PROPOSED

Species at Risk Act
Management Plan Series
Adopted under Section 69 of SARA

Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in Canada

Coeur d'Alene Salamander



2016

Government of Canada
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For copies of the management plan, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

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[1] http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1

MANAGEMENT PLAN FOR THE COEUR D'ALENE SALAMANDER (*Plethodon idahoensis*) IN CANADA

2016

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of British Columbia has given permission to the Government of Canada to adopt the *Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in British Columbia* (Part 2) under section 69 of the *Species at Risk Act* (SARA). Environment Canada has included a federal addition (Part 1) which completes the SARA requirements for this management plan.

The federal management plan for the Coeur d'Alene Salamander in Canada consists of two parts:

Part 1 - Federal Addition to the *Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in British Columbia*, prepared by Environment Canada.

Part 2 - *Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in British Columbia*, prepared by British Columbia Ministry of Environment.

Table of Contents

Part 1 - Federal Addition to the *Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in British Columbia*, prepared by Environment Canada

Preface 2
Additions and Modifications to the Adopted Document 3
1.0 Effects on the Environment and Other Species 3

Part 2 - *Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in British Columbia*, prepared by British Columbia Ministry of Environment

Part 1 - Federal Addition to the *Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in British Columbia*, prepared by Environment Canada

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c. 29) (SARA), the federal competent ministers are responsible for the preparation of management plans for listed species of special concern and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of the Environment and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Coeur d'Alene Salamander and has prepared this management plan (Part 1) as per section 65 of SARA. To the extent possible, it has been prepared in cooperation with the British Columbia (B.C.) Ministry of Environment. SARA section 69 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for the content. The B.C. Ministry of Environment led the development of the attached management plan for the Coeur d'Alene Salamander (Part 2) in cooperation with Environment Canada and the Parks Canada Agency.

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this management plan and will not be achieved by Environment Canada, the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this plan for the benefit of the Coeur d'Alene Salamander and Canadian society as a whole.

Implementation of this management plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

[2] http://registrelep-sararegistry.gc.ca/default.asp?lang=en&n=6B319869-1#2

Additions and Modifications to the Adopted Document

The following section has been included to address specific requirements of SARA that are not addressed in the *Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in British Columbia* (Part 2) and/or to provide updated or additional information.

Under SARA, there are specific requirements and processes set out regarding the protection of species and their habitats. Therefore, statements in the provincial management plan referring to protection of species and their habitats may not directly correspond to federal requirements, and are not being adopted by Environment Canada or the Parks Canada Agency as part of the federal management plan.

1.0 Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[3]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the Federal Sustainable Development Strategy's[4] (FSDS) goals and targets.

Conservation planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of management plans may inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the management plan itself, but are also summarized below in this statement.

The provincial management plan for Coeur d'Alene Salamander contains a short section describing the effects of management activities on other species (i.e., Section 8). Environment Canada adopts this section of the provincial management plan as the statement on effects of management activities on the environment and other species. The distribution of Coeur d'Alene Salamander overlaps with that of other federally-listed species at risk that occur in seepages and streams in central- and south-central B.C., including Cutthroat Trout (*Oncorhynchus clarkii lewisi*) and Western Toad (*Anaxyrus boreas*), both of which are Special Concern. Conservation planning activities for Coeur d'Alene Salamander will be implemented with consideration for all co-occurring species at risk, such that there are no negative impacts to these species or their habitats. Some management actions for Coeur d'Alene Salamander

[3] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[4] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1

(e.g., preventing sedimentation, water diversion and chemical spills) may assist in the conservation of other species at risk that overlap in distribution and rely on similar habitat attributes.

Part 2 - *Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in British Columbia*, prepared by British Columbia Ministry of Environment

Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in British Columbia



Prepared by B.C. Ministry of Environment

BRITISH COLUMBIA

July 2015

About the British Columbia Management Plan Series

This series presents the management plans that are prepared as advice to the Province of British Columbia. Management plans are prepared in accordance with the priorities and management actions assigned under the British Columbia Conservation Framework. The Province prepares management plans for species that may be at risk of becoming endangered or threatened due to sensitivity to human activities or natural events.

What is a management plan?

A management plan identifies a set of coordinated conservation activities and land use measures needed to ensure, at a minimum, that the target species does not become threatened or endangered. A management plan summarizes the best available science-based information on biology and threats to inform the development of a management framework. Management plans set goals and objectives, and recommend approaches appropriate for species or ecosystem conservation.

What's next?

Direction set in the management plan provides valuable information on threats and direction on conservation measures that may be used by individuals, communities, land users, conservationists, academics, and governments interested in species and ecosystem conservation.

For more information

To learn more about species at risk recovery planning in British Columbia, please visit the Ministry of Environment Recovery Planning webpage at:

<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>

Management Plan for the Coeur d'Alene Salamander (*Plethodon idahoensis*) in British Columbia

Prepared by B.C. Ministry of Environment

July 2015

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Cover illustration/photograph

Penny Ohanjanian

Additional copies

Additional copies can be downloaded from the B.C. Ministry of Environment Recovery Planning webpage at:

<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>

Disclaimer

The B.C. Ministry of Environment has prepared this management plan, as advice to the responsible jurisdictions and organizations that may be involved in managing the species.

This document identifies the management actions that are deemed necessary, based on the best available scientific and traditional information, to prevent Coeur d'Alene Salamander populations in British Columbia from becoming endangered or threatened. Management actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. These goals, objectives, and management approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions have had an opportunity to review this document. However, this document does not necessarily represent the official positions of the agencies or the personal views of all individuals.

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this management plan. The B.C. Ministry of Environment encourages all British Columbians to participate in the conservation of Coeur d'Alene Salamander.

ACKNOWLEDGEMENTS

This management plan was prepared by Penny Ohanjanian (consultant). Funding for this draft was provided by the B.C. Ministry of Environment (MOE) through the Land Based Investment Strategy. The threats assessment was completed by Penny Ohanjanian, Purnima Govindarajulu (MOE), and Dave Fraser (MOE), with facilitation by Leah Westereng (MOE) and Peter Fielder (MOE).

EXECUTIVE SUMMARY

The Coeur d'Alene Salamander (*Plethodon idahoensis*) is a lungless salamander of the family Plethodontidae. It requires moist microhabitats to respire and uses wet, rocky retreats such as waterfall splash zones, wet talus, rock seepages, and stream banks to prevent desiccation in summer and avoid freezing in winter. It is associated with steep terrain, where fractured bedrock is close to the surface and deep talus is found at the base of cliffs.
The Coeur d'Alene Salamander is federally listed as Special Concern on Schedule 1 of the *Species at Risk Act* (SARA). Listing was recommended by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2007) because of Coeur d'Alene Salamander's restricted range in southeastern British Columbia and its dependence on moist, rocky features in an area that is relatively dry. Since 2007, however, other populations have been confirmed in wetter areas of the province. This expanded range offsets the initial concerns about the species. In British Columbia, the Coeur d'Alene Salamander is ranked S4 (apparently secure) by the B.C. Conservation Data Centre and is on the provincial Yellow list. The B.C. Conservation Framework ranks the Coeur d'Alene Salamander as a priority 2 under Goal #2 (prevent species and ecosystems from becoming at risk). It is protected from capture and killing under the B.C. *Wildlife Act*. It is also listed as a species that requires special management attention to address the impacts of forest and range activities under the *Forest and Range Practices Act* (FRPA) as described in the Identified Wildlife Management Strategy (Province of British Columbia 2004).

The overall Threat Impact for this species is Low. Threats include renewable energy developments such as run-of-river projects that change hydrology; roads and railroads through rock scaling, blasting, and dumping of spoils that destroy habitat and individuals; and logging and wood harvesting, which destroys individuals and disturbs habitat along small and ephemeral streams.

The management goal for Coeur d'Alene Salamander is to maintain a stable population across its distribution in British Columbia.

The management objectives are:

1. to clarify Coeur d'Alene Salamander's distribution
2. to monitor persistence, relative abundance and age structure at selected locations in various watersheds and elevations distributed across the species range;
3. to initiate threat assessment studies and plan recovery actions if threats and/or declines are detected during population monitoring (Objective 2).

TABLE OF CONTENTS

ACKNOWLEDGEMENTS III
EXECUTIVE SUMMARY IV
1 COSEWIC* SPECIES ASSESSMENT INFORMATION 1
2 SPECIES STATUS INFORMATION 1
3 SPECIES INFORMATION 2
3.1 Species Description 2
3.2 Populations and Distribution 2
3.3 Habitat and Biological Needs of the Coeur d'Alene Salamander 5
3.4 Limiting Factors 6
4 THREATS 6
4.1 Threat Assessment 8
4.2 Description of Threats 10
5 MANAGEMENT GOAL AND OBJECTIVES 14
5.1 Management Goal 14
5.2 Rationale for the Management Goal 14
5.3 Management Objectives 14
6 APPROACHES TO MEET OBJECTIVES 15
6.1 Actions Already Completed or Underway 15
6.2 Recommended Management Actions 16
6.3 Narrative to Support Management Actions Table 16
7 MEASURING PROGRESS 17
8 EFFECTS ON OTHER SPECIES 18
9 REFERENCES 19
10 APPENDIX 1. INFORMATION FOR ROAD CREWS TO PROTECT COEUR D'ALENE SALAMANDERS 23

LIST OF TABLES

Table 1. Status and description of Coeur d'Alene Salamander populations in B.C. 4
Table 2. Threat classification table for Coeur d'Alene Salamander in British Columbia. 8
Table 3. Recommended management actions and suggested implementation schedule for Coeur d'Alene Salamander. 16

LIST OF FIGURES

Figure 1. Illustration of Coeur d'Alene Salamander 2
Figure 2. Coeur d'Alene Salamander distribution in Canada/North America 3
Figure 3. Coeur d'Alene Salamander distribution in British Columbia 4

1 COSEWIC* SPECIES ASSESSMENT INFORMATION

Assessment Summary – November 2007
Common Name: Coeur d'Alene Salamander
Scientific Name: *Plethodon idahoensis*
Status: Special Concern
Reason for Designation: The species has a restricted range in southeastern British Columbia and a limited area of occupancy. It is highly dependent on moist, shaded, faulted, rock outcrops, which are scattered throughout the otherwise dry landscape of the Southern Columbia Mountains. The climate in this region, which is characterized by extremes in temperature and humidity levels, compounds the isolated nature of the populations. This species' highly specialized habitat requirements and life history increase its vulnerability to habitat disturbance and fragmentation. Road construction and small-scale hydroelectric development are potential threats.
Occurrence: British Columbia
Status History: Designated Special Concern in April 1998. Status re-examined and confirmed in November 2001 and November 2007. Last assessment based on an updated status report.

* Committee on the Status of Endangered Wildlife in Canada.

2 SPECIES STATUS INFORMATION

Coeur d'Alene Salamander[a]	
Legal Designation:	
FRPA:[b] Species at Risk OGAA:[b] Species at Risk	B.C. *Wildlife Act:*[c] Schedule A SARA Schedule 1:[d] Special Concern (2003)
Conservation Status[e]	
B.C. List: Yellow B.C. Rank: S4 (2010) National Rank: N4 (2011) Global Rank: G4 (2002) Other Subnational Ranks:[f] ID: S2; MT: S2	
B.C. Conservation Framework (CF)[g]	
Goal 1: Contribute to global efforts for species and ecosystem conservation.	Priority:[h] 4 (2010)
Goal 2: Prevent species and ecosystems from becoming at risk.	Priority: 2 (2010)
Goal 3: Maintain the diversity of native species and ecosystems.	Priority: 4 (2010)
CF Action Groups:[f] Monitor Trend; Status Report; Planning	

[a] Data source: B.C. Conservation Data Centre (2014) unless otherwise noted.
[b] Species at Risk = a listed species that requires special management attention to address the impacts of forest and range activities on Crown land under the *Forest and Range Practices Act* (FRPA; Province of British Columbia 2002) and/or the impacts of oil and gas activities on Crown land under the *Oil and Gas Activities Act* (OGAA; Province of British Columbia 2008) as described in the Identified Wildlife Management Strategy (Province of British Columbia 2004).
[c] Schedule A = designated as wildlife under the B.C. *Wildlife Act*, which offers it protection from direct persecution and mortality (Province of British Columbia 1982).
[d] Schedule 1 = found on the List of Wildlife Species at Risk under the *Species at Risk Act* (SARA).
[e] S = subnational; N = national; G = global; X = presumed extirpated; H = possibly extirpated; 1 = critically imperiled; 2 = imperiled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure.
[f] Data source: NatureServe (2014).
[g] Data source: B.C. Ministry of Environment (2010).
[h] Six-level scale: Priority 1 (highest priority) through to Priority 6 (lowest priority).

3 SPECIES INFORMATION

3.1 Species Description

The Coeur d'Alene Salamander is a member of the family Plethodontidae. It is ectothermic, lacks lungs, and respires through its skin and membranes in the mouth (Spotila 1972). It is dark brown to black with grey to white flecking along its sides and limbs (Wilson and Ohanjanian 2002) (Figure 1). It has a yellowish throat patch and a dorsal stripe (Cassirer *et al.* 1994). This stripe (which occasionally may be absent) has irregular edges and may be yellow, amber, orange, or red. The Coeur d'Alene Salamander has vertical naso-labial grooves between the nostrils and lip and distinctly raised parotoid glands at the rear of the head (Matsuda *et al.* 2006).

The legs of the Coeur d'Alene Salamander are relatively long and its toes short and slightly webbed (Nussbaum *et al.* 1983). Most often there are 14 intercostal folds. Adult females are bigger than males and maximum snout-to-vent length can exceed 65 mm (Wilson and Ohanjanian 2002). There is no aquatic larval stage; rather there is direct development from egg to juveniles that have a smaller, yet adult-like form. Hatchlings average 18 mm snout-vent length (range 16–22 mm), juveniles range from 23 to 43 mm snout-vent length, and sexual maturity occurs when snout-vent length is greater than 45 mm (Lynch 1984; Cassirer *et al.* 1994; Wilson and Ohanjanian 2002).

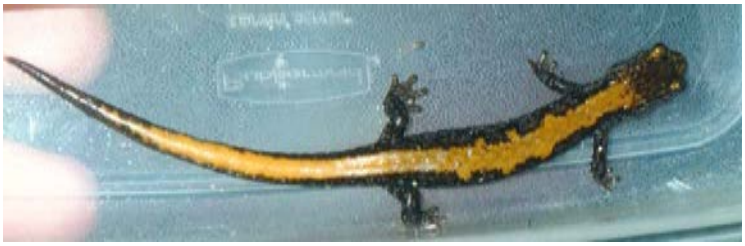


Figure 1. Illustration of Coeur d'Alene Salamander (photo credit M.A. Beaucher).

3.2 Populations and Distribution

In the United States, the Coeur d'Alene Salamander is found in northwestern Montana and northern Idaho (Figure 2). The highest elevation at which this species is known to occur is 1524 m (Wilson *et al.* 1997). In Canada, the Coeur d'Alene Salamander is found only in southeastern British Columbia.

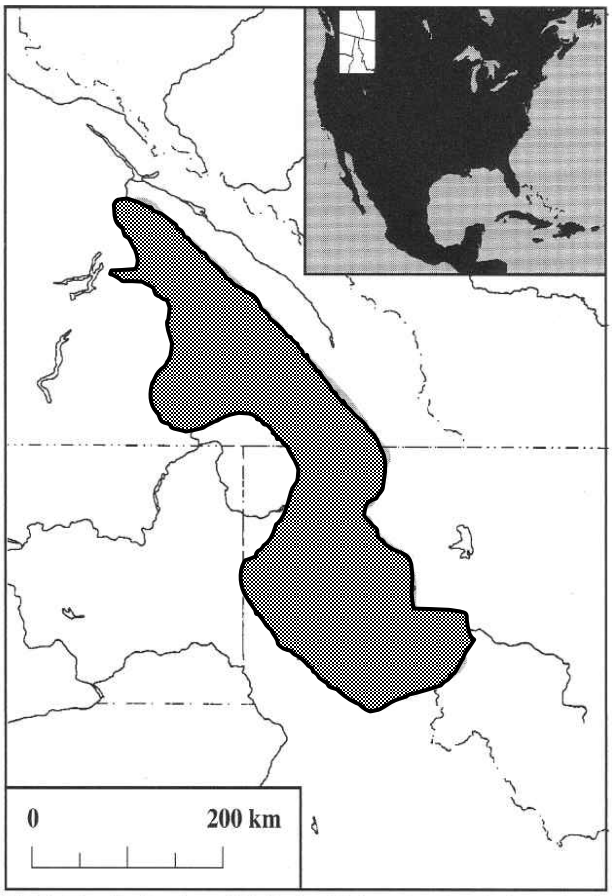


Figure 2. Coeur d'Alene Salamander distribution in Canada/ North America (after Wilson and Ohanjanian 2002; Iredale 2009).

In British Columbia the Coeur d'Alene Salamander is found at over 74 sites in seven areas: along Kootenay Lake, the Duncan Reservoir, Upper and Lower Arrow Lake, the East Kootenay (including Yahk), the Pend d'Oreille, Revelstoke, Glacier and the eastern Shuswap (Ohanjanian 2003; Iredale 2009) (Figure 3; Table 1). Recently it has been found north of Rogers Pass in Glacier National Park (L. Larson, pers. comm., 2015). The northernmost limit of its range is 95 km north of Revelstoke and the eastern-most limit is near Kimberley (Ohanjanian 2003). Its most westerly known occurrence is near Griffin Lake in the Shuswap (Iredale 2009).

Note that numerous watercourses with the same habitat structure are located between confirmed Coeur d'Alene Salamander sites within the species' range. These have not been sampled due to night-time access constraints. There is no reason to believe they do not also support the species.

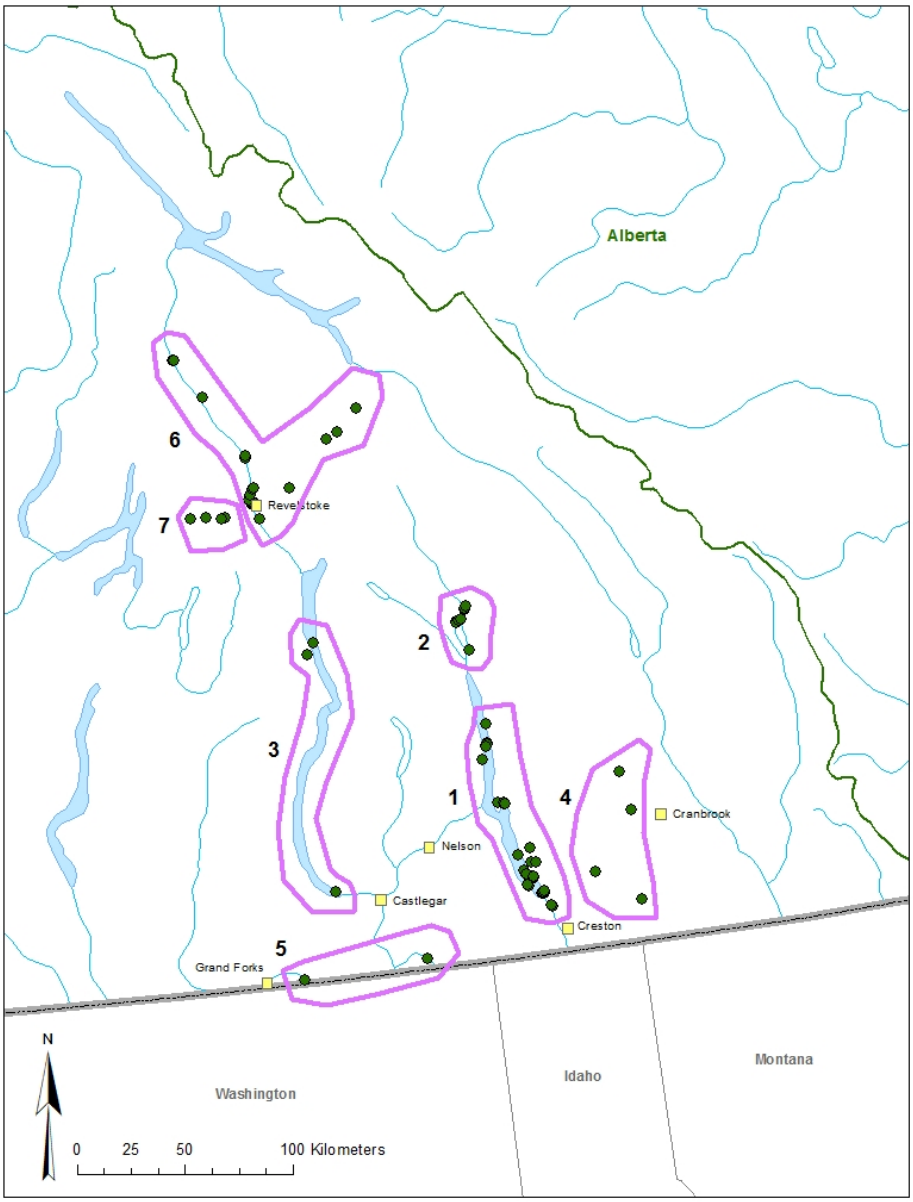


Figure 3. Coeur d'Alene Salamander distribution in British Columbia as of 2015 (map prepared by Diana Demarchi, Ministry of Forests, Lands, and Natural Resource Operations).

Table 1. Status and description of Coeur d'Alene Salamander populations in B.C.

Area		Description	Land tenure[a]
1.	Kootenay Lake	Found along multiple steep streams.	Private, Crown land, highway right of way (RoW)
2.	Duncan Reservoir	Found along multiple steep streams, rock walls.	Private, Crown land, highway RoW

Area		Description	Land tenure[a]
3.	Upper and Lower Arrow Lake	Presence confirmed at 3 sites	Provincial park, MOTI rest area, Crown land
4.	East Kootenay[b]	Presence confirmed on 3 watercourses	Crown land, highway RoW
5.	Pend'Oreille	Presence confirmed at 1 waterfall	Crown land
6.	Revelstoke/ Glacier	Found in multiple sites in Mount Revelstoke National Park, Glacier Nat Park and on highway RoW	National park, Crown land, highway RoW
7.	Eastern Shuswap	Presence confirmed at 3 sites	Crown land, highway RoW

[a] RoW = right of way; MOTI = Ministry of Transportation and Infrastructure.
[b] This includes the Moyie River drainage and the St. Mary's River, a tributary of the Kootenay River.

Estimates of absolute population size have not been made, largely because capture-mark-recapture work to date have had very low recapture rates (4%) and this is insufficient to provide robust population estimates (Ohanjanian 2001; Larsono 2009). There is also extremely high variability in numbers of Coeur d'Alene Salamanders observed at a given site between capture days because detection rates on the surface are extremely variable: Iredale (2009) detected 3 individuals on September 9 at one site which, when revisited three weeks later, yielded 192 individuals. This variability makes indices of even relative abundance statistically challenging to estimate. Both relative abundance estimates and population size estimation can be improved if effort is invested in multiple visits to each site within and between years.

3.3 Habitat and Biological Needs of the Coeur d'Alene Salamander

As a terrestrial, lungless salamander, the Coeur d'Alene Salamander needs moisture to facilitate trans-dermal oxygen transfer for respiration and to prevent desiccation from water loss through evaporation (Cassirer *et al.* 1994). It also requires underground retreats to avoid freezing in winter, and desiccation and heat stress in summer. Terrain with fractured bedrock or deep moist talus provides this habitat (Ohanjanian 2003; Larson 2009). In British Columbia, the species has been found in the following habitats: seeps, rock walls with water flowing over them, waterfall splash zones, stream-side habitats with exposed bedrock, caves, avalanche paths, and wet talus (Ohanjanian 2003; COSEWIC 2007; Larson 2009). These habitat features are found in a variety of contexts. Over-story vegetation ranges from sparse (at rock walls with limited vegetation) to dense, deciduous shrubs (e.g., in avalanche paths), to mixed coniferous forest of varying ages. Larson (2009) demonstrated the association of shrubs, forbs, and moss with Coeur d'Alene Salamander occurrence on the surface and available boulders and cobbles in lower gradient stream-side habitats. Forested land that is adjacent to specific habitat features such as caves and rock walls may be used for foraging, mating, and travel. No egg masses have been found in the wild, however it is likely that these are deposited in underground crevices.

Coeur d'Alene Salamander activity is almost entirely nocturnal and the species spends most of its life underground in moist, interstitial spaces (Lynch 1984; Cassirer *et al.* 1994), especially during dry or cold periods (Nussbaum *et al.* 1993; Wilson and Larsen 1998). Most of the diet is comprised of aquatic or semi-aquatic invertebrates, reflecting the salamander's habitat. Prey items include springtails (Collembola), adult and larval beetles (Coleoptera), stonefly nymphs (Plecoptera), caddisflies (Tricoptera), and adult and larval dipterans (Diptera), with some ants (Hymenoptera), snails and slugs (Gastropoda), and spiders (Aranaea) eaten as well (Wilson and Larsen 1988; Lindeman 1993). There appears to be no difference in diet between males and females (Lindeman 1993).

3.4 Limiting Factors

The Coeur d'Alene Salamander has a disjunct distribution with limited opportunities for dispersal in some parts of their range. This makes them potentially vulnerable to local extinctions, loss of genetic variability, and inbreeding depression (Cassirer *et al.* 1994). Although restricted to moist micro-habitats, certain populations are found in some of the driest biogeoclimatic zones in British Columbia: the Interior Cedar–Hemlock very dry subzone (ICHxw) and the Interior Douglas-fir undifferentiated subzone (IDFun) (Braumandl and Curran 1992); overland movements for dispersal and recolonization are restricted to sporadic events when rain is abundant and long lasting. In wetter areas such as Revelstoke, movement among populations may be more frequent.

The age of first reproduction is 3.5 years for males and 4.5 years for females (Cassirer *et al.* 1994). Clutch size, between 4 and 12 eggs, is not large (Matsuda *et al.* 2006). Females probably reproduce in alternate years (Lynch 1984; Nussbaum et al. 1983). This reproductive strategy reduces the Coeur d'Alene Salamander's capacity for quick reproductive response in light of a stochastic event (COSEWIC 2007). The average generation time has been calculated as 6 to 7 years, based on limited knowledge of lifespan (approximately 13 years)[1].

4 THREATS

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (adapted from Salafsky *et al.* 2008). For purposes of threat assessment, only present and future threats are considered.[2] Threats do not include limiting factors,[3] which are presented in Section 3.4.

[1] Estimated from report of lifespan in captivity of at least 12 years (A. Wilson, pers. comm., 2000)
[2] Past threats may be recorded but are not used in the calculation of Threat Impact. Effects of past threats (if not continuing) are considered when determining long- and/or short-term trend factors (Master *et al.* 2012).
[3] It is important to distinguish between limiting factors and threats. Limiting factors are generally not human induced and include characteristics that make the species or ecosystem less likely to respond to recovery/conservation efforts (e.g., inbreeding depression, small population size, and genetic isolation).

For the most part, threats are related to human activities, but they can also be natural. The impact of human activity may be direct (e.g., destruction of habitat) or indirect (e.g., introduction of invasive species). Effects of natural phenomena (e.g., fire, flooding) may be especially important when the species is concentrated in one location or has few occurrences, which may be a result of human activity (Master *et al.* 2012). As such, natural phenomena are included in the definition of a threat, though they should be considered cautiously. These stochastic events should only be considered a threat if a species or habitat is damaged from other threats and has lost its resilience. In such cases, the effect on the population would be disproportionately large compared to the effect experienced historically (Salafsky *et al.* 2008).

4.1 Threat Assessment

The threat classification below is based on the IUCN-CMP (International Union for the Conservation of Nature –Conservation Measures Partnership) unified threats classification system (IUCN 2014) and is consistent with methods used by the B.C. Conservation Data Centre. For a detailed description of the threat classification system, see the Open Standards website (Open Standards 2014). Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized here in terms of scope, severity, and timing. Threat "impact" is calculated from scope and severity. For information on how the values are assigned, see Master *et al.* (2012) and table footnotes for details. Threats for the Coeur d'Alene Salamander were assessed for the entire province (Table 2).

Table 2. Threat classification table for Coeur d'Alene Salamander in British Columbia.

Threat #[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]
3	Energy production & mining	Low	Small	Moderate	High
3.2	Mining & quarrying	Negligible	Negligible	Moderate	High
3.3	Renewable energy	Low	Small	Moderate	High
4	Transportation & service corridors	Low	Restricted	Moderate	High
4.1	Roads & railroads	Low	Restricted	Moderate	High
5	Biological resource use	Low	Small	Moderate	High
5.1	Hunting & collecting terrestrial animals	Negligible	Negligible	Negligible	High
5.3	Logging & wood harvesting	Low	Small	Moderate	High
6	Human intrusions & disturbance	Negligible	Negligible	Negligible	High
6.1	Recreational activities	Negligible	Negligible	Negligible	High
6.3	Work & other activities	Negligible	Negligible	Negligible	High
7	Natural system modifications	Negligible	Negligible	Serious	High
7.1	Fire & fire suppression	Negligible	Negligible	Moderate	High
7.2	Dams & water management/use	Negligible	Negligible	Serious	High
7.3	Other ecosystem modifications	Negligible	Negligible	Unknown	High
8	Invasive & other problematic species & genes	Unknown	Pervasive	Unknown	High
8.1	Invasive non-native/alien species	Unknown	Pervasive	Unknown	High
9	Pollution	Negligible	Negligible	Unknown	High
9.3	Agricultural & forestry effluents	Negligible	Negligible	Unknown	High
10	Geological events	Negligible	Negligible	Serious	High
10.3	Avalanches/landslides	Negligible	Negligible	Serious	High

Threat #[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]
11	Climate change & severe weather	Not calculated	Pervasive	Extreme	Low
11.1	Habitat shifting & alteration	Not calculated	Pervasive	Extreme	Low
11.2	Droughts	Not calculated	Pervasive	Extreme	Low
11.3	Temperature extremes	Not calculated	Pervasive	Extreme	Low

[a] Threat numbers are provided for Level 1 threats (i.e., whole numbers) and Level 2 threats (i.e., numbers with decimals).

[b] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on severity and scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment time (e.g., timing is insignificant/negligible [past threat] or low [possible threat in long term]); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[c] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[d] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. For this species a generation time of 6-7 years was used resulting in severity being scored over a 20-year timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit $\geq$ 0%).

[e] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

4.2 Description of Threats

The overall province-wide Threat Impact for this species is Low. This overall threat considers the cumulative impacts of multiple threats.

Because the Coeur d'Alene Salamander primarily occurs in terrain with steep gradients, the likelihood of some types of anthropogenic alterations to habitat such as residential development and agriculture is decreased. Other threats, however, include energy production and mining, roads and railroads, and logging and wood harvesting (Table 2). Details are discussed below under the Threat Level 1 headings.

IUCN-CMP Threat 3. Energy production & mining

Mining and quarrying can have a negative effect on Coeur d'Alene Salamanders if their bedrock and talus retreats are blasted. Not only would habitat be destroyed but individuals as well. While bedrock is not generally disturbed in placer mining operations, spoils could be piled at the site and this overburden could not only alter habitat structure but also bury salamanders. The severity of these impacts is rated as moderate, since recolonization from either above or below on a given watercourse would likely occur over a period of 20 years (or approximately 3 generations). Some mining exploration occurred historically in the Creston area, and a small exploration cave with seepage now provides Coeur d'Alene Salamander habitat.

Renewable energy in the form of micro-hydroelectric development to generate power has the potential for localized impacts on Coeur d'Alene Salamanders. By diverting water from the stream the hydrology is altered – water levels may be lowered, thus leading to desiccation of interstitial spaces and seep habitats. Riparian vegetation and cover can be removed during the construction phase resulting in habitat loss. During the operational phase, salamanders can be flushed into turbines. Diminished water flows may also reduce prey items such as aquatic insects found in pools. Several run-of-river projects have been initiated on watercourses known to support Coeur d'Alene Salamanders. However, the presence of Coeur d'Alene Salamanders was a major factor in denying approval for at least one of these projects (T. Antifeau, pers. comm., 2014). While the scope is small at present, the severity is rated as moderate since continuous, long-term reduction of water flow over a given reach could lead to a reduced population size at that site. In addition, the uninterrupted lowered flows could also prevent recolonization.

IUCN-CMP Threat 4. Transportation & service corridors

Coeur d'Alene Salamanders have been found clinging to rock walls and venturing onto the gravel shoulder on rainy nights along highway corridors throughout their range in southeastern British Columbia (Ohanjanian 2003). Intensely disruptive activities, including rock-scaling, ditch-cleaning, culvert repair and replacement, road widening, and blasting, are associated with highway construction and maintenance. All of these will directly kill Coeur d'Alene Salamanders and/or disrupt their habitat. In addition, vegetation clearing, dumping of spoil, and salt application all have the potential to harm Coeur d'Alene Salamanders (but are considered below, Threat 9, Pollution). Planned widening of the Trans-Canada highway near Revelstoke will cause direct mortality to Coeur d'Alene Salamanders. The scope of these activities is

classified as Restricted (11–30%) as it is fair to assume that there will be the need to carry out rock scaling, and other maintenance activities for public safety at virtually all sites where Coeur d'Alene Salamanders and roads intersect. This work is ongoing and will continue into the future. The severity is only scored as moderate because recolonization will ultimately occur within 3 generations (estimated 20 years) from elsewhere on the watercourse.

IUCN-CMP Threat 5. Biological resource use

Illegal collecting of Coeur d'Alene Salamander for the pet trade is theoretically possible. Whether this occurs in British Columbia is unknown.

Logging and wood harvesting may negatively affect Coeur d'Alene Salamander in several ways. Removal of overstory vegetation allows more incident solar radiation to reach the forest floor, thus raising temperatures and altering moisture regimes. The dependence of this species on moist substrates and high humidity makes them vulnerable to canopy and leaf cover reduction. Ephemeral streams and rock seepages may go unnoticed during logging and road building; crucial subsurface water may be diverted by blasting, leading to desiccation of downslope habitats. Heavy equipment may cause direct mortality of salamanders and compaction (Moorman *et al.* 2011). Slumping and soil compaction can clog interstitial spaces thus smothering and/or preventing movement of salamanders.

While the potential for disturbance of habitat and/or individuals from logging is multi-faceted and potentially very damaging at a given site, logging has been and will continue to be discontinuous in both time and space over the forested land base on which the species occurs. Few, if any, watercourses supporting Coeur d'Alene Salamanders will be within a cutblock over a 10-year time span. Where cutblocks intercept fish-bearing creeks (S1 to S4), best management practices under the provincial *Forest and Range Practices Act* (Province of British Columbia 2002) will address some of this concern. Non–fish-bearing streams (S5 and S6), however, are more vulnerable. Several that have been identified are in Wildlife Habitat Areas (WHA), where logging activities are modified for the sake of Coeur d'Alene Salamanders (Province of British Columbia 2004). Furthermore, the opportunity for recolonization of disturbed sites exists over the subsequent 20 years (or 3 generations).

IUCN-CMP Threat 6. Human intrusions & disturbance

Because much of the Coeur d'Alene Salamander habitat is on steep terrain, direct disturbance from human activities is limited. Disturbance can occur, however, at recreational sites at the base of waterfalls, where trail modification and trampling of vegetation alter habitat and remove cover. Due to the salamander's nocturnal habits, direct crushing of individuals from human traffic is unlikely.

Work such as surveying of riparian areas, staking mining claims, or other land surveys on a private lot could have the potential to crush salamanders. However, because of the species' nocturnal habits, this is highly unlikely and is rated as negligible.

IUCN-CMP Threat 7. Natural system modifications

Prescribed and natural burns may have a negative effect on Coeur d'Alene Salamander if these remove wooden cover objects close to watercourses at which the species occurs. Direct mortality is unlikely because in the cold climate of southeastern B.C. the species has evolved to use deep rock cover retreats to prevent freezing. So, the salamanders are not at the surface during the prescribed burning window. Even at other times, this salamander appears to spend relatively little time on the surface. If a natural fire occurs, it could retreat and if a site is destroyed it can be recolonized from other reaches of the watercourse over three generations. Occasionally, however, a massive wildfire could occur, which would modify the natural system for some time and eliminate the species at that location. That some of these would be directly human-caused is likely. The degree to which fire suppression has increased the probability and intensity of massive wildfire (either human-caused or lightning caused) is not known. It is clear however, that a mixed fire-regime existed historically through the Coeur d'Alene Salamander range (Klenner *et al*. 2008).

Dams have the potential to greatly modify habitat by changing water flow patterns that, in turn, could lead to desiccation of habitat or, alternatively, flooding of interstitial spaces during water releases. Large dams near Duncan, Revelstoke, and Kimberley likely have negatively impacted Coeur d'Alene Salamander habitat in the past but these are not expected to have ongoing effects. The species persists near these locations, probably due to persistent occupancy at other elevations on a given watercourse and subsequent recolonization.

The alteration of stream flow by small dams or diversions for rural domestic water supply may drown salamanders in interstitial spaces that get flooded. Alternatively, salamander habitat downstream of such diversions could dry out, leading to habitat loss (Cassirer *et al.* 1994). These water works are likely in some areas of the Kootenay region. Effects on the Coeur d'Alene Salamander, however, would be highly localized, and are unlikely to have major impacts on populations.

Because of this species' affinity for steep terrain, a potential threat exists from tourism and recreational development if water is diverted to make snow on ski hills. Again, this would be a highly localized event.

Management activities such as rip-rapping along a watercourse could negatively affect the species' ability to enter underground retreats. Alternatively, this could enhance habitat complexity for salamanders and provide opportunities for cover while they are on the surface. Exact outcomes of such activities are unknown.

IUCN-CMP Threat 8. Invasive & other problematic species & genes

Chytridiomycosis, caused by the non-native fungus *Batrachochytrium dendrobatidis* (Bd), has been responsible for frog and toad declines around the world (Olson *et al.* 2013). Bd has been detected on eastern Plethodons, but the fungus was found to be at exceptionally low levels (Muletz *et al.* 2014). Eastern Red-backed Salamanders (*Plethodon cinereus*) have bacteria on their skin that produce anti-fungal metabolites that inhibit Bd (Loudon *et al.* 2014). It is not known if Bd is present in the Coeur d'Alene Salamander. Nor is it known if the skin of this western salamander species would have similar traits that would give it resistance should it

become infected. Although it lacks an aquatic larval stage, the Coeur d'Alene Salamander does forage in small pools where it could, in theory, pick up spores. A second fungus, the congeneric *Batrachochytrium salamandrivorans* sp. nov., is responsible for declines of the fire salamander (*Salamandra salamandra*) in the Netherlands, causing erosive skin disease and rapid mortality (Martel *et al.* 2013). To date, this fungus has not been detected in North America and should it arrive, the consequences for Coeur d'Alene Salamanders is not known.

IUCN-CMP Threat 9. Pollution

The direct effect of herbicide application on Coeur d'Alene Salamanders has not been studied. They respire through highly permeable skin and theoretically could be vulnerable, depending on the type of herbicide used. In silviculture, herbicides are commonly used to reduce competition from deciduous species and promote growth and release of young conifers (Lautenschlager and Sullivan 2002). Most frequently the herbicide of choice is one of the commercial formulations with glyphosate as the active ingredient. Studies have shown that one formulation (Roundup Regular) is lethal to both larval and juvenile anurans (Relyea 2005; King and Wagner 2010). Current evidence suggests that it is the surfactant used in some formulations of glyphosate that causes the negative impacts on amphibians. More research, however, is needed to establish ecosystem levels of toxicity of this formulation and other, apparently less toxic formulations, such as Roundup BiActive (Howe *et al.* 2004). Furthermore the effects of Roundup on Coeur d'Alene Salamanders have not been studied and are unknown. Other compounds with potential toxic effects are not widely used in the species' area of occupation.

In winter, salt (or other chemical de-icers) is regularly applied on all routes; the potential of these substances to damage the species is unknown. Increased salinity of ponds from road salt application can affect embryonic development of other amphibians including Spotted Salamanders (*Ambystoma maculatum*) and acute toxicity from different de-icers has been shown in experiments with Wood Frogs (*Lithobates sylvatica*) (Turtle 2000; Harless *et al.* 2009). While Coeur d'Alene Salamanders, which do not have an aquatic larval stage, may not be affected directly, it is reasonable to assume that increased salinity could negatively affect their aquatic prey base.

IUCN-CMP Threat 10. Geological events

Because of the Coeur d'Alene Salamander's affinity for steep terrain debris flow, disturbance is an ongoing potential threat in much of its range. Some areas are naturally prone, others are made worse by industrial activity or road building (see above, Threat 5, Biological Resource Use). Landslides that have a high proportion of very fine-grained materials may prevent reoccupation of a site for many years as rocky retreats become covered. The relative amount of anthropogenic vs natural impact cannot be assessed other than on a site-specific basis, where known activities such as upslope logging, can be implicated.

IUCN-CMP Threat 11. Climate change & severe weather

If climate change causes drought, which in turn alters hydrology (e.g., reduction in flow volumes) in the Coeur d'Alene Salamander's range, the species will be negatively affected as watercourses dry up. Temperature extremes may also affect the species. Modelling by

Milanovich *et al.* (2010) suggests that plethodontid salamander species that are currently distributed at mid and high elevations are most vulnerable to climate warming if their current climatic zone is lost. The reason for this, they propose, is because those species have limited ability to disperse through warmer valley bottoms in Appalachia. Bernardo and Spotila (2006) describe physiological constraints to plethodontids caused by global warming. These concerns likely apply also to the Coeur d'Alene Salamander. Models are consistent for warmer temperatures in the species' range in southern BC (Prov. of British Columbia 2015).

While climate change is not expected to cause a pervasive transformation in the next 10 years, it may become significant in the long term. There will likely be different effects in different areas of the salamander's range; in drier locations, such as near Creston, the consequences of climate change may appear sooner than in wetter locations, such as Revelstoke.

5 MANAGEMENT GOAL AND OBJECTIVES

5.1 Management Goal

The management goal for Coeur d'Alene Salamander is to maintain a stable population across its distribution in British Columbia.

5.2 Rationale for the Management Goal

Since the COSEWIC assessment (2007), our knowledge of the range of this species has grown (Iredale 2009; Larson 2009) and it is likely even more widespread than previously documented. As a result of this additional information, its provincial conservation status was determined to be S4 in 2010 and it is now on the provincial Yellow list, which indicates that this species is apparently secure and not at risk of extinction. The goal therefore is to maintain a stable population and to prevent declines of populations within the range of the species in B.C., while clarifying the species distribution

5.3 Management Objectives

The management objectives are:

1. to clarify Coeur d'Alene Salamander's distribution
2. to monitor persistence, relative abundance and age structure at selected locations in various watersheds and elevations distributed across the species range;
3. to initiate threat assessment studies and plan recovery actions if threats and/or declines are detected during population monitoring (Objective 2)

6 APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Underway

The following actions have been identified by the Action Groups of the B.C. Conservation Framework (B.C. Ministry of Environment 2010): Monitor Trends, Compile Status Report, Planning, inventory, and habitat protection and private land stewardship.

Monitor Trends (incomplete)

- Between 1997 and 2003, about 5 occurrence sites were revisited to determine persistence. Monitoring of *Plethodon idahoensis* has not occurred since 2003.

Compile Status Report (complete)

- COSEWIC report completed (COSEWIC 2007). Species is due for re-assessment in 2015.

Planning (complete)

- B.C. Management Plan completed (this document, 2015).

Inventory (partially complete)

- Inventories have been carried out along Kootenay Lake/Duck Lake, the Duncan Reservoir, the East Kootenay, Arrow Lakes, the Pend'Oreille, the Revelstoke area (including Mount Revelstoke National Park), and the eastern Shuswap (Ohanjanian 1997, 1998, 2000, 2003; Ohanjanian and Beaucher 2000; Iredale 2009). These were carried out at a presence/not detected level of intensity

Habitat Protection and Private Land Stewardship (in progress)

- Thirty Wildlife Habitat Areas have been established for *Plethodon idahoensis* under the *Forest and Range Practices Act* (B.C. Ministry of Environment 2014). The provisions for these WHAs include protecting populations by maintaining the structural and hydrological integrity of known subsurface retreats and adjacent above-surface foraging and breeding habitat as well as no harvesting or salvage inside the core area (Province of British Columbia 2004). General Wildlife Measures outside WHAs seek to protect the population from physical disturbance and direct mortality, disruptions of natural flow regimes of watercourses, and removal of rock and stream crossings/road building that fail to control silt and sediments (Province of British Columbia 2004).
- One occurrence is in a provincial park (Syringa Creek) (Ohanjanian 2000).
- Seven occurrences are within Mount Revelstoke National Park (Larson 2009) and are thus protected under SARA.
- A pamphlet targeted towards Ministry of Transportation and Highways was provided to B.C. Ministry of Environment to guide works along highways in areas that support salamanders (see Appendix 1).

6.2 Recommended Management Actions

Table 3. Recommended management actions and suggested implementation schedule for Coeur d'Alene Salamander.

Objective	Conservation Framework action group	Actions to meet objectives	Threat[a] or concern addressed	Priority[b]
1	Compile status report	Clarify range distribution. Areas remaining to be inventoried include the entire Shuswap and possibly the Thompson.	Knowledge gap	Necessary
2	Monitor Trend	Develop and follow a monitoring plan to resurvey known locations, and establish population persistence and trends at selected sites distributed across the range	Knowledge gap	Necessary
2	Monitor Trend	Develop and follow a monitoring plan to assess threats at selected sites with concurrent population trend monitoring	Knowledge gap	Necessary
3	Habitat protection, private land stewardship	If population trend monitoring and threat assessments indicate that recovery action is necessary, implement appropriate measures to protect habitat and species, and recover populations	All threats	Beneficial

[a] Threat numbers according to the IUCN-CMP classification (see Table 2 for details). In this case, the overall province-wide Threat Impact for Coeur d'Alene Salamander is Low. At this time, no specific actions are included to address threats; however, if monitoring indicates that the management goal is not being met, then threats to this species will be re-evaluated and additional actions will need to be taken.

b Essential (urgent and important, needs to start immediately); Necessary (important but not urgent, action can start in 2–5 years); or Beneficial (action is beneficial and could start at any time that was feasible).

6.3 Narrative to Support Management Actions Table

Recommended actions have been categorized by the action groups of the B.C. Conservation Framework.

Compile status report

Determining the distribution of the Coeur d'Alene Salamander will inform the re-assessment of the species' status.

The most recent status report was completed in 2007 (COSEWIC 2007). In light of new information on the distribution of Coeur d'Alene Salamanders acquired since the last COSEWIC assessment (Iredale 2009; Larson 2009), it is recommended that the status report be updated. The reason for the species' designation as Special Concern was based on restricted range in the relatively dry landscape of the Southern Columbia Mountains. In 2009, the discovery of the Coeur d'Alene Salamander in the eastern Shuswap (Iredale 2009) as well as expanded occurrence in the wet Interior Cedar–Hemlock biogeoclimatic zone near Revelstoke (Ohanjanian 2003; Larson 2009) indicates that the species is more widespread than previously known.

Monitor trends

To meet the management goal, which is "to maintain a stable population across its distribution in British Columbia", monitoring is needed. Estimates of absolute population size have not been

made, due to low recapture rates and high variability in detection probability of salamanders between visits and among sites. Repeated and long-term monitoring is necessary to establish population persistence and trends. Population viability can also be assessed using the following metrics:

- persistence at a site (presence/no detection level of intensity);
- evidence of reproduction (gravid females, presence of juveniles);
- age structure and sex ratio (presence of a range of sizes and both sexes); and
- overall persistence of species throughout range.

In addition, assessment of current and emerging threats such as climate change is necessary. There is anecdotal evidence that these salamander populations can recover from small scale habitat modification and destruction events (e.g., blasting during highway construction) by immigrating from other elevations/reaches of the same watercourse. This has been indirectly demonstrated by the species' presence on numerous highway cuts that had been historically blasted and research showing Coeur d'Alene Salamanders at more than one location on a watercourse (Ohanjanian and Beaucher 2000; Ohanjanian 2003). Currently, there is no systematic threat assessment and such monitoring is necessary to implement protection measures and to prevent cumulative impacts from which these salamander populations cannot recover.

If monitoring indicates that the distribution of Coeur d'Alene Salamander is not being maintained, and/or that current or emerging threats could cause potential population declines, additional actions will need to be taken, e.g., threats mitigated.

7 MEASURING PROGRESS

The performance indicators presented below provide a way to define and measure progress toward achieving the management goal and objectives. Performance measures are listed below for each objective.

Successful achievement of the management goal may be indicated through positive monitoring outcomes:

- No reduction in Coeur d'Alene Salamander range and distribution gaps are clarified
- No reduction in the number of Coeur d'Alene Salamander occurrence sites;
- Population monitoring indicates stable populations with all size, age and sex classes.
- No indication of rapidly emerging threats or expansion of current threat impacts.

Measurable for Objective 1

- Adequate surveys will have been undertaken to allow a clear understanding of the distribution of the Coeur d'Alene Salamander by 2020.

Measurable for Objective 2

- A monitoring plan for population trends and emerging and current threats will be in place by 2018 with monitoring occurring as per the plan by 2020.

Measurable for Objective 3

- Population protection and recovery plans are formulated as necessary to address declines in population numbers, and mitigation plans are formulated to address potential threat impacts detected or suspected during ongoing monitoring.

8 EFFECTS ON OTHER SPECIES

The Coeur d'Alene Salamander has some unique habitat attributes. They may exist in ephemeral seepages and non–fish-bearing streams. They also occur in association with larger watercourses that do support fish, sometimes at waterfalls that present barriers to fish. At salamander occurrence sites and downstream, the benefits of good management for this species (such as avoiding sedimentation and preventing water diversion and chemical spills) will be advantageous to other organisms as well, including Cutthroat Trout (*Oncorhynchus clarkii lewisi*) and Western Toad (*Anaxyrus boreas*), both of which are Special Concern under SARA and on the provincial Blue list.

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10 APPENDIX 1. INFORMATION FOR ROAD CREWS TO PROTECT COEUR D'ALENE SALAMANDERS

Pamphlet prepared for the Ministry of Transportation and Highways and submitted to the Ministry of Water, Land and Air Protection (Nelson, B.C.) (Ohanjanian 2003).

Coeur d'Alene Salamanders live in wet rock walls, waterfall splash zones, and deep, moist boulder piles.

At night they cling to rock walls along highway cuts and walk on the forest floor.

By day they retreat into cracks or under rocks and logs.

When it rains they come to the surface.

If it is dry or freezing they remain below ground, or deep in moist cracks in the bedrock

WITH CARE AND PLANNING YOU CAN HELP PRESERVE THIS SPECIES.



Coeur d'Alene Salamanders

Information for Road Crews

GENERAL GUIDELINES FOR WORK *WITHIN 50 M* OF SALAMANDER SITES (See Road Features Inventory):

1. SCHEDULE WORK FOR EARLY SPRING, LATE FALL OR WINTER, WHEN TEMPERATURES ARE COLD (LESS THAN 4°)
2. IF 1. NOT POSSIBLE, SCHEDULE WORK FOR HOT, DRY PERIODS , MORE THAN 4 DAYS AFTER RAIN

ACTIVITY	CONSEQUENCES	RECOMMENDED ACTIONS
ROAD CONSTRUCTION	DIRECT MORTALITY FROM BLASTING DESTRUCTION OF HABITAT	➢ USE PRY BARS OR S-MITE, NOT DYNAMITE ➢ SEEK ALTERNATIVE ROUTE/ACTIONS WHERE POSSIBLE
DITCH CLEANING	ANIMALS KILLED WHEN BURIED BY SEDIMENTS	➢ AS MINIMAL AND INFREQENT AS POSSIBLE ➢ AT BASE OF ROCK WALLS, DO NOT DISTURB UNTIL TEMPS LESS THAN 4° - ONLY ½ M DEEP
DUMPING OF WASTES OR WATER DIVERSION	ANIMALS KILLED WHEN BURIED BY SEDIMENTS ALTERATION OF HABITAT FILLS SPACES AND SUFFOCATES ANIMALS HABITAT DRIES OUT, KILLING SALAMANDERS	➢ DO NOT DUMP WASTES CLOSER THAN 50 M FROM ANY ROCKY FORMATION OR BOULDER PILE ➢ DO NOT DUMP WASTES CLOSER THAN 50 M FROM STREAM BANKS
CULVERT REPAIR AND REPLACEMENT	ANIMALS KILLED WHEN BURIED BY SEDIMENTS ALTERATION OF HABITAT FILLS SPACES AND SUFFOCATES ANIMALS LOSS OF COARSE WOODY DEBRIS COVER.	➢ MAINTAIN WATER FLOW AND MINIMIZE DISTURBANCE TO SITE ➢ LEAVE AS MUCH COARSE WOODY DEBRIS AS POSSIBLE ➢ MOVE DEBRIS TO DOWNSTREAM SIDE OF CULVERT – DON'T REMOVE FROM SITE
PESTICIDE APPLICATION	POTENTIAL SUSCEPTIBILITY OF TO NEGATIVE EFFECTS OF PESTICIDES	➢ USE BIOLOGICAL CONTROL FOR KNAPWEED ➢ HAND OR MECHANICAL REMOVAL FOR OTHER
SALT	POTENTIAL HARM TO LOCAL MICROHABITAT	➢ IF SAFETY ALLOWS, APPLY GRAVEL, MINIMIZE SALT USE