

## Recovery Strategy for Puget Oregonian Snail (*Cryptomastix devia*) in British Columbia



Prepared by the British Columbia Invertebrates Recovery Team



Ministry of  
Environment

January 2008

## **About the British Columbia Recovery Strategy Series**

This series presents the recovery strategies that are prepared as advice to the Province of British Columbia on the general strategic approach required to recover species at risk. The Province prepares recovery strategies to meet our commitments to recover species at risk under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada – British Columbia Agreement on Species at Risk*.

### **What is recovery?**

Species at risk recovery is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

### **What is a recovery strategy?**

A recovery strategy represents the best available scientific knowledge on what is required to achieve recovery of a species or ecosystem. A recovery strategy outlines what is and what is not known about a species or ecosystem; it also identifies threats to the species or ecosystem, and what should be done to mitigate those threats. Recovery strategies set recovery goals and objectives, and recommend approaches to recover the species or ecosystem.

Recovery strategies are usually prepared by a recovery team with members from agencies responsible for the management of the species or ecosystem, experts from other agencies, universities, conservation groups, aboriginal groups, and stakeholder groups as appropriate.

### **What's next?**

In most cases, one or more action plan(s) will be developed to define and guide implementation of the recovery strategy. Action plans include more detailed information about what needs to be done to meet the objectives of the recovery strategy. However, the recovery strategy provides valuable information on threats to the species and their recovery needs that may be used by individuals, communities, land users, and conservationists interested in species at risk recovery.

### **For more information**

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

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

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(*Cryptomastix devia*) in British Columbia**

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## Recommended citation

British Columbia Invertebrates Recovery Team. 2008. Recovery strategy for Puget Oregonian Snail (*Cryptomastix devia*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 21 pp.

## Cover illustration/photograph

William P. Leonard

## 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>>

## Publication information

### Library and Archives Canada Cataloguing in Publication Data

British Columbia Invertebrates Recovery Team.

Recovery strategy for Puget Oregonian Snail (*Cryptomastix devia*) in British Columbia [electronic resource]  
(British Columbia recovery strategy series)

Available on the Internet.

“January 2008”

Includes bibliographical references: p.  
ISBN 978-0-7726-5932-3

1. Snails - British Columbia. 2. Wildlife recovery - British Columbia. 3.  
Endangered species – British Columbia. I. British Columbia. Ministry of Environment.  
II. Title.

QL430.4 B74 2008

594'.3

C2008-960038-X

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## Disclaimer

This recovery strategy has been prepared by the British Columbia Invertebrates Recovery Team, as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The British Columbia Ministry of Environment has received this advice as part of fulfilling its commitments under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada – British Columbia Agreement on Species at Risk*.

This document identifies the recovery strategies that are deemed necessary, based on the best available scientific and traditional information, to recover Puget Oregonian Snail populations in British Columbia. Recovery 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 recovery approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions and all members of the recovery team 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 on the recovery team.

Success in the recovery 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 strategy. The Ministry of Environment encourages all British Columbians to participate in the recovery of Puget Oregonian snail.

## RECOVERY TEAM MEMBERS

### British Columbia Terrestrial Invertebrates Recovery Team

Jennifer M. Heron (Chair) B.C. Ministry of Environment Vancouver, BC	Arthur Robinson Canadian Forest Service, Pacific Forestry Centre Victoria, BC
Jessica J. Hellmann University of Notre Dame Notre Dame, IN	Geoff G.E. Scudder University of British Columbia Vancouver, BC
Chris Junck Garry Oak Ecosystems Recovery Team Victoria, BC	Shyanne Smith Garry Oak Ecosystems Recovery Team Victoria, BC
William Woodhouse British Columbia Parks and Protected Areas Nanaimo, BC	Ross Vennesland Parks Canada Agency Vancouver, BC
Suzie L. Lavallee University of British Columbia Vancouver, BC	

## AUTHORS

Jennifer Heron, B.C. Ministry of Environment  
Kristiina Ovaska, Biolinx Environmental Research Ltd.  
Lennart Sopuck, Biolinx Environmental Research Ltd.

## RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for Puget Oregonian snail under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service participated in the development of this recovery strategy.

## ACKNOWLEDGEMENTS

The initial draft of this recovery strategy was prepared on behalf of the B.C. Invertebrates Recovery Team by Kristiina Ovaska and Lennart Sopuck of Biolinx Environmental Research, with scientific edit by Robert Forsyth. Tom Kogut, Nancy Duncan, and Terry Frest provided unpublished information on Puget Oregonian snail from their databases or personal observations in Washington State. Andreas Hamann provided a map of the distribution of the bigleaf maple in British Columbia. Additional reviews were completed by Jenny Feick, Ted Lea, Patrick Daigle, Kym Welstead, Jeff Brown and Brenda Costanzo (B.C. Ministry of Environment); Rob Cannings (Royal BC Museum); Robb Bennett (BC Ministry of Forests); Trish Hayes and Lucy Reiss (Environment Canada's Canadian Wildlife Service).

## EXECUTIVE SUMMARY

Puget Oregonian snail (*Cryptomastix devia* Gould, 1846) is a large (adult shell, 18–25 mm diameter) land snail endemic to western North America ranging from southwestern British Columbia (B.C.) through Washington to northern Oregon. In B.C., the species is known from three historical (1850–1905) records on Vancouver Island and the Lower Fraser Valley. Surveys between 1984 and 2006 within the historic range have not located any new populations or old shells. In 2002, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated Puget Oregonian snail as Extirpated from Canada.

Historic records of Puget Oregonian snail in B.C. are from older forest ecosystems with a component of bigleaf maple (*Acer macrophyllum*). Populations elsewhere within the species' global range inhabit moist, mixed-wood older forests and riparian zones at low and mid-elevations. Important habitat features include the presence of groves of large diameter bigleaf maples with abundant epiphyte layers, deep leaf litter, abundant coarse woody debris, friable organic soil, and understorey plant species that require abundant moisture.

Potential threats to Puget Oregonian snail include habitat loss and degradation, competition from and presence of exotic plants and animals, and pesticide use.

The recovery goal is to confirm the presence/absence of Puget Oregonian snail within the species' historic range and protect<sup>1</sup> any extant population(s) if found. The recovery objectives are 1) to survey all historical sites and areas of potential habitat and locate any existing population(s) of Puget Oregonian by 2017; 2) to implement habitat protection<sup>1</sup> and threat mitigation for any populations located by 2017; and 3) to investigate feasibility and need to re-establish populations by 2017.

A single-species approach is taken in this recovery strategy because of the extirpated status of the species, which requires special considerations. Inventory, habitat assessment, and public education should be completed within a multi-species program.

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<sup>1</sup> Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas.

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## BACKGROUND

### Species Assessment Information from COSEWIC

**Common Name:** Puget Oregonian snail

**Scientific Name:** *Cryptomastix devia* Gould, 1846

**Assessment Summary:** November 2002

**Status:** Extirpated

**Reason for designation:** In Canada, the species was known previously (1850–1905) from only three old records from Vancouver Island and the southwestern mainland of British Columbia. Despite surveys of 38 forested localities in 1986 and 450 localities since 1990 for terrestrial gastropods, and of 142 localities specifically to locate *C. devia* (total of about 110 person-hours), no specimens have been found. Regions in which known localities for *C. devia* were said to have occurred have been heavily impacted by urbanization and agricultural use.

### Description of the Species

Puget Oregonian snail (*Cryptomastix devia* Gould 1846) is a large (adult shell, 18–26 mm diameter) land snail endemic to western North America. A brief morphological description is given in Forsyth (2004). Mature adults have a pale white and thickened lip of the shell and a white, tooth-like structure within the curve opening of the shell.

Three species could potentially be confused with Puget Oregonian snail – Oregon Forestsnail (*Allogona townsendiana* Lea) which has a larger shell 28–35 mm in diameter; Pygmy Oregonian (*Cryptomastix germana* (Gould)) that is much smaller (shell  $\leq$  8 mm in diameter) and hairy (long, curved hairs on the shell); and Northwest Hesperian (*Vespericola columbianus* (I. Lea)) which is also covered in hairs and does not have the tooth-like structure, but is of similar adult shell size. Juveniles of these species are difficult to separate. A brief morphological description is given in Forsyth (2004).

**Classification:** Phylum Mollusca: Class Gastropoda: Order Stylommatophora: Family Polygyridae

### Populations and Distribution

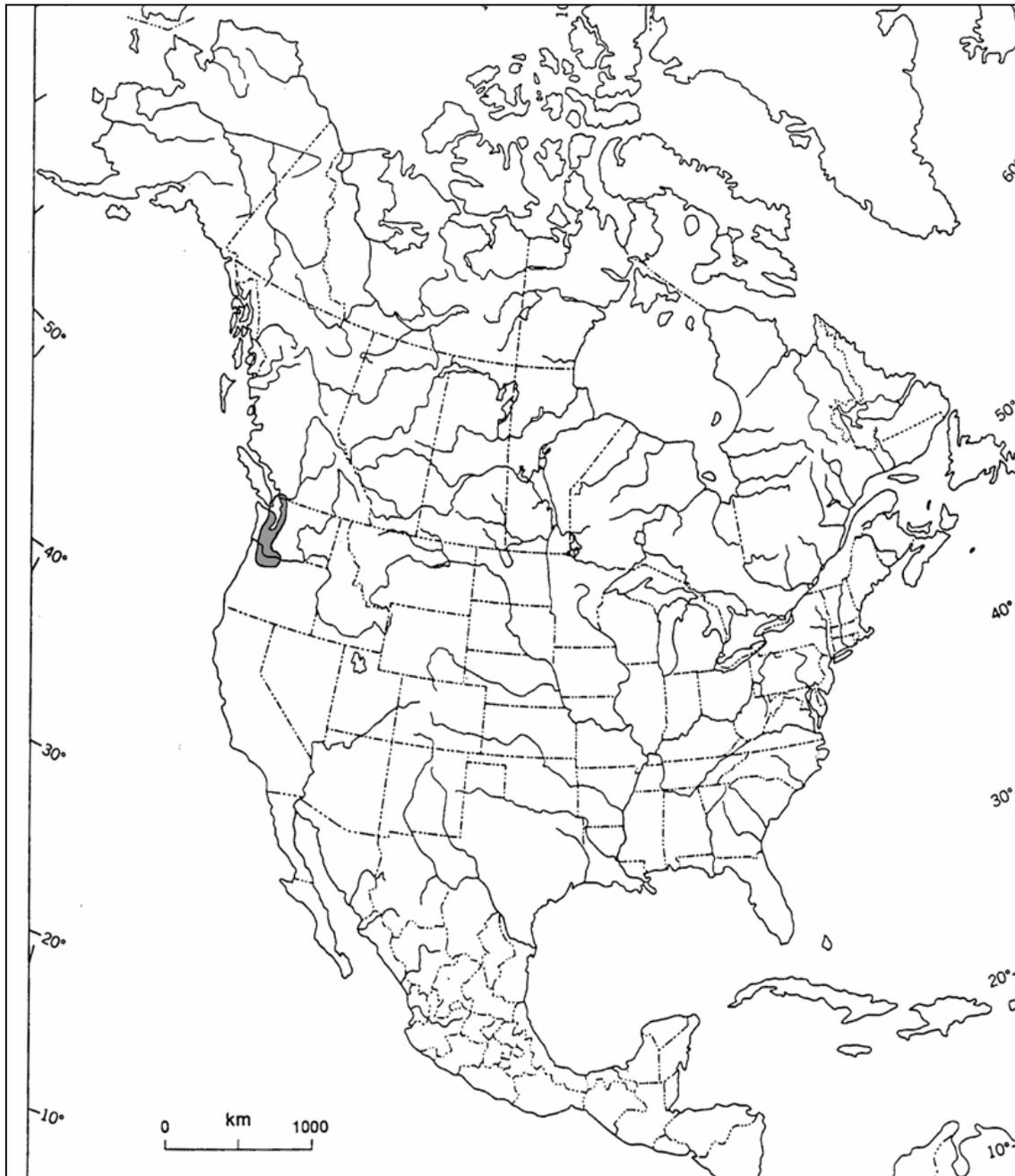
The global range of Puget Oregonian snail extends from the Lower Mainland region of southwestern B.C., south through western Washington to the Oregon side of the Columbia Gorge and including the western Cascade Range and Puget Trough (Figure 1). The species has a patchy and scattered distribution throughout most of its range. A few isolated records exist from the eastern Cascade Mountains. A cluster of locality records exists from the Cowlitz and Cispus River drainages in the western Cascade Range, Washington (T. Burke, pers. comm., 2002; N. Duncan, pers. comm., 2003). There are no recent locality records north of the Seattle area.

In Canada, Puget Oregonian snail is known from three historical records (1850–1905) from B.C.: two are from Vancouver Island (Pfeiffer 1850; Taylor 1889), and a third (Dall 1905) places the species in the Sumas Prairie area of the Lower Fraser Valley, near present-day Chilliwack

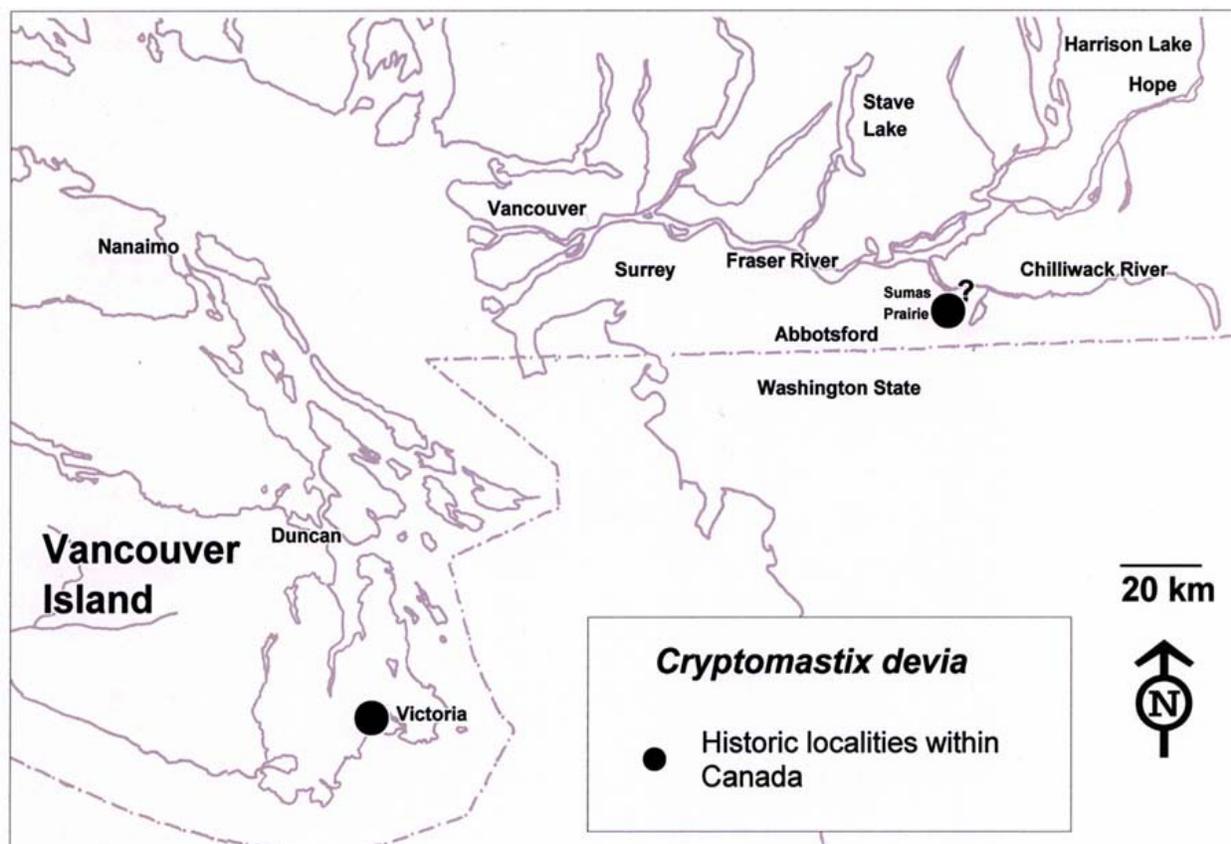
(Figure 2; Appendix B). Ovaska and Forsyth (2002) discussed the accuracy of these records and concluded that there is no reason to doubt Taylor's (1889) record from Vancouver Island, which gives the locality as "Esquimalt, near Victoria." The accuracy of the other two records is more uncertain. There are no recent records of the species from Canada, although several searches have taken place for terrestrial gastropods in likely habitats for the species both on Vancouver Island and in the Lower Fraser Valley (see Appendix A for a summary of recent surveys). The species may exist in small pockets of suitable unsurveyed habitat.

There is no information on population trends and the species may never have been abundant in Canada. Taylor (1889) reported finding only one individual. The trend in abundance follows the distribution trend and, as far as is known, the population has declined to extirpation over the past century.

Because of its apparent rarity and association with late succession forests, this species was designated as a "Survey and Manage Species" under the *United States Northwest Forest Plan* in the mid-1990s (Kelley *et al.* 1999). Since its designation, knowledge about the species' distribution within the United States has increased, and new localities continue to be found. In Washington, 36 new records for the species were found in 2001–2002, bringing the total number of records in the Survey and Manage database to 148 (N. Duncan, pers. comm., 2003). The species has the global heritage rank of G3 (vulnerable) (NatureServe 2008). The species has not been ranked nationally.



**Figure 1.** Global distribution of Puget Oregonian snail (from Ovaska and Forsyth 2002).



**Figure 2.** Canadian distribution of Puget Oregonian snail, based on historical records. The record at Sumas Prairie is not confirmed, although suspected to be Puget Oregonian (COSEWIC 2002).

## Needs of the Puget Oregonian

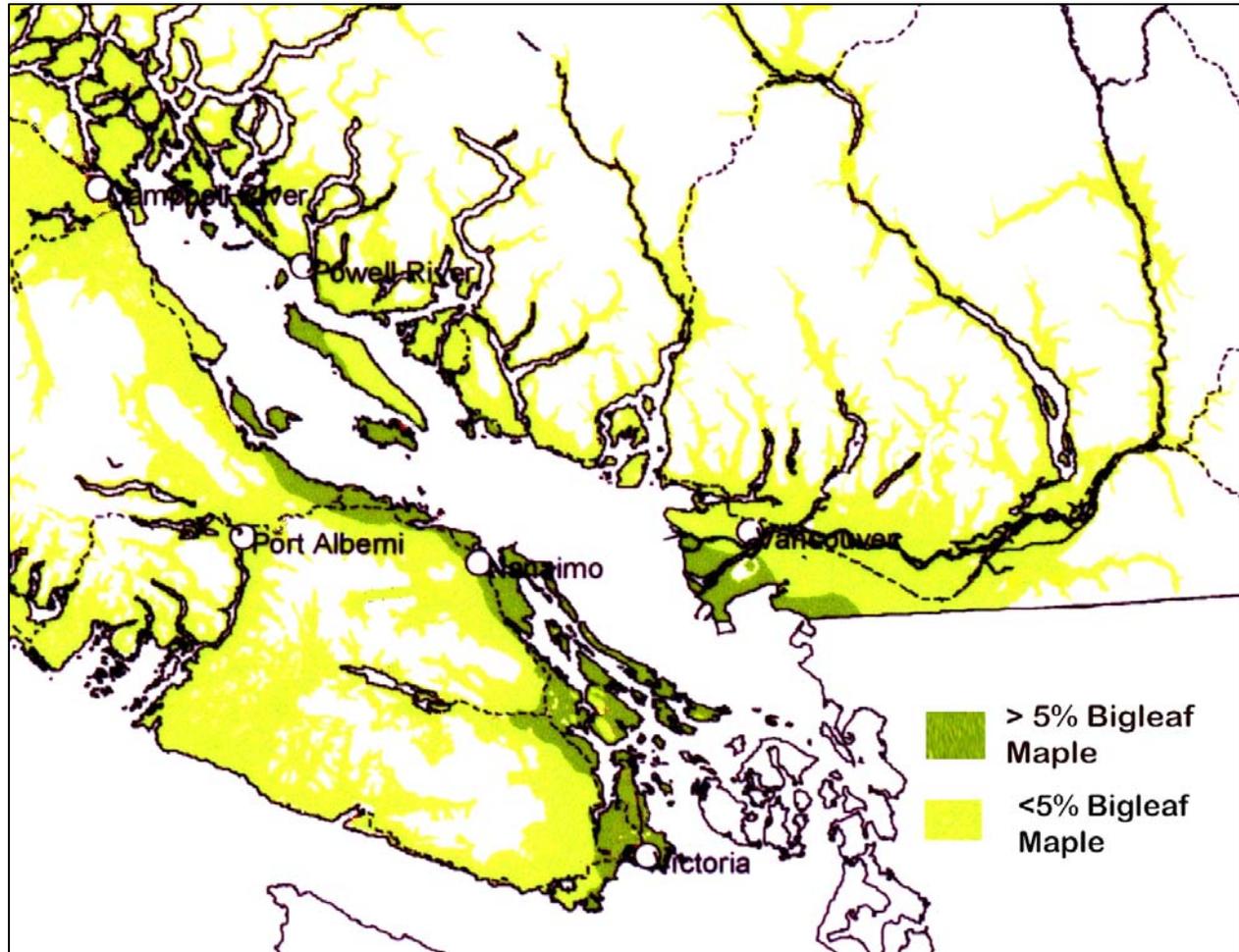
### Habitat and biological needs

No individuals have been located in recent surveys (within the past 100 years) and no information is available on actual habitats of Puget Oregonian snail in Canada. The species' habitat requirements in the United States must be used to infer habitat suitability. In the United States, the species inhabits older mixed-wood or deciduous forest stands that typically contain bigleaf maple (*Acer macrophyllum* Pursh.), at low and mid-elevations (Burke 1999; Kelley *et al.* 1999). Stands are continually moist, such as riparian zones, and contain an understory of swordfern (*Polystichum munitum* [Kaulf.] C. Presl.), herbaceous plants, and hardwood leaf litter (Burke 1999). Recent information suggests that the species' association with bigleaf maple is even more important than was previously thought (T. Burke, pers. comm., 2002). In the Cowlitz Valley Ranger District, Washington, suitable habitats have the following characteristics (T. Kogut, pers. comm., 2003): groves of 20 or more large (>50 cm diameter) bigleaf maples; deep leaf litter; flat or gently-sloping (<25%) terrain; understory vegetation, such as swordfern, vanilla leaf (*Achlys triphylla* [Smith] DC.), or stinging nettle (*Urtica dioica* L.), that require

moist conditions; abundant downed wood, including large decaying logs; and stable substrates (not prone to flooding). A habitat model is under development for the species (U.S. Forest Service, Pacific Northwest Region) and will incorporate the above attributes (T. Kogut, pers. comm., 2003).

Within suitable bigleaf maple stands, nests are most likely located in areas of soft soils that remain moist for extended periods in the spring and early summer, but are not prone to flooding. Soft, crumbly (*friable*), moist soils appear to be a universal requirement for nesting burrows of land snails (Tompa 1984). Puget Oregonian snail digs a burrow in the soil, into which it lays its eggs. The nest is very difficult to find after the snail has completed egg-laying and covered the entrance with soil. Nests of many snails might be clustered in the same area, especially in small intact habitat patches (within a larger disturbed habitat) where there are moist decaying logs, seeps, and continual moisture, as well as forbs and shrubs to prevent sun exposure in hot summer months. Only a few nests have ever been found, all in Washington State (Burke 1999). Specific features of the nest and their use are poorly known and have to be inferred from similar species. Oregon Forestsnail (*Allogona townsendiana*) and Puget Oregonian snail are sometimes found in the same habitats and appear to have similar egg-laying behaviour (Burke 1999).

In B.C., the most reliable historical record (Taylor 1889) is from southern Vancouver Island within the Coastal Douglas-fir biogeoclimatic zone. Present forest habitats in this area include mixed-wood stands with Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco), western redcedar (*Thuja plicata* Donn), grand fir (*Abies grandis* [Douglas. ex D. Don.] Lindl.), western hemlock (*Tsuga heterophylla* [Raf.] Sarg.), and bigleaf maple in the overstorey. Potential recovery habitats for the snails are expected to overlap with the distribution of the bigleaf maple (Figure 3).



**Figure 3.** Bigleaf maple habitat capability within the Coastal Douglas-fir biogeoclimatic zone in southwestern British Columbia. Potential Puget Oregonian snail habitat is within these areas. Generated from digital map by Andreas Hamann, Department of Forest Science, University of British Columbia, Vancouver, BC.

### Ecological role

Puget Oregonian snail is endemic to the west coast of North America and is the sole representative of its subgenus on the coast. Like other similar forest-dwelling snails (e.g., Oregon Forestsnail), this species has ecological importance as a decomposer, consumer of both live and decaying vegetation, and prey for a number of vertebrate and invertebrate predators (Ovaska and Forsyth 2002). These gastropods help to build healthy soil. Burke (1999) suggested that Puget Oregonian snail might be an important vector for dispersal of fungal spores, including species that form mycorrhizal associations with roots of forest trees, which promote healthy tree growth.

## Limiting factors

Little is known of the biology of Puget Oregonian snail. Biological factors that may restrict the species' distribution or pose constraints to recovery through re-establishment include low reproductive potential; poor colonizing ability, association with older forests, particularly with a component of bigleaf maple, or attributes of older forests; and marginal former existence in B.C. at the northern extremity of the species' range.

Like other large land snails, this species is thought to be slow maturing, and young may not reach sexual maturity until several years after hatching (Ovaska and Forsyth 2002). No information exists on clutch size and frequency of reproduction. Like other members of the family Polygyridae, Puget Oregonian snail is hermaphroditic, but there is no evidence of self-fertilization, which would enhance a species' ability to colonize. The dispersal ability of these snails is likely to be poor, based on their scattered distribution pattern in the United States. These isolated populations probably represent remnants of a formerly wider distribution rather than propagules in newly colonized areas. The association of the snails with older forests or their attributes may limit their distribution and recovery. In particular, their requirement for protected, moist sites for refuges and oviposition would necessitate the maintenance of adequate structural features of mature forests.

Historical records from Canada represent the northern extremity of the species' geographic range. The persistence of peripheral populations is inherently precarious due to harsher climate, lower survival rates and abundance, and stochastic fluctuations in population size (Lawton 1993). These factors may have contributed to the species' extirpation throughout its Canadian range.

## Threats

Habitat loss, fragmentation, and degradation due to human activities are the most prominent threats to populations of Puget Oregonian snail in the United States (Burke 1999). Degradation of habitat due to high-intensity fires and inadvertent alteration from other management activities, such as raking the litter for mushrooms, also threaten populations in some areas (Burke 1999). In addition, predation by various invertebrates and vertebrates, as well as competition with exotic gastropods, may adversely affect the viability of populations.

## Description of the threats

In B.C., habitat loss and fragmentation have likely contributed to population declines over the past century, although with so few records it is difficult to measure decline. Potential threats that continue in remaining habitats and might adversely affect any recovery activities for the species include:

1. *Habitat loss and degradation.* Most ecosystems of southern Vancouver Island and the Lower Mainland that contain potentially suitable Puget Oregonian habitat are under development pressure, or have been lost to urban/agricultural conversion. Human population growth, urbanization, and agricultural expansion continue to encroach on remaining forested habitats

within the species' potential range on Vancouver Island and in the Lower Fraser Valley. These factors also contribute to degradation of habitat quality in small habitat patches.

2. *Invasive and exotic species.* Interactions with exotic organisms, such as alien gastropods, through competition and/or predation are threats to native gastropods. Exotic plants and animals are common on southern Vancouver Island and the Lower Fraser Valley, especially in disturbed habitats and urban areas. These organisms include numerous exotic species of gastropods (Forsyth 1999, 2001). Some species, such as the Chocolate Arion slug (*Arion rufus* L.), are widespread and have also penetrated into forested areas. Exotic species may compete with Puget Oregonian snail for food or refuges. Carnivorous species, such as the Dark-bodied Glass-snail (*Oxychilus draparnaudi* Beck), may prey on their eggs and young.
3. *Pesticide use.* Use of general pesticides, especially those aimed at gastropods and herbicides to control regeneration of bigleaf maple on commercial forestry lands can threaten populations. These trees can compete with conifers on plantations, and herbicide treatments (either stump or foliage applications) used to control their growth can potentially harm or reduce habitat available to land snails.

## **Actions Already Completed or Underway**

The past and ongoing work involving Puget Oregonian snail has focused on inventories. The COSEWIC status report for Puget Oregonian (2002) summarized surveys for terrestrial gastropods that have been conducted within the potential range of this species in British Columbia. Additional surveys have been completed since the preparation of the status report (see Appendix A). Few workers have searched for terrestrial gastropods on Vancouver Island and Lower Fraser Valley over the past few decades, but a relative large number of sites (> 600) have been surveyed at least once. Two studies (Ovaska *et al.* 2001; Ovaska and Sopuck 2002a) specifically focused on this and other species deemed to be at risk and their potential habitats. None of the surveys located Puget Oregonian snail.

## **Knowledge Gaps**

In British Columbia, the distributions of terrestrial gastropods are not well known. It is important to ascertain that no remnant populations of Puget Oregonian snail have been overlooked and thus inventory is the primary knowledge gap. This information is needed both to protect such possible populations and to evaluate the need and potential for experimental re-establishments. Knowledge gaps include captive breeding and re-establishment information, general life history and breeding information, habitat requirements at the landscape, stand and micro-scale, clarification of site specific habitat threats, as well as potential disease, predators and ecosystem role.

## **RECOVERY**

### **Recovery Feasibility**

Recovery is “the process by which the decline of an endangered, threatened or extirpated species is arrested or reversed, and the threats removed or reduced to improve the likelihood of the species persistence in the wild. A species will be considered recovered when its long-term

persistence in the wild has been secured” (Environment Canada *et al.* 2005). Recovery of Puget Oregonian snail depends upon locating at least one population, eliminating threats to this population, and otherwise ensuring its survival.

As with many other rare species, little is known about the historical distribution of Puget Oregonian snail. Nothing indicates that this species was ever abundant or widespread in B.C. No data exist on the habitat and ecology of this species and population viability cannot be estimated. Recovery of Puget Oregonian snail is technically and ecologically feasible (see recovery criteria questions below), and the recovery framework for species at risk in British Columbia will assist in this process.

**1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?**

Yes. No populations of Puget Oregonian are known from Canada. Recent locality records closest to the Canadian border are in the Seattle area, approximately 125 km away (“Survey and Manage” database; N. Duncan, pers. comm., 2003). The populations within the Seattle area would be the closest source population and, in theory, are available as a source population if reintroduction is deemed feasible and no populations are located within Canada. Before reintroduction trials, a series of genetic tests and feasibility studies would need to occur. The protocols for this would be written in the action plan for the species.

**2. Is sufficient habitat available to support the species or could it be made available through habitat management or restoration?**

Yes. Scattered stands of moist, older forest with a high component of bigleaf maple are present on southern Vancouver Island and in the Lower Fraser Valley; all of these stands could be potential habitat for Puget Oregonian.

**3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?**

Yes. Threats to potential habitats of Puget Oregonian snail will always be present. Most potential habitats are subject to some degree of human disturbance, including recreational activities within protected areas. Within these areas it might be possible to manage and control human access to sites if the species is found or potential high-quality habitats suitable for possible re-establishment are available. Once exotic species of gastropods have become established, it is difficult, if not impossible, to eliminate them. Efforts could be expended on preventing their spread into new areas, especially within parks and protected areas, by limiting transport of nursery products and building materials among sites and by appropriate disposal of garden waste. Before any re-establishments are considered, a detailed assessment of the quality of potential habitats and threat factors operating in these habitats is necessary.

**4. Do the necessary recovery techniques exist and are they known to be effective?**

Yes. Little information is available on captive breeding of Puget Oregonian snail; however, other polygyrid snails, such as the Oregon Forestsnail (*Allogona townsendiana*) and Northwest Hesperian (*Vespericola columbianus*), oviposit in captivity and can be reared with relative ease (K. Ovaska, unpubl. data). Captive breeding may take place to gain knowledge regarding this species’ life history and reproductive capabilities, although if captive breeding was to occur it

would likely take place outside of Canada. Techniques used to recover this species are similar to the recovery planning applied to species with similar threats, issues, and requirements, both from an ecological perspective and a social perspective. None of the proposed recovery techniques likely to be applied to the recovery of this species are thought of as highly experimental by the academic community, gastropod experts, or the recovery team members.

## Recovery Goal

The recovery goal is to confirm the presence/absence of Puget Oregonian snail within the species' historic range and protect<sup>1</sup> any extant population(s) if found.

## Recovery Objectives (2007 – 2017)

- I. To survey all historical sites and areas of potential habitat and locate any existing population(s) of Puget Oregonian by 2017.
- II. To implement habitat protection<sup>1</sup> and threat mitigation for any populations located by 2017.
- III. To investigate feasibility and need to re-establish populations by 2017.

## Approaches Recommended to Meet Recovery Objectives

The recommended approach consists of integrating survey efforts and public education initiatives into projects that cover multiple species and the coastal Douglas-fir, bigleaf maple ecosystem. Several other gastropod species that are deemed to be at risk occur within potential areas for Puget Oregonian snail (see Effects on Other Species section), and these species can be surveyed with similar methods. Strategies and specific steps required to meet the objectives are shown in Table 1.

The broad strategies to address the threats:

- I. *Inventory* – survey historic locations and additional suitable habitat.
- II. *Site protection* – protect<sup>1</sup> any extant populations and their habitats.
- III. *Research* – explore the feasibility of and identify potential sites for reintroduction and potential threats at these sites
- IV. *Education* – link public education programs and habitat stewardship to other species and existing programs.

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<sup>1</sup> Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas.

## Recovery planning table

**Table 1.** Recovery Planning Table

Priority	Broad Approach	Obj. no.	Threat	Recommended approaches to meet recovery objectives	Performance Measures
High	Inventory	I-III	I-III	<ul style="list-style-type: none"> <li>○ Draft an <i>Inventory Strategy for Puget Oregonian snail</i>, a document that describes a scheduled approach to surveying historically occupied sites and areas of potential habitat for Puget Oregonian, including procedures for long-term monitoring of any newly found populations. Survey sites would include areas within the bigleaf maple areas (Figure 3).</li> <li>○ Within the Inventory Strategy for Puget Oregonian snail, identify and record potential threats at each historic and newly surveyed location.</li> <li>○ Build a detailed habitat map for the likely range of Puget Oregonian snail, showing the distribution of potential bigleaf maple habitats within the species' historic range.</li> </ul>	<ul style="list-style-type: none"> <li>○ Confirmation of presence of Puget Oregonian snail.</li> <li>○ Percentage of potential habitat surveyed.</li> <li>○ Detailed habitat map of sites searched for Puget Oregonian, showing habitat and quality assessment of habitat.</li> <li>○ Identification and confirmation of real threats to the habitat at each site.</li> </ul>
High	Site Protection	II	I - III	<ul style="list-style-type: none"> <li>○ If a population is located, work towards effective protection<sup>1</sup> for the site(s).</li> </ul>	<ul style="list-style-type: none"> <li>○ Number of extant populations and their habitats protected<sup>1</sup>.</li> </ul>
Low	Research	III	I-III	<ul style="list-style-type: none"> <li>○ Establish research contacts with biologists and the appropriate government agencies in the United States, to learn more about Puget Oregonian snail.</li> <li>○ Explore the feasibility of reintroductions of the snail with those biologists in the United States.</li> <li>○ Identify the invasive species that may further threaten the Puget Oregonian snail.</li> <li>○ Support further research into the threats to Puget Oregonian snail</li> </ul>	<ul style="list-style-type: none"> <li>○ Contact with US researchers working on projects involving Puget Oregonian snail; further understanding of species within it's natural environment</li> </ul>
Low	Education	I-II	I-III	<ul style="list-style-type: none"> <li>○ Develop an outreach program for gastropod species at risk and the threats to these species, in conjunction with the <i>South Coast</i></li> </ul>	<ul style="list-style-type: none"> <li>○ Number of landowners who have had their property searched for Puget</li> </ul>

Priority	Broad Approach	Obj. no.	Threat	Recommended approaches to meet recovery objectives	Performance Measures
				<p><i>Conservation Program - Outreach Recovery</i></p> <p>Implementation Group – target audiences include consultants conducting wildlife assessments, foresters, land owners/users which have suitable habitat on their properties and the public.</p> <ul style="list-style-type: none"> <li>○ Develop an approach to establishing stewardship agreements, covenants, or other relevant partnerships with private owners of suitable Puget Oregonian snail habitat, in conjunction with other species and habitats at risk.</li> </ul>	<p>Oregonian.</p> <ul style="list-style-type: none"> <li>○ Consultants and biologists know how to identify this species and considered them during wildlife assessments leading to an increased probability of detection.</li> <li>○ Number of resource materials where Puget Oregonian has been integrated into the material.</li> </ul>

## Performance Measures

Criteria for evaluating progress towards achieving the goals and objectives of this strategy are listed in Table 1.

## Critical Habitat

### Identification of the species' critical habitat

No critical habitat, as defined under the federal *Species at Risk Act* [S.2], is proposed for identification at this time. The critical habitat for Puget Oregonian snail cannot be identified because the species was last recorded prior to 1889 and specific habitat information is not available. If a population of Puget Oregonian snail is found, a schedule of studies to identify critical habitat will be prepared, and critical habitat will be identified within an action plan for this species within five years of the date of finding the population.

## Existing and Recommended Approaches to Habitat Protection

If a population of Puget Oregonian snail is found, the habitat should be a priority for protection. If the habitat is private land, landowner contact should be initiated and best management practices be made available to the landowner. If the habitat is Crown owned, legislative protection measures should be implemented. If the land is regional or municipally owned, contact these governments and make best management practices available.

Stewardship involves voluntary cooperation of all Canadian society to protect species at risk and the ecosystems they rely on. The Preamble to the federal *Species at Risk Act* states that “stewardship activities contributing to the conservation of wildlife species and their habitat should be supported” and that “all Canadians have a role to play in the conservation of wildlife

in this country, including the prevention of wildlife species from becoming extirpated or extinct.” For successful implementation of species at risk protection measures, there is a strong need for engaging stewardship activities on various land tenures, including municipal, regional, provincial and federal lands.

## Effects on Other Species

Bigleaf maple ecosystems, the preferred habitat of Puget Oregonian snail, would benefit from a detailed evaluation of the quality of these habitats and an assessment of potential threats/conflicts facing them from human activities (beneficial effects rated “probable”). Although these trees are relatively common at lower elevations and latitudes in southwestern British Columbia, mixed-wood stands with a high proportion (>15%) of this species including groves of old trees, are uncommon. Such stands often have high biodiversity values. For example, older bigleaf maples support remarkable and luxuriant epiphyte (moss, lichen, liverwort, fern) communities on their trunks, stems, and branches; they contribute significantly to nutrient cycling and calcium sequestration through the weight of their leaf fall, high nutrient content, and relatively rapid decay rates; and they provide abundant coarse woody debris and nurse logs when they fall (Peterson *et al.* 1999).

Inventory efforts directed toward locating possible remnant populations of Puget Oregonian snail have the potential to increase available information on distributions and habitat associations of other species of our native terrestrial gastropods, including species at risk. Species deemed to be at risk that might benefit from such surveys include:

1. Oregon Forestsnail (*Allogona townsendiana*) (COSEWIC 2002, Endangered). The two species occupy somewhat similar habitats elsewhere within their range (Pilsbry 1940);
2. Blue-grey Taildropper slug (*Prophysaon coeruleum* Cockerell) (COSEWIC 2006, Endangered). The sole locality for this species is in the general area of a historical record for Puget Oregonian snail on southern Vancouver Island, and the two species have similar habitat requirements (Kelley *et al.* 1999);
3. Warty Jumping-slug (*Hemphillia glandulosa* Bland and W.G. Binney) (COSEWIC 2003, Special Concern). This species is found on southern Vancouver Island in a variety of forest types, including habitats where Puget Oregonian snail might occur; and
4. Tall bugbane (*Actaea elata* Nutt.) (COSEWIC 2001, Endangered). This species lives in mixed-wood forests with high moisture retention.
5. Ecosystems, including older deciduous stands, with a component of bigleaf maple and an extensive epiphyte component that includes club moss (*Selaginella oregana* D.C.Eaton) and abundant true mosses *Hylocomium splendens* (Hedwig) Schimper, *Leucolepis menziesii* (Hook.), *Isoetecium stoloniferum* (Brid.), and *Neckera menziesii* (Hook.). Lichens (*Cladonia*, *Nephroma*, and *Crocynia* spp.) and licorice fern (*Polypodium glycyrrhiza* D.C.Eaton).

Outreach programs that include Puget Oregonian snail are expected to benefit other native gastropods, as well as raise the profile of their forest habitats.

## **Socioeconomic Considerations**

Recovery of Puget Oregonian snail is not expected to have extensive socio-economic implications. A detailed review of the socio-economic considerations will be completed in the action plan for this species, which will be drafted if a population of Puget Oregonian snail is located. The main considerations involve urban/agricultural development of the remaining older growth mixed-wood and riparian forests where these species live, as well as potential recreational opportunities within these forests. The historic range of Puget Oregonian snail is widely used for recreation, particularly low-elevation areas that are easily accessible by foot and automobile. The area is highly urbanized and fragmented; the remaining low elevation habitats are shrinking and are becoming further degraded by human use.

## **Recommended Approach for Recovery Implementation**

A single-species approach is taken because of the extirpated status of the species, which requires special considerations (such as possible re-establishments). However, the approaches recommended for recovery, especially those that focus on survey efforts, can and should incorporate multiple species, including other gastropod species deemed to be at risk that occupy similar habitats and can be surveyed with the same methods. Stands with a large component of bigleaf maple, especially with groves of old, epiphyte-draped trees, are productive ecosystems for a large array of organisms, including plants, invertebrates, and vertebrates (Peterson *et al.* 1999). Efforts expended to delineate these stands and to assess their quality will assist in the management of these remarkable ecosystems and all the species that they contain. This species is included within the South Coast Conservation Program.

## **Statement on Action Plans**

A recovery action plan for Puget Oregonian snail is scheduled for completion by March 2012. This recovery action plan will be combined with other gastropod species at risk (Oregon Forestsnail, Dromedary Jumping-slug, and Blue-grey Taildropper slug).

## REFERENCES

British Columbia Ministry of Forests. 2001. Tree book.

<<http://www.for.gov.B.C.ca/hfd/library/documents/treebook/bigleafmaple.htm>> Accessed [March 2005]

\_\_\_\_\_. 1999. The ecology and silviculture of bigleaf maple. Victoria, BC. Extension Note 33:1–5. <<http://www.for.gov.B.C.ca/hfd/pubs/Docs/En/En33.pdf>> Accessed [February 2003]

British Columbia Ministry of Sustainable Resource Development. 2005. Sensitive Ecosystems Inventory Website. <[http://srmwww.gov.B.C.ca/sei/van\\_gulf/technical/sec4211.html#426](http://srmwww.gov.B.C.ca/sei/van_gulf/technical/sec4211.html#426)> Accessed [March 2005]

Burke, T.E. 1999. Management recommendations for terrestrial mollusk species. *Cryptomastix devia*, Puget Oregonian snail. V. 2.0. Prepared for Oregon Bureau Land Manage. 33 p. <[http://www.or.blm.gov/surveyandmanage/MR/TM4Species/2000-015\\_1.pdf](http://www.or.blm.gov/surveyandmanage/MR/TM4Species/2000-015_1.pdf)> Accessed [February 2003]

Cameron, R.A.D. 1986. Environment and the diversities of forest snail faunas from coastal British Columbia. *Malacologia* 27:341–355.

Centre for Forest Gene Conservation, University of British Columbia. 2002. Bigleaf maple. Vancouver, BC. <<http://genetics.forestry.ubc.ca/cfgc/>> Accessed [February 2003]

Chen, J., J.F. Franklin, and T.A. Spies. 1995. Growing-season microclimatic gradients from clearcut edges into old-growth Douglas-fir forests. *Ecol. Applic.* 5:74–86.

Capital Regional District (CRD). 2002a. Report on the environment: monitoring trends in the Capital Regional District. <<http://www.crd.B.C.ca/rte/report/p-c1.htm>> Accessed [February 2003]

\_\_\_\_\_. 2002b. Natural areas atlas. <<http://www.crd.B.C.ca/es/natatlas>> Accessed [February 2003]

Dall, W.H. 1905. Land and fresh water mollusks. Harriman Alaska Expedition 8:i–xii, 1–171.

Environment Canada. 2002. Species at Risk.

<[http://www.speciesatrisk.gc.ca/strategy/SARA\\_FAQs\\_e.cfm](http://www.speciesatrisk.gc.ca/strategy/SARA_FAQs_e.cfm)> Accessed [January 2003]

Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada. 2005. Species at Risk Act Policy: recovery – draft policy on the feasibility of recovery. April 15, 2005.

Ottawa, ON

Forsyth, R.F. 1999. Distribution of nine new or little-known exotic land snails in British

- Columbia. *Can. Field-Nat.* 113:559–568.
- \_\_\_\_\_. 2001. First records of the European land slug *Lehmannia valentiana* in British Columbia, Canada. *Festivus* 33:75–78.
- Forsyth, R.G. 2004. Land snails of British Columbia. Royal B.C. Museum, Victoria, BC. 188 p.
- Kelley, R.S., N. Duncan, and T. Burke. 1999. Field guide to survey and manage terrestrial mollusk species from the Northwest Forest Plan. Oregon Bureau Land Manage. 114 p.
- Lawton, J.H. 1993. Range, population abundance and conservation. *Trends Ecol. Evol.* 8:409–413.
- MacKinnon, A. and M. Eng. 1995. Old forests: Inventory for coastal British Columbia. *Cordillera* 2(1):20–33.
- NatureServe. 2008. Vertebrate data summary. Version 1.3 updated 1 July 2003.  
<<http://www.natureserve.org/explorer/sumvert.htm>> Accessed [January 2008]
- New, T.R. 1995. An introduction to invertebrate conservation biology. Oxford Univ. Press, Oxford, UK. 194 p.
- Ovaska, K. and R.G. Forsyth. 2002. COSEWIC status report on Puget Oregonian snail snail. Unpubl. rep. for Committee on the Status of Endangered Wildlife in Canada. Victoria, BC. 22 pp.
- Ovaska, K. and L. Sopuck. 2000. Evaluation of the potential of terrestrial gastropods (slugs and snails) for monitoring ecological effects of logging practices on forest-floor conditions on Vancouver Island, British Columbia. A pilot study, October–November 1999. Unpubl. rep. by Biolinx Environmental Research Ltd. for Weyerhaeuser Co. Ltd., Nanaimo, BC. 44 p.
- \_\_\_\_\_. 2001. Potential of terrestrial gastropods and salamanders as indicators for monitoring ecological effects of variable-retention logging practices. Unpubl. rep. by Biolinx Environmental Research Ltd. for Weyerhaeuser Co. Ltd., Nanaimo, BC. 105 p.
- \_\_\_\_\_. 2002a. Surveys for terrestrial and freshwater molluscs on DND lands near Victoria, Vancouver Island, British Columbia. Unpubl. rep. by Biolinx Environmental Research Ltd. for DND/CFS Natural Resources Management Program, CFB Esquimalt, Victoria, BC. 56 p.
- \_\_\_\_\_. 2002b. Terrestrial gastropods and salamanders as indicators for monitoring ecological effects of variable-retention logging practices. A pilot study, May–October 2001. Unpubl. rep. by Biolinx Environmental Research Ltd. for Weyerhaeuser Co. Ltd., Nanaimo, BC. 72 pp.

- \_\_\_\_\_. 2003a. Inventory of rare gastropods in southwestern British Columbia. Unpubl. rep. by Biolinx Environmental Research Ltd. for Biodiversity Branch, Terrestrial Ecosystems Science Section, B.C. Min. Water, Land and Air Protection, Victoria, BC.
- \_\_\_\_\_. 2003b. Terrestrial gastropods as indicators for monitoring ecological effects of variable-retention logging practices. Pre-disturbance surveys at experimental sites, May–October 2002. Unpubl. rep. by Biolinx Environmental Research Ltd. for Weyerhaeuser Co. Ltd., Nanaimo, BC.
- \_\_\_\_\_. 2005. Inventory of rare gastropods in southwestern British Columbia. Unpubl. rep. by Biolinx Environmental Research Ltd. for Biodiversity Branch, Terrestrial Ecosystems Science Section, B.C. Min. Water, Land and Air Protection, Victoria, BC.
- \_\_\_\_\_. 2006. Inventory of rare gastropods in lower mainland, British Columbia. Unpubl. rep. by Biolinx Environmental Research Ltd. for Biodiversity Branch, Terrestrial Ecosystems Science Section, B.C. Min. Environ., Victoria, BC.
- \_\_\_\_\_. [2007]. Inventory of rare gastropods in southwestern Vancouver Island, British Columbia. Unpubl. rep. by Biolinx Environmental Research Ltd. for B.C. Environ., Biodiversity Branch, Terrestrial Ecosystems Science Section, Victoria, BC. In preparation.
- Ovaska, K., L. Chichester, H. Reise, W.P. Leonard, and J. Baugh. 2002. Anatomy of and new distributional records for the Dromedary Jumping-slug, *Hemphillia dromedarius* Branson 1972 (Gastropoda: Stylommatophora: Arionidae). *Nautilus* 116:89–94.
- Ovaska, K., R.G. Forsyth, and L.G. Sopuck. 2001. Surveys for potentially endangered terrestrial gastropods in southwestern British Columbia, April–November, 2000–2001. Final report. Unpubl. rep. by Biolinx Environmental Research Ltd., Sidney, BC, for the Endangered Species Recovery Fund and Wildlife Habitat Canada. 47 p.
- Peterson, E.B., N.M. Peterson, P.G. Comeau, and K.D. Thomas. 1999. Bigleaf maple managers' handbook for British Columbia. B.C. Min. For., Research Program, Victoria, BC.  
<<http://www.for.gov.B.C.ca/hfd/pubs/docs/mr/Mr090/Mr090-1.pdf>> Accessed [February 2003]
- Pilsbry, H.A. 1940. Land mollusca of North America (north of Mexico). *Acad. Nat. Sci. Philadelphia, Monogr.* 3, 1(2):575–994, i–ix.
- Pfeiffer, L. 1850. Descriptions of twenty-four new species of *Helicea*, from the collection of H. Cuming, Esq. *Proc. Zool. Soc. Lond.* 17:126–131.

- Pollard, E. 1975. Aspects of the ecology of *Helix pomatia*. *J. Anim. Ecol.* 44:305–329.
- Primack, R.B. 1993. *Essentials of conservation biology*. Sinauer Associates, Sunderland, MA. 564 p.
- \_\_\_\_\_. 2000. *A primer of conservation biology*. 2nd ed. Sinauer Associates, Sunderland, MA. 319 pp.
- Taylor, G.W. 1889. The land snails of Vancouver Island. *Ottawa Nat.* 3:84–94.
- Tompa, A.S. 1984. Land snails (Stylommatophora). Pages 51–140 *in* K.M. Wilbur (editor in chief) and A.S. Tompa, N.H. Verdonk, and J.A.M. van den Biggelaar, eds. *The Mollusca*. Vol. 7. *Reproduction*. Academic Press Inc., New York.
- U.S. Department of Agriculture Forest Service and U.S. Department of the Interior, Bureau of Land Management. (undated). *Background on survey and manage and protection buffer standards and guidelines*.  
<http://www.or.blm.gov/ForestPlan/Survey%20and%20Manage/FY99%20Surveys/background.htm> Accessed [February 2003]
- Wood, P.M. 1997. Biodiversity as the source of biological resources: a new look at biodiversity values. *Environ. Values* 6(3):251–68.
- \_\_\_\_\_. 2004. Intergeneration justice and curtailments on the discretionary powers of governments. *Environ. Ethics* 26(4):411–428.
- Wood, P.M. and L. Flahr. 2004. Taking endangered species seriously? British Columbia's species-at-risk policies. *Can. Public Policy* 30(4):381–399.

### **Personal Communications**

- Burke, Tom. April 2002. Wildlife Biologist, Wenatchee National Forest, Entiat Ranger District, Washington. (member of Interagency Survey and Manage Mollusk Taxa Team), 616 Chinook, Wenatchee, WA 98801. Tel: (509) 665-0455. Email: burketc4@gte.net.
- Duncan, Nancy. February 2003. Roseburg District, Washington and Oregon Bureau of Land Management, 777 Garden Valley Blvd., Roseburg, OR 97470. Tel: (541) 464-3338, Fax: (541) 440-4948. Email: nduncan@or.blm.gov.
- Frest, Terrence. February 2003. Deixis Consultants, Seattle, WA. Email: tjfrest@earthlink.net.
- Kogut, Tom. February 2003. District Wildlife Biologist, Cowlitz Valley Ranger District, USDA Forest Service, Pacific Northwest Region, Randle, WA 98377. Tel: (360) 497-1131. Email:

tkogut@fs.fed.us

Ovaska, Kristiina. January 2004. Senior researcher. Biolinx Environmental Research Ltd., 4180 Clinton Place, Victoria, BC V8Z 6M1 Email: kovaska@jdmicro.com

## Websites

B.C. Conservation Data Centre Species and Ecosystems Explorer:

<<http://srmwww.gov.bc.ca/atrisk/toolintro.html>>

B.C. Forest Practices Code: <<http://www.for.gov.bc.ca/tasb/legsregs/fpc/>>

B.C. Forest and Range Practices Act: <<http://www.for.gov.bc.ca/code/>>

B.C. Identified Wildlife Management Strategy: <<http://wlapwww.gov.B.C.ca/wld/identified/>>

B.C. Stewardship Centre: <[www.stewardshipcentre.bc.ca](http://www.stewardshipcentre.bc.ca)>

B.C. Wildlife Act: <[http://www.qp.gov.bc.ca/statreg/stat/W/96488\\_01.htm](http://www.qp.gov.bc.ca/statreg/stat/W/96488_01.htm)>

B.C. Wildlife Amendment Act: <[http://www.legis.gov.bc.ca/37th5th/1st\\_read/gov51-1.htm](http://www.legis.gov.bc.ca/37th5th/1st_read/gov51-1.htm)>

Capital Regional District: <[www.crd.bc.ca](http://www.crd.bc.ca)>

Federal Species At Risk Act: <[http://www.sararegistry.gc.ca/default\\_e.cfm](http://www.sararegistry.gc.ca/default_e.cfm)>

Fraser Valley Regional District: <<http://www.fvrd.com/>>

Greater Vancouver Regional District: <<http://www.gvrd.ca/growth/biodiversity.htm>>

## **APPENDIX A**

### **Summary of recent gastropod surveys and the scope of each survey. No Puget Oregonian occurrences were found during these surveys.**

1. Inventory of Rare Gastropods in Southern Vancouver Island, British Columbia, 2006 (Ovaska and Sopuck 2007, in prep.), British Columbia Ministry of Environment
2. Inventory of Rare Gastropods in Lower Mainland British Columbia, 2006 (Ovaska and Sopuck 2006), British Columbia Ministry of Environment
3. Inventory of Rare Gastropods in Southwestern British Columbia, 2005 (Ovaska and Sopuck 2005), British Columbia Ministry of Environment
4. Inventory of Rare Gastropods in Southwestern British Columbia, June 2003 (Ovaska and Sopuck 2003a)
5. Surveys for terrestrial and freshwater molluscs on Department of National Defense (DND) lands near Victoria, Vancouver Island, in March and September–October 2002 (Ovaska and Sopuck 2002a)
6. Surveys for potentially endangered terrestrial gastropods in southwestern British Columbia, 2000 and 2001 (Ovaska *et al.* 2001)
7. Research on effects of forestry practices on terrestrial gastropods, 1999–2002 (Ovaska and Sopuck 2000, 2001, 2002, 2003)
8. Surveys by Robert Forsyth for gastropods in British Columbia, 1990–present
9. Surveys for terrestrial gastropods by R.A.D. Cameron on Vancouver Island and in Lower Fraser Valley, 1984 (Cameron 1986)

**APPENDIX B****Historical records for Puget Oregonian snail in British Columbia (from Ovaska and Forsyth 2002)**

<b>Name used in citation</b>	<b>Locality</b>	<b>Collector reference</b>	<b>Notes</b>
<i>Helix baskervillei</i>	Vancouver Island	Pfeiffer 1849:130	Described from material in the H. Cuming collection (Natural History Museum, London)
<i>Mesodon devius</i>	Esquimalt <sup>b</sup>	Taylor 1889:85, 91	
<i>Mesodon devius</i>	Vancouver Island	Taylor 1891a:92	Based on Taylor 1889
<i>Polygyra devia</i>	Esquimalt	Dall 1905:24	Based on Taylor 1889
<i>Polygyra devia</i>	Sumas Prairie <sup>c</sup>	Dall 1905:24	
<i>Triodopsis devia</i>	Vancouver Island	Pilsbry 1940:857	Based on earlier published records
<i>Triodopsis devia</i>	British Columbia	La Rocque 1953:307	Based on earlier published records

<sup>a</sup> Without further locality.

<sup>b</sup> Near Victoria, Vancouver Island, BC.

<sup>c</sup> Present-day Abbotsford/Chilliwack, Fraser Valley, BC.