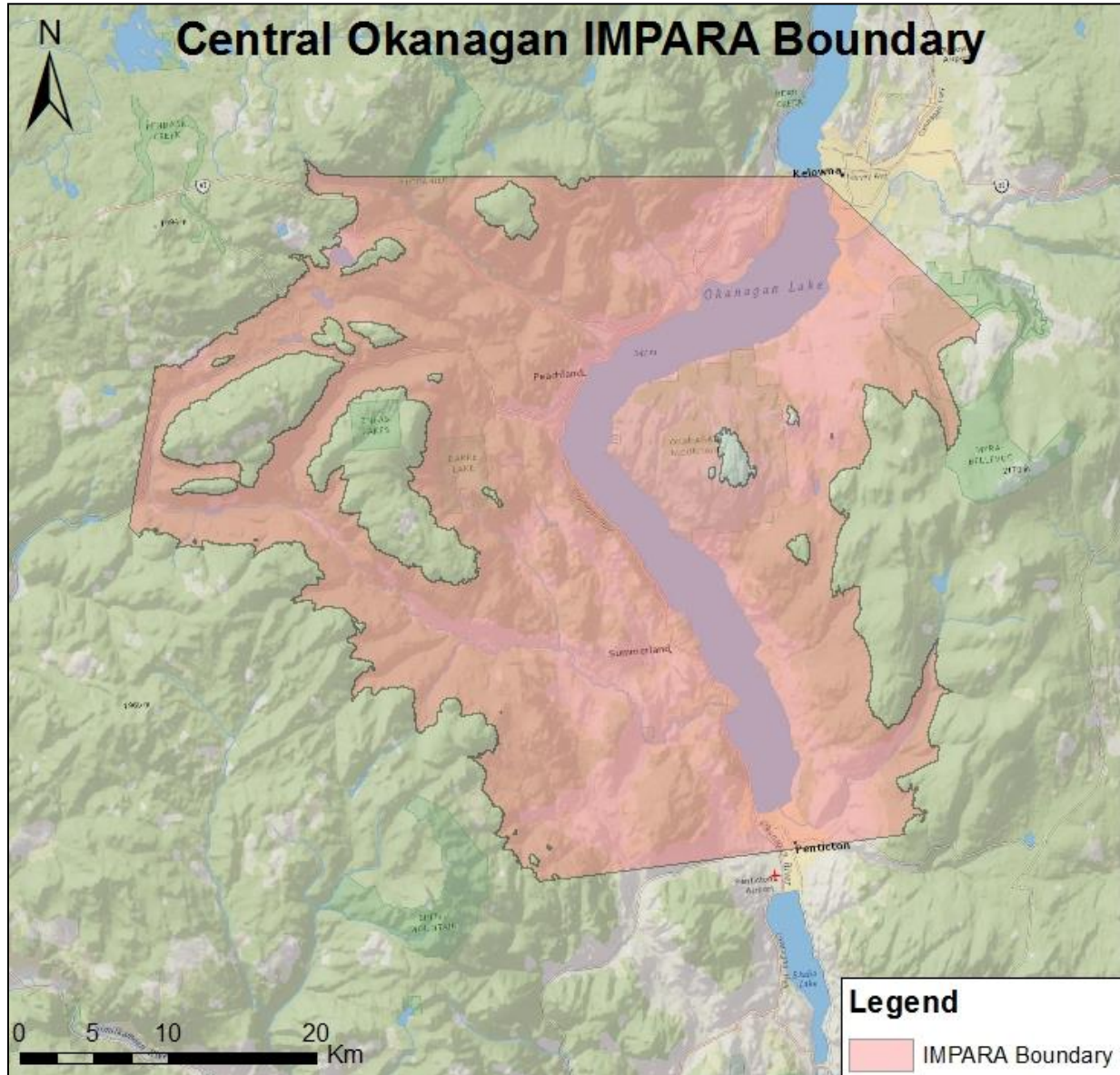


Figure 1. Location of Central Okanagan IMPARA in southern British Columbia.



Figure 2. Examples of habitat found in the Central Okanagan: rocky bluffs and pine woodland (top left, J. Crowley); recently-burnt woodland (top right, D. Cunnington); lake (bottom left, J. Crowley); rocky cliffs (bottom right, J. Crowley).



Figure 3. A selection of amphibian and reptile species found in the Central Okanagan. Long-toed Salamander (top left, D. Cunnington), Western Tiger Salamander, Southern Mountain Population (top right, D. Cunnington), Western Yellow-bellied Racer (middle left, J. Crowley), Western Painted Turtle (middle right, J. Crowley), Pacific Treefrog (bottom left, J. Crowley), Northern Alligator Lizard (bottom right, J. Crowley).

The Okanagan Valley is a region of high biological diversity within British Columbia and the rest of Canada. It experiences some of the warmest and driest weather conditions in the province and country. The complex glacial terrain, combined with a moderated semi-arid climate, has resulted in a wide diversity of ecosystems and organisms. The Okanagan Valley is a north to south corridor that connects the dry interior landscapes of the Nicola, Thompson, Fraser, and Chilcotin Rivers in British Columbia to southern grassland ecosystems of the Columbia Basin in

the U.S., which, in turn, connects the deserts of the Southwest U.S. and Mexico. This corridor has been, and continues to be the principal entry route for southern plants and animals into B.C.'s dry interior. Many of the species that occur in the Okanagan are at the northern end of their range. Increasingly, scientists are finding that peripheral populations have a genetic resilience that allows them to persist in more adverse conditions, which may allow them to adapt to future changes, such as climate change, better than core populations (Scudder 1991).

The Central Okanagan falls into the ecological region classification of "North American Desert – Western Interior Basins and Ranges" (Commission for Environmental Cooperation, 1997). The region is quite dry due to a rain shadow from westward mountains. Three different biogeoclimatic zones (Meidinger and Pojar 1991) are found within the Central Okanagan ecological region:

Bunchgrass zone: Low elevation, arid grasslands dominated by bunchgrass and sagebrush. Few trees are present. In Canada, this habitat is only found in the Thompson, Okanagan, and upper Fraser valleys.

Ponderosa Pine zone: Dry, low elevation forests, dominated by Ponderosa Pine.

Interior Douglas Fir: Low- to mid-elevation forests composed predominantly of Douglas Fir. Also some grassland regions produced by soil type, topography, and fire history.

Most of the species of concern are usually found in the lower-elevation habitat types, however some species (*i.e. Ambystoma macrodactylum*) occur at high elevations. See Meidinger and Pojar 1991.

Water Bodies: The main lake occurring in the Central Okanagan valley is Okanagan Lake. Numerous small creeks feed into Okanagan Lake. See Cannings *et al.* (1998) for further details.

Land Ownership

If there are five or fewer owners, please list them. Otherwise, an appropriate government representative, such as municipal council or regional district, is sufficient.

Name: Councillor Karla Kozakevich (Chair)
Organization/Affiliation: Okanagan Similkameen Regional District
Address: RR1, S9C14
City/Town: Naramata
Province/Territory: BC
Postal Code: V0H 1N0
Telephone and Fax: 250-809-2557
E-mail: kkozakevich@rdos.bc.ca;

Name: Councillor Gail Given (Chair)
Organization/Affiliation: Central Okanagan Regional District
Address: 1450 KLO Road
City/Town: Kelowna
Province/Territory: BC
Postal Code: V1W 3Z4

Telephone and Fax: 250-575-7079;
 E-mail: gail.given@cord.bc.ca; info@cord.bc.ca

Are the land owners/managers aware of the importance of the site to amphibian and reptile conservation?

Managers at some sites within the region are aware of its importance.

Are they aware of this site nomination, and if so did they participate in the process?
 No.

Amphibian and Reptile Species

In the table provided, please list all species of amphibians and reptiles recorded at the site, estimated numbers of individuals of each species (if known), and any citations from which information was obtained (include the name of an observer if information is not published). Provide a Literature Cited section at the end of the nomination.



Western Skink (J. Crowley)

Species	Status	No. of Individuals	References
Western Tiger Salamander (Southern Mountain Population) <i>Ambystoma mavortium</i>	COSEWIC=endangered SARA=endangered BC=S2 (imperiled), Red list	Area includes five occurrences that may contain tens to hundreds of adults each. 50 occurrences are known in BC. No robust, formal population estimate exists. Estimated number of breeding adults in BC 2,500-10,000.	ECCC 2017, BC Recovery Plan 2016, BC Conservation Data Centre 2018
Great Basin Spadefoot <i>Spea intermontana</i>	COSEWIC=threatened SARA=threatened BC=S3 (vulnerable), Blue list	Central Okanagan contains 2 of 93 known occurrences in BC. Okanagan, Similkameen, Kettle-Granby River Valleys combined: possibly > 5,000 adults, but no accurate estimates available	ECCC 2017, BC Recovery Plan 2017, COSEWIC 2007

Western Rattlesnake <i>Crotalus oreganus</i>	COSEWIC=threatened SARA=threatened BC=S3 (vulnerable), Blue list	Population size is not known. Central Okanagan includes part of 1 of 4 populations in BC. Occurrence data is considered sensitive and is not publicly available.	BC Recovery Plan 2016, COSEWIC 2015
Great Basin Gophersnake <i>Pituophis catenifer deserticola</i>	COSEWIC=threatened SARA=threatened BC=S2S3, Blue list	Central Okanagan includes 4 of 17 known occurrences for BC. No comprehensive inventory, but estimated ~2,500-10,000 individuals in BC. The number of mature individuals is likely < 5,000. ~34% of range area occurs in Okanagan-Similkameen	COSEWIC 2002, BC Conservation Data Centre 2018
Western Yellow-bellied Racer <i>Coluber constrictor mormon</i>	COSEWIC=special concern SARA=special concern BC=S3 (vulnerable), Blue list	Central Okanagan contains 7 of 46 known BC occurrences. Population size unknown, but estimated 5,000-10,000 mature individuals in 5 populations in BC, the largest of which is Okanagan/Similkameen.	ECCC Management Plan 2012, BC Conservation Data Centre 2018
Western Painted Turtle (Intermountain – Rocky Mountain population) <i>Chrysemys picta bellii</i>	COSEWIC=special concern SARA=special concern BC=S2S3 (imperiled/vulnerable), Blue list	Central Okanagan contains 2 of 50 occurrences in BC. BC Population estimated at 5,000-10,000 with 1215-1852 in the Thompson-Okanagan.	ECCC Management Plan 2017, BC Conservation Data Centre 2018
Western Skink <i>Plestiodon skiltonianus (Eumeces skiltonianus)</i>	COSEWIC=special concern SARA=special concern BC=S3 (special concern, vulnerable), Blue list	Uncommon. Population size unknown, few data. Estimated BC population size 2,500-100,000.	BC Management Plan 2013
Northern Rubber Boa <i>Charina bottae</i>	COSEWIC=special concern SARA=special concern BC=S4 (apparently secure), Yellow list	Uncommon. Population size unknown, but given wide distribution estimated 10,000-100,000 in southern BC. Management plan shows approximately 12 detections located in Central Okanagan, of approximately 130 detections in BC.	BC Management Plan 2015
Western Toad	BC=Yellow list	Between Common and	BC Conservation

<i>Bufo boreas</i>		Uncommon. No estimate for available the Central Okanagan. Common in most of BC but population declines suspected in the SW part of the province. BC Population size estimated at 100,000-1,000,000	Data Centre 2016
Pacific Tree Frog <i>Hyla regilla</i>	BC=S5, Yellow list	Abundant. Population size unknown	BC Conservation Data Centre 2016
Common Gartersnake <i>Thamnophis sirtalis</i>	BC=S5, Yellow list	Uncommon. Population size unknown	BC Conservation Data Centre 2012
Western Terrestrial Gartersnake <i>Thamnophis elegans</i>	BC=S5, Yellow list	Common. Population size unknown	BC Conservation Data Centre 2012
Long-toed Salamander <i>Ambystoma macrodactylum</i>	BC=S5, Yellow list	Common. Not at Risk, Secure in Canada	BC Conservation Data Centre 2017
Columbia Spotted Frog <i>Rana luteiventris</i>	BC=S5?	Common. Not at Risk, Secure in Canada	BC Conservation Data Centre 2017
Northern Alligator Lizard <i>Elgaria coerulea</i>	BC=S4, Yellow list	Common. Not at Risk (COSEWIC), Secure in Canada	BC Conservation Data Centre 2017

*In the table above, **occurrence** is used as in the BC Conservation Data Centre to mean “an area of land and/or water in which a species is, or was present. Often corresponds to the local population, but when appropriate may be a portion of a population or a group of nearby populations (e.g., metapopulations)”.



Western Rattlesnake (J. Crowley)

Other Species

Please list other significant non-amphibian and non-reptile species (e.g. rare or endemic) that are present at the site and describe the importance of the site to these species.

Species	Status	Importance of Site	References
Dark Saltflat Tiger Beetle <i>Cicindela parowana</i>	COSEWIC=endangered SARA=endangered BC=S1, Red List	Central Okanagan is one of four regional districts where species occurs	BC Conservation Data Centre 2017
Monarch <i>Danaus plexippus</i>	COSEWIC=endangered SARA=special concern BC=S3B, Blue List	occurs in area	BC Conservation Data Centre 2017
Rocky Mountain Ridged Mussel <i>Gonidea angulata</i>	COSEWIC=endangered SARA=special concern BC=S2, Red List	Only population in Canada occurs in the Okanagan Basin, with 3 of 7 known locations in the Central Okanagan	BC Conservation Data Centre 2017
Common Nighthawk <i>Chordeiles minor</i>	COSEWIC=threatened SARA=threatened BC=S4B, Yellow List	occurs in area	BC Conservation Data Centre 2017
Olive-sided Flycatcher <i>Contopus cooperi</i>	COSEWIC=threatened SARA=threatened BC=S3S4B, Blue List	occurs in area	BC Conservation Data Centre 2017
Rusty Blackbird <i>Euphagus carolinus</i>	COSEWIC=special concern SARA=special concern BC=S3S4B, Blue List	occurs in area	BC Conservation Data Centre 2017
Yellow-breasted Chat <i>Icteria virens</i>	COSEWIC=endangered SARA=endangered BC=S1S2B, Red List	Area falls within species small range mostly restricted to the Okanagan and Similkameen valleys, ~300ha area of occupancy for B.C.	BC Conservation Data Centre 2017
Western Screech-Owl <i>Megascops kennicottii macfarlanei</i>	COSEWIC=threatened SARA=endangered BC=S3, Blue List	occurs in area	BC Conservation Data Centre 2017
Flammulated Owl <i>Psilosops flammeolus</i>	COSEWIC=special concern SARA=special concern BC=S3B, Blue List	significant numbers occur in the Okanagan, ~750 breeding pairs in BC	BC Conservation Data Centre 2017

Little Brown Myotis <i>Myotis lucifugus</i>	COSEWIC=endangered SARA=endangered BC=S4, Yellow List	occurs in area	BC Conservation Data Centre 2017
Spotted Bat <i>Euderma maculatum</i>	COSEWIC=special concern SARA=special concern BC=S3S4, Blue List	occurs in area	BC Conservation Data Centre 2017
Western Harvest Mouse <i>Reithrodontomys megalotis</i>	COSEWIC=special concern SARA=special concern BC=S3, Blue List	Most of limited range in central-south Okanagan Valley, 4 of 10 known locations within Central Okanagan	BC Conservation Data Centre 2017
Nuttall's Cottontail <i>Sylvilagus nuttallii</i>	COSEWIC=special concern SARA=special concern BC=S3, Blue List	2 of 7 known locations occur within Central Okanagan	BC Conservation Data Centre 2017

Site Criteria

Under each category, please provide a description of how this site fulfills the Important Amphibian and Reptile Areas criteria (see Part 1). If a category does not apply to this site then simply leave it blank (e.g. if there are no threatened species present then leave the Threatened Species category blank).

1. Species of Conservation Concern:

The Central Okanagan harbours one endangered amphibian, one threatened amphibian, two threatened reptiles, and four reptiles of special concern (listings are for COSEWIC and SARA). The area includes 5 of 50 known BC occurrences for the endangered Tiger Salamander, 2 of 93 known BC occurrences for the threatened Great Basin Spadefoot, 4 of 17 known occurrences for the threatened Gophersnake, and 7 of 46 known BC occurrences for the Western Yellow-bellied Racer (COSEWIC threatened, SARA special concern).

2. High Species Diversity:

The Central Okanagan has high species diversity with 100% of the regional amphibian (6 of 6) and reptile (10 of 10) species represented. This herpetofaunal assemblage is unique from a Canadian perspective. In addition to all of the species common in the rest of B.C., this region contains several species that inhabit the desert ecosystems that extend from the Thompson-Okanagan Plateau, through the Columbia Basin and the Great Basin, to the Sonoran Desert. Some of these species reach the northern extent of their range in Canada in the Central Okanagan (e.g. Blotched Tiger Salamander, Western Skink). Others reach the northern extent of their range in the Thompson Plateau or middle Fraser Valley (e.g. Western Rattlesnake, Great Basin Spadefoot), and the narrow valley of the Central Okanagan connects these populations to more extensive habitat in the Columbia Basin and south. Within Canada, the relatively diverse amphibian and reptile community in the Okanagan is comparable only to the

Carolinian region, and (to a lesser the extent) the Mixed Grassland prairie region. The combination of individual species in the Okanagan is unique.

3. Important Life History Requirements:

Human Impacts

Please describe how human activities are impacting the site and the immediately surrounding areas in the following ways:

- Current site usage (if any), e.g., industrial, residential, farming, logging, camping, recreation, etc. (please indicate relative importance):

The main economic activities of the Central Okanagan region are agriculture/viticulture (11% of the area; 2015 Central Okanagan Development Commission), tourism, retail trade, manufacturing, forestry and construction (2015 Okanagan Valley Economic Development Society). Emerging industries include film, aviation, health care and technology industries (2015 Okanagan Valley Economic Development Society). Many business start-ups, as well as expansion and relocation projects, are attracted to the resources and beauty of the Valley.

- Pollution (air, water, light, noise):

Air: Topography and weather conditions in the Okanagan slow the dispersal of air pollutants, leading provincial meteorologists to identify the Valley as one of three areas of provincial concern. Smog periodically becomes trapped on the Okanagan. Environment Canada samples air quality hourly in the Central Okanagan and monitors for five pollutants: fine particulates, sulphur dioxide, nitrogen oxides, carbon monoxide, and ozone. Two of these (fine particulates and ground level ozone) periodically exceed national standards (2001 Central Okanagan Regional Growth Strategy). Orchard and agricultural soils in the area also continue to emit “legacy” chlorinated pesticides into the regional atmosphere (Bidleman et al. 2006).

Water: Pesticides and fertilizer/manure run-off from agricultural activities are detected in runoff and small stream water samples in the Okanagan (e.g., organochlorine, endosulfan-sulfate, DDE [a breakdown product of DDT]; Elliott et al. 1994, Kuo et al. 2012). DDT was used in orchards in the valley up until 1972.

Light: Some light pollution from cities, particularly Kelowna (e.g., see <https://www.lightpollutionmap.info/#zoom=8&lat=6428739&lon=-13174434&layers=B0TFFFFFFF>)

- Threats to habitat (e.g. development, habitat loss or degradation, succession, fire)

Since the 1970s the rate of growth in the Central Okanagan has presented both challenges and concerns to provincial and local governments. The 1996 population census for the Central Okanagan was 136,000 (compared to 50,000 in 1970), and is projected to increase to an additional 80,000 by 2020; a rate of growth ~2%/year. The current major land management classes in the Central Okanagan are: Resource Lands (66.4%), Private Land (14.6%), Agriculture and Crown Leases (8.9%), Conservation Lands (7.8%), Dedicated Open Space

(1.6%), and Indian Reserve (0.8%) (Okanagan Collaborative Conservation Program 2013). Major current threats in the area include development, urban expansion, agriculture, invasive alien species, and climate change. For example, huge expanses of fertile land have been converted to vineyards. Loss of wetlands is also major concern in the Central Okanagan, where once-numerous wetlands and marshes, as well as riparian zones of streams and lakeshores, have been filled in or heavily altered by urban settlement and agriculture.

The Okanagan generally has seen a large loss of natural habitat, e.g. 53% reduction of Ponderosa Pine/Bluebunch Wheatgrass and 77% loss of Idaho Fescue/Bluebunch Wheatgrass in the 2000s relative to historic (pre-European levels). Fire suppression has likely interrupted natural fire-dependent habitat cycles, with negative effects on wildlife. The interaction between climate change and wine production in the Okanagan may also lead to conservation challenges (e.g., Hannah et al. 2013).

- Past or current habitat conservation or restoration efforts:

Some examples:

- Mission Creek Restoration Initiative: a multi-stakeholder partnership formed in 2002 to restore functions to the lower reaches of Mission Creek in Kelowna, BC.
<http://www.missioncreek.ca/>
- Habitat restoration at Glenmore Landfill: The City of Kelowna along with the Okanagan Basin Water Board, are working to restore and provide alternate habitat for American Avocets (BC Blue List) nesting in the landfill
- Munson Pond Park Naturalization project, Kelowna: Central Okanagan Land Trust, in collaboration with Environment Canada (EcoAction Canada), to establish functioning riparian and upland ecosystems
- Habitat Restoration and Sockeye Salmon Reintroduction in the Okanagan Valley, on-going (Okanagan Nation Alliance Fisheries Department)

Recommended conservation actions for this area

Please describe any conservation actions that are needed/recommended for this area:

For many of the species at risk present in the Central Okanagan, knowledge gaps need to be addressed such as: monitoring and inventory of (sub)-populations, distribution, habitat requirements, population structure and biological processes across the landscape, effects of climate change, road mortality, disease, pollution, pesticides and herbicides, invasive species, and effectiveness of recovery actions. Habitat protection, largely through land use designations and management, and habitat restoration and enhancement where wetlands and terrestrial habitats have been degraded will be important components of species recovery. Management actions recommended for the amphibian and reptile species found in the Central Okanagan include: protect and restore core habitat, including movement corridors across subpopulations and across seasonal land use; mitigate road mortality and in some cases reduce persecution; develop strategies to detect and confine disease outbreaks; and address knowledge gaps relative to threats and effectiveness of recovery actions (summarized from federal and provincial recovery strategies listed in Table 1).

Other Concerned Organizations

Please provide contact information for organizations or individuals that are involved in protection/conservation of this site, *i.e.* World Wildlife Fund Canada, Nature Conservancy Canada, Ducks Unlimited, Federation of Nova Scotia Naturalists.

BC Parks

Keith Baric, Planning Section Head (Kootenay-Okanagan)
Keith.Baric@gov.bc.ca

BC Ministry of Environment

Orville Dyer, A/Small Mammal and Herpetofauna biologist
Orville.Dyer@gov.bc.ca

Penticton Indian Band

James Pepper, Director, PIB Natural Resources Department
jpepper@pib.ca

Westbank First Nation

Communications and Economic Development
communications@wfn.ca

Okanagan Nation Alliance

Lisa Wilson, Natural Resources Manager,
nrmanager@syilx.org

Okanagan Collaborative Conservation Program

Tanis Gieselman, Projects Coordinator
occp333@gmail.com

Central Okanagan Land Trust

Laura Hooker, President
#225-1889 Springfield Road
Kelowna, B.C. V1Y 5V5
info@coltrust.ca
Facebook: Central Okanagan Land Trust

Central Okanagan Naturalist Club

Don Guild
guilds@telus.net

Previous Work

Please list studies/documents/papers that have been derived from this site. If possible, include the documents with the submission or provide enough information so that the sources can be retrieved by CHS

See recovery strategy documents listed in the Literature Cited section below, as well as:

Williams KE, Hodges KE, Bishop CA. 2015. Hibernation and oviposition sites of Great Basin Gophersnakes (*Pituophis catenifer deserticola*) near their northern range limit. *Journal of Herpetology*, 49 (2): 207-216. Online <http://journalofherpetology.org/doi/abs/10.1670/13-162>

Williams KE, Hodges KE, Bishop CA. 2014. Demography and life history of Great Basin Gophersnakes at the northern range edge. *Herpetological Conservation and Biology* 9(2): 246-256.

Williams KE, Hodges KE, Bishop CA. 2012. Small reserves around hibernation sites may not adequately protect mobile snakes: the example of the Great Basin Gophersnakes (*Pituophis catenifer deserticola*) in British Columbia. *Canadian Journal of Zoology* 90:304-312.

Literature Cited

- B.C. Western Skink Working Group. 2013. Management Plan for the Western Skink (*Plestiodon skiltonianus*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 28 pp.
- B.C. Ministry of Environment. 2015. Management plan for the Northern Rubber Boa (*Charina bottae*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 24 pp.
- Bidleman TF, Leone AD, Wong F, van Vliet L, Szeto S, Ripley BD. 2006. Emission of legacy chlorinated pesticides from agricultural and orchard soils in British Columbia, Canada. *Environmental Toxicology and Chemistry* 25:1448-1457.
- Cannings, RJ, Durance E, and LK Scott. 1998. South Okanagan Ecosystem Recovery Plan: Scientific Assessment. Unpublished. Obtained from Orville Dyer, South Okanagan Regional Biologist.
- Central Okanagan Economic Development Commission. 2015. Central Okanagan Economic Profile for Agriculture. 20 pp.
- Central Okanagan Regional Growth Strategy. 2001. Air quality in the Central Okanagan: A discussion paper within the Regional Growth Strategy. Regional District of Central Okanagan.
- Elliott JE, Martin PA, Arnold TW, Sinclair PH. 1994. Organochlorines and reproductive success of birds in orchard and non-orchard areas of central British Columbia, Canada, 1990-1991. *Archives of Environmental Toxicology and Contaminants* 26:435-443.
- Environment and Climate Change Canada. 2017. Recovery Strategy for the Tiger Salamander (*Ambystoma tigrinum*) Southern Mountain population in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. 2 parts, 19 pp. + 39 pp.
- Environment and Climate Change Canada. 2017. Recovery Strategy for the Great Basin Spadefoot (*Spea intermontana*) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. 2 parts, 31 pp. + 40 pp.
- Environment and Climate Change Canada. 2017. Management Plan for the Western Painted Turtle (*Chrysemys picta bellii*) Intermountain – Rocky Mountain population in Canada [Proposed]. Species at Risk Act Management Plan Series. Environment and Climate Change Canada, Ottawa. 2 parts, 4 pp. + 31 pp.
- Environment Canada. 2015. Management Plan for the Western Yellow-bellied Racer (*Coluber constrictor mormon*) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa. 3 pp. + Annex.
- Hannah L, Roehrdanz PR, Ikegami M, Shepard AV, Shaw MR, Tabor G, Marquet PA, Hijmans RJ. 2013. Climate change, wine, and conservation. *PNAS* 110:6907-6912. doi: 10.1073/pnas.1210127110.

- Kuo J, Soon AY, Garrett C, Wan MTK, Pasternak JP. 2012. Agricultural pesticide residues of farm runoff in the Okanagan Valley, British Columbia, Canada. *Journal of Environmental Science and Health, Part B* 47. <http://dx.doi.org/10.1080/03601234.2012.636588>.
- Lea T. 2008. Historical (pre-settlement) ecosystems of the Okanagan Valley and Lower Similkameen Valley of British Columbia – pre-European contact to the present. *Davidsonia* 19:3-38.
- Meidinger D and Pojar J. 1991. Ecosystems of British Columbia. Special Report Series-Ministry of Forests, British Columbia, (6).
- Okanagan Valley Economic Development Society. 2015. Okanagan Valley Economic Profile 2015. 148 pp.
- Okanagan Collaborative Conservation Program 2013. A Biodiversity Conservation Analysis for the North and Central Okanagan Region. Submitted by: Caslys Consulting Ltd.
- Scudder GGE. 1991. Biodiversity over Time. In: *Our Living Legacy: Proceedings of a Symposium on Biological Diversity*. Eds MA Fenger, EH Miller, JF Johnson and EJR Williams. Royal B.C. Museum, Victoria, B.C.
- Southern Interior Reptile and Amphibian Working Group. 2017. Recovery plan for the Great Basin Spadefoot (*Spea intermontana*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 40 pp. Repr. of 1st ed., Southern Interior Reptile and Amphibian Working Group, Victoria, BC. 40 p. (Orig. pub. 2016)
- Southern Interior Reptile and Amphibian Working Group. 2016. Recovery plan for the Western Rattlesnake (*Crotalus oreganus*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 37 pp.
- Southern Interior Reptile and Amphibian Working Group. 2016. Recovery plan for the Gopher Snake, deserticola subspecies (*Pituophis catenifer deserticola*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 36 pp.
- Tarangle, D and M Yelland. 2005. 2005 Central/South Okanagan wetland auditory survey of amphibian species - with emphasis on Great Basin Spadefoot detection (*Spea intermontana*). Internal working report prepared for the Ministry of Environment, Penticton, BC.

| Central Okanagan (Penticton to Kelowna) British Columbia was designated as an IMPARA in December 2019.