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

Multispecies Management Plan for the Magnum Mantleslug (*Magnipelta mycophaga*), Pygmy Slug (*Kootenaia burkei*), and Sheathed Slug (*Zacoleus idahoensis*) in Canada

Magnum Mantleslug, Pygmy Slug, and Sheathed Slug

2023

Environment Canada Environnement Canada

Canada

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The official version of the recovery documents is the one published in PDF. All hyperlinks were valid as of date of publication.

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The non-official version of the recovery documents is published in HTML format and all hyperlinks were valid as of date of publication.

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

Cover illustration: © Kristiina Ovaska (all photographs)

Également disponible en français sous le titre
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[1] www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

MULTISPECIES MANAGEMENT PLAN FOR THE MAGNUM MANTLESLUG (*MAGNIPELTA MYCOPHAGA*), PYGMY SLUG (*KOOTENAIA BURKEI*), AND SHEATHED SLUG (*ZACOLEUS IDAHOENSIS*) IN CANADA

2023

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

In the spirit of cooperation of the Accord, the Government of British Columbia has given permission to the Government of Canada to adopt the *Multispecies Management Plan for Magnum Mantleslug (*Magnipelta mycophaga*), Pygmy Slug (*Kootenaia burkei*), and Sheathed Slug (*Zacoleus idahoensis*) in British Columbia* (Part 2) under Section 69 of the *Species at Risk Act* (SARA). Environment and Climate Change Canada has included a federal addition (Part 1) which completes the SARA requirements for this management plan.

The federal management plan for the Mangum Mantleslug, Pygmy Slug, and Sheathed Slug in Canada consists of two parts:

Part 1 – Federal Addition to the *Multispecies Management Plan for Magnum Mantleslug (*Magnipelta mycophaga*), Pygmy Slug (*Kootenaia burkei*), and Sheathed Slug (*Zacoleus idahoensis*) in British Columbia*, prepared by Environment and Climate Change Canada.

Part 2 – *Multispecies Management Plan for Magnum Mantleslug (*Magnipelta mycophaga*), Pygmy Slug (*Kootenaia burkei*), and Sheathed Slug (*Zacoleus idahoensis*) in British Columbia*, prepared by the British Columbia Ministry of Environment and Climate Change Strategy.

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Part 1 – Federal Addition to the *Multispecies Management Plan for Magnum Mantleslug (Magnipelta mycophaga), Pygmy Slug (Kootenaia burkei), and Sheathed Slug (Zacoleus idahoensis)in British Columbia*, prepared by Environment and Climate Change Canada

Preface

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

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Magnum Mantleslug, and the Minister of Environment and Climate Change is the competent minister under SARA for the Pygmy Slug and the Sheathed Slug. The competent minister has prepared the federal component of this management plan (Part 1), as per section 65 of SARA. To the extent possible, it has been prepared in cooperation with the Province of British Columbia as per section 66(1) of SARA. SARA section 69 allows the competent minister to adopt all or part of an existing plan for the species if the competent minister is of the opinion that an existing plan relating to wildlife species includes adequate measures for the conservation of the species. The Province of British Columbia provided the attached multi-species management plan for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug (Part 2) as science advice to the jurisdictions responsible for managing the species in British Columbia. It was prepared in cooperation with Environment and Climate Change and the Parks Canada Agency.

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this plan and will not be achieved by Environment and Climate Change Canada, and/or the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this plan for the benefit of the Magnum Mantleslug, Pygmy Slug, and Sheathed Slug and Canadian society as a whole.

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

[2] www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

Additions and Modifications to the Adopted Document

The following sections have been included to address specific requirements of the federal *Species at Risk Act* (SARA) that are not addressed in the *Multispecies Management Plan for Magnum Mantleslug (*Magnipelta mycophaga*), Pygmy Slug (*Kootenaia burkei*), and Sheathed Slug (*Zacoleus idahoensis*) in British Columbia* (Part 2 of this document, referred to henceforth as "the provincial management plan") and/or to provide updated or additional information.

Under SARA, prohibitions regarding the protection of species and their habitat do not apply to species of special concern. Conservation measures in the provincial management plan dealing with the protection of individuals and their habitat are still adopted to guide conservation efforts but would not result in federal legal protection.

1. Species Status Information

This section replaces information on the species status information and SARA legal designation for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug in Canada in Section 2 of the provincial management plan.

The legal designations of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug on SARA Schedule 1 are Special Concern (2017, 2019, and 2019 respectively).

Table 1. Conservation Status of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug (from NatureServe 2021*, and B.C. Conservation Data Centre 2021).

	Global (G) Rank*	National (N) Rank*	Sub-national (S) Rank*	COSEWIC Status	B.C. List**
Magnum Mantleslug	G3	Canada (N2N3)	British Columbia (S2S3) Idaho (S2) Montana (S2S3) Washington (S2)	Special Concern (2012)	Blue List
Pygmy Slug	G3	Canada (N3)	British Columbia (S3) Idaho (S5) Montana (S1S2)	Special Concern (2016)	Blue List
Sheathed Slug	G3G4	Canada (N3?)	British Columbia (S3?) Idaho (S5) Montana (S2S3) Washington (SNR)	Special Concern (2016)	Blue List

* Rank 1– critically imperiled; 2– imperiled; 3- vulnerable to extirpation or extinction; 4- apparently secure; 5– secure.
** Blue List is defined by the B.C. Conservation Data Centre as "Any species or ecosystem that is of special concern."

2. Management Goals and Objectives

The provincial multispecies management plan contains a management goal and objectives i.e. Part 2, Section 5 for the recovery of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug. Environment and Climate Change Canada adopts the management

goal rationale (i.e. Part 2, Section 5.2) and management objectives (i.e. Part 2, Section 5.3), with the following modifications:

Management Objective

The management goal is to improve the redundancy[3] of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug in Canada by addressing human-caused threats that are contributing to a decline in the area, extent, quality, and connectivity of suitable habitat for known subpopulations within the species' known ranges in Canada, including any additional subpopulations that may be identified in the future.

Additional Rationale for the Management Objective

The overall management objective aims to ensure that habitats of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug are maintained in a suitable condition for these species and that both landscape and subpopulation connectivity are maintained or restored to the extent possible. It is assumed that if habitat is secure and other human-caused threats mitigated, subpopulations of the slugs will persist. All three species have relatively small areas of occupancy, combined with ongoing threats that result in continuing habitat loss, degradation, and fragmentation. Preventing habitat loss and degradation at locations with known extant subpopulations, and minimizing further fragmentation within known distribution ranges for these species will be necessary to ensure that the number of subpopulations stays above thresholds that may otherwise warrant consideration for reassessment of these species into higher risk categories.

3. Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[4]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's (FSDS)[5] goals and targets.

[3] Redundancy refers to the number of (sub) populations and/or the degree to which the species is widespread (the relevant metric of redundancy will depend on the circumstance). A species that has multiple (sub) populations or locations, or a distribution that is very widespread, is more likely to persist over the long term because of reduced risk of catastrophic loss or extirpation from a single, local event. If one (sub) population becomes destroyed, others may be able to act as a source population.
[4] www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html
[5] www.fsds-sfdd.ca/index.html#/en/goals/

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

The provincial management plan for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug contains a section describing the effects of management activities on other species (i.e., Section 8). Environment and Climate Change Canada adopts this section of the provincial management plan as the statement on effects of management activities on the environment and other species. Management planning activities for the Magnum Mantleslug, Pygmy Slug, and Sheathed Slug will be implemented with consideration for all co-occurring species at risk, such that any potential negative impacts to these species or their habitats are mitigated or avoided. Some management actions for the Magnum Mantleslug, Pygmy Slug, and Sheathed Slug (e.g., inventory and habitat protection) may promote the conservation of other species at risk that overlap in distribution and rely on similar habitat attributes.

4. References

B.C. Conservation Data Centre. 2021. Species Summary: *Kootenaia burkei*. BC Species and Ecosystems Explorer. B.C. Ministry of Environment, Victoria B.C. Available: http://a100.gov.bc.ca/pub/eswp/ (Accessed: November 3, 2021).

B.C. Conservation Data Centre. 2021. Species Summary: *Magnipelta mycophaga*. BC Species and Ecosystems Explorer. B.C. Ministry of Environment, Victoria B.C. Available: http://a100.gov.bc.ca/pub/eswp/ (Accessed: November 3, 2021).

B.C. Conservation Data Centre. 2021. Species Summary: *Zacoleus idahoensis*. BC Species and Ecosystems Explorer. B.C. Ministry of Environment, Victoria B.C. Available: http://a100.gov.bc.ca/pub/eswp/ (Accessed: November 3, 2021).

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NatureServe. 2021. NatureServe Explorer [web application]. NatureServe, Arlington, Virginia. Available https://explorer.natureserve.org. *Zacoleus idahoensis* page: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.114211/Zacoleus_idahoensis (Accessed: November 3, 2021).

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Prepared by British Columbia Ministry of Environment and Climate Change Strategy

BRITISH COLUMBIA

September 2018

About the British Columbia Management Plan Series

This series presents the management plans that are prepared as advice to the Province of British Columbia. The Province prepares management plans for species that may be at risk of becoming endangered or threatened due to sensitivity to human activities or natural events.

What is a management plan?

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

What's next?

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

For more information

To learn more about species at risk recovery planning in British Columbia, please visit the B.C. Recovery Planning webpage at:
<http://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/species-ecosystems-at-risk/recovery-planning>

Multispecies Management Plan for Magnum Mantleslug (*Magnipelta mycophaga*), Pygmy Slug (*Kootenaia burkei*), and Sheathed Slug (*Zacoleus idahoensis*) in British Columbia

Prepared by the B.C. Ministry of Environment and Climate Change Strategy

September 2018

Recommended citation

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Cover illustration/photographs

Kristiina Ovaska (all photographs).

Additional copies

Additional copies can be downloaded from the B.C. Recovery Planning webpage at: <http://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/species-ecosystems-at-risk/recovery-planning/recovery-planning-documents>

Publication information

This is an updated version of the September 2018 first edition of this document.
See **Updates** for specific changes to the document.

Updates

Updated October 2022: Corrected the entry for "Reason for designation" for Pygmy Slug in the COSEWIC Status and Assessment table (p. 1). The original version incorrectly listed the information for Sheathed Slug in the Pygmy Slug table.

Disclaimer

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

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

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

Success in the conservation of these species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this management plan. The B.C. Ministry of Environment and Climate Change Strategy encourages all British Columbians to participate in the conservation of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug.

ACKNOWLEDGEMENTS

This management plan was prepared by Kristiina Ovaska, Lennart Sopuck (Biolinx Environmental Research ltd.) and Jennifer Heron (Ministry of Environment and Climate Change Strategy [ENV]). Funding for this document was provided by Environment and Climate Change Canada (ECCC) and the British Columbia Ministry of Environment and Climate Change Strategy. Lea Gelling (ENV), Leah Ramsay (ENV), Lindsay Anderson (Ministry of Forests, Lands, Natural Resource Operations and Rural Development [FLNR]), in addition to the report authors, participated in the threats assessment. Karen Stefanyk (ENV) provided policy and editorial review. The photographs included in the plan were taken by Kristiina Ovaska. Mapping was completed by Byron Woods (ENV). Katie Calon (British Columbia Conservation Foundation) provided administrative support. Kristiina Ovaska, Lennart Sopuck, Robert Forsyth, Claudia Copley, Darren Copley and Heidi Gartner provided information on search effort and shared occurrence records for the province. Additional review was completed by: Matt Huntley and Eric Gross (ECCC–Pacific Region); Paul Johansen (ECCC–National Capital Region); Bryan Chruszcz and Diane Casimir (Parks Canada Agency); Dave Trotter (British Columbia Ministry of Agriculture); and Lindsay Anderson (FLNR).

EXECUTIVE SUMMARY

This multispecies management plan has been developed to guide the management of Magnum Mantleslug (*Magnipelta mycophaga*), Pygmy Slug (*Kootenaia burkei*), and Sheathed Slug (*Zacoleus idahoensis*), the entire Canadian distributions of which are restricted to southeastern British Columbia. Pygmy Slug and Sheathed Slug are found mainly in the West Kootenay region, and Magnum Mantleslug ranges farther to the east, west, and north of the Kootenay area of the province. Magnum Mantleslug, Pygmy Slug, and Sheathed Slug are treated together in this management plan because they occur in the similar forest habitats of southeastern British Columbia and because similar management measures apply.

Each of the three species has been designated as of *Special Concern* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Magnum Mantleslug is on Schedule 1 of the *Species at Risk Act* (SARA) and Pygmy Slug and Sheathed Slug are not yet listed under this Act. In British Columbia, Magnum Mantleslug is ranked S2S3 (imperiled/vulnerable), Pygmy Slug is ranked S3 (vulnerable) and Sheathed Slug S3 by the B.C. Conservation Data Centre. The B.C. Conservation Framework ranks Magnum Mantleslug, Pygmy Slug and Sheathed Slug all as a priority #2 under goal 3 (maintain the diversity of native species and ecosystems).

Magnum Mantleslug is a large (up to ~80 mm in length when extended), robust slug. The most distinctive feature of this slug is its large mantle, covering at least two-thirds of the animal's body length. This species inhabits moist coniferous forests and subalpine slopes up to elevations of 2280 m above sea level (asl). Key habitat features include very moist substrate and abundant cover, such as coarse woody debris or talus in subalpine areas. As of October 2017, the species is known from 23 records grouped into 22 subpopulations in British Columbia (subpopulations are defined as occurrences separated by a distance greater than 1 km). Several new subpopulations have been documented since the preparation of the 2012 COSEWIC status report and additional subpopulations may exist.

Pygmy Slug is a minute slug (up to ~16 mm in length when extended). These slugs are dark grey or tan in colour with dense bluish flecking on the mantle and tail, which has characteristic parallel ridges and grooves. This species inhabits moist mixedwood and coniferous forests and is commonly associated with riparian habitats along small creeks. Key habitat requirements include high substrate moisture with abundant woody debris and leaf litter for shelter. As of October 2017, the species is known from 44 subpopulations in British Columbia; no new subpopulations have been documented since the preparation of the 2016 COSEWIC status report, although additional subpopulations may exist.

Sheathed Slug is a small, slender slug (up to ~26 mm in length when extended). Characteristic features include a tail with a mid-dorsal ridge or keel, a tri-partite sole of the foot, and a solid grey-tan colour, often with tiny light or blue flecks. The species inhabits shady coniferous forests, where it often occurs in riparian areas and other very moist microsites. As of October 2017, the species is known from nine subpopulations in British Columbia and no new subpopulations have been found since the preparation of the 2016 COSEWIC status report. Sheathed Slug appears to be rarest of the three species of slugs considered in this management plan and has the most restricted distribution and fewest known subpopulations.

Magnum Mantleslug, Pygmy Slug, and Sheathed Slug are all threatened by cumulative and multiple threats. Primary threats common to all three species include forest harvesting, logging and operations, and climate change.

Logging is prevalent throughout the ranges of the three species, and the threat from logging practices applies to all subpopulations on provincial Crown or private forestry lands. Large areas of the landscape have been subjected to clearcut and selective logging and new logging continues to degrade slug habitat and fragment the species' ranges. Logging has the potential to disturb habitat hydrology and temperature regimes, alter microclimates and the structure of the forest floor, leading to a decrease in habitat suitability and further isolating subpopulations.

Increased frequency of prolonged droughts, as predicted under climate change, are expected to increase mortality and reduce the length of time available for growth and reproduction of these moisture-loving species. Increased storm and flood events threaten subpopulations inhabiting riparian zones, particularly those in steep-sided gullies in rugged terrain.

Other threats include increasing frequency and severity of fires, such as those in recent years within the south and central interior of British Columbia; habitat fragmentation by roads, and predation by and competition with non-native invertebrates, including other gastropods, the spread of which is facilitated by increased human access to the backcountry along resource roads.

The management goal is to maintain all subpopulations[1] of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug by securing, protecting or restoring the habitats for these extant subpopulations within the province, including any additional subpopulations that may be identified in the future. It is assumed that if habitat is secure and other threats mitigated, subpopulations of the slugs will persist.

The management objectives are:

1. to ensure protection[2] (with no loss of habitat functionality) for the habitats at extant subpopulations[3] of Magnum Mantleslug, Sheathed Slug, and Pygmy Slug;
2. to clarify the distribution of Magnum Mantleslug, Sheathed Slug, and Pygmy Slug within their respective geographic ranges in British Columbia;
3. to assess and mitigate threats and restore connectivity of habitat at extant subpopulations and, more broadly, at suitable habitats with possible undocumented subpopulations within the ranges of Magnum Mantleslug, Sheathed Slug, and Pygmy Slug; and
4. to address knowledge gaps, including, but not limited to: (a) habitat requirements at the landscape, stand, and microhabitat scales; (b) reproductive and other life history features; (c) clarification of threats from invasive non-native invertebrates.

[1] Subpopulations are defined as geographically inter-connected groups of individuals within a habitat patch (or patches) with no, or limited, gene flow with other such groups.

[2] Protection can be achieved through various mechanisms, including voluntary stewardship agreements, conservation covenants, sale of private lands by willing vendors, land use designations, and protected areas.

[3] Extant: occurrence has been recently verified as still existing within the past 20 years and where the habitat is still intact.

Approaches to management actions to address these objectives include planning, inventory, monitoring trends, habitat protection, and private land stewardship. The actions in this management plan focus on identification and protection of habitat, primarily through stewardship and incorporation into existing regulations and legislative options. These actions are expected to benefit other forest-dwelling species in these ecosystems. No negative impacts are anticipated on other species at risk as a result of management efforts for these three slug species.

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1 COSEWIC SPECIES ASSESSMENT INFORMATION

Assessment Summary: May 2012 **Common Name:** Magnum Mantleslug **Scientific Name:** *Magnipelta mycophaga* **Status:** Special Concern **Reason for Designation:** This large slug, up to 80 mm in length, is regionally endemic to the northern Columbia Basin in western North America. About half of the species' global range extends into southeastern British Columbia. It occurs in a number of widely separated habitat patches and is confined to cool, moist places in coniferous forests at mid- to high elevations. While hundreds of sites have been searched for slugs and land snails within the range of this slug, mostly within the past decade, as of November 2010 there are only 13 records for it in Canada. Since the 1960s its habitat has become increasingly fragmented. The number and variety of threats including logging, recreational developments and activities, wildfire, and changes in moisture regimes caused by climate change increase the level of risk. **Occurrence:** British Columbia **Status History:** Designated as Special Concern in May 2012
Assessment Summary: May 2016 **Common Name:** Pygmy Slug **Scientific Name:** *Kootenaia burkei* **Status:** Special Concern **Reason for Designation:** In Canada, this small slug is confined to the moist forests of the northern Columbia basin of British Columbia. It is found in moist mixed-wood and coniferous forests and commonly associated with riparian habitats along small creeks. Key habitat requirements include high substrate moisture with abundant woody debris and leaf litter for shelter. Threats include: existing and new roads resulting in fragmentation, increased edge effects, and barriers to dispersal; predation and competition from invasive species; damage to riparian areas associated with livestock grazing; habitat loss and degradation associated with logging activities; and, projected consequences of climate change, including an increase in drought conditions and an increase in both the number and severity of wildfires. **Occurrence:** British Columbia **Status History:** Designated as Special Concern in April 2016
Assessment Summary: May 2016 **Common Name:** Sheathed Slug **Scientific Name:** *Zacoleus idahoensis* **Status:** Special Concern **Reason for Designation:** In Canada, this slug is confined to a small area in the Kootenay region of southeastern British Columbia, generally within 25 km of the Canada–U.S. border. Most records are from older shady coniferous forest stands ranging from approximately 50 to [greater than] 200 years. The species often inhabits riparian areas and other very moist microsites. Threats include logging and wood harvesting, and projected consequences of climate change including an increase in drought condition and wildfires. A decline is projected in the area, extent, and quality of habitat. The low number of scattered subpopulations makes the species vulnerable to both natural and human disturbances. **Occurrence:** British Columbia **Status History:** Designated as Special Concern in April 2016

COSEWIC = Committee on the Status of Endangered Wildlife in Canada.

2 SPECIES STATUS INFORMATION

	Magnum Mantleslug	Pygmy Slug	Sheathed Slug
Legal Designation			
FRPA[a]	No	No	No
OGAA[a]	No	No	No
B.C. *Wildlife Act*[b]	No	No	No
SARA[c]	Schedule 1: Special Concern (2012)	No	No
Conservation Status[d]			
B.C. List[e]	Blue	Blue	Blue
B.C. Rank (Year)	S2S3 (2015)	S3 (2015)	S3? (2015)
National Rank (Year)	Not completed	N1 (2013)	N1N3 (2011)
Global Rank (Year)	G3 (2006)	G2 (2010)	G3G4 (2006)
Other Subnational Ranks[f]	Not completed	Idaho (S2), Montana (S1S2)	Idaho (S2), Montana (S2S3), Washington (SNR)
B.C. Conservation Framework (CF)[g]		**Priority #[h]**	
Goal 1: Contribute to global efforts for species and ecosystem conservation.	3	2	3
Goal 2: Prevent species and ecosystems from becoming at risk.	6	6	6
Goal 3: Maintain the diversity of native species and ecosystems.	2	2	2
CF Action Groups[g]	Inventory	Inventory	Inventory

[a] No = not listed in one of the categories of wildlife that requires special management attention to address the impacts of forestry and range activities on Crown land under the *Forest and Range Practices Act* (FRPA; Province of British Columbia 2002) and/or the impacts of oil and gas activities on Crown land under the *Oil and Gas Activities Act* (OGAA; Province of British Columbia 2008).
[b] No = not designated as wildlife under the British Columbia *Wildlife Act* (Province of British Columbia 1982).
[c] No = not on any schedules under the (*Species at Risk Act*) SARA (Government of Canada 2002). Schedule 1 = found on the List of Wildlife Species at Risk under the SARA (Government of Canada 2002).
[d] S = subnational; N = national; G = global; 1 = critically imperilled; 2 = imperilled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; NR = unranked; ? = Denotes inexact or uncertain numeric.
[e] Blue: Includes any indigenous species or subspecies considered to be of Special Concern (formerly Vulnerable) in British Columbia.
[f] Data source: NatureServe (2017).
[g] See B.C. Ministry of Environment (2009) for information regarding current Conservation Framework prioritization and action sorting tools.
[h] Six-level scale: Priority 1 (highest priority) through to Priority 6 (lowest priority). The conservation framework priority was last reviewed in June 2010.

3 SPECIES INFORMATION

Magnum Mantleslug, Pygmy Slug, and Sheathed Slug are treated together in this management plan because these gastropods occur in similar habitats in the mountainous interior of southeastern British Columbia and because similar management measures apply.

3.1 Species Description

Magnum Mantleslug (*Magnipelta mycophaga*), Pygmy Slug (*Kootenaia burkei*), and Sheathed Slug (*Zacoleus idahoensis*) are endemic to western North America, and in Canada range only in south-eastern British Columbia (COSEWIC 2012, 2016a, 2016b). Magnum Mantleslug and Sheathed Slug are currently placed in the large cosmopolitan family Arionidae (subfamily Ariolimacidae), which some authorities have raised to full family status (e.g., Burke 2013). Magnum Mantleslug is only distantly related to other genera within this group. Pygmy Slug is placed in family Arionidae (subfamily Anadeninae), also considered by some authorities a full family. The family Arionidae is currently under revision.

There is little information on the life histories of these slugs. All three species are hermaphroditic, possessing both female and male reproductive organs (Pilsbry and Brunson 1954; Webb and Russell 1977); however, individuals probably exchange sperm, which may be required for successful reproduction. Copulation and egg-laying probably occur during wet periods from spring to autumn. Although individual Magnum Mantleslugs may live several years, Pygmy Slugs and Sheathed Slugs likely complete their life cycle within one year with only a few adults surviving to their second year (COSEWIC 2012, 2016a, 2016b). Eggs laid in autumn may hatch the following spring soon after snowmelt, as suggested for Magnum Mantleslug and observed in other slugs in high-elevation habitats (Duncan 2008).

The active season for these slugs extends from spring to autumn, peeking during cool and moist seasonal periods. Magnum Mantleslug, in particular, can become active very early in spring when snow is still on the ground (Brunson and Kevern 1963). The slugs retreat deep into moist forest floor microhabitats during prolonged summer dry periods and winter cold periods.

Little specific information is available on the diet of these slugs, but similar to other forest floor slugs they probably feed on green and decaying organic matter and on hyphae and fruiting bodies of fungi. In British Columbia, all three species have been observed feeding on mushrooms,[4] which provide a seasonally important food source. The slugs are likely nocturnal or crepuscular but may be found active during the day under very moist conditions, as noted for Magnum Mantleslug (Ovaska and Sopuck 2009a). During the day, all these species are most often found when looking under coarse woody debris, or in the case of Pygmy Slug, sifting through moist leaf litter (Ovaska and Sopuck 2009a, 2014, 2015).

[4] Ovaska, K. and L. Sopuck, unpublished data. 2007–2015. Data collected during terrestrial gastropod surveys in the Kootenay region as part of various projects by Biolinx Environmental Research Ltd., Sidney, BC.

3.1.1 Magnum Mantleslug

The following description is condensed from Forsyth (2004) and COSEWIC (2012). Magnum Mantleslug is a large (up to 80 mm in length), robust slug when extended. The large mantle is the most distinctive feature of this slug and covers at least two-thirds of the animal's body length. As described by Pilsbry (1953), the mantle is "smooth, chamois coloured, with an irregular black stripe on each side and elsewhere unevenly spotted with black" (Figure 1). The slit-shaped respiratory pore is approximately in the middle of the mantle margin on the right side. The anterior end of the mantle is partially free and allows the slug to raise its mantle and flap the folds of the outer fleshy skin in "bat-like fashion" if disturbed (Pilsbry and Brunson 1954). This behaviour is thought to distract or deter potential predators. The large body size and large mantle help distinguish this species from all other sympatric slugs. One recently described slug from within Magnum Mantleslug's range in western North America also has a large mantle (*Securicauda hermani* in Idaho; Leonard *et al.* 2011), but this species has not been documented from British Columbia.

Figure 1. Magnum Mantleslug (*Magnipelta mycophaga*) (K. Ovaska photo).

3.1.2 Pygmy Slug

The following description is condensed from Burke (2013) and COSEWIC (2016a). Pygmy Slugs are small (up to 16 mm in extended length) and slender slugs. The mantle covers approximately one-half the length of the animal's body length (Figure 2). The respiratory pore is on the right side and slightly posterior to the middle of the mantle margin. The tail is rounded (lacking a mid-dorsal ridge or keel) and has a series of parallel and oblique longitudinal grooves, which branch near the tip of the tail, forming characteristic small polygons (Burke 2013). The grooves on the tail may resemble thin dark stripes. Pygmy Slugs are dark grey to tan with dense bluish flecking covering the mantle and tail; dark mottling is often present on the mantle. Small adult size, lack of dark lateral stripes on the mantle, and lack of an abscission line on tail (delineating the point

of breakage when the slug is seized by a predator) externally distinguishes this species from those in the taildropper genus (*Prophysaon* species).

Figure 2. Pygmy Slug (*Kootenaia burkei*) (K. Ovaska photo).

3.1.3 Sheathed Slug

The following description is condensed from Burke (2013) and COSEWIC (2016b). Sheathed Slugs are small (up to 26 mm in extended length) and slender slugs. The mantle is smooth and covers approximately 40% of the animal's body length (Figure 3). The respiratory pore is approximately two-thirds towards the posterior of the mantle on the right side. The sides and tail have longitudinal and oblique grooves. The tail is keeled with a pronounced ridge and tapers into a laterally compressed tip. The sole is tri-partite (i.e., divided into three sections by longitudinal grooves). The colour is solid grey or brownish grey, often with small light or bluish flecks. Sheathed Slug superficially resembles the sympatric Meadow Slug (*Deroceras laeve*), which also has a tripartite sole and respiratory pore towards the posterior end of the mantle. The mantle of Sheathed Slugs, however, lacks fine concentric wrinkles present in Meadow Slugs; its mid-dorsal ridge or keel extends the entire length of the tail, rather than confined to near the tip as in Meadow Slugs.

Figure 3. Sheathed Slug (*Zacoleus idahoensis*) (K. Ovaska photo).

3.2 Populations and Distribution

The Canadian distributions of the three slug species covered in this management plan are in southeastern and south-central British Columbia. Pygmy Slug and Sheathed Slug are found mainly in the West Kootenay region, whereas Magnum Mantleslug ranges farther to the east, west, and north (Figures 4 and 5). About 50% of the global range of Magnum Mantleslug, 36% of the global range of Pygmy Slug, and 1–10% of the global range of Sheathed Slug occur in Canada (see the respective COSEWIC status reports for the global distribution maps).

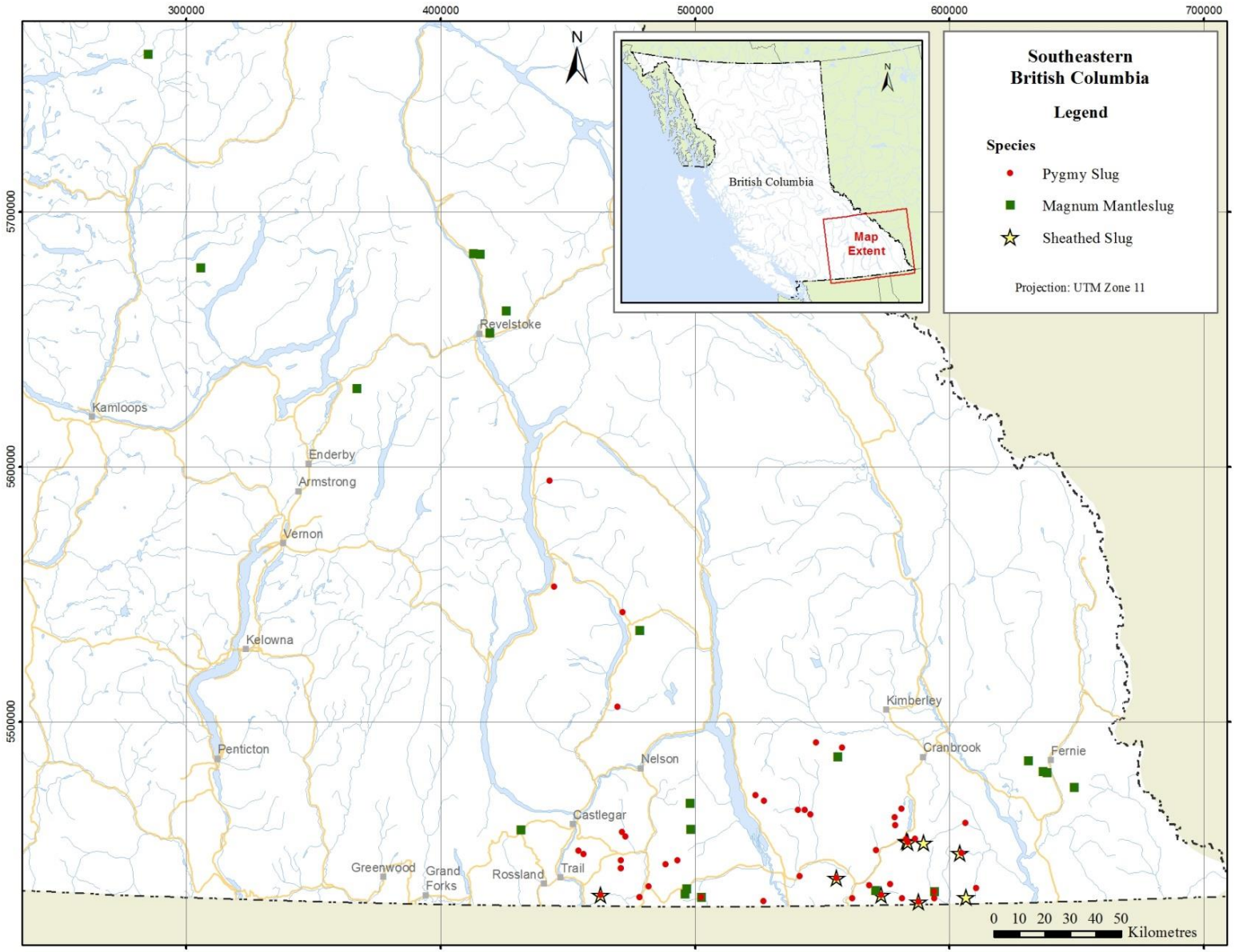

Figure 4. Distribution of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug in British Columbia.

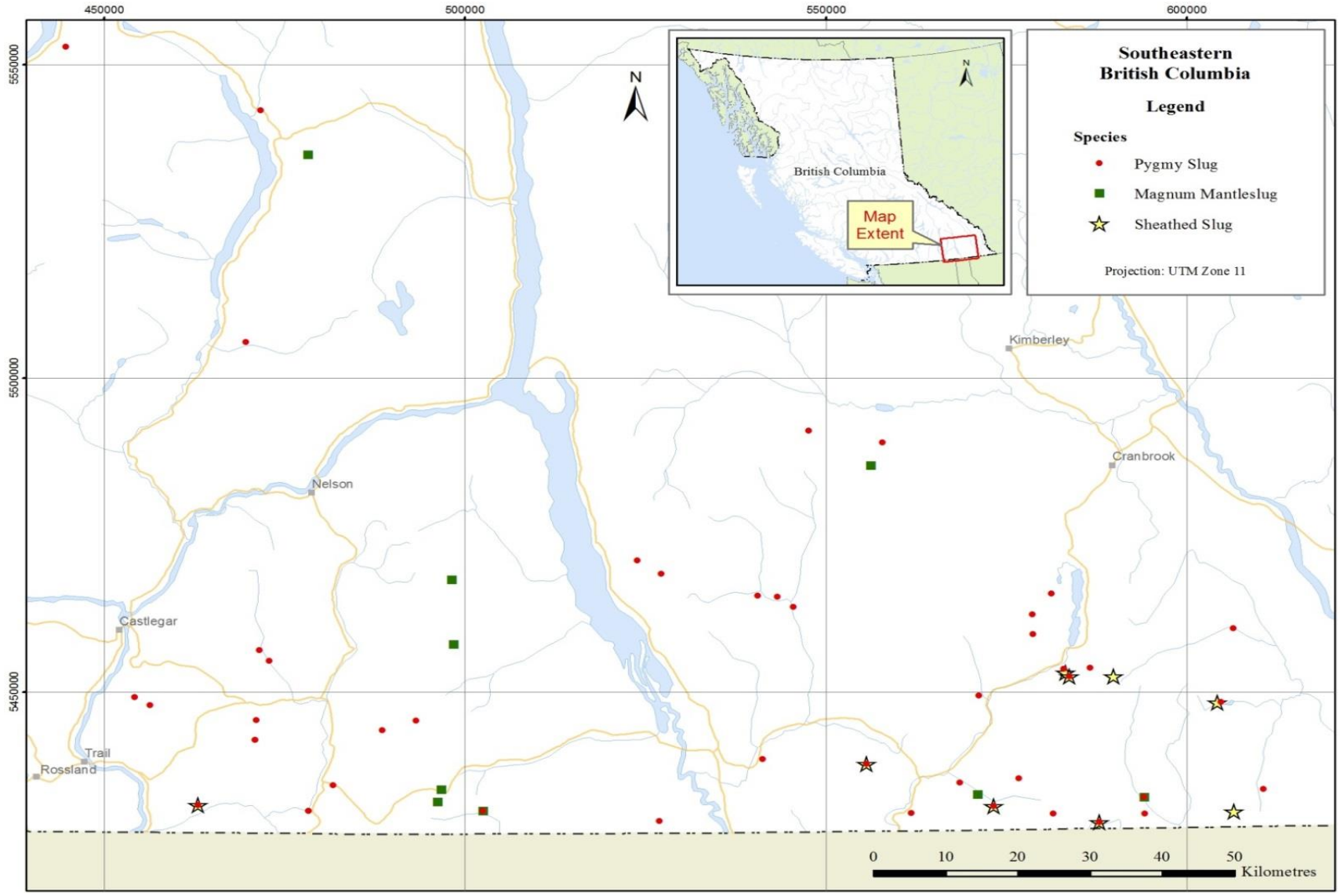

Figure 5. Enlargement of the lower part of Figure 4, showing the entire British Columbia range of Sheathed Slug in more detail and the area of overlap with the ranges of Magnum Mantleslug and Pygmy Slug. The dotted line indicates the Canada–United States border.

3.2.1 Magnum Mantleslug

In Canada, Magnum Mantleslug ranges in southeastern and south-central British Columbia, between latitudes 49–52°N and longitudes 115–120°W (Figure 4) (COSEWIC 2012). Its distribution extends from the Canada–United States border northwest to Wells Gray Provincial Park and in the south from near Trail eastward to Fernie. This distribution encompasses portions of the Rocky Mountains, Columbia Mountains (Purcell, Selkirk, and Monashee ranges), and Shuswap Highlands. Since the preparation of the COSEWIC (2012) status report, 10 new subpopulations have been identified, including nine from 2011 to 2015 and one from 1936 from a previously unidentified specimen in Royal British Columbia Museum collections. These records do not change the overall boundaries of the species' distribution in British Columbia but help fill in gaps in the species' distribution within the known Canadian range.

As of October 2017, 23 records of the species exist from 22 scattered subpopulations in British Columbia (subpopulations are defined occurrences within in-tact habitat that are greater than1 km from each other, where the intervening habitat is not suitable for the slug). Subpopulations 1–13 correspond to those in the COSEWIC report (2012); subpopulations 0 and 14–22 have been documented since the preparation of that report (Table 1).

Table 1. Status and description of Magnum Mantleslug (*Magnipelta mycophaga*) subpopulations in British Columbia.

Subpopulation no.[a]	Status[b]	Date of last observation (no. of slugs)	Subpopulation geographic location and description	Habitat	Land tenure
0	Historical	1-Jun-36 (1)	Mt Revelstoke, Selkirk Mountains	Unknown	Federal national park
1–2	Unknown	Aug-92 (1), Aug-93 (1)	East Barrière Lake, ~30 km northeast of Barrière, Shuswap Highlands region	Older (120 years old), post-fire coniferous forest; mostly large Douglas-fir with smaller cedars and some spruce and hemlock; understorey bare, with no shrubs or forbs	BC Crown forestry lands
3	Unknown	01-Aug-93 (2)	Sicamous Creek, ~7 km east-southeast of Sicamous, west slope of Monashee Mountains region	Old-growth coniferous forest with subalpine fir and spruce; productive sub-hydric site with shrubs and herbs	BC Crown forestry lands
4	Unknown	No recent records despite revisit in September 2008; 23-Sep-98 (1)	Near Nancy Greene Park, ~20 km west of Castlegar, Monashee Mountains	Spruce forest near treeline on mid-elevation plateau	BC Crown forestry lands
5	Extant	18-Aug-02 (1)	Stagleap Provincial Park, northeast of Ripple Mountain, Selkirk Mountains (Nelson Range)	Rocky forest opening on mountain side with subalpine fir; dense layer of low shrubs and herbs	Provincial park

Subpopulation no.[a]	Status[b]	Date of last observation (no. of slugs)	Subpopulation geographic location and description	Habitat	Land tenure
6	Extant	11-Aug-09 (1)	Stagleap Provincial Park, Selkirk Mountains (Nelson Range)	Open old coniferous forest with subalpine fir and shrubs (white rhododendron)	Provincial park
7	Extant	11-Sep-04 (1)	Wells Gray Provincial Park, near Dawson Falls, Shuswap Highlands region	Coniferous forest with western redcedar and abundant coarse woody debris	Provincial park
8	Extant	13-Jul-07 (1)	Lizard Range, ~4 km southwest of Fernie, Rocky Mountain range	Open coniferous forest with scattered Engelmann spruce and subalpine fir on subalpine mountain slope; slug found in patch of dense shrubs and herbaceous vegetation by small stream/waterfall	Private resort/ recreational
9	Extant	18-Aug-09 (1)	Lizard Range, ~5 km southwest of Fernie, Rocky Mountain range	Dense patch of western redcedar in older second-growth coniferous forest with little or no understorey	Private resort/ recreational
10	Extant	13-Sep-10 (1)	Lizard Range, ~12 km southwest of Fernie, Rocky Mountain range	Avalanche chute in very open subalpine forest with subalpine fir in surrounding area; abundant herbs and shrubs	Private resort/ recreational
11	Extant	7-Sep-10 (1)	Mt Revelstoke, Revelstoke/Glacier National Park, Selkirk Mountains	Old-growth coniferous forest with abundant shrub understorey and some herbs	Federal national park
12	Extant	14-Sep-10 (4)	Morrissey Ridge, near Fernie, Rocky Mountain range	Steep, northeast-facing slope in creek valley with abundant shrubs, herbs, and ferns; almost no trees on slope but trees occur on lip of canyon and opposite bank	Private forestry lands
13	Extant	12-Sep-10 (3)	Salmo (Darkwoods), north of Porcupine Lake, Selkirk Mountains	Rocky/talus scree hillside in subalpine forest	Private, protected (Nature Conservancy of Canada)
14	Extant	1-Aug-11 (1)	Idaho Peak, New Denver	Subalpine	Crown, recreational
15	Extant	11-Sep-11 (1)	Herzog Road, Mt Wurttemberg (Darkwoods)	Subalpine fir and subalpine larch forest	Private, protected (Nature Conservancy of Canada)

Subpopulation no.[a]	Status[b]	Date of last observation (no. of slugs)	Subpopulation geographic location and description	Habitat	Land tenure
16	Extant	5-Aug-12 (2)	Mt Revelstoke, Revelstoke/Glacier National Park, Selkirk Mountains	N/A	Federal national park
17	Extant	18-Sep-14 (1)	Hellroaring Creek forest service road (Site 2), south of St. Mary's Lake	Narrow riparian zone along fast-flowing tributary creek through old clearcut; patch of old forest across road along stream (opposite side of road from search area)	BC Crown forestry lands
18	Extant	21-Sep-14 (1)	Yahk River forest service road (Site 3)	Moist, periodically flooded alluvial site along fast-slowing larger stream (Yahk River); forest gap with abundant understorey vegetation	BC Crown forestry lands
19	Extant	23-Sep-14 (2)	Hawkins-Canuck Creek forest service road (Site 1), east of Yahk	Shallow ravine with an intermittent, small creek; moist, north-facing site with abundant herbaceous vegetation	BC Crown forestry lands
20	Extant	27-Sep-14 (1)	Monk Creek forest service road (Site 1)	Moist old coniferous forest with productive deep soil in swale	BC Crown forestry lands
21	Extant	20-Sep-15 (1)	Carnes Creel forest service road (Site 1), off Highway 23 north of Revelstoke	Remnant old growth within logged landscape; moist riparian habitat along fast-flowing tributary creek	BC Crown forestry lands
22	Extant	20-Sep-15 (1)	Carnes Creek forest service road (Site 2), off Highway 23 north of Revelstoke	Remnant old growth within logged landscape; moist riparian habitat along fast-flowing tributary creek adjacent to recent (< 5 years old) clearcut	BC Crown forestry lands

[a] B.C. Conservation Data Centre (2017a); subpopulations are defined occurrences within in-tact habitat that are greater than1 km from each other, where the intervening habitat is not suitable for the slug.
[b] **Extant:** occurrence has been recently verified as still existing (NatureServe 2002); **Historical**: used when there is a lack of recent field information verifying the continued existence of the occurrence and, despite field surveys, the occurrence has not been confirmed for a minimum of 20 years (NatureServe 2002); **Unknown (failed to find):** the population has not been found despite a search by an experienced observer, but appropriate habitat still remains at the site.

3.2.2 Pygmy Slug

In Canada, Pygmy Slug ranges within the Selkirk and Purcell sub-ranges of the Columbia Mountains in southeastern British Columbia (COSEWIC 2016a). Its range extends from the east arm of Columbia River (Lake Koocanusa) to Arrow Lakes in the west. The northernmost record (50.5 N°) is from 62 km southeast of Revelstoke on the east side of Upper Arrow Lake. No new subpopulations have been recorded since the preparation of the COSEWIC (2016a) status report.

The species is known from 44 subpopulations (Table 2). Additional subpopulations may be found with further search effort.

Table 2. Status and description of Pygmy Slug (*Kootenaia burkei*) sites in British Columbia. All subpopulations occur on provincial Crown forestry land.

Subpopulation no.[a]	Status[b]	Date of last observation (no. of slugs)	Subpopulation location and description	Habitat
1	Extant	22-Sep-07 (1)	Lost Creek (rest area), off Highway 3 between Salmo and Creston	Second-growth mixedwood forest; riparian forest along river
2	Extant	23-Sep-07 (8)	Hawkins Creek, Yahk Meadow forest service road, ~3 km from Yahk	Second-growth mixedwood forest; riparian floodplain along creek
3	Extant	5-Sept-08 (1)	Yahk River forest service road, along tributary of Sunrise Creek	Second-growth coniferous forest; riparian forest along dried-up creek
4	Extant	3-Sep-08 (3)	Lemon Creek, Slocan Valley	Second-growth mixedwood forest; riparian area along creek
5	Extant	8-Oct-08 (2)	Halfway River forest service road, south of Galena (east of Arrow Lake)	Older mixedwood forest; riparian area along creek
6	Extant	9-Oct-08 (1)	Marsh Creek Road, off Champion Park Road (off Highway 3), between Fruitvale and Salmo	Older mixedwood forest; edge of small forest gap in a moist depression
7	Extant	8-Oct-09 (1)	Sundown Creek forest service road (spur), ~5 km southeast from Moyie	Second-growth mixedwood forest; moist riparian area along creek
8	Extant	11-Sep-10 (16)	Sundown Creek, southwest of Moyie	Second-growth mixedwood forest; seepage area by small creek
9	Extant	22-Sep-13 (1)	Slewiskin (McDonald) forest service road (Site 2), south of Nakusp	Second-growth mixedwood forest along fast-flowing tributary creek
10	Extant	22-Sep-13 (1)	East Wilson Creek forest service road (Site 2), north of New Denver	Second-growth mixedwood forest along fast-flowing tributary creek
11	Extant	23-Sep-13 (1)	9 Mile Creek (Site	Older coniferous forest;

Subpopulation no.[a]	Status[b]	Date of last observation (no. of slugs)	Subpopulation location and description	Habitat
			2B), Pend d'Oreille	moist forest along creek
12	Extant	24-Sep-13 (3)	Sheep Creek forest service road (Site 1), south of Salmo	Older mixedwood forest; riparian forest along fast-flowing tributary creek
13	Extant	24-Sep-13 (2)	Sheep Creek forest service road (Site 2), south of Salmo	Second-growth mixedwood forest; riparian area along fast-flowing creek
14	Extant	24-Sep-13 (1)	Carroll Creek Road, west of Yahk	Old-growth coniferous forest; moist area along creek
15	Extant	25-Sep-13 (9)	Teepee Creek forest service road, southeast of Cranbrook	Older coniferous forest; moist creekside
16	Extant	18-Sep-14 (4)	Meachen Creek forest service road (Site 3 at Fiddler Creek), approx. 14 km south of Mary's Lake	North-facing sloping side of ravine with second-growth forest and young cottonwoods along fast-flowing tributary creek
17	Extant	18-Sep-14 (1)	Hellroaring Creek forest service road (Site 1), south of St. Mary's Lake	Cottonwood fringe along road in steep mid slope mainly coniferous forest
18	Extant	20-Sep-14 (2)	Cherry Creek forest service road (Site 3), near Cherry Lake	Alluvial flat with alders by stream in coniferous forest, perhaps seasonally flooded
19	Extant	20-Sep-14 (1)	Bloom Creek forest service road (Site 3)	Riparian area with alders along small stream (trickle of water) in second-growth forest
20	Extant	21-Sep-14 (1)	Yahk River forest service road (Site 3)	Moist, periodically flooded alluvial site along fast-flowing larger stream; canopy gap in older coniferous forest with abundant understorey vegetation
21	Extant	22-Sep-14 (1)	Lamb Creek forest service road (Site 1), west of Moyie	Moist riparian floodplain in narrow ravine within landscape of shelterwood logging; several very large cottonwoods
22	Extant	22-Sep-14 (5)	Tate Creek forest service road (Site 1),	Riparian buffer (50–75 m wide) with large

Subpopulation no.[a]	Status[b]	Date of last observation (no. of slugs)	Subpopulation location and description	Habitat
			off Lamb Creek forest service road	cottonwoods in rich floodplain along creek
23	Extant	22-Sep-14 (2)	Tate Creek forest service road (Site 2), off Lamb Creek forest service road	Forested ravine along small creek (riparian zone < 20 m) surrounded by upland old coniferous forest
24	Extant	22-Sep-14 (1)	Irishman River forest service road, near Moyie	Older moist coniferous forest with little understorey except in canopy gaps
25	Extant	23-Sep-14 (2)	Cold-Freeman forest service road (Site 2), off Hawkins forest service road, east of Yahk	Moist riparian area along creek with hummocks and depressions and cottonwoods in second-growth coniferous forest
26	Extant	24-Sep-14 (1)	Skelly Creek forest service road (Site 1), off Goat Creek forest service road, northeast of Creston	Riparian floodplain along creek with cottonwoods in second-growth, mainly coniferous, forest
27	Extant	24-Sep-14 (1)	Skelly Creek forest service road (Site 2), off Goat Creek forest service road, northeast of Creston	Narrow (~10 m wide) riparian zone along fast-flowing tributary creek, surrounded by dense second-growth coniferous forest with little understorey
28	Extant	24-Sep-14 (1)	Goat River forest service road (Site 2, Kianuko Creek), northeast of Creston	Moist depression in second-growth (~60–70 years old) forest
29	Extant	24-Sep-14 (1)	Mt Thompson forest service road (Site 1), east of Creston	Moist riparian area with cottonwoods along fast-flowing creek in otherwise dry coniferous slope with little understorey
30	Extant	25-Sep-14 (5)	Sanca Creek forest service road (Site 1), north of Creston	Narrow (~10 m wide) riparian zone along fast-flowing tributary creek in otherwise dry, pine-dominated landscape; rare, moist area
31	Extant	25-Sep-14 (1)	Sanca Creek forest service road (Site 4; South Fork), north of Creston	Moist riparian area on floodplain along stream in older coniferous forest; abundant

Subpopulation no.[a]	Status[b]	Date of last observation (no. of slugs)	Subpopulation location and description	Habitat
				blowdown and big boulders
32	Extant	26-Sep-14 (1)	Dodge Creek forest service road (Site 2) at Dodge Creek south of Creston	Riparian zone with some cottonwoods in young forest; landscape is otherwise dry with clearcutting and only a few creeks
33	Extant	27-Sep-14 (2)	Monk Creek forest service road (Site 1)	Moist older coniferous forest with productive deep soil and shrubs in swale
34	Extant	24-Sep-15 (8)	Highway 6 to Nelway (Creggan Creek; small spur), south of Salmo	Moist riparian area along fast-flowing stream in second-growth coniferous forest
35	Extant	28-Sep-14 (1)	Champion Lakes (Site 2), north of Trail	Older coniferous forest with abundant well-decayed moist wood and patches of shrubs in moist depressions
36	Extant	24-Sep-15 (5)	Archibald-Tillicum forest service road (Site 2), southwest of Salmo	Moist riparian zone with cottonwoods along small fast-flowing creek within logged landscape in second-growth forest
37	Extant	29-Sep-14 (2)	Erie Creek forest service road (Site 1), north of Erie, northwest of Salmo	Moist ravine with cottonwoods along small creek within landscape of dry, younger (logged) forest
38	Extant	29-Sep-14 (1)	Erie Creek forest service road (Site 2), north of Erie, northwest of Salmo	Moist riparian floodplain with alder in older coniferous forest
39	Extant	24-Sep-15 (2)	Beaver Lookout Road (off Archibald-Tillicum forest service road)	Riparian area beside of fast-flowing creek along small moist, shrubby opening
40	Extant	24-Sep-15 (3)	Elmer Creek forest service road, southeast of Creston	Riparian area along small fast-flowing tributary stream
41	Extant	25-Sep-15 (1)	American Creek forest service road, off Hawkins Creek, Meadow Road, east of Yahk	Canopy gap with abundant herbaceous growth on sloping terrain in moist forest; seepage area on slope

Subpopulation no.[a]	Status[b]	Date of last observation (no. of slugs)	Subpopulation location and description	Habitat
42	Extant	25-Sep-15 (2)	Randal Creek forest service road, south off Hawkins Creek forest service road	Moist grassy slope in forest gap (~30 m upslope from small creek/depression)
43	Extant	25-Sep-15 (3)	West Yahk Road, east of Yahk	Moist bench between two streams in older forest
44	Extant	25-Sep-15 (2)	West Yahk Road (Site 3), east of Yahk	Riparian habitat along trickling creek in forest patch

[a] Subpopulation numbers correspond to those in COSEWIC (2016a) and B.C. Conservation Data Centre (2017b); no additional sites were found as of October 2017; subpopulations are defined occurrences within in-tact habitat that are greater than1 km from each other, where the intervening habitat is not suitable for the slug.
[b] **Extant:** occurrence has been recently verified as still existing (NatureServe 2002); **Historical:** used when there is a lack of recent field information verifying the continued existence of the occurrence and, despite field surveys, the occurrence has not been confirmed for a minimum of 20 years (NatureServe 2002); **Unknown (failed to find):** the population has not been found despite a search by an experienced observer, but appropriate habitat still remains at the site.

3.2.3 Sheathed Slug

In Canada, Sheathed Slug ranges in the southern portion of the West Kootenay region where it is known from nine subpopulations south of 49°22'N (Figure 5; Table 3) (COSEWIC 2016b). Records exist from just east of Trail eastwards to approximately 25 km west of Koocanusa Lake and northward to approximately 30 km south of Cranbrook. The majority of localities occur between the West Arm of Kootenay Lake and the Columbia River (Lake Koocanusa). An isolated record exists for the Pend d'Oreille drainage, approximately 140 km to the east of the nearest occurrence. Survey efforts in the intervening area have failed to locate the species (Ovaska *et al.* 2010). Additional, undocumented subpopulations may be found with further search effort. Of the three species of slugs considered in this management plan, Sheathed Slug is the rarest, having the most restricted distribution and fewest known occurrences.

Table 3. Status and description of Sheathed Slug (*Zacoleus idahoensis*) sites in British Columbia. All subpopulations occur on provincial Crown forestry land.

Subpopulation no.[a]	Status[b]	Date of last observation (no. of slugs)	Subpopulation location and description	Habitat
1	Extant	8-Oct-09 (1)	Sundown Creek forest service road (by 2 km post), ~5 km southeast from Moyie	Moist riparian area along small creek/seepage area in second-growth coniferous forest
2	Extant	11-Sep-10 (2)	Sundown Creek, southwest of Moyie	Seepage area by small creek; moist mixedwood second-growth forest with abundant shrubs and herbs; recent logging in general area
3	Extant	23-Sep-13 (2)	9 Mile Creek (Site 2A), Pend d'Oreille	Riparian area in patch of old coniferous forest (slug found ~30 m from creek)
4	Extant	24-Sep-13 (1)	Carroll Creek Road, west	Old-growth coniferous forest with sparse

Subpopulation no.[a]	Status[b]	Date of last observation (no. of slugs)	Subpopulation location and description	Habitat
			of Yahk	understorey; very moist area along creek with numerous mushrooms; signs of old selective logging
5	Extant	19-Sep-14 (2)	Cherry Creek forest service road (Site 1), near Cherry Lake	Stunted forest on south-facing slope at south end of lake
6	Extant	20-Sep-14 (1)	Yahk River forest service road (Site 1; near Blacktail Creek)	Seepage along small creek in old spruce forest on north-facing slope
7	Extant	21-Sep-14 (1)	Yahk River forest service road (Site 8)	Patch of trees in ravine
8	Extant	25-Sep-15 (1)	American Creek forest service road, off Hawkins Creek, Meadow Road, east of Yahk	Canopy gap with abundant herbaceous growth on sloping terrain in moist second-growth forest; seepage area (mostly dry) on site
9	Extant	23-Sep-14 (4)	West Yahk Road, east of Yahk	Bottom of gully of small tributary creek (to Hawkins Creek) and surrounding older forest

[a] **S**ubpopulation numbers correspond to those in COSEWIC (2016b) and B.C. Conservation Data Centre (2017c); no additional sites were found as of October 2017; subpopulations are defined occurrences within in-tact habitat that are greater than1 km from each other, where the intervening habitat is not suitable for the slug.

[b] **Extant:** occurrence has been recently verified as still existing (NatureServe 2002); **Historical**: used when there is a lack of recent field information verifying the continued existence of the occurrence and, despite field surveys, the occurrence has not been confirmed for a minimum of 20 years (NatureServe 2002); **Unknown (failed to find):** the population has not been found despite a search by an experienced observer, but appropriate habitat still remains at the site.

3.3 Habitat and Biological Needs of Southeastern British Columbia Slugs

3.3.1 Magnum Mantleslug

The following description is condensed from the COSEWIC 2012 status report, supplemented by site-specific information for British Columbia occurrences of Magnum Mantleslug (see summary in Table 1). In British Columbia, the species occurs in the Interior Cedar–Hemlock and Engelmann Spruce–Subalpine Fir biogeoclimatic zones (Meidinger and Pojar 1991), where the slugs inhabit cool, moist coniferous forests at mid- to high elevations. These slugs are often associated with older (greater than 100 years old) or old-growth forest with subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*), and western redcedar (*Thuja plicata*) at lower elevations. At higher elevations with sparse tree cover, the species is occasionally found in moist, stable talus slides. The understorey vegetation is highly variable and ranges from sparse to lush herbaceous growth along mountain creeks. The slugs require moist retreats, such as decayed, moist logs or pieces of bark, or rocks. Most Magnum Mantleslugs found in British Columbia were associated with coarse woody debris. In the Unites States, the species tends to occur in relatively undisturbed forests with an intact duff layer (Frest and Johannes 1995; Hendricks *et al.* 2007; Montana Fish, Wildlife, and Parks and Montana Natural Heritage Program 2018).

3.3.2 Pygmy Slug

The following description is condensed from the COSEWIC status report (2016a), supplemented by site-specific information for British Columbia occurrences of Pygmy Slug (see summary in Table 2). In British Columbia, most occupied sites (82%) are in the Interior Cedar–Hemlock biogeoclimatic zone. Infrequently, the species has also been found in the Montane Spruce and Engelmann Spruce–Subalpine Fir zones, which border the Interior Cedar–Hemlock zone. The Interior Cedar-Hemlock zone, sometimes referred to as the Interior Wet Belt, is the wettest of interior British Columbia's biogeoclimatic zones, resembling moist coastal coniferous forests. Pygmy Slugs inhabit moist mixedwood and coniferous stands, ranging from 40–50-year-old second-growth to old-growth stands. Common tree species include western redcedar, black cottonwood (*Populus trichocarpa*), Engelmann spruce, and western hemlock (*Tsuga heterophylla*). Within these stands, Pygmy Slugs are typically associated with riparian habitats along small, fast-flowing streams. The riparian zone along occupied creeks is often confined to narrow strips in steep-sided gullies; however, where the terrain is flatter, the slugs may occur in more expansive seepage areas. A diverse understorey is usually present and often includes moisture-loving species, such as thimbleberry (*Rubus parviflorus*), devil's club (*Oplopanax horridus*), and lady fern (*Athyrium filix-femina*). Open shorelines or wetlands, such as cattail (*Typha latifolia*) marshes, are unsuitable. Pygmy Slugs require moist forest-floor conditions and refuges provided by coarse woody debris or accumulations of leaf litter, such as wet, decaying cottonwood leaves. The availability of suitable moist microhabitats may be more important than the forest type or age.

3.3.3 Sheathed Slug

The following description is condensed from the COSEWIC status report (2016b), supplemented by site-specific information for British Columbia occurrences of Sheathed Slug (see summary provided in Table 3). In British Columbia, most subpopulations (6 of 9 subpopulations) are in the Interior Cedar–Hemlock zone. Remaining subpopulations occur in the Montane Spruce and Engelmann Spruce–Subalpine Fir zones, which border the Interior Cedar–Hemlock zone. The slugs inhabit moist, shaded, and mainly coniferous forests, ranging from 40–50-year-old second-growth to old-growth (greater than 200 years old) stands; most records are from older forest stands. Sheathed Slugs are often associated with abundant coarse woody debris; the moist refuges provided by decaying logs are important microhabitat features for the slugs. Similar to Magnum Mantleslug and Pygmy Slug, Sheathed Slugs require moist forest-floor conditions and suitable retreat sites. Riparian areas and gullies associated with small, often fast-flowing tributary streams provide consistently moist microhabitats.

3.3.4 Summary of Habitat Characteristics

Habitat features where Magnum Mantleslug Slug, Pygmy Slug, and Sheathed Slug have been found in British Columbia are summarized in Table 4. The essential functions, features, and attributes of habitats for these slugs, based on the best information available when this management plan was written (September 2018) are found in Table 5.

Table 4. Summary of habitat characteristics for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug in British Columbia.

Characteristic	Magnum Mantleslug[a]	Pygmy Slug[b]	Sheathed Slug[c]
Habitat feature elevation (m)	800–2280	580–1585	618–1612
Biogeoclimatic zone[d]	ESSF, ICH, MS (1 site only)	ICH	ICH and ESSF
Stand age[e] and structure	70-year-old second-growth to old-growth, mainly coniferous, forest or open canopy subalpine habitats with moist refuges	40–50-year-old second-growth to old-growth coniferous or mixed-wood (cottonwood often present)	40–50-year-old second-growth to old-growth mainly coniferous forest
Important habitat features	• Cool, moist conditions • Forest floor under heavily shaded forest canopy, *or* splash zones of cascading creeks and avalanche chutes in open habitats • Abundant herbaceous vegetation or talus in more open habitats • Moist refuges provided by decaying logs and other coarse woody debris, rocks in stable talus, or other cover in moist depressions or seepage areas	• Cool, moist conditions • Riparian habitats along small, often fast-flowing, tributary creeks • Decaying logs and other coarse woody debris and pockets of deep leaf litter	• Cool, moist conditions • Shady coniferous forest • Riparian areas and gullies associated with small, fast-flowing tributaries, seepage areas, and other moist microsites • Decaying logs and other coarse woody debris

[a] Source: COSEWIC 2012; Ovaska and Sopuck, unpubl. data; pers. comm. 2017
[b] Source: COSEWIC 2016a; Ovaska and Sopuck, unpubl. data; pers. comm. 2017
[c] Source: COSEWIC 2016b; Ovaska and Sopuck, unpubl. data; pers. comm. 2017
[d] ESSF = Engelmann Spruce–Subalpine Fir; ICH = Interior Cedar–Hemlock; MS = Montane Spruce (Meidinger and Pojar 1981)
[e] Old growth is defined as ≥ 200 years old.

Table 5. Summary of essential functions, features, and attributes of Magnum Mantleslug, Pygmy Slug and Sheathed Slug habitat in British Columbia.

Life stage	Function[a]	Feature(s)[b]	Attributes[c]
Magnum Mantleslug			
Egg	Incubation	Egg-laying sites have not been reported from British Columbia or United States; probably occur in moist, sheltered microsites such as those provided by decaying logs, talus patches, or other cover objects or crevices[d].	High humidity; refuge from predators and environmental fluctuations
Juvenile/Adult	Feeding, foraging, overwintering, and dispersal	Intact duff layer; moist refuge sites such as those provided by decaying logs or other coarse woody debris or root crevices; seepage areas, gullies, riparian areas along cascading streams, or other very moist sites. Shady forest floor with structural complexity, as found in older forest; talus or splash zones of cascading creeks and avalanche chutes in open subalpine habitats.	High humidity; availability of food (green and decaying vegetation, fungi); refuge from predators
Adult	Mating, egg-laying	Mating sites are unknown; see above for egg-laying site features. Neither mating nor egg-laying have been observed in British Columbia.	Mating site attributes are unknown. High humidity; refuge from predators and environmental fluctuations
Pygmy Slug			
Egg	Incubation	Egg-laying sites have not been reported from British Columbia or United States; probably occur within or under coarse woody debris, crevices on forest floor, or within moss or leaf litter; high-humidity, sheltered microsites such as those provided by decaying logs or other cover objects or crevices.	High humidity; refuge from predators and environmental fluctuations
Juvenile/Adult	Feeding, foraging, overwintering, and dispersal	Intact duff layer; moist refuge sites such as those provided by decaying logs or other coarse woody debris or root crevices; seepage areas, gullies, riparian areas along cascading streams, or other very moist sites. Riparian areas along fast-flowing creeks; moist gullies and seepage areas.	High humidity; availability of food (green and decaying vegetation, fungi); refuge from predators
Adult	Mating, egg-laying	Mating sites are unknown; see above for egg-laying site features. Neither mating nor egg-laying have been observed in British Columbia.	Mating site attributes are unknown; see above for egg-laying requirements

Life stage	Function[a]	Feature(s)[b]	Attributes[c]
Sheathed Slug			
Egg	Incubation	Egg-laying sites have not been reported from British Columbia or United States; probably within or under coarse woody debris or crevices on forest floor; high-humidity, sheltered microsites such as those provided by decaying logs or other cover objects or crevices.	High humidity; refuge from predators and environmental fluctuations
Juvenile/Adult	Feeding, foraging, overwintering, and dispersal	Intact duff layer; moist refuge sites such as those provided by decaying logs or other coarse woody debris or root crevices; seepage areas, gullies, riparian areas along cascading streams, or other very moist sites. Shady forest floor with structural complexity, as found in older forest; riparian areas along fast-flowing creeks; moist gullies and seepage areas.	High humidity; availability of food (green and decaying vegetation, fungi); refuge from predators
Adult	Mating, egg-laying	Mating sites are unknown; see above for egg-laying site features. Neither mating nor egg-laying have been observed in British Columbia.	Mating site attributes are unknown; see above for egg-laying requirements

[a] **Function:** a life-cycle process of the species (e.g., breeding, feeding/foraging and dispersal).
[b] **Feature:** the essential structural components of the habitat required by the species.
[c] **Attribute:** the building blocks or *measurable* characteristics of a feature.
[d] Based on other native forest slugs (e.g., *Hemphillia camelus*).

3.4 Ecological Role

Magnum Mantleslug, Pygmy Slug, and Sheathed Slug are species considered regionally endemic to the moist forests of the northern Columbia Basin and adjacent highlands and mountains, an area that contains many unique plants and animals (Brunsfeld *et al.* 2001). These slugs contribute to the natural capital (i.e., ecosystem goods and services) of the forest ecosystems they occupy. Gastropods help decomposition processes by turning over organic matter on the forest floor (Mason 1970; Richter 1979). Slugs play an ecological role as decomposers, soil builders, consumers of live and decaying plant matter, and as prey for various vertebrate and invertebrate predators. Some species also disperse seeds of forest plants and fungal spores (Richter 1980; Gervais *et al.* 1998; McGraw *et al.* 2002). Other western North American forest slugs feed extensively on the fruiting bodies of fungi that form important symbiotic mycorrhizal associations with tree roots, potentially dispersing their spores and so contributing to forest health. Ecological interactions of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug have not been studied, but they probably also play similar ecological roles.

All three species reach the northern limits of their distributions in British Columbia. Subpopulations at the northern extremity of a species' distribution may possess unique ecological adaptations and provide a reservoir of genetic variability that allows the species to respond to changing environmental conditions.

3.5 Limiting Factors

Limiting factors are generally not human-induced and include characteristics that make the species less likely to respond to management or conservation efforts.

- **Dispersal Ability –** The dispersal ability of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug is considered poor; they are physiologically limited in their ability to move. By their very nature, slugs are sedentary and cryptic animals, and their natural ability to colonize new areas is likely poor. It is unclear how much spatial area (habitat) is required to sustain local subpopulations or the extent of their home range.
- **Requirement for High-moisture Environments –** Magnum Mantleslug, Pygmy Slug, and Sheathed Slug require microhabitats that remain consistently moist. Slugs are known to initiate "water seeking" responses to dehydration after a short-term reduction in locomotor activity (Prior 1985). The physiology and activity patterns of these slugs inherently make them susceptible to continuous water loss through dehydration. All slugs deposit a dilute mucous trail, and experience constant evaporative water loss through the lung surface and integument. Within 2 hours, active slugs can lose 30–40% of their initial body weight and habitat selection by slugs is correlated with water availability (Prior 1985). Although this information pertains to other slug species, it is likely similar for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug.
- **Patchiness of Habitat –** Because they require habitats with high moisture and refuges from predators and environmental fluctuations, the distributions of all three species are highly patchy. This pattern is accentuated by poor dispersal abilities and the speed at which habitat patches can be recolonized after stochastic extirpation. Forests within the species'

distributions are extensively logged or burned, further constraining natural dispersal and increasing isolation resulting from natural habitat patchiness.

- **Northernmost Extent of Global Range –** Magnum Mantleslug, Pygmy Slug, and Sheathed Slug are at the northernmost extent of their global ranges, which likely increases these species' susceptibility to climatic and stochastic population fluctuations under the often harsh conditions.

4 THREATS

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (adapted from Salafsky *et al.* 2008). For purposes of threat assessment, only present and future threats are considered.[5] Threats presented here do not include limiting factors,[6] which are discussed in Section 3.5.

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

4.1 Threat Assessment

The threat classification below is based on the International Union for Conservation of Nature–Conservation Measures Partnership (IUCN–CMP) unified threats classification system and is consistent with methods used by the B.C. Conservation Data Centre. For a detailed description of the threat classification system, see the Open Standards website (Open Standards 2014). Threats may be observed, inferred, or projected to occur in the near term (over next 10-year period). Threats are characterized here in terms of scope, severity, and timing. Threat "impact" is calculated from scope and severity. For information on how the values are assigned, see Master *et al.* (2012) and table footnotes for details. Threats for Magnum Mantleslug (Table 6), Pygmy Slug (Table 7), and Sheathed Slug (Table 8) were assessed by three separate threats calculators for the entire province of British Columbia (and thus their entire Canadian range).

[5] Past threats may be recorded but are not used in the calculation of threat impact. Effects of past threats (if not continuing) are taken into consideration when determining long-term and/or short-term trend factors (Master *et al.* 2012).

[6] It is important to distinguish between limiting factors and threats. Limiting factors are generally not human-induced and include characteristics that make the species or ecosystem less likely to respond to management/conservation efforts (e.g., inbreeding depression, small population size, and genetic isolation).

Table 6. Threat classification table for Magnum Mantleslug in British Columbia.

Threat no.[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Subpopulations(s)
1	Residential & commercial development	Low	Small	Moderate	High	
1.1	Housing & urban areas	Negligible	Negligible	Serious	High	8, 9, 10, 12, 13
1.3	Tourism & recreation areas	Low	Small	Moderate	High	4, 5, 6, 7, 8, 9
2	Agriculture & aquaculture	Negligible	Negligible	Moderate	High	
2.3	Livestock farming & ranching	Negligible	Negligible	Moderate	High	Potentially applicable to known and unchecked provincial Crown land sites
3	Energy production & mining	Low	Small	Moderate	High	
3.2	Mining & quarrying	Low	Small	Moderate	High	4
4	Transportation & service corridors	Low	Restricted	Moderate	High	
4.1	Roads & railroads	Low	Restricted	Moderate	High	1–4, 7–9, 11–13, 15, 17–22
4.2	Utility & service lines	Negligible	Negligible	Moderate	High	20
5	Biological resource use	Low	Restricted	Moderate	High	
5.3	Logging & wood harvesting	Low	Restricted	Moderate	High	1–4, 12, 13, 17–22
6	Human intrusions & disturbance	Negligible	Restricted	Negligible	High	
6.1	Recreational activities	Negligible	Restricted	Negligible	High	4, 2, 11, 14, 16
7	Natural system modifications	Low	Small	Moderate	High	
7.1	Fire & fire suppression	Low	Small	Moderate	High	All
7.3	Other ecosystem modifications	Unknown	Unknown	Unknown	High	All
8	Invasive & other problematic species, genes & diseases	Low	Small	Moderate–Slight	High	
8.1	Invasive non-native/alien species/diseases	Low	Small	Moderate–Slight	High	Not reported from any known subpopulations but potential at 4, 7–9

Threat no.[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Subpopulations(s)
9	Pollution	Unknown	Unknown	Unknown	High	
9.3	Agricultural & forestry effluents	Unknown	Unknown	Unknown	High	Most subpopulations except Mt Revelstoke National Park and protected areas (0, 5, 6, 7, 11,16)
9.5	Air-borne pollutants	Unknown	Unknown	Unknown	High	All
10	Geological events	Negligible	Negligible	Negligible	High	
10.3	Avalanches/landslides	Negligible	Negligible	Negligible	High	5, 6, 8–11, 16, 17, 21, 22
11	Climate change & severe weather	Low	Pervasive	Slight	High	
11.1	Habitat shifting & alteration	Low	Pervasive	Slight	High	All
11.2	Droughts	Low	Pervasive	Slight	High	All
11.4	Storms & flooding	Low	Restricted	Slight	High	17, 19

[a] Threat numbers are provided for Level 1 threats (i.e., whole numbers) and Level 2 threats (i.e., numbers with decimals).
[b] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on severity and scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population. The median rate of population reduction for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75%), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment time (e.g., timing is insignificant/negligible [past threat] or low [possible threat in long term]); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.
[c] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).
[d] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation time frame. For this species a 10-year time frame was used was used, resulting in severity being scored over a 10-year time frame. Severity is usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).
[e] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or three generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Table 7. Threat classification table for Pygmy Slug in British Columbia.

Threat no.[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Subpopulation(s)
1	Residential & commercial development	Negligible	Negligible	Extreme	High	
1.1	Housing & urban areas	Negligible	Negligible	Extreme	High	10
1.2	Commercial & industrial areas	Negligible	Negligible	Extreme	High	10, 11, 24
1.3	Tourism & recreation areas	Negligible	Negligible	Serious	High	1, 35
2	Agriculture & aquaculture	Low	Small	Moderate–Slight	High	
2.1	Annual & perennial non-timber crops	Negligible	Negligible	Serious	High	Potentially applicable to potential private land subpopulations.
2.3	Livestock farming & ranching	Low	Small	Moderate–Slight	High	7, 10, 11, 14, 15, 41, 42, 43
3	Energy production & mining	Negligible	Negligible	Extreme–Serious	Moderate	
3.2	Mining & quarrying	Negligible	Negligible	Extreme–Serious	Moderate	10, 12, 13, 19
4	Transportation & service corridors	Low	Small	Moderate–Slight	High	
4.1	Roads & railroads	Low	Small	Moderate–Slight	High	All
4.2	Utility & service lines	Negligible	Negligible	Moderate	High	1, 7, 11, 15, 32, 33
5	Biological resource use	Low	Restricted	Moderate	High	
5.2	Gathering terrestrial plants	Negligible	Restricted–Small	Negligible	High	All
5.3	Logging & wood harvesting	Low	Restricted	Moderate	High	All except 26, 35
6	Human intrusions & disturbance	Negligible	Restricted	Negligible	High	
6.1	Recreational activities	Negligible	Restricted	Negligible	High	1, 2, 6, 11, 12, 15, 18, 28, 29, 35
7	Natural system modifications	Low	Small	Moderate	High	
7.1	Fire & fire suppression	Low	Small	Moderate	High	21, 22
7.2	Dams & water management/use	Negligible	Negligible	Serious	Moderate	11
7.3	Other ecosystem modifications	Unknown	Unknown	Unknown	High	All

Threat no.[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Subpopulation(s)
8	Invasive & other problematic species, genes & diseases	Medium–Low	Restricted	Moderate–Slight	High	
8.1	Invasive non-native/alien species/diseases	Medium–Low	Restricted	Moderate–Slight	High	1, 6, 41 (found); 10, 11, 15, 2, 24, 29, 34, 35 (very likely)
9	Pollution	Unknown	Unknown	Unknown	High	
9.3	Agricultural & forestry effluents	Unknown	Unknown	Unknown	High	Potentially applicable to known and unchecked provincial Crown land subpopulations.
9.5	Air-borne pollutants	Unknown	Unknown	Unknown	High	Potentially applicable to known and unchecked provincial Crown land subpopulations.
10	Geological events	Negligible	Negligible	Negligible	High	
10.3	Avalanches/landslides	Negligible	Negligible	Negligible	High	16, 24, 27, 28, 30, 37, 38
11	Climate change & severe weather	Low	Pervasive	Moderate–Slight	High	
11.1	Habitat shifting & alteration	Unknown	Restricted–Small	Unknown	High	All
11.2	Droughts	Low	Pervasive	Slight	High	All
11.4	Storms & flooding	Low	Restricted–Small	Moderate–Slight	High	1–17, 20, 22, 24–27, 29-32, 37–39, 43

[a] Threat numbers are provided for Level 1 threats (i.e., whole numbers) and Level 2 threats (i.e., numbers with decimals).
[b] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on severity and scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population. The median rate of population reduction for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75%), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment time (e.g., timing is insignificant/negligible [past threat] or low [possible threat in long term]); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.
[c] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).
[d] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation time frame. For this species a 10-year time frame was used was used, resulting in severity being scored over a 10-year time frame. Severity is usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).
[e] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or three generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Table 8. Threat classification table for Sheathed Slug in British Columbia.

Threat no.[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Subpopulation(s)
1	Residential & commercial development	Negligible	Negligible	Extreme	High	
1.1	Housing & urban areas	Negligible	Negligible	Extreme	High	All
1.2	Commercial & industrial areas	Negligible	Negligible	Extreme	High	3
1.3	Tourism & recreation areas	Negligible	Negligible	Serious	Moderate	5
2	Agriculture & aquaculture	Low	Small	Slight	High	
2.3	Livestock farming & ranching	Low	Small	Slight	High	4
3	Energy production & mining	Negligible	Negligible	Extreme–Serious	Moderate	
3.2	Mining & quarrying	Negligible	Negligible	Extreme–Serious	Moderate	All
4	Transportation & service corridors	Low	Small	Moderate–Slight	High	
4.1	Roads & railroads	Low	Small	Moderate–Slight	High	All
4.2	Utility & service lines	Negligible	Negligible	Moderate	High	3
5	Biological resource use	Medium	Restricted	Serious	High	
5.2	Gathering terrestrial plants	Negligible	Restricted–Small	Negligible	High	All
5.3	Logging & wood harvesting	Medium	Restricted	Serious	High	All
6	Human intrusions & disturbance	Negligible	Restricted	Negligible	High	
6.1	Recreational activities	Negligible	Restricted	Negligible	High	4, 5, 8, 9
7	Natural system modifications	Medium	Restricted	Serious	High	
7.1	Fire & fire suppression	Medium	Restricted	Serious	High	All
7.2	Dams & water management/use	Negligible	Negligible	Serious	Moderate	3
7.3	Other ecosystem modifications	Unknown	Pervasive	Unknown	High	All

Threat no.[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Subpopulation(s)
8	Invasive & other problematic species, genes & diseases	Low	Restricted	Moderate–Slight	High	
8.1	Invasive non-native/alien species/diseases	Low	Restricted	Moderate–Slight	High	8 (found); 3, 4 (very likely)
9	Pollution	Unknown	Unknown	Unknown	High	
9.3	Agricultural & forestry effluents	Unknown	Unknown	Unknown	High	All
9.5	Air-borne pollutants	Unknown	Unknown	Unknown	High	All
10	Geological events	Negligible	Negligible	Serious	High	
10.3	Avalanches/landslides	Negligible	Negligible	Serious	High	All
11	Climate change & severe weather	Low	Pervasive	Slight	High	
11.1	Habitat shifting & alteration	Unknown	Pervasive	Unknown	High-Moderate	All
11.2	Droughts	Low	Pervasive	Slight	High	All
11.4	Storms & flooding	Low	Restricted–Small	Moderate–Slight	High	3, 4, 9

[a] Threat numbers are provided for Level 1 threats (i.e., whole numbers) and Level 2 threats (i.e., numbers with decimals).
[b] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on severity and scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population. The median rate of population reduction for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75%), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment time (e.g., timing is insignificant/negligible [past threat] or low [possible threat in long term]); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.
[c] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).
[d] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation time frame. For this species a 10-year time frame was used was used, resulting in severity being scored over a 10-year time frame. Severity is usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).
[e] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or three generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

4.2 Description of Threats

The COSEWIC status assessments for Magnum Mantleslug (2012), Pygmy Slug (2016a), and Sheathed Slug (2016b), which applied the IUCN threats calculator, showed that all three species are subject to multiple and cumulative threats. For this management plan, the scores were re-evaluated, and minor changes were deemed appropriate based on the current knowledge of distributions and threats (Tables 6–8). Table 9 shows the overall impact ratings in a side-by-side comparison. In general, these changes included lowering the impact of some threats for Magnum Mantleslug and increasing some of the threats for Sheathed Slug. Because undocumented subpopulations are likely to exist, threats were assessed for suitable habitats over the entire known ranges of the species rather than only for known subpopulations.

Province-wide, the overall threat impact was assessed as Medium for Magnum Mantleslug, High–Medium for Pygmy Slug and High for Sheathed Slug. These overall threat impacts consider the cumulative impacts of multiple low- and medium-level threats. Primary threats common to all three species include Threat 5 Biological Resource Use (specifically Threat 5.3 Logging & Woodcutting) and Threat 11 Climate Change & Severe Weather (Table 9).

In addition to the impacts derived from the IUCN threats calculator, different identified threats may interact synergistically, resulting in a cumulative effect greater than that expected from the individual threats alone. Examples include interactions among climate change and severe weather, fire and fire suppression, and logging. Increased frequency and severity of prolonged summer droughts is likely to exacerbate the effects of logging (both recent and planned) and wildfires on the species' habitats, especially in narrow riparian zones and small seepage areas, where the slugs may no longer be viable under prolonged and (or) more frequent drought conditions. Any activities that increase human access, such as resource roads, also increase the potential for the introduction and spread of invasive, non-native gastropods and other invertebrates that can prey on or compete with the native slugs. A potentially significant but unknown threat is from climate change. This threat may facilitate the spread of invasive species and ecosystem-level changes with largely unknown and untracked impacts on native gastropods.

Table 9. Comparison of overall threat impact ratings for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug.

Threat no.[a]	Threat description	Overall calculated impact[b]		
		Medium	**High–Medium**	**High**
		Magnum Mantleslug	**Pygmy Slug**	**Sheathed Slug**
1	Residential & commercial development	Low	Negligible	Negligible
1.1	Housing & urban areas	**Negligible**	Negligible	Negligible
1.2	Commercial & industrial areas	Not applicable	Negligible	Negligible
1.3	Tourism & recreation areas	Low	Negligible	Negligible
2	Agriculture & aquaculture	**Negligible**	Low	Low
2.1	Annual & perennial non-timber crops	Not applicable	Negligible	Not applicable
2.3	Livestock farming & ranching	**Negligible**	Low	Low
3	Energy production & mining	Low	Negligible	Negligible
3.2	Mining & quarrying	Low	Negligible	Negligible
4	Transportation & service corridors	Low	Low	Low
4.1	Roads & railroads	Low	Low	Low
4.2	Utility & service lines	**Negligible**	Negligible	Negligible
5	Biological resource use	**Low**	Low	**Medium**
5.2	Gathering terrestrial plants	Not applicable	Negligible	Negligible
5.3	Logging & wood harvesting	**Low**	Low	**Medium**
6	Human intrusions & disturbance	**Negligible**	Negligible	Negligible
6.1	Recreational activities	**Negligible**	Negligible	Negligible
6.3	Work & other activities	Not applicable	Not applicable	Negligible
7	Natural system modifications	Low	Low	**Medium**
7.1	Fire & fire suppression	Low	Low	**Medium**
7.2	Dams & water management/use	Not applicable	Negligible	Negligible
7.3	Other ecosystem modifications	Unknown	Unknown	Unknown

Threat no.[a]	Threat description	Overall calculated impact[b]		
		Medium	**High–Medium**	**High**
		Magnum Mantleslug	**Pygmy Slug**	**Sheathed Slug**
8	Invasive & other problematic species, genes, & diseases	**Low**	Medium–Low	**Medium–Low**
8.1	Invasive non-native/alien species/diseases	**Low**	Medium–Low	**Medium–Low**
9	Pollution	Unknown	Unknown	Unknown
9.3	Agricultural & forestry effluents	Unknown	Unknown	Unknown
9.5	Air-borne pollutants	Unknown	Unknown	Unknown
10	Geological events	Negligible	Negligible	Negligible
10.3	Avalanches/landslides	Negligible	Negligible	Negligible
11	Climate change & severe weather	**Low**	**Low**	Low
11.1	Habitat shifting & alteration	Low	Unknown	Unknown
11.2	Droughts	Low	Low	Low
11.4	Storms & flooding	Negligible	Low	Low

Note: Bold type indicates the ratings that were revised from those in the COSEWIC status reports for these species (2012, 2016a, 2016b).

The details for threats are discussed below under the Threat Level 1 headings. These descriptions are adapted from the COSEWIC status reports for the three species (2012, 2016a, 2016b) and updated where there is new information.

Threat 1. Residential & commercial development

Magnum Mantleslug primarily occurs in high-elevation habitats that have the potential for recreational developments, such as new ski areas; the scope of the threat may be above 1%. A large expansion of the Sun Peaks Ski Resort was recently completed in suitable Magnum Mantleslug habitat, approximately 40 km south of the Barrière subpopulation 1–2. The planned development of Jumbo Glacier Resort southwest of Invermere threatens Magnum Mantleslug, Sheathed Slug, and Pygmy Slug habitat.

This threat is assessed as Negligible for Pygmy Slug and Sheathed Slug as these species occur in lower elevation forested areas away from the larger centres in which expansion of human population and associated development is expected. Therefore, the assigned overall impact of this threat category is Low.

Threat 2. Agriculture & aquaculture

Livestock farming and ranching (Threat 2.3), is the only activity that contributes to this threat category. Its overall impact was considered Negligible for Magnum Mantleslug and Low for both Pygmy Slug and Sheathed Slug. Livestock grazing is limited in the moist, higher-elevation forests inhabited by Magnum Mantleslug, and therefore the impact is Negligible. Free-ranging livestock is uncommon in the steep, densely forested areas characteristic of the West Kootenays. Grazing tenures within the range of Pygmy Slug and Sheathed Slug occur mostly in the drier, more open, forests to the south and east (iMapBC 2014[i]). Nevertheless, free-ranging cattle and other livestock tend to concentrate in riparian areas, where they can affect slug habitat by compacting soils, impacting soil nutrients through urination and defecation, and grazing that removes understorey vegetation. Although this threat is scored as a Low impact, it is not as significant as other threats with a similar score, especially logging (Threat 5.3) and droughts (Threat 11.2).

Threat 3. Energy production & mining

Mining and quarrying (Threat 3.2), contribute to this threat category. These activities occur throughout the ranges of the three slug species and have the potential to destroy slug habitats in localized areas. Mining does not pose a threat at any of the subpopulations of the three species; only very small portions of the species' ranges are expected to be affected. The overall impact was rated as Low for Magnum Mantleslug and Negligible for Pygmy Slug and Sheathed Slug. An area of extensive coal strip-mining within potential habitat for the species occurs 22–35 km northeast of subpopulations near Fernie and Morrissey Ridge (Subpopulation 8 – Magnum Mantleslug). Plans also exist for the construction of two new mines and expansion of another mine in this same area.

Threat 4. Transportation & service corridors

Roads and railroads (Threat 4.1), contribute to this threat category. The ranges of the three slug species in southeast British Columbia are heavily fragmented by roads, especially by logging roads, which crisscross forest habitats in many areas. Major roads continue to form barriers to slug movements, but the effect on slug subpopulations is probably historical. New roads associated with forestry and other types of resource extraction are likely to increase over the next 10 years, with the expansion of these activities to new areas and the potential reactivation of roads in previously logged areas. Adverse effects on slugs result from: habitat loss along the road corridor and through edge effects, which can extend far into the forest; possible changes to drainage patterns; desiccation through increased wind and solar radiation; and habitat fragmentation through barriers to movements. Roadkill is not considered to be an issue for these species. The overall threat impact was rated as Low for all three species.

Roads facilitate the introduction and spread of non-native plants (Trombulak and Frissell 2000) and animals, including invertebrate predators and competitors; threats from non-native species are discussed under Threat 7. Adverse effects on slugs may also stem from traffic on existing roads, where dust extends into the surrounding forest (see Threat 9).

Threat 5. Biological resource use

Logging and wood harvesting (Threat 5.3), is considered one of the main threats to all three species of slugs. The overall impact is rated as Low for Magnum Mantleslug and Pygmy Slug but Medium for Sheathed Slug. The limited range of Sheathed Slug results in a greater probability that logging will occur in the relatively productive, lower-elevation forests included in its range.

Logging is prevalent throughout the ranges of the three slug species, and the threat from logging practices applies to all occurrences on provincial Crown or private forestry lands. Large areas of the landscape have already been clearcut and selectively logged and new logging, including harvest in maturing second-growth forests, continues to degrade habitat and fragment the species' ranges. The amount of habitat that will be affected over the next 10 years is unknown. Logged areas will regenerate slowly in the cool, mid- to high-elevation terrain inhabited by the slugs. Logging does not pose a threat in the national and provincial parks or other private conservation lands.

Magnum Mantleslug, Pygmy Slug, and Sheathed Slug are forest-dwelling slugs, and while not restricted to old-growth forests, they need shady, moist forest floor conditions and other old-growth attributes such as abundant coarse woody debris. Logging can potentially disturb site hydrology and temperature regimes and alter microclimates and structure of the forest floor in slug habitats. Forest management practices, including pre-commercial thinning, pruning, removal of select tree species, patch-size harvesting, and clearcut harvesting, may have detrimental effects on these slugs. Changes in the abundance, structure, and composition of coarse woody debris are often associated with logging and reduced habitat complexity on the forest floor.

Although the survival of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug within a harvested and (or) second-growth forest landscape is poorly known, it will likely depend on the availability of moist microhabitats, including old decaying logs, which offer cover from

predators and the weather as well as potential egg-laying sites. Large-diameter downed logs may be in short supply in intensively managed forests; these logs may help to maintain stable microclimates where the slugs can retreat during adverse conditions (dry periods in summer and cold periods in winter). Riparian buffers and undisturbed gullies and steep terrain also ameliorate conditions for all three species. Riparian buffers are required along larger, fish-bearing streams under the British Columbia *Forest and Range Practices Act* but not for the small, fishless streams (S6 streams), or non-classified drainage features such as seepages, where these slugs are often found. Some forestry companies operating in the Kootenay region may voluntarily leave buffers along all streams, regardless of their size or status (Stuart-Smith, pers. comm., 2014). Nevertheless, even with voluntary efforts, slug habitats will likely be affected.

Threat 6. Human intrusions & disturbance

Recreational activities (Threat 6.1), is the only applicable threat in this category. The overall impact is rated as Negligible for all three slug species. Recreational use of forested areas for camping, hiking, foot and bicycle traffic, and the use of all-terrain vehicles and trail bikes, can degrade habitat quality through soil compaction and can also cause accidental slug mortality, especially if these activities occur off established trails and roads. All-terrain vehicle use is the main sources of disturbance, whereas hiking on trails has little or no impact. Logging roads have increased public access to the backcountry, including off-road vehicles that compact soil and can destroy habitat patches used by the slugs. Although several subpopulations for each species include recreational areas or areas near trail heads, the scope for entire ranges is relatively small because much habitat is away from well-travelled areas; however, intensive recreational activities may be an issue in local areas.

Threat 7. Natural system modifications

Fire and fire suppression (Threat 7.1), is the greatest contributor to this threat category. The overall impact rating is Low for Magnum Mantleslug and Pygmy Slug, and Medium for Sheathed Slug. The impact is considered greater for Sheathed Slug because of its relatively small range and the greater probability that occupied sites will be affected; this slug has a more southerly distribution in lower-elevation forests that are more likely to burn than moister, high-elevation habitats. Fires are harmful to terrestrial gastropods by causing direct mortality and reducing habitat suitability, including altering food availability and microhabitat conditions (Jordan and Hoffman Black 2012). Because of their low mobility, gastropods are both unable to escape fire events by moving away and are slow to recolonize burned areas. A trend towards increased length of the fire season and size of burned areas has been observed in several ecosystems across British Columbia over the past decades (Austin *et al.* 2008). As climate change proceeds, resulting in hotter and drier summers, fire frequency and intensity are expected to increase within the ranges of these slugs (COSEWIC 2012, 2016a, 2016b). As an example, the Southern and Central Interior of British Columbia experienced an unusually severe fire season in the summer of 2017 (Carman 2017). Within the portion of southeastern British Columbia encompassing the range of the three slug species, 110 000 ha of forest was burned in 2017.[7]

[7] Based on GIS shapefiles downloaded from DataBC Data Catalogue for B.C. Wildfire Service in 2017 (https://catalogue.data.gov.bc.ca/dataset/fire-perimeters-current/resource/d20791df-e866-4c6c-aa32-d8db725a785d).

The impact of fires on slugs will depend on both the size and intensity of the burn. The greatest effects will occur when the burn covers a large continuous area and extends deep into the ground. In contrast, small, discontinuous burns may allow slugs to survive in underground refuges or in seepages or depressions skipped by the fire. Slugs inhabiting riparian areas along small creeks, especially in steep gullies and on north-facing slopes, may be somewhat protected from fires that sweep the landscape (COSEWIC 2016a, 2016b).

Several studies have reported negative effects of fire on species richness and (or) abundance of terrestrial gastropods (review in Jordan and Hoffman Black 2012). Snails seem particularly vulnerable (Anderson 2004; Duncan 2005) but effects on slugs have also been reported (Duncan 2005). In southwestern Oregon, slugs (in general) were absent from over one-quarter of sites that supported them during pre-fire surveys. Fire retardants used in fighting fires can also be detrimental to slugs but no data are available.

Threat 8. Invasive & other problematic species, genes & diseases

Invasive non-native/alien species (Threat 8.1) is the only applicable threat in this threat category. Non-native invertebrates, including gastropods, could prey on, or compete with, Magnum Mantleslug, Pygmy Slug, and Sheathed Slug, and although potentially harmful, much uncertainty surrounds their impact on these slug species. The overall threat impact is rated as Low for Magnum Mantleslug and Medium–Low for Pygmy Slug and Sheathed Slug. Because few introduced gastropods have been recorded or are likely to occur in higher-elevation habitats, the impact is considered lower for Magnum Mantleslug. Although in recent years, composting toilets that use non-native earthworms are becoming more widespread within the backcountry and within protected ares. The impacts of the introduction and spread of non-native earthworms to these higher elevation habitats is unknown, however will likely change the soil structure and microhabitat at a site. No known issues exist with emerging diseases affecting terrestrial gastropod populations, but they have not been sought or monitored.

Non-native terrestrial gastropods are widespread within urban and agricultural landscapes in British Columbia (Forsyth 2004), including the Columbia Basin (Forsyth 1999). Mostly found in disturbed areas, many are spreading into forest habitats, especially sites frequented by humans such as picnic areas, campsites, and rest stops along highways. Non-native gastropods could compete with native species for food and shelter, or prey on their eggs and young. Non-native gastropods have been detected only at a few habitats occupied by Magnum Mantleslug, Pygmy Slug, or Sheathed Slug (COSEWIC 2012; 2016a, 2016b), but their distribution will likely increase over the next 10 years with increased human access to the backcountry along resource roads.

Introduced predators, including ground beetles (family Carabidae), are widespread in British Columbia. Ground beetles are voracious predators, and many species include gastropods in their diet (Symondson 2004). *Carabus granulatus* has been observed preying on native forest gastropods, such as *Prophysaon andersoni* and *Hemphillia camelus*, in the West Kootenays (Ovaska and Sopuck, unpubl. data; pers. comm. 2017). Non-native ground beetles are expected to spread into new areas over the next 10 years through increased human access to the backcountry. The significance of such interactions on Magnum Mantleslug, Pygmy Slug, and Sheathed Slug at their respective Canadian population level remain uncertain.

Threat 9. Pollution

Agricultural and forestry effluents (Threat 9.3), and airborne pollutants (Threat 9.5), are the main contributors to this threat category. Generally, pesticides and herbicides are not used in forestry in the West Kootenays. Fertilizers are applied only occasionally to planted areas, but this is not a common practice. Erosion and dust from gravel roads that crisscross the habitat may affect slugs and degrade their habitat, but no information is available. The occasional fuel spill may also affect slug habitat. For example, a fuel spill associated with fighting a forest fire 2 km downstream of a Pygmy Slug site (Lemon Creek; Subpopulation 4) occurred in July 2013. The pollution threat from various sources was assessed as Unknown for all three slug species.

Threat 10. Geological events

Landslides and avalanches occur frequently in the rugged landscapes occupied by these slugs; their steep gully habitat is particularly susceptible. The frequency of large landslides may increase along with severe storms generated by climate change (e.g., a large landslide occurred at Johnson's Landing by Kootenay Lake in 2012 just northeast of known Magnum Mantleslug, and Pygmy slug ranges). Although local impacts may occur, this threat was rated as Negligible over the entire ranges of all three slug species.

Threat 11. Climate change & severe weather

Droughts (Threat 11.2) and storms and flooding (Threat 11.4), are the main contributors to this threat category. Habitat shifts (Threat 11.1) are also an issue for the higher-elevation range of Magnum Mantleslug. Much uncertainty exists about the severity of climate change and severe weather impacts, except that these are expected to be negative. The overall threat impact was rated as Low for all species over the next 10 years, but a progressive increase in impacts is expected as climate change proceeds. A precautionary approach is warranted because of the potentially widespread and serious nature of this threat.

Climate models predict more frequent and prolonged summer droughts for the region (Utzig 2012). All three slug species rely on habitats with high moisture; therefore, prolonged and severe summer droughts may increase mortality and reduce the length of time available for growth and reproduction. Recurring droughts that extend well into the autumn will be particularly detrimental to these species. Several periods of dry, and very dry, conditions have occurred in the Kootenay region in recent years during the active periods of the slugs (e.g., during May–September 2015 and August–October 2017; B.C. Ministry of Forests, Lands and Natural Resource Operations 2017). Although the effect of drought on the overall Canadian population has generally not been tracked, a small number of Sheathed Slug and Pygmy Slug extant subpopulations were revisited in late September 2015, following a prolonged drought. Low detection rates were noted when compared to previous years, and this reduction was particularly evident at a subpopulation on the eastern periphery of Pygmy Slug's range; however, it is unknown whether the slugs were deeper in the substrate or whether they had suffered declines.

Flooding is an issue at some Pygmy Slug and Sheathed Slug subpopulations because of their affinity for riparian habitats, but they may be capable of surviving floods, which are a natural

seasonal event. Spring freshets may be more intense in the future, although probably of short duration, and may displace slugs. At subpopulation habitats on flatter terrain, flooding may result in local extirpations.

Climate change is expected to result in shifts to habitats and ecosystems, but much uncertainty exists both on the speed and type of these changes. A slight but persistent increase in temperature was recorded in winter, spring, and summer over a 30-year period (1971–2000) within the range of these three slug species, and these trends are expected to continue (Austin *et al.* 2008). Species inhabiting higher-elevation habitats, such as Magnum Mantleslug, may be particularly vulnerable. For example, studies on other montane species in Europe have shown that even small changes may result in habitat shifts along altitudinal gradients (Müller *et al.* 2009).

Although region-wide changes to climate patterns and droughts are expected, slugs in some parts of the range may be affected differently because of moisture regime variations related to hydrology, terrain, and availability of refuges. This is particularly the case for Magnum Mantleslug, with its scattered distribution pattern over a relatively wide area. Habitat quality, including patch size and availability of moist refuges, is also likely to influence the response of slugs to droughts. With a few exceptions, impacts associated with climate change are unstudied for terrestrial gastropods. The studies that do exist have focused on habitat shifts along altitudinal gradients in Europe and have projected range shrinkages and population declines for high-elevation species (Müller *et al.* 2009), as well as upward altitudinal shifts for lower-elevation species (Baur and Baur 2013). Proximate factors such as droughts that drive ecosystem shifts are probably more important over the short term (next 10 years) than the ecosystem shifts themselves.

5 MANAGEMENT GOAL AND OBJECTIVES

5.1 Management Goal

The management goal is to maintain all subpopulations[8]1 above of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug by securing, protecting2 aboveor restoring the habitats for these extant[9] subpopulations within the province, including any additional subpopulations that may be identified in the future.

5.2 Rationale for the Management Goal

The overall population and distribution goal aims to ensure that habitats of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug are maintained in a suitable condition for these species and that both landscape and subpopulation connectivity are maintained or restored to the extent possible. It is assumed that if habitat is secure and other threats mitigated, subpopulations of the slugs will persist. Although new subpopulations within the known range of each species may be recorded

[8]Subpopulations are defined as geographically inter-connected groups of individuals within a habitat patch (or patches) with no, or limited, gene flow with other such groups.

[9] Extant: occurrence has been recently verified as still existing within the past 20 years and where the habitat is still intact.

with increased survey effort, there is no information to indicate that these species were previously more widespread in British Columbia. Little current or historical information is available on the abundance of these species at occupied habitats, and the extent of their distribution within these habitats is poorly known.

Active management to increase the number of occupied habitats is not currently specified as a management goal because knowledge gaps exist related to the species' habitat requirements and current distributions across their ranges. A further understanding of the species' life histories may be possible through captive breeding; however, captive breeding is not recommended to augment or supplement wild subpopulations, nor is it recommended as a mitigation option because of the knowledge gaps cited above. Uncertainty also surrounds the feasibility of habitat restoration. The management goal can be met, and the viability of subpopulations and the status of the species potentially improved, by effectively managing threats at known and other suitable habitats within the species' ranges.

At present, the management goal for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug cannot be quantified because of knowledge gaps, including unknown subpopulation sizes at occupied habitats and unknown number of undocumented subpopulations in suitable habitats. These slugs are not readily numerated using conventional methods such as mark-recapture because of their small size and soft bodies, fragility and vulnerability when being handled, cryptic habits, and rarity within the landscape.

5.3 Management Objectives

The management objectives are:

1. to ensure protection[10] (with no loss of habitat functionality) for the habitats at extant[11] subpopulations[12] of Magnum Mantleslug, Sheathed Slug, and Pygmy Slug;
2. to clarify the distribution of Magnum Mantleslug, Sheathed Slug, and Pygmy Slug within their respective geographic ranges in British Columbia;
3. to assess and mitigate threats and restore connectivity of habitat at extant subpopulations, more broadly, at suitable habitats with possible undocumented subpopulations within the ranges of Magnum Mantleslug, Sheathed Slug, and Pygmy Slug; and
4. to address knowledge gaps, including, but not limited to: (a) habitat requirements at the landscape, stand, and microhabitat scales; (b) reproductive and other life history features; (c) clarification of threats from invasive non-native invertebrates.

[10] Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale of private lands by willing vendors, land use designations, and protected areas.

[11] Extant: occurrence has been recently verified as still existing (NatureServe 2002).

[12] Subpopulations are defined as geographically inter-connected groups of individuals within a habitat patch (or patches) with no, or limited, gene flow with other such groups.

6 APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Underway

The following actions have been categorized by action groups of the B.C. Conservation Framework (B.C. Ministry of Environment 2009). Status of the action group for this species is given in parentheses.

Compile Status Report (complete)
COSEWIC report completed:
- Magnum Mantleslug (COSEWIC 2012)
- Pygmy Slug (COSEWIC 2016a)
- Sheathed Slug (COSEWIC 2016b)

Send to COSEWIC (complete)
Species assessed as Special Concern
- Magnum Mantleslug (COSEWIC 2012) Re-assessment 2022.
- Pygmy Slug (COSEWIC 2016a) Re-assessment 2022.
- Sheathed Slug (COSEWIC 2016b) Re-assessment 2022.

Planning (in progress)
- B.C. Management Plan completed (this document, 2018).

Inventory (in progress)
- There have been substantial surveys for terrestrial gastropods of conservation concern, including the three species addressed in this management plan (see Ovaska and Sopuck 2009a, 2009b, 2014, 2015; Ovaska *et al.* 2010; Ovaska and Sopuck, 2010–2014, unpubl. data, pers. comm. 2017; and see COSEWIC 2012, 2016a, and 2016b for a summary of the survey effort).

Ecosystem and Habitat Protection, Restoration, and Private Land Stewardship (in progress)
- Magnum Mantleslug, Pygmy Slug, and Sheathed slug occur mainly on British Columbia Crown or private forestry lands. Some search effort for terrestrial gastropods have been expended on other private properties with forest habitat (Ovaska *et al.* 2010), but potential habitats are often disturbed and highly fragmented, and no records exist from these habitats. Searches have also been conducted on Ktunaxa First Nations reserve lands in the east Kootenays (Ovaska and Sopuck 2009b), but the species have not been recorded from this area.

Provincial Crown lands and private land protection
- Habitat adjacent to riparian areas is potentially protected under provisions of the *Water Sustainability Act* (Province of British Columbia 2014), which came into force February 29, 2016. This Act replaces the provincial *Water Act*, as well as components of the *Fish Protection Act*, which has now been renamed the *Riparian Areas Protection Act* (Province of British Columbia 1997), with some sections repealed. The *Water Sustainability Act* includes some guidance on the protection of sensitive streams and protection of aquatic ecosystems.

For example, under Section 16, the decision maker can require mitigation measures for, and changes in and about, a stream (including the diversion of a stream) when proposed activities are likely to have adverse impact on an aquatic ecosystem. Additional potential protection mechanisms are included in Part 3, Division 4, which refers to "Water Sustainability Plans" (Section 65). Under this section, the Minster may designate an area for the development of a water sustainability plan, if the Minister considers it will assist in preventing or addressing risks to aquatic ecosystem health.

- The Riparian Areas Regulation, enacted under the *Riparian Areas Protection Act*, calls on local governments to protect riparian areas during residential, commercial, and industrial development by ensuring that a qualified environmental professional conducts a science-based assessment of proposed activities.
- Available protection mechanisms under the provincial *Land Act* (Province of British Columbia 1996a) include the following. (Note: when this management plan was written (2017), none of these protection mechanisms were in place for Magnum Mantleslug, Pygmy Slug, or Sheathed Slug.)
    - Notations of Interest: these do not afford any protection to the land base but notify the Land Officer the species is present, such that the Land Officer can seek additional information or clarification as to how the desired use of the land will impact the ecosystem value (e.g., presence of the slug subpopulation).
    - Section 17 reserves ("conditional withdrawal" reserves): these allow land to be set aside for a specific purpose (e.g., conservation); however, if compatible, overlapping uses may occur. All land uses must be specified so that they are included in the tenure language for the reserve.
    - Section 15 and 16 reserves ("full withdrawal for exclusive use of the land"): these require an order in council and provide strong protection for the land and allow for land to be set aside when no existing uses of Crown land occur in the location and the placement of the reserve will not conflict with any known potential use of the land.

Provincial parks

- Magnum Mantleslug – Stagleap Provincial Park; Wells Gray Provincial Park
- Pygmy Slug – Champion Lakes Provincial Park; although no records exist, this species may also occur in other provincial parks, including Valhalla, Kokanee Glacier, West Arm, Lockhart Creek, Kianuko, Stagleap, and Kootenay Lake.
- Sheathed Slug – none

Regional District parks and municipal parks

- Magnum Mantleslug – none
- Pygmy Slug – none
- Sheathed Slug – none

Private conservation land

- Magnum Mantleslug – Darkwoods Conservation Area, Nature Conservancy of Canada
- Pygmy Slug – none
- Sheathed Slug – none

Stewardship on private lands

- The Kootenay Conservation Program is active within the range of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug, helping partner organizations to protect important wildlife habitat and engaging in outreach and landowner contacts. Gastropods at risk or their habitats have not been specifically targeted.

Federal Crown lands and parks

- Protection for Magnum Mantleslug occurrences within Mount Revelstoke National Park and Glacier National Park is provided by the *Canada National Parks Act* (Government of Canada 2000). If additional occurrences of Magnum Mantleslug, Pygmy Slug and/or Sheathed Slug are recorded from national parks, the same protection will apply.
    - Magnum Mantleslug – Mount Revelstoke and Glacier National Parks
    - Pygmy Slug – none
    - Sheathed Slug – none
- Section 79 of the *Species at Risk Act* (Government of Canada 2002) applies to Magnum Mantleslug occurrences on federal lands. Section 79 states that, if an Act of Parliament requires that an assessment of the environmental effects of a project is conducted, the assessment must identify the adverse effects of the project on the listed wildlife species and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. If Pygmy Slug and Sheathed Slug area also added to Schedule 1 of SARA, Section 79 will also apply to these species if they occur on federal lands.

6.2 Recommended Management Actions

Management planning for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug is concurrent with conservation planning approaches for species with similar habitats and threats. Because of the extensive knowledge gaps for these slug species, most of the recommended management activities (Table 10) involve inventory, habitat information collection, habitat mapping, and threat clarification. These activities will help prioritize areas for future surveys and habitat protection efforts. A combined approach to management includes engaging the academic, naturalist, and stewardship community in conservation projects for these species, including inventory, natural history studies, and habitat assessment.

Table 10. Recommended management actions for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug.

Objective	Conservation Framework action group[a]	Actions to meet objectives	Performance measure	Threat[b] or concern addressed	Priority[c]
1. To ensure protection (with no loss of habitat functionality) for the habitats at extant subpopulations of Magnum Mantleslug, Sheathed Slug, and Pygmy Slug.	Habitat Protection Private Land Stewardship	1. Using geographic information system applications, complete habitat mapping and spatial delineation of suitable survival and connectivity habitat within the British Columbia ranges of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug to identify: (a) subpopulations based on distance and habitat connectivity; and (b) potential area of occupancy at each habitat patch.	1. Spatial delineation of suitable habitat near known occurrences and connectivity analysis are completed by 2023.	All identified threats (see Table 9), including main threats: 1.1–1.3, 4.1, 5.3	Necessary
	Habitat Protection Private Land Stewardship	2. Identify land ownership category (e.g., provincial Crown, municipal, protected area, private forestry or residential) of polygons with suitable habitat for each Magnum Mantleslug, Pygmy Slug and Sheathed Slug site. Prioritize areas for securement, stewardship efforts, and inventory.	2. Land ownership and priority subpopulations for stewardship engagement are identified for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug by 2023.		Necessary
	Habitat Protection Private Land Stewardship	3. Identify the appropriate environmental protection tools as afforded under current legislation (e.g., Development Permit Areas, Riparian Areas Regulation, and Land Act Reserves and others) for each Magnum Mantleslug, Pygmy Slug, and Sheathed Slug site. On undesignated provincial Crown land locations and habitat polygons, establish a Section 15, 16, or 17 reserve and (or) a notation of interest under the *Land Act* such that future development interests will be aware that species at risk habitat for Magnum Mantleslug, Pygmy Slug, and (or) Sheathed Slug occurs at the site.	3. Work with appropriate authorities to ensure protection of each of these species' habitat under the appropriate legislation by 2023. Habitat polygon maps are completed for subpopulations on provincial Crown land, and draft applications for a Section 15, 16, or 17 reserve and (or) notation of interest under the *Land Act* at these habitats are submitted by 2023.		Necessary
	Habitat Protection Private Land Stewardship	4. For subpopulations on private lands, work with landowners and provide them with guidelines to encourage protection of forest habitats through stewardship activities.	4. Work towards stewardship agreements and (or) covenants for known (and any new) subpopulations on private conservation lands, private timber land, and regional district and municipal lands by 2023.		Necessary
	Habitat Protection Private Land Stewardship	5. For subpopulations in provincial parks, incorporate management actions for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug into park master plans, where such plans exist. If no master plans exist, draft a separate management recommendation for any provincial park in which these species occur.	5. Existing park master plans are updated, or separate management guidance documents are drafted with appropriate information on management measures or inventory by 2023.		Necessary
	Habitat Protection	6. Recommend that Magnum Mantleslug, Pygmy Slug, and Sheathed Slug are listed as Identified Wildlife under the provincial *Forest and Range Practices Act* and *Oil and Gas Activities Act.*	6. Recommendation made to list these three species under the category of Species at Risk under these acts and an Identified Wildlife Species Account is drafted for these species under these acts by 2023.		Necessary
	Habitat Protection	7. Determine the forest company tenure on provincial Crown land slug habitats throughout the range of all three species. Work with forest companies to inventory priority slug habitats and enable effective protection at extant subpopulations and any newly identified subpopulations (in conjunction with Action #6 above).	7. Prioritized list of potential slug wildlife habitat areas identified and mapped (ongoing).		Beneficial
	Private Land Stewardship	8. Incorporate Magnum Mantleslug, Pygmy Slug, and Sheathed Slug into multispecies stewardship programs to protect and manage habitats and to ensure recovery actions for one species does not jeopardize recovery of another species.	8. Number of multispecies stewardship programs where these species have been included.		Necessary
	Habitat Protection	9. Work with local stewardship and conservation organizations to establish landowner contacts and raise awareness for the forest ecosystems where Magnum Mantleslug, Pygmy Slug, and Sheathed Slug occur.	9. Number of landowners contacted with potential habitats for these slugs; number of private land habitats surveyed for these species; and spatial area of habitat surveyed.		Necessary
	Private Land Stewardship	10. Prepare a fact sheet or at-risk brochure on terrestrial gastropods at risk in the Kootenays of southern British Columbia, highlighting the habitats in which they occur and their protection needs.	10. A fact sheet/brochure incorporating this species is prepared.		Beneficial
	Private Land	11. Promote the inclusion of Magnum Mantleslug, Pygmy Slug, and Sheathed	11. Type and number of interpretive materials prepared that include these		Beneficial

Objective	Conservation Framework action group[a]	Actions to meet objectives	Performance measure	Threat[b] or concern addressed	Priority[c]
1. to ensure protection (with no loss of habitat functionality) for the habitats at extant subpopulations of Magnum Mantleslug, Sheathed Slug, and Pygmy Slug. [continued]	Stewardship	Slug in interpretive materials by local governments and by provincial and national parks within the species' known ranges (e.g., park interpretive signage, website content, fact sheets).	three gastropod species at risk.	All identified threats (see Table 9), including main threats:1.1–1.3, 4.1, 5.3 [continued]	
	Habitat Protection Private Land Stewardship	12. Promote the inclusion of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug in workshops on conservation and restoration of forest ecosystems in the range of the species.	12. Workshops, presentations or outreach programs delivered, and the number of people and/or landowners engaged in the outreach and extension.		Beneficial
	Habitat Protection Private Land Stewardship	13. From the mapping in Action 1, develop a habitat suitability map across the British Columbia distributions of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug to help prioritize areas for surveys and to identify possible undocumented subpopulations requiring protection.	13. A habitat suitability map is prepared for each species by 2023.		Beneficial
2. to clarify the distribution of Magnum Mantleslug, Sheathed Slug, and Pygmy Slug within their respective species' ranges in British Columbia;	Planning Habitat Protection Private Land Stewardship Monitoring	14. Based on the habitat suitability map, develop a prioritized inventory schedule for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug within their respective ranges.	14. Inventory schedule is developed for the next 10 years.	All identified threats (see Table 9), including main threats: 1.1–1.3, 4.1, 5.3	Necessary
		15. Develop standardized inventory methods for Mantleslug, Pygmy Slug, and Sheathed Slug, including timing of surveys, methodology, and information to be collected on habitat and threats	15. Inventory methods are drafted and tested by 2023.		Necessary
		16. Using standard inventory methods and following the prioritized inventory schedule, conduct fieldwork to clarify the distribution and habitats of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug and to identify possible previously undocumented subpopulations in need of protection.	16. Number of habitats and/or spatial area of habitats surveyed; and habitat descriptions for extant subpopulations Magnum Mantleslug, Pygmy Slug and Sheathed Slug described by 2023.		Necessary
3. to assess and mitigate threats and restore connectivity of habitat at extant subpopulations, more broadly, at suitable habitats with possible undocumented occurrences within the ranges of Magnum Mantleslug, Sheathed Slug, and Pygmy Slug;	Planning Habitat Protection Private Land Stewardship Monitoring	17. Confirm the scope, severity, and timing of applicable threats to Magnum Mantleslug, Pygmy Slug, and Sheathed Slug at extant subpopulations.	17. Detailed threats are evaluated for each known site by 2028.	All identified threats (see Table 9)	Beneficial
		18. Using the results of the habitat suitability modeling (see Action 1), determine the immediate threats to these habitat polygons and adjust inventory to prioritize subpopulation habitats with immediate development, logging, and (or) other land conversion threats.	18. Threats are evaluated at a broad scale for habitat polygons at extant subpopulations and incorporated into the prioritization scheme in the 10-year inventory plan.		Necessary
		19. Develop and implement a monitoring project at a sample of extant subpopulations for each species (e.g., photographic record to monitor natural successional processes, tree die-back from drought) and wildfire to monitor long-term habitat changes. This action would link with monitoring for the effects of climate change.	19. A monitoring plan for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug presence and habitat condition at select subpopulations is developed and tested by 2023.		Necessary
		20. Prepare best management practice guidelines specific for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug for distribution to local governments and other landowners/managers near known subpopulations and in potential habitats.	20. Best management practices are prepared by 2023.		Necessary
4. to address knowledge gaps, including, but not limited to: (a) habitat requirements at the landscape, stand, and microhabitat scales; (b) reproductive and other life history features; (c) clarification of threats from invasive non-native invertebrates	Planning Ecosystem and Habitat Protection Species Management	21. Compile a working list of priority research needs for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug.	21. Working list of research priorities is compiled by 2023.	All identified threats (see Table 9)	Necessary
		22. Support and encourage studies on habitat use, including minimum patch size, plant associations, and habitat characteristics in areas with subpopulations of Magnum Mantleslug, Pygmy Slug, or Sheathed Slug.	22. Information collection for habitat use required for population viability assessment is initiated by 2023.		Necessary
		23. Investigate distribution and habitat use patterns of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug in relation to non-native plants and invertebrate competitors/predators, including non-native gastropods.	23. Investigation into invasive non-native species interactions is initiated by 2023.		Beneficial
		24. Engage the academic community, local natural history interest groups, and	24. One or more research projects initiated to fill in information gaps by		Beneficial

Objective	Conservation Framework action group[a]	Actions to meet objectives	Performance measure	Threat[b] or concern addressed	Priority[c]
		(or) private citizens in research projects needed to address Magnum Mantleslug, Pygmy Slug, and Sheathed Slug population and natural history gaps.	2023.		

[a] Threat numbers according to the IUCN–CMP classification (see Tables 6–8 for details).
[b] Essential (urgent and important, needs to start immediately); Necessary (important but not urgent, action can start in 2–5 years); or Beneficial (action is beneficial and could start at any time that was feasible).

6.3 Narrative to Support Management Actions Table

Recommended actions have been categorized by action groups of the B.C. Conservation Framework (B.C. Ministry of Environment 2009).

6.3.1 Planning

Planning activities include landscape planning and zoning aimed at protecting loss of forest habitats where Magnum Mantleslug, Pygmy Slug, and Sheathed Slug occur. The actions include identifying where the habitats are located and their ownership, working with municipalities on zoning and habitat protection, and clarifying threats. It also involves the inclusion of these slug subpopulations and their habitats into site-specific plans for the localities in which they occur. Specific activities that aid and support the above actions include developing a habitat suitability map for each of the three species, which delineates the area of occupancy at extant subpopulations and analyzes landscape connectivity. Opportunities should be taken to include these species and their habitats in various planning processes, such as new and updated provincial park master plans, local development areas, private conservation land management plans, and other similar documents.

Listing of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug as Identified Wildlife under the province's *Forest and Range Practices Act* (Province of British Columbia 2002) and *Oil and Gas Activities Act* (Province of British Columbia 2008) is recommended to allow for various additional habitat protection mechanisms, such as the establishment of Wildlife Habitat Areas. Whenever feasible, including these species in multispecies management programs is recommended. Existing mechanisms for land protection are summarized below and could be used whenever feasible (Table 11).

Table 11. Existing mechanisms that afford habitat protection for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug.

Existing mechanisms that afford habitat protection	Threat[a] or concern addressed	Magnum Mantleslug	Pygmy Slug	Sheathed Slug
Riparian Areas Protection Act (Province of British Columbia 1997)	1.1, 1.2, 1.3, 4.1, 5.3, 6.1	x	x	x
Canada National Parks Act (Government of Canada 2000)	1.1, 1.3, 4.1, 4.2, 5.3, 6.1, 7.1, 7.3, 8.1, 10.3	x	–	–
Park Act (Province of British Columbia 1996c)	1.1, 1.2, 1.3, 4.1, 5.3, 6.1, 10.3	x	x	–
Forest and Range Practices Act (Province of British Columbia 2002)	4.1, 5.3, 6.1, 7.1, 8.1, 9.3, 10.3	Not yet listed under this act		
Land Act, Section 15, 16, or 17 Reserves or Notations of Interest (Province of British Columbia 1996a)	1.1, 1.2, 1.3, 2.3, 4.1	x	x	x

[a] Threat numbers according to the IUCN–CMP classification (see Table 9 for details).

6.3.2 Inventory

Much of the potential suitable habitat across the Canadian range of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug remains to be surveyed. Actions in this management plan are intended to apply a systematic approach to inventory. The first step is to conduct geographic information systems (GIS) habitat suitability mapping based on existing vegetation, forest cover, and biophysical mapping. An updated GIS map layer showing the distribution of potentially suitable forests is necessary. Developing standard survey protocols will improve the effectiveness of surveys, and a 10-year inventory schedule will enable the systematic tracking of progress. Because of the relatively large area involved, a prioritized sampling regime is required to cover different geographic areas across the species' ranges.

6.3.3 Monitor Trends

The actions focus on monitoring trends in the extent and quality of habitat, rather than patterns of abundance of the slugs at the occupied habitats across their range; however, some survey effort is required to confirm continued occupancy in relation to habitat conditions and level of threats. Unfortunately, owing to the slugs' small size and cryptic habits, resources required to carry out thorough annual surveys at occupied habitats is not logistically feasible. The recommended actions address the development and implementation of a program that monitors habitat trends at prioritized sampling stations in different portions of the species' ranges. Where habitats have been modified or threats have increased, surveys for the species' persistence and abundance should be conducted. Collaborative opportunities to incorporate these slugs and their habitats into a multispecies monitoring program (e.g., under climate change monitoring) will be explored. For example, a collaborative program monitoring gastropods, amphibians, and mammals was conducted from 2010 to 2014 in northern Idaho (Lucid *et al.* 2016).

6.3.4 Habitat Protection and Private Land Stewardship

Because of their small subpopulation size, protection is needed for all known subpopulations of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug. Protective measures on provincial Crown lands, including the listing of these species as Identified Wildlife under the *Forest and Range Practices Act* (Province of British Columbia 2002), are considered urgent. Including provisions for these species in park management plans at all levels of government, and implementing recommendations within such plans, will help minimize threats within these protected areas.

Portions of suitable habitat and (or) some extant subpopulations are on private forest lands; therefore, stewardship activities and securement through covenants and memoranda of understanding are an essential component of habitat protection and management. Protection on private forest lands will involve voluntary stewardship initiatives. Developing best management practices for these species and including them in public education programs will help support and initiate stewardship activities that provide the main options for habitat protection in human populated areas and on private lands, such as those managed by forest companies. The recommended management actions involve collaboration with local conservation groups, such as the Kootenay Conservation Program, who are already working with private landholders and encouraging them to protect habitat through habitat management or formal means (e.g., conservation covenants). Management actions also entail raising awareness about these slug

species and their habitats among landholders and managers through outreach activities in partnership with governments and local conservation organizations, industry associations, farmer institutes, and (or) researchers. Developing best management practices for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug habitat is an essential priority action recommended as part of a best management practices document for terrestrial gastropods.

7 MEASURING PROGRESS

Performance indicators provide a way to define and measure progress toward achieving the management (population and distribution) goals and objectives. Performance indicators have been integrated into the Management Action Table in Section 6.2 (Table 10). The management plan will be reviewed in 10 years to assess progress and to identify additional approaches or changes that may be required to achieve recovery.

8 EFFECTS ON OTHER SPECIES

Management activities for Magnum Mantleslug, Pygmy Slug, and Sheathed Slug will be implemented with consideration for all co-occurring species at risk, such that no negative impacts occur to these species or their habitats. The habitat protection and stewardship measures recommended here are expected to benefit other forest-dwelling species that exist in these ecosystems. No negative impacts are anticipated as a result of recovery efforts for these slug species. The protection and management of key areas may help to restore these ecosystems over the long term.

The actions in this management plan focus on identification and protection of habitat, primarily through stewardship and incorporation into existing regulations and legislative options. The GIS habitat mapping undertaken for these slugs will likely benefit other forest-dwelling species in the region. Surveys as well as threat and habitat assessments for the species are also expected to be useful in managing other gastropod species at risk within similar habitats and overlapping geographic ranges. All gastropods can be surveyed simultaneously to ensure surveyors are not missing important microsites. Additionally, provincially listed flora and ecological communities of concern whose ranges overlap those of Magnum Mantleslug, Pygmy Slug, and Sheathed Slug (summarized in Table 12) may benefit from the management efforts for these southeastern slug species.

Table 12. Species and ecosystems at risk that may benefit from management actions associated with Magnum Mantleslug, Pygmy Slug, and Sheathed Slug.

Common Name	Scientific Name	Provincial rank[a,b]	*Species at Risk Act* status[c]	COSEWIC status[c]
Gastropods				
Banded Tigersnail	*Anguispira kochi*	S3	No status	Not at risk
Coeur d'Alene Oregonian	*Cryptomastix mullani*	S3	No status	Not assessed
Pale Jumping-slug	*Hemphillia camelus*	S3	No status	Not assessed
Subalpine Mountainsnail	*Oreohelix subrudis*	S3	No status	Not assessed
Fir Pinwheel	*Radiodiscus abietum*	S2?	No status	Not assessed
Vascular Plants				
Margined streamside moss	*Scouleria marginata*	S1	Schedule 1: Endangered	Endangered
Southern maiden-hair	*Adiantum capillus-veneris*	S1	Schedule 1: Endangered	Endangered
Whitebark pine	*Pinus albicaulis*	S2S3	Schedule 1: Endangered	Endangered
Limber pine	*Pinus flexilis*	S2	No schedule	Endangered
Ecological Communities				
Black cottonwood/red-osier dogwood–Nootka rose	*Populus trichocarpa/Cornus stolonifera–Rosa nutkana*	S1S2	NA	NA
Western hemlock/common snowberry	*Tsuga heterophylla/Symphoricarpos albus*	S2	NA	NA
Douglas-fir/common snowberry/arrowleaf balsamroot	*Pseudotsuga menziesii/Symphoricarpos albus/Balsamorhiza sagittata*	S2	NA	NA
Douglas-fir/tall Oregon-grape/parsley fern	*Pseudotsuga menziesii/Berberis aquifolium/Cryptogramma acrostichoides*	S2?	NA	NA
Douglas-fir–western larch/pinegrass	*Pseudotsuga menziesii–Larix occidentalis/Calamagrostis rubescens*	S2	NA	NA

[a] B.C. Conservation Data Centre (2017)

[b] S = subnational; T = refers to the subspecies level; B = breeding; X = presumed extirpated; H = possibly extirpated; 1 = critically imperilled; 2 = imperilled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure; NA = not applicable; NR = unranked; U = unrankable; ? = Inexact numeric rank; the addition of a ? qualifier to a 1–5 conservation status rank denotes that the assigned rank is imprecise.

[c] Government of Canada (2017). Ecological communities are not listed under the *Species at Risk Act*.

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