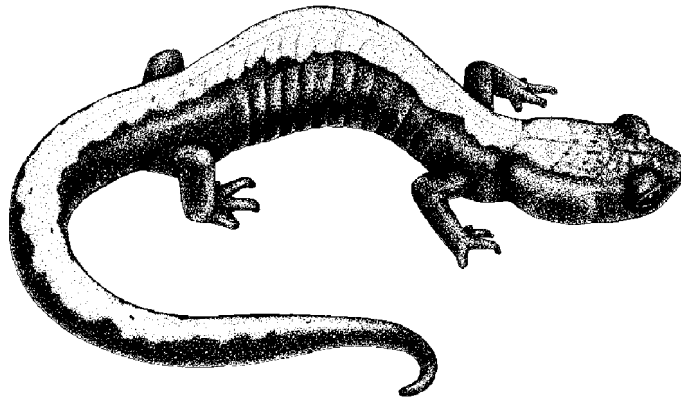


**COSEWIC**  
**Assessment and Update Status Report**

on the

**Coeur d'Alene Salamander**  
*Plethodon idahoensis*

in Canada



**SPECIAL CONCERN**  
**2007**

**COSEWIC**  
Committee on the Status  
of Endangered Wildlife  
in Canada



**COSEPAC**  
Comité sur la situation  
des espèces en péril  
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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## COSEWIC Assessment Summary

### 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 hydro 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 update status report.



**COSEWIC**  
**Executive Summary**

**Coeur d'Alene Salamander**  
*Plethodon idahoensis*

**Species information**

*Plethodon idahoensis* is the only member of the family Plethodontidae (lungless salamanders) in southeastern British Columbia. It is dark brown to black with a scalloped, usually orange, dorsal stripe. Snout-vent length averages 54 mm and total length (including the tail) averages 109 mm. The largest individual ever recorded was a female with a SVL of 69 mm, north of Creston, BC.

**Distribution**

The species range is limited to northwestern Montana, northern Idaho and southeastern British Columbia. Found in seven general areas of the Purcell and Selkirk mountain ranges, its range is discontinuous and follows roughly the Columbia and Kootenay Rivers and their tributaries. In BC its northern limit is 95 km north of Revelstoke, and its eastern limit is near the town of Kimberley.

**Habitat**

*Plethodon idahoensis* occupies moist microhabitats in steep terrain where fractured, incised bedrock or talus occurs in association with water. Habitats include rock walls with seepages or streams flowing over them, waterfall splash zones, caves, step-like streams with exposed bedrock, avalanche paths, and wet talus. Overstory vegetation includes deciduous shrubs (at avalanche paths or seepages) and coniferous forest (young to mature structural stages).

## **Biology**

*Plethodon idahoensis* spends much of its life in subterranean retreats. Reproduction is delayed until 3 – 4 years of age, and females lay eggs in alternate years. There is no larval stage. The diet consists primarily of aquatic and semi-aquatic insects. As with other plethodontids, this species has physiological constraints – it requires moist micro-environments to facilitate oxygen transfer across the skin and is prone to dehydration through evaporation. *Plethodon idahoensis* is most active on the surface during rainy nights when substrate temperatures are above 4° C. Home range size is not known, but movements >100 m were recorded for one individual. Another moved 48 m in a seven week period.

## **Population sizes and trends**

Nocturnal surveys between 1995 and 2003 detected 919 *P. idahoensis* at 56 sites in British Columbia. Reproduction was noted at 52% of occurrence sites. It is probable that there are more than 10,000 individuals considering the uncertainties involved in estimating total population size and our knowledge of the number of localities. Broad size class distributions and the presence of juveniles indirectly suggest that the population may be stable. Due to steep topography and difficulties of access at night, much of the suitable habitat between known occurrence sites remains unsurveyed.

## **Limiting factors and threats**

The most imminent threat to >20 occurrence sites is highway widening and maintenance. Other threats include water diversion, sedimentation of interstitial spaces, removal of overstory vegetation and alterations to hydrology arising from logging. Silvicultural activities such as burning and herbicide application can be carried out right to the edge of non-fish bearing streams that support *P. idahoensis*. Further threats may include increased isolation of habitat patches, the effects on habitats of small scale hydro developments and the effects of climate change on metabolism and habitat availability.

## **Special significance of the species**

*Plethodon idahoensis* may be a relic of a previously widespread plethodontid salamander fauna. It is the only lungless salamander in eastern British Columbia.

## **Existing protection or other status designations**

*Plethodon idahoensis* was assessed by COSEWIC in 1998 as Vulnerable (= Special Concern) and re-confirmed, as Special Concern, in 2001. The species is listed under Schedule 1 (Part 4) of the *Species at Risk Act*. Its Global Rank is G4 and its British Columbia rank is S3 (Blue-listed). It is S2 in both Idaho and Montana. Individuals are protected under the Wildlife Act. Habitat at 27 of the 56 known localities for this species in British Columbia have been designated Wildlife Habitat Areas, two are in national parks, one is in a provincial park, and one is on property managed by the Columbia Basin Fish and Wildlife Compensation Program.



## COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

## COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

## COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

## DEFINITIONS (2007)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

\* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

\*\* Formerly described as "Not In Any Category", or "No Designation Required."

\*\*\* Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.



Environment Canada  
Canadian Wildlife Service

Environnement Canada  
Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

**Update  
COSEWIC Status Report**

on the

**Coeur d'Alene Salamander**  
*Plethodon idahoensis*

in Canada

2007



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## SPECIES INFORMATION

### Name and classification

The Coeur d'Alene Salamander, *Plethodon idahoensis*, (figure 1) is a member of the family Plethodontidae (lungless salamanders). First described as a species by Slater and Slipp (1940), it was subsequently considered to be a subspecies of Van Dyke's Salamander, i.e. *Plethodon vandykei idahoensis*, by Lowe 1950. Collins (1990) recommended that this taxon be recognized as a distinct species. The distinction of *P. idahoensis* at the species level has since been corroborated by morphometric analysis (Wilson and Larsen 1998) and genetic work (Howard *et al.* 1993; Carstens *et al.* 2004, 2005).



Figure 1. Adult *Plethodon idahoensis*.

## Morphological description

Body color is dark brown to black, with light flecking on the sides and legs. In Canada, dorsal stripe coloration is primarily pale orange, yellow or occasionally red. The stripe does not extend to the tip of the tail, has irregular edges, and may be interrupted. A yellow throat patch is usually present on the underside of the head. Juveniles are similar to adults in appearance.

The trunk generally has 14 costal grooves. The legs are typically long, with 0.5 - 3 costal folds present between adpressed limbs (Wilson and Ohanjanian 2002). The slightly webbed toes are short. *Plethodon idahoensis* has parotoid glands at the back corners of the head and males have a mental gland. Females are larger than males (Nussbaum *et al.* 1983), with a maximum snout-to-vent length (SVL) of 69 mm recorded from a female north of Creston, B. C. (Ohanjanian and Beaucher 2002). Among adult *P. idahoensis* captured between 2000 and 2003 at 13 sites in southeastern British Columbia, mean snout-to-vent length (SVL) was 54.0 mm  $\pm$  4.8 (SD) (n = 248, range 45-69 mm). Mean total length (TL) was 109 mm  $\pm$  10.5 (n = 248, range 79-132 mm) (Ohanjanian, unpubl. data). In juveniles from the same sample, average SVL was 34.3 mm  $\pm$  7.4 (SD) (n = 143, range 19 to 44 mm) and average TL was 67.0 mm  $\pm$  16.4 (n = 143, range = 34 – 100).

## Genetic description

*Plethodon idahoensis* shows significant genetic distinctiveness from *P. vandykei* (Carstens *et al.* 2004, 2005). Divergence resulting from vicariance (or geographical barrier(s) restricting gene flow) and isolation has been long-term.

## DISTRIBUTION

### Global range

The global range of *P. idahoensis* (figure 2) is the product of postglacial events and the species' ability to disperse under conditions that largely no longer exist in today's forested landscape. Recent genetic work has shown that the species dispersed north into Canada from a Pleistocene refugium at a rate of averaging around 50 m per year (Carstens *et al.* 2004) as conditions became favourable. This movement was possible due to the salamander's ability to exploit wet, ephemeral habitats, in the form of glacial moraines, created during glacial retreat.



Figure 2. Global distribution of *Plethodon idahoensis*.

In the United States, *P. idahoensis* is found in northwestern Montana and northern Idaho (Wilson *et al.* 1997; Wilson and Ohanjanian 2002, Maxell *et al.* 2003). There are 209 documented occurrence sites in the U.S. sites: 164 in northern Idaho and 45 in Montana (Cassirer *et al.* 1994; Maxell *et al.* 2003). In Montana, the southern limits of its range are in the Bitterroot River drainage (Maxell *et al.* 2003). In Idaho *P. idahoensis* is found south to the Selway River drainage (Wilson and Ohanjanian 2002). To date, it has not been found in Washington.

## Canadian range

*Plethodon idahoensis* is known from south-eastern British Columbia (figure 3), in the Purcell and Selkirk mountain ranges (Charland 1992, Ohanjanian 1997, 2001b, 2002, Dulisse 1999, Ohanjanian and Beaucher 2002, Dykstra 2004, Adama and Ohanjanian 2005). It was first discovered in British Columbia some 20 years ago, and by 1998 was known from 15 sites (Dupuis and Ohanjanian, 1998). The 56 occurrence sites now known are situated in seven general areas along the Columbia and Kootenay Rivers and their tributaries. The largest number of sites is on the eastern shore of Kootenay Lake, continuing north along the east shore of the Duncan Reservoir. Other sites are located along the east shore of Upper Arrow and Lower Arrow Lakes, the Moyie drainage, the St. Mary River drainage, the east shore of the Columbia River north of Revelstoke, along the Trans Canada Highway east of Revelstoke and on a tributary of the Pend d'Oreille River. The northernmost (and most westerly) limit of the species' range is a small tributary of the Columbia River, 95 km north of Revelstoke, although recently the species has been reported at a site on the west side of the Arrow Lakes (Dave Fraser, pers. comm.). The most southerly occurrence is near the U.S. border. The distance between these two points is approximately 320 km. The most easterly occurrence is south of Kimberley on a tributary of the Kootenay River.

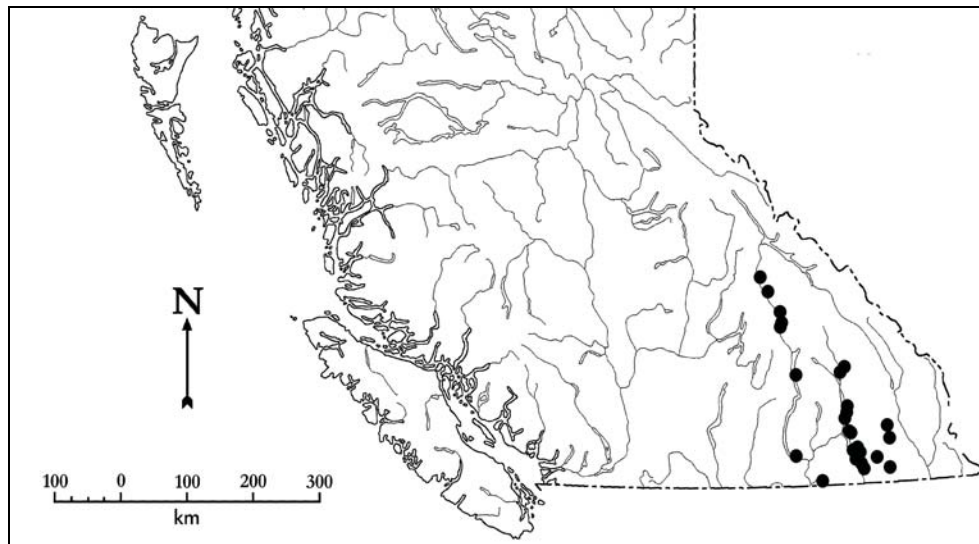


Figure 3. Distribution of *Plethodon idahoensis* in British Columbia. From Matsuda *et al.* (2006).

The Extent of Occurrence (EO) for *P. idahoensis* in British Columbia, if calculated using the minimum convex polygon method and encompassing all recorded sites, is approximately 17,000 km<sup>2</sup>. However, because the species occurs in highly disjunct areas, a more biologically relevant calculation of EO may be done by adding together each of the areas in which the species occurs and excluding large extents of unsuitable habitat such as lakes and farmland. Considering that the species has been found from 500 m to 1365 m elevation in British Columbia, high elevation

alpine and tundra habitats in the region should also be excluded. EO for *P. idahoensis* in British Columbia is only 2,000 km<sup>2</sup> when estimated in this way. It should be noted, though, that the Flathead Valley, the Rocky Mountains and tributaries of the Columbia River in the Monashee range might contain salamanders but remain un-surveyed

Area of occupancy (AO), when calculated based on a 2 km x 2 km grid, without buffers, using known occurrences, comes to 100 km<sup>2</sup>. A minimum estimate of AO based on known occurrence sites, with a 1 km buffer, is 336 km<sup>2</sup>.

## HABITAT

### Habitat requirements

In south-eastern British Columbia, *Plethodon idahoensis* is associated with incised and fractured bedrock or wet talus in conjunction with water. It is known from rock walls with seepages or streams flowing over them (14 of the 56 known occurrence sites), waterfall splash zones (24 of 56 sites), caves (1 of 56 sites), step-like streams with exposed bedrock (10 of 56 sites), avalanche paths (3 of 56 sites), and wet talus (4 of 56 sites). These environments occur in steep terrain where the bedrock is near the surface and/or the talus has fallen down a slope. Overstory vegetation at sites is highly variable, ranging from deciduous shrubs (on steep seepage sites and avalanches courses) to mixed coniferous forest, in young to mature structural stages.

In south-eastern British Columbia, winters are cold and summers dry (Braumandl and Curran 1992). Whereas other western species of plethodontid salamanders, such as the western red-backed salamander (*P. vehiculum*) and the wandering salamander (*Aneides vagrans*) occupy deep, wet soils and downed logs of the humid coastal forest (K. Ovaska 1987, Davis 1998), soils in much of the range of *P. idahoensis* are shallow with limited leaf litter, and logs may remain dry even during extended rainy periods. In this harsh environment, the cracks in the bedrock provide refuge both from freezing and from desiccation for *P. idahoensis*, which may spend up to seven months of the year underground in moist interstitial spaces between rocks (Cassirer *et al.* 1994). Such deep rock retreats are vital to certain salamanders during extreme cold weather. The Appalachian species, *P. dorsalis* and *P. richmondi*; can survive extreme cold in areas that have talus and rocky substrates with numerous underground passageways (Petranka 1979). The structure and extent of underground retreats, although a vital, potentially limiting component of the habitat requirements of *P. idahoensis*, remain unknown. Interstitial spaces, portals from this subterranean environment to the surface, and conduits of moisture below the surface must all be important factors.

## Habitat trends

*Plethodon idahoensis* habitat in British Columbia is generally in steep terrain where access is difficult. Highway widening and maintenance, however, will likely impact over 20 *P. idahoensis* sites that are partly in highway right-of ways, thus resulting in losses of habitat.

## Habitat protection/ownership

Of the 56 confirmed occurrence sites, 31 have some degree of protection. Twenty-seven have been designated Wildlife Habitat Areas for *P. idahoensis* under the provincial Forest and Range Practices Act and 4 more are under consideration for this status (Identified Wildlife Management Strategy 2004). One site is on property managed by the Columbia Basin Fish and Wildlife Compensation Program (CBFWCP), 2 sites are in Mt. Revelstoke National Park (Dykstra 2004) and 1 is in Syringa Creek Provincial Park. Of the remaining sites, three are on private land, six on highway rights-of-way, and one at a Ministry of Transportation and Highways Rest Area. Two sites span both private land and highway rights-of-way, and nine span both crown land and highway rights-of-way.

There is an inherent bias in the number of reported occurrence sites that are adjacent to highway rights-of-way; safety and access concerns in steep terrain during nocturnal surveys resulted in a tendency to sample roadside habitats preferentially. Additional sites likely occur upslope on many watercourses, away from the road. Similarly, there are likely more sites on private land that was not accessed.

## BIOLOGY

Members of the family Plethodontidae comprise 230 of the 380 known salamander species worldwide (Cohn 1994). One distinguishing feature of this family is the fact that all species entirely lack lungs at all developmental stages (Nussbaum *et al.* 1983), and they respire through their skins or the mucous membranes of their mouths. To facilitate oxygen transfer and to avoid dehydration from moisture loss through the skin, they are restricted to moist environments. Unlike other plethodontids, *P. idahoensis* lives in the relatively harsh climates of interior British Columbia, northern Idaho and northwestern Montana. These areas are typified by extremes of temperature and humidity. To survive, the species requires the thermal and hygric buffer provided by wet areas such as seeps, waterfalls and streams. It also requires specific over-wintering habitat in the form of moist, deep crevices in rocks into which salamanders can retreat to avoid freezing.

## Life cycle and reproduction

*Plethodon idahoensis* spends much of its life in subterranean retreats. It is most active on the surface during rainy nights when substrate temperatures are above 4° C (Wilson and Larsen 1988). Previously believed to be above ground only in spring and fall (Nussbaum *et al.* 1983), the species has been consistently observed on the surface in summer during rainy weather, and at waterfall sites that maintain a moist environment (Ohanjanian 2001b).

*Plethodon idahoensis* are relatively long-lived; one individual in captivity reached an age of at least 12 years (A. Wilson, pers. comm.). Sexual maturity occurs in their fourth summer of life (Lynch 1984), and females probably breed in alternate years (Nussbaum *et al.* 1983). Clutch sizes are small; females in northern Idaho are reported to have, on average, 6.7 ovarian eggs (range 4 -12) (Nussbaum *et al.* 1983). These factors result in a low reproductive rate. Their elaborate courtship ritual, described by Lynch and Wallace (1987), may take place in spring or fall (Lynch 1984). Early phases of this ritual were observed in October 1995 in southeastern British Columbia (Ohanjanian and Teske 1996).

Females are highly secretive during egg laying and no *P. idahoensis* nests have been found. It is likely that the female attends the nest and broods the eggs as in other plethodontids (Nussbaum *et al.* 1983, Truath *et al.* 2006.). Two nests of the closely related *P. vandykei* were found under a rock (Noble 1925; cited in Nussbaum *et al.* 1983) and in a fallen log (Jones 1989).

There is no larval stage. Hatchlings average 18 mm SVL (range 16-21 mm) and emerge from their eggs in fall or spring (Lynch 1984). Several individuals of 19 and 20 mm SVL were observed in May and June 2000 in British Columbia (Ohanjanian 2001a), indicating that hatching occurred in the spring of that year. Preliminary data from recaptures of eleven individuals between 28 May and 16 October revealed a mean growth rate of 0.05 mm per day (SD = 0.01, range = 0.03 – 0.07 mm) (Ohanjanian 2001a). Among *P. idahoensis* captured between 2000 and 2003 at 13 sites in southeastern British Columbia, 143 out of 391 salamanders (i.e. 37%) were juveniles (Ohanjanian, unpubl. data).

## Feeding/predation

No studies of food habits of *P. idahoensis* have been carried out in British Columbia. At a seepage habitat in Montana *P. idahoensis* fed primarily on insects, including aquatic larval forms of Hemiptera, Plecoptera, Ephemeroptera, as well as Diptera adults and larvae, Homoptera at various developmental stages, and adult Coleoptera (Wilson and Larsen 1998). Other non-insect invertebrates, including spiders, oligochaetes and gastropods were eaten as well. Similar results were obtained at a falls in Idaho, with aquatic and semi-aquatic insects (primarily springtails, Collembola) predominating (Lindeman 1993).



Predation by the American robin, *Turdus migratorius*, has been recorded by Wilson and Simon (1985). Other potential predators of adults, young and eggs may include small mammals, such as the pack rat, *Neotoma cinerea*, garter snakes and large invertebrates.

## Physiology

*Plethodon idahoensis* requires moist micro-environments to facilitate oxygen transfer, and, like other plethodontids, is prone to water loss through evaporation (Spotila 1972, Grover 1998). The species' rates of dehydration and rehydration, its critical thermal maximum, preferred humidity, and ability to acclimate have not been studied. There are inter-specific differences in these physiological constraints, even within the genus *Plethodon*, and these differences are reflected in niche partitioning along moisture gradients and in behaviour (Spotila 1972).

*Plethodon idahoensis* is active on the surface at temperatures significantly lower than other species of plethodontids, many of which occupy much warmer climates in south-eastern United States or on the west coast (Spotila 1972, Grover 1998, Ovaska 1987). One individual was observed near Kimberley at 3°C (Ohanjanian 2002). Surface movements of *P. idahoensis* are also significantly reduced when the weather is dry (Wilson and Larsen 1988). This has been shown to be the case with other plethodontids; duration of activity is directly related to substrate moisture level (Keen 1984). In the mountainous regions of south-eastern British Columbia, northwestern Montana and northern Idaho, temperatures are generally low at those times of year when the rains provide adequate moisture for surface activities.

## Dispersal/migration

Information on dispersal of *P. idahoensis* is limited. *Plethodon idahoensis* has been detected at different locations on the same watercourse (Ohanjanian 2002). This indicates that dispersal must occur along an altitudinal gradient as well as between watercourses. The mechanisms for dispersal may be passive, for example individuals being carried downstream by run-off or flood events, or active, with individuals walking upstream, downstream, or laterally away from one watercourse to another. The physiology of *P. idahoensis* constrains the timing and distances traveled laterally between watercourses. In the southern parts of its British Columbia range, the intervening forested habitats are arid, thus severely limiting opportunities for dispersal.

The size of home ranges is not known for *P. idahoensis*. The longest distance recorded in British Columbia was a 52.8 m movement by an individual from its prior location at a waterfall. The same salamander was found back at the waterfall two years later, indicating that it traveled a minimum distance of 103.6 m (Ohanjanian and Beaucher 2002). An annual fall migration of salamanders from the interior of a cave to the outside was observed for three years at a site near Kootenay Lake (Ohanjanian 2001); both adult and juvenile *P. idahoensis* occupied the cave from the late spring

through the summer and fall each year, but moved towards the entrance and then left the cave in late October. The cave was almost 29 m deep, and several individuals moved at least 25 m to reach the entrance. One individual moved > 48 m between September 25 and November 11 1999 (Ohanjanian 2000).

### **Interspecific interactions**

Interspecific displacement and competition between salamander species has been documented in the eastern United States (Grover and Wilbur 2002, Marshall *et al.* 2004). In British Columbia, the only other salamander species whose range overlaps that of *P. idahoensis* is the long-toed salamander, *Ambystoma macrodactylum*. As both are nocturnal and feed at night, there is the potential for competitive interaction between the two species.

### **Adaptability**

Due to the physiological constraints described above, *P. idahoensis* is not adaptable to alterations in hydrology and the physical structure of its environment; underground refuges with adequate moisture must be available to avoid desiccation. That being said, its use of fractured bedrock retreats (as opposed to the forest floor) is an adaptation that presumably has allowed its persistence in a mountainous region that is not only climatically harsh, but has been subjected historically to recurrent wild fires.

## **POPULATION SIZES AND TRENDS**

### **Search effort**

*Plethodon idahoensis* was the subject of directed surveys from 1995 to 2003, and was included in two amphibian surveys of Glacier and Mt Revelstoke National Parks in 2003 and 2004 (Dykstra 2004, Adama and Ohanjanian 2005). A presence/not detected protocol was used for all surveys, and consisted of non-destructive, visual scanning by two people for individuals out at night in wet areas around waterfalls, seepages and stream banks.

Approximately 280 person hours were spent conducting nocturnal surveys at 189 potential sites. Due to the steep topography and difficulty of access of *P. idahoensis* habitat, many watercourses with the same surficial habitat features were not surveyed. Many dozens of these were located between known occurrence sites, well within the species' range. It is highly probable, therefore, that the number of occurrences is an under-estimate. In addition, surveys were carried out upstream or downstream of 8 occurrence sites; *P. idahoensis* was found either upstream or downstream of a known site on 6 of 8 (75%) watercourses. These data are preliminary, but indicate that it is highly probable that the total number of occurrence sites is an under-estimate.

## **Abundance**

The total number of adult *P. idahoensis* in Canada cannot be estimated with certainty as most watercourses cannot be completely sampled and over 50 watercourses situated between known occurrence sites cannot be accessed for nocturnal surveys. Nevertheless, an approximate figure can be derived.

In line with the behaviour of other species of terrestrial plethodontid salamanders, an unknown percentage of individuals is hidden and undetectable via surface surveys. Taub (1961) estimated that between 2% and 32% of eastern red-backed salamanders, *Plethodon cinereus*, were at the soil surface at any one time. Burton and Likens (1975) refined that estimate for *P. cinereus* in the Hubbard Brook Experimental Forest of New Hampshire to 21%. Davis (1996), working on southern Vancouver Island, estimated that no more than 24% of the estimated number of western red-backed salamanders, *Plethodon vehiculum*, in enclosed experimental plots were found at the surface at any given time. Considering that a total of 919 *P. idahoensis* have been found at the 56 known occurrence sites in British Columbia and that juveniles comprise about 37% of encountered individuals (Ohanjanian, unpublished), and assuming the more conservative Burton and Likens estimate of detectability of 21%, there are at least 2,776 mature individuals in the surveyed areas of known sites. This is certainly an underestimate of the total population. Taking in account that no more than about 10% of the Canadian range that has been surveyed, it seems safe to say there are more 10,000 mature individuals in Canada. Distributed as they are along small streams, no site is likely to have more than 1,000 individuals present.

## **Fluctuations and trends**

Population densities, sex ratios and age distributions of other plethodontid species are relatively stable over time (Hairston 1987, Grover 1998) compared to most amphibians. Several measures suggest that it may also be true for *P. Idahoensis*. Juveniles were observed at over 50% of occurrence sites, indicating that reproduction is occurring at these locations. Frequency histograms of size classes at three monitoring sites revealed that all size classes were present and size distribution was stable over a three year period (Ohanjanian and Beaucher 2001,2002; Ohanjanian 2001a). Individuals in the 50 – 60 mm SVL size categories (young adults and mature adults) are consistently encountered (Ohanjanian and Beaucher 2002, 2003; Ohanjanian 2001a). These provide indirect evidence that ordinarily the species is largely stable in numbers.

## **Rescue effect**

Given the species' physiological constraints and low dispersal ability, rescue from the closest US populations is unlikely.

## LIMITING FACTORS AND THREATS

### Highway Maintenance and Widening

The most imminent threat to at least 20 of the 56 known *P. idahoensis* sites is highway widening and maintenance. At these sites, watercourses or seepages intercept transportation corridors, and blasting and rock scaling may directly kill salamanders and alter habitat configuration. Dumping of highway wastes may bury individuals, and culvert repair or replacement may cause direct mortality or alter habitat structure. As these are often issues of public safety, it is unlikely that mitigating actions could take place. To offset this, however, is the fact that *P. idahoensis* has been found at more than one place on a watercourse (Ohanjanian 2002). It is, therefore, unlikely that their only occurrence would be at the highways. Safety and access issues at night created a strong bias to survey at highway locations.

### Logging Activities

In coastal British Columbia, Dupuis *et al.* (1995) found a reduction in populations of terrestrial amphibians after clear-cutting of old growth. Clear-cut harvesting and the consequent reduced canopy cover increases solar gain, creating higher ground temperatures and rates of evaporative water loss (Geiger 1971, cited in Dupuis *et al.* 1995). The effect of the removal of overstory vegetation on the petrophilic *P. idahoensis* has not been studied. Loss of forested cover could lead to rapid drying of soil and reduce the time available to salamanders for foraging. Low-flow or ephemeral seepage sites may be particularly vulnerable to subtle alterations in hydrology. Silviculture, including herbicide application and burning, is carried out right up to the banks of these small, non fish-bearing streams. Such activities will alter vegetative composition, soil moisture content, remove coarse woody debris and affect the invertebrate prey base. The degree of threat to these streams cannot be predicted, as it will vary with logging plans over future years. There is a provision to prevent this in the guidelines for Wildlife Habitat Areas (Ohanjanian, 2004).

During logging operations, there is the potential for equipment and machinery to crush salamanders, cause compaction or downstream siltation of interstitial spaces, divert water and deposit debris in gullies. As many *P. idahoensis* sites are located in gullies or areas of steep terrain, compromised side-slope stability may pose a threat.

### Isolation of habitat patches and physiological constraints

*Plethodon idahoensis* occurs in small subpopulations, thus making it more vulnerable to loss of genetic variation and possibly limiting the species' ability to adapt to changing conditions. The moist micro-environments required are highly fragmented over the landscape, and the physiology of *P. idahoensis* is such that dispersal between suitable habitat patches depends on wet weather and the presence of subterranean retreats and/or adequate cover objects on the surface. In the dry southern portions of its range (mean summer precipitation < 200 mm, Braumandl and Curran 1992), the dry

logs and soil conditions that typify the landscape between these micro-habitats limit opportunities for genetic exchange. In the northern portions of the species' range, for example in the Revelstoke area, rainfall is higher (mean up to 400 mm in summer, Braumandl and Curran 1992). Opportunities for dispersal, colonization of new habitats and genetic exchange are therefore greater. Although data are lacking, the degree of risk derived from isolation of habitat patches may be less significant in that area than in the south.

### Water diversion and altered hydrological regimes

Small-scale hydro development, which lends itself to the steep topography in the range of *P. idahoensis*, could alter flow rates at salamander occurrence sites, and reduce moisture levels and humidity in subterranean retreats. This form of private power generation has increased; over 570 additional streams have been identified as having the potential for this type of development (BC Hydro 2000).

In addition to anthropogenic threats, *P. idahoensis* may be vulnerable to natural catastrophes such as flooding during spring run-off, landslides and flow diversions.

### Climate change

The ability of *P. idahoensis* and other amphibians to respond to anticipated rapid warming of the earth's climate (Intergovernmental Panel on Climate Change 2001) is a matter of uncertainty at present. Possible responses include movements, behavioural changes, and physiological adaptation. As ectotherms, with a relatively limited ability to move and a highly constrained dependence on low temperatures and humidity, plethodontids may be at risk. Ecological modeling has been used to synthesize what is known about species' habitat requirements and relate these to possible future conditions (Teixera and Arntzen 2002). If climate change reduces rainfall and alters hydrology in south-eastern British Columbia, those *P. idahoensis* populations on ephemeral or low-flow watercourses will be at risk, should these dry up.

Of additional concern is a recent mechanistic analysis of the capacity of other montane plethodontid salamanders, such as the genus *Desmognathus*, to tolerate warming-induced stress (Bernardo and Spotila 2005). The cold-adapted, specialized species studied already live at or near the limit of their physiological tolerances. Montane-adapted salamanders showed dramatic metabolic depression when subjected to higher temperatures. Migration upwards along an elevational gradient in response to warming will lead to range contraction which, in turn, will lead to decreased population sizes and, thereby, the erosion of genetic variability.

There is no aboriginal traditional knowledge of this salamander relevant to assessment (Donna Hurlburt and Henry Lickers, pers. comm.).

## **SPECIAL SIGNIFICANCE OF THE SPECIES**

*Plethodon idahoensis* is the only lungless salamander in southeastern British Columbia and represents the last remnant of a larger array of plethodontid salamanders that now is able to persist only in remnant moist microhabitats (Wilson and Larsen 1998).

## **EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS**

*Plethodon idahoensis* was assessed by COSEWIC in 1998 as Vulnerable (Dupuis and Ohanjanian 1998). That status was re-confirmed, as Special Concern, in 2001. The species is listed under Schedule 1 (Part 4) of the *Species at Risk Act*.

The Global Rank of *P. idahoensis* is G4 (apparently secure). In Montana and Idaho the official rank of the species is S2 (Idaho Comprehensive Wildlife Conservation Strategy 2006, Montana Animal Species of Concern 2006, NatureServe 2006). In British Columbia, it is currently “Blue-listed” with a rank of S3 (B.C. Conservation Data Centre 2006).

*Plethodon idahoensis* is protected under the B.C. Wildlife Act (1982), and individuals cannot legally be killed, collected or held in captivity without permit. This act does not protect the species from habitat loss or destruction. The habitat at 31 of 56 (55%) occurrence sites has some protection; 27 have been designated Wildlife Habitat Areas for *P. idahoensis* under the provincial Forest and Range Practices Act and four more are under consideration for this status. Resource extraction at these sites must follow guidelines laid out in the Species Account for Coeur d’Alene Salamander (Identified Wildlife Management Strategy 2004). One site is on property managed by the Columbia Basin Fish and Wildlife Compensation Program (CBFWCP) (T. Antifeau, pers. comm.), two sites are in Mt. Revelstoke National Park (Dykstra 2004) and one is in Syringa Creek Provincial Park (Dulisse 1999).

## TECHNICAL SUMMARY

### ***Plethodon idahoensis***

Coeur d'Alene Salamander

Salamandre de Coeur d'Alène

Range of Occurrence in Canada: British Columbia

#### **Extent and Area Information**

<ul style="list-style-type: none"> <li><i>Extent of occurrence (EO)(km<sup>2</sup>)</i> Calculated based on minimum convex polygon encompassing all recorded sites: excluding large extents of unsuitable habitat:</li> </ul>	17,000 km <sup>2</sup> 2,000 km <sup>2</sup>
<ul style="list-style-type: none"> <li><i>Specify trend in EO</i></li> </ul>	Stable
<ul style="list-style-type: none"> <li><i>Are there extreme fluctuations in EO?</i></li> </ul>	No
<ul style="list-style-type: none"> <li><i>Area of occupancy (AO) (km<sup>2</sup>)</i> Calculated based on a 2 km x 2 km grid, without buffers: Calculated based on known occurrence sites, with a 1 km buffer:</li> </ul>	100 km <sup>2</sup> 336 km <sup>2</sup> .
<ul style="list-style-type: none"> <li><i>Specify trend in AO</i></li> </ul>	Stable
<ul style="list-style-type: none"> <li><i>Are there extreme fluctuations in AO?</i></li> </ul>	No
<ul style="list-style-type: none"> <li><i>Number of known or inferred current locations</i> The extent of range has become better known in recent years</li> </ul>	56
<ul style="list-style-type: none"> <li><i>Specify trend in #</i></li> </ul>	Stable
<ul style="list-style-type: none"> <li><i>Are there extreme fluctuations in number of locations?</i></li> </ul>	No
<ul style="list-style-type: none"> <li><i>Specify trend in area, extent or quality of habitat</i></li> </ul>	Decline

#### **Population Information**

<ul style="list-style-type: none"> <li><i>Generation time (average age of parents in the population)</i> First reproduction at 3.5 to 4.5 years of age.</li> </ul>	5 years
<ul style="list-style-type: none"> <li><i>Number of mature individuals</i> Calculated based on the total of 919 individuals found, about 37% of which are juveniles, and estimating a detectability of 21% (Burton and Likens, 1975)</li> </ul>	approximately 2,776 adults among surveyed areas. Probably > 10,000 in total.
<ul style="list-style-type: none"> <li><i>Total population trend:</i></li> </ul>	Unknown
<ul style="list-style-type: none"> <li><i>% decline over the last/next 10 years or 3 generations.</i></li> </ul>	Unknown
<ul style="list-style-type: none"> <li><i>Are there extreme fluctuations in number of mature individuals?</i></li> </ul>	No
<ul style="list-style-type: none"> <li><i>Is the total population severely fragmented?</i></li> </ul>	No
<ul style="list-style-type: none"> <li><i>Specify trend in number of populations</i></li> </ul>	Stable
<ul style="list-style-type: none"> <li><i>Are there extreme fluctuations in number of populations?</i></li> </ul>	No
<ul style="list-style-type: none"> <li>List populations with number of mature individuals in each: no data</li> </ul>	

#### **Threats (actual or imminent threats to populations or habitats)**

<p>Threats include water diversion, sedimentation of interstitial spaces, removal of overstory vegetation, small hydro-electric projects and alterations to hydrology arising from logging. An imminent threat to &gt;20 occurrence sites is highway widening and maintenance with its effects on the traversed streams. Silvicultural activities, such as burning and herbicide application, that are carried out right to the edge of the non-fish bearing streams that support <i>P. idahoensis</i> threaten to damage habitats. Small scale hydro developments divert and channelize streams, destroying habitat. Further threats may include increased isolation of habitat patches and road and trail construction. Climate change, forcing the salamanders to move to higher elevations, may also be a long-term potential threat to this species because of its limited abilities to disperse.</p>
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**Rescue Effect (immigration from an outside source)**

<ul style="list-style-type: none"> <li>• <i>Status of outside population(s)?</i> USA: S2 in both Montana and Idaho.</li> </ul>	
<ul style="list-style-type: none"> <li>• <i>Is immigration known or possible?</i> Although the nearest US site is close to the Canadian border, <i>Plethodon</i> salamanders are very poor dispersers.</li> </ul>	Immigration is unknown and unlikely to be significant
<ul style="list-style-type: none"> <li>• <i>Would immigrants be adapted to survive in Canada?</i></li> </ul>	Yes
<ul style="list-style-type: none"> <li>• <i>Is there sufficient habitat for immigrants in Canada?</i></li> </ul>	Yes
<ul style="list-style-type: none"> <li>• <i>Is rescue from outside populations likely?</i></li> </ul>	Very unlikely

**Quantitative Analysis**

n/a
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**Current Status**

COSEWIC: Special Concern (November 2007) [G4, S3, Blue-listed (BC) S2 (Idaho and Montana)]
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**Status and Reasons for Designation**

<b>Status:</b> Special Concern	<b>Criteria:</b> not applicable
<p><b>Reasons for Designation:</b> 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 hydro development are potential threats.</p>	

**Applicability of Criteria**

<b>Criterion A:</b> Not applicable. No quantitative estimates of decline available.
<b>Criterion B:</b> Not applicable. Although Area of Occupancy is less than 2,000 km <sup>2</sup> , there are many more than 10 known localities, the range is not severely fragmented and there are not extreme fluctuations in range or abundance
<b>Criterion C:</b> Given the uncertainties involved in estimating total population size and current knowledge of the number of localities, it is possible that there are more than 10,000 individuals.
<b>Criterion D:</b> Not applicable. Area of Occupancy exceeds 20 km <sup>2</sup> and there are probably more than 1,000 mature individuals.
<b>Criterion E:</b> Not applicable. Insufficient data.



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Bryce Maxell – Montana Heritage Program  
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Al Wilson – Researcher, Spokane Falls Community College  
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Ted Antifeau – Rare & Endangered Species Biologist B.C. Min. of Environment, Nelson  
Leah Ramsay – B.C. Conservation Data Centre  
Dave Fraser – Endangered Species Specialist, B.C. Min. of Environment  
David Cunnington – Canadian Wildlife Service, British Columbia

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## **BIOGRAPHICAL SUMMARY**

### **I. A. (Penny) Ohanjanian**

Penny Ohanjanian has an M.A. from Oxford, England (*Litterae Humaniores*) and a M.Sc. (Biological Sciences) from Simon Fraser University (1986). Her thesis examined optimal foraging and prey selection by red-necked grebes (*Podiceps grisegena*) in the Creston Valley Wildlife Management Area. Since 1985, Penny has worked as a biological consultant, specializing primarily on rare and endangered amphibians and birds, including the northern leopard frog, western toad, Coeur d'Alene Salamander, long-billed curlew, Columbian sharp-tailed grouse, western grebe and Williamson's sapsucker. She is a member of the Northern Leopard Frog (Southern Mountain Population) Recovery Team.