

Conservation Assessment

for

Pristiloma arcticum crateris,
Crater Lake Tightcoil

**Originally issued as
Management Recommendations
October 1999**

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**reconfigured September 2004
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**USDA Forest Service Region 6 and
USDI Bureau of Land Management, Oregon and Washington**

TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
I. NATURAL HISTORY	6
A. Taxonomic/Nomenclatural History	6
B. Species Description.....	6
1. Morphology	6
2. Reproductive Biology	7
3. Ecology	7
C. Range and Known Sites	7
D. Habitat Characteristics and Species Abundance.....	8
1. Habitat Characteristics	8
2. Species Abundance	9
II. CURRENT SPECIES SITUATION.....	9
A. Status History.....	9
B. Major Habitat and Viability Considerations	10
C. Threats to the Species	11
D. Distribution Relative to Land Allocations	11
III. MANAGEMENT GOALS AND OBJECTIVES	12
IV. HABITAT MANAGEMENT	12
A. Lessons from History	12
B. Identification of Species Habitat Areas	13
C. Management within Species Habitat Areas	13
D. Other Management Issues and Considerations	14
V. RESEARCH, INVENTORY, AND MONITORING OPPORTUNITIES.....	15
A. Data Gaps and Information Needs	15
B. Research Questions	15
C. Monitoring Opportunities and Recommendations.....	16
VI. REFERENCES.....	17

Preface:

Converting Survey and Manage Management Recommendations into Conservation Assessments

Much of the content in this document was included in previously transmitted Management Recommendations developed for use with Survey and Manage Standards and Guidelines. With the removal of those Standards and Guidelines, the Management Recommendations have been reconfigured into Conservation Assessments to fit Special Status/Sensitive Species Program (SSSSP) objectives and language. Changes include: the removal of terminology specific to Survey and Manage Standards and Guidelines, the addition of Oregon Natural Heritage Information Center ranks for the species, and the addition of USDA Forest Service and USDI Bureau of Land Management (BLM) Special Status/Sensitive Species status and policy. Habitat, range, and taxonomic information have also been updated to be current with data gathered since the Management Recommendations were initially issued. The framework of the original document is maintained in order to expedite getting this information to field units. For this reason this document does not entirely conform to recently adopted standards for the Forest Service and BLM for Conservation Assessment development in Oregon and Washington.

Assumptions about site management

In the Final Supplemental Environmental Impact Statement (FSEIS) and Record of Decision (ROD) to Remove or Modify the Survey and Manage Standards and Guidelines (USDA and USDI 2004), assumptions were made as to how former Survey and Manage species would be managed under Agency Special Status/Sensitive Species policies. Under the assumptions in the FSEIS, the ROD stated “The assumption used in the final SEIS for managing known sites under the Special Status Species Programs was that sites needed to prevent a listing under the Endangered Species Act would be managed. For species currently included in Survey and Manage Categories A, B and E (which require management of all known sites), it is anticipated that only in rare cases would a site not be needed to prevent a listing.... Authority to disturb special status species sites lies with the agency official who is responsible for authorizing the proposed habitat-disturbing activity”. This species was in Category A at the time of the signing of the ROD, and the above assumptions apply to this species’ management under the agencies’ SSSSP.

Management Considerations

Within the following Conservation Assessment, under the “Managing in Species Habitat Areas” section, there is a discussion on “Management Considerations”. “Management Considerations” are actions and mitigations that the deciding official can utilize as a means of providing for the continued persistence of the species’ site. These considerations are not required and are intended as general information that field level personnel could utilize and apply to site-specific situations. Management of the species covered in this Conservation Assessment follows Forest Service 2670 Manual policy and BLM 6840 Manual direction. (Additional information, including species specific maps, is available on the Interagency Special Status and Sensitive Species website.)

EXECUTIVE SUMMARY

Species: *Pristiloma arcticum crateris* Pilsbry, 1946.
Common Name: Crater Lake Tightcoil

Taxonomic Group: Mollusks (Phylum Mollusca); Snail (Class Gastropoda); Land Snail (Order Pulmonata)

Management Status: Bureau Sensitive Species, Oregon BLM; Forest Service Region 6 Sensitive Species. Oregon Natural Heritage Information Center ranks this as a List 1 species, with Global ranking G1, State ranking S1.

Range: *Pristiloma arcticum crateris* may be found sparsely distributed throughout the Oregon Cascades, at moderate to high elevations, over 610 meters (2000 feet). It has been found from Winema National Forest in southern Oregon to the Bull Run Watershed in northern Oregon.

Specific Habitat: This species may be found in perennially moist situations in mature conifer forests and meadows among rushes, mosses and other surface vegetation or under rocks and woody debris within 10 m. of open water in wetlands, springs, seeps and streams, generally in areas which remain under snow for long periods in the winter. Riparian habitats in the Eastern Oregon Cascades that are suitable for this species, limited to the extent of permanent surface moisture, are often much less than 10 m. from open water. Essential habitat components include uncompacted soil, litter, logs, and other woody debris in a perennially wet environment.

Threats: Loss or degradation of wetland habitat leading to loss of populations at sites occupied by the Crater Lake Tightcoil is considered to be the major threat to the species. Activities that compact soils or snow, disturb ground vegetation and/or litter, remove woody debris, alter temperature and/or humidity of the microsite, or alter the water table could be deleterious to the habitat of this species. These activities include water diversions and improvements, livestock grazing, timber management, recreation (i.e., camping, ORVs), burning, heavy equipment operation, and construction activities. With so few known locations, inadvertent degradation of occupied sites, not yet known, would also be of concern.

Cold temperatures and short growing seasons at the higher elevation habitats where some of these populations are located limit mollusk activity to just a few of the warmer months of the year (Pilsbry 1946). This species almost certainly has a 1-year life span and produces only one clutch of eggs (Frest and Johannes 1995). Therefore, the loss of a single cohort could have devastating consequences on the population.

Management Considerations: For populations on National Forest and BLM administered lands, during grazing, timber management, recreation, and other land management activities consider:

- Maintaining shading to minimize temperature and humidity fluctuations on and within the ground at the site.
- Maintaining natural understory vegetation and a layer of uncompacted organic litter and

- debris on the ground.
- Avoiding activities that would cause soil compaction. Litter and porous soil will provide cover and insulation against temperature extremes.
- Maintaining existing logs and other woody debris. Retain CWD in species habitat areas during firewood gathering.
- Avoiding activities that would lower the water table at the site, thus reducing soil moisture below that required by the species, or possibly altering vegetative communities.
- Avoiding burning within occupied habitats.
- Protection from grazing.

Research, Inventory and Monitoring Opportunities:

Specific areas in which there is a lack of or insufficient data include:

- Accurate range of the species and extent of populations;
- Specific habitat conditions required (i.e., temperature and moisture tolerances, and how these are maintained within the natural habitat);
- Biology (breeding season, egg repositories, life span, seasonal habits, i.e., aestivation, hibernation);
- Ecology (food, ecosystem functions);
- Predators, diseases, and other natural threats;
- Additional refinement of search methodology may be needed because of the minute size of this species.
- Investigate methods for transplantation of colonies at risk.

Monitoring Opportunities: Studies or monitoring of *Pristiloma arcticum crateris* should use sampling methods that affect less than 5% of the suspected population area. Objectives for monitoring include:

- Verify existing known populations:
 - describe macro and micro-habitat conditions; and
 - determine the extent of the populations.
- Conduct surveys to locate additional populations in areas identified as potential habitat.
- Monitor known population sites following land management activities for effectiveness of management considerations applied.

I. NATURAL HISTORY

A. Taxonomic/Nomenclatural History

Pristiloma arcticum crateris was originally described by Pilsbry (1946) when it was known from a single locality one mile south of Crater Lake. Henderson (1929) had reported it as "*Anceyia* species undetermined."

Pilsbry (1946) gave no reason for considering this to be a subspecies of *P. arcticum*. Frest and Johannes (1995(b)) agreed with Riedel (1980) that *P. a. crateris* may be a distinct subspecies. Since, to date, no one has published findings from dissection or genetic analysis of the relationships of these snails, Pilsbry's classification is accepted.

B. Species Description

1. Morphology

This is a minute snail, about 2.75 mm diameter in 5 1/8 whorls. The shell is imperforate with a low conic spire, and it is tightly coiled with a crescentic aperture. There are no apparent sulci (radial indented lines on the shell). It is distinguished from other similar *Pristiloma* by its unshouldered last whorl, the periphery of which is rounded and widest at about mid-whorl. The basal apertural margin is a little more flattened than that of *P. arcticum arcticum*.

Pilsbry (1946) described this species as follows: "The shell is imperforate, depressed, with quite low, conoid spire and rounded periphery, median in position; pinkish buff, glossy. Sculpture of weak but subregular ripples of growth below the suture, soon disappearing, leaving the peripheral region and base smooth except for very weak lines of growth; very fine, close spirals are seen on the upper surface. The whorls are regularly and rather closely coiled, the last not unduly wider. The aperture is narrowly crescentic, the outer and basal margins of the lip thin, columellar margin slightly spreading, thickened within, reflected at the insertion in a small callus over the axis. Height 1.5 mm, diameter 2.75 mm; 5 1/8 whorls.

"The shell is smaller than that of *Pristiloma idahoense*, with the peripheral convexity median, not above the middle as in *P. idahoense*. *P. a. crateris* is very similar to *P. a. arcticum*, but the base is more flattened, producing a less deeply concave basal lip and somewhat different shape of aperture, and there is a fraction of a whorl more (Pilsbry, 1946)."

2. Reproductive Biology

Specific reproductive biology of *P. arcticum crateris* is unknown at present. However, Frest and Johannes (1995) wrote that almost all small land snails are hermaphroditic and semelparous (i.e., breed only once in a lifetime). Most small land snails live only one year unless conditions prohibit breeding, in which case some may over-winter so they may breed the following year.

3. Ecology

Pristiloma arcticum crateris grazes on microscopic periphyton (bacteria, fungi, yeasts and other microscopic organisms) found on moist surfaces of wood, green and decaying vegetation and rocks. It is known from high-elevation sites and apparently remains unfrozen under snow when air temperatures are well below freezing. Its body fluids may contain biological “anti-freeze” compounds of interest to humans. The species is one of many organisms that compose the biotic community within the ecosystems in which they occur. Each species occupies a specific niche, and performs its functions that, working together with all other organisms in the community, maintain a balance within that segment of the ecosystem. Minute snails are often numerous where they occur, and probably contribute significantly as primary and secondary consumers. As consumers, they contribute to soil building and probably also contribute to the dissemination of spores and possibly other microbes. Most gastropods are alternate hosts for one or more parasites within natural ecosystems. Dispersal mechanisms for very small mollusks such as this species are thought to be mostly passive; adults and eggs may be carried for distances in mud particles by vertebrate vectors such as waterfowl and ungulates.

C. Range and Known Sites

Pristiloma arcticum crateris is endemic to Oregon and occurs locally in scattered wetland areas at elevations over 2000 feet throughout the Oregon Cascades from Mt Hood National Forest in the north to the Umpqua and Winema National Forests in the south. Junius Henderson first collected this subspecies in 1928 from 1.4 km. (1 mile) south of Crater Lake, in Crater Lake National Park, Klamath County, Oregon (type locality). Collections were made at a second site by Allyn G. Smith in July 1968, and July 1970. This site is at Wizard Falls Fish Hatchery on the Metolius River, Jefferson County, Oregon. In 1997, Terrence Frest and Edward Johannes collected it from at least three sites in the Upper Klamath Lake watershed, south of Crater Lake National Park and in the Thousand Springs area, west of that Park. In the spring (1998), immature specimens were found in the riparian zone of the Bull Run River, Multnomah County, Oregon. Since 1998, additional sites have been documented in the Deschutes, Winema and

Umpqua National Forests. Most of these sites are on the western slope of the Cascades, but some are also on the eastern slope at high elevations.

D. Habitat Characteristics and Species Abundance

1. Habitat Characteristics

The type specimens of *P. arcticum crateris* were reportedly found "on pine logs". Those from the Bull Run Watershed were under bits of conifer bark under a small shrub in a moist forested riparian site. Although typical *P. a. arcticum* is generally considered to be from high elevations (near or above timberline), the sites from which *P. a. crateris* are known are from 838 to 1950 meters (2750 to 6400 feet) elevation. *P. a. arcticum* is usually found in bogs or other acid habitats, while *P. a. crateris* is more often found in non-acid fens or sedge habitats. Frest emphasized that the sites where he has found *P. a. crateris* are small openings such as "spring meadows" in generally undisturbed forests. They may be found on or under woody debris or on the bases of sedges. If the site has been grazed, these snails are usually lacking, but they may occur in spots missed by the livestock.

Microsite conditions for these snails can be discussed based on their basic environmental needs for relatively even, cool temperatures and moisture, an available food source, and cover for protection from enemies and the elements. The species has been found in perennially moist situations in mature conifer forests and among rushes, mosses and other surface vegetation or under rocks and woody debris within 10 m. of open water in wetlands, springs, seeps and riparian areas, generally in areas which remain under snow for long periods in the winter. Riparian habitats in the Eastern Oregon Cascades may be limited to the extent of permanent surface moisture, which is often much less than 10 m. from open water. Slope positions such as benches or depressions adjacent to streams where moisture accumulates often provide perennial moisture while offering protection from fluctuations in stream flow. Riparian sites which experience periodic flooding or large fluctuations in water level are not suitable habitat for this species. Natural porous soils and litter provide some cover necessary for protection against excessive temperature and humidity fluctuations, as well as for hiding or escape from predators. Where and how these snails or their eggs overwinter is also important. Since the specific details of this are not currently known, maintaining existing habitat is essential for not disrupting the reproductive cycles of this species.

Foods of this species are also unknown, but living on woody debris or among decaying litter implies that they likely feed upon fungi or other micro-organisms that grow on those organic materials. Green understory

vegetation is important in maintaining temperature and humidity at ground level. The roots help to maintain soil texture and porosity, and the plants contribute to litter and humus, and provide organic matter that produces the microphytes on which these snails and other invertebrates feed. Shading and evapotranspiration help to maintain the humidity and cool temperature in the litter and debris, which in turn maintains the wet microhabitats used by the snails, and probably their food sources as well. Overstory vegetation that shades the ground is also important because it moderates temperature and moisture fluctuations by its influence on the overall habitat.

2. Species Abundance

At present, approximately 160 sites for *Pristiloma arcticum crateris* have been found. Population density at known sites has not been determined, however only a few individuals have been found at most sites, which are widely scattered across the species' range and separated by non-habitat. Two specimens were found in the Henderson collection in the Academy of Natural Sciences of Philadelphia, collected from the type locality in 1928, and the Smith collection at the California Academy of Sciences contains two records, collected from the Metolius River site two years apart, 1968 and 1970. Four specimens (1 sub-adult; 3 small juveniles) were found under the same piece of bark at the Bull Run Site. Pilsbry (1946) suggested that there might be other specimens of Henderson's, from the type locality, in the collection at the University of Colorado.

II. CURRENT SPECIES SITUATION

A. Status History

This species was listed under both the "Protect Sites From Grazing" Standard and Guideline; and Table C-3, Survey Strategies 1 and 2 of the Survey and Manage Standard and Guidelines (USDA, Forest Service, and USDI, Bureau of Land Management, 1994: Standards and Guidelines C-6 and C-59). The viability analysis for *P. arcticum crateris* done at that time projected a 40% likelihood that it would be well distributed, 37% that it would be locally restricted, 17% that it would be restricted to refugia, and 7% that it would be extirpated, under Option 9 (the preferred alternative) of the FSEIS (USDA, Forest Service, and USDI, Bureau of Land Management, 1994). According to USDA, Forest Service, and USDI, Bureau of Land Management (1994), the rating reflects the potential for the species to be disturbed by grazing, and uncertainty about what level of protection is afforded by the alternative (Option 9).

P. arcticum crateris was considered to be a rare species under Survey and Manage based on the low number of occurrences, its low detection rate in suitable

habitat and its small range. Oregon Natural Heritage Information Center ranks this as a List 1 species, with Global ranking G1, State ranking S1 (Critically imperiled globally and within the state because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation). In 2004, both Region 6 of the Forest Service and OR BLM classified this species as Sensitive.

B. Major Habitat and Viability Considerations

Extirpation of one or more of the existing known sites through natural catastrophic events or inadvertent human-caused degradation of habitat could result in large gaps in the distribution of the species, especially in geographic areas where there are already widely scattered. At present it is not known whether this species is widespread but overlooked within its range, or if it is highly locally endemic. Other populations are likely to occur but are currently unknown.

As well as being more easily lost than larger, more well distributed populations, small populations and low population densities tend to reduce the number of unrelated individuals available for mating, thus increasing the chance of inbreeding within the population. Inbreeding generally tends to reduce the genetic diversity, which usually reduces adaptability, and weakens a population's chance of survival in a variety of ways.

As Pilsbry (1946) suggested for *P. a. arcticum*, habitats in the higher elevations of its range offer cold temperatures and short growing seasons, which would limit activity of these snails to a relatively short annual period for growth and reproduction. Frest and Johannes (1995) related that small species, like this one, almost certainly have a one-year life span and lay only one clutch of eggs. Therefore, the loss of a single cohort could have devastating consequences for the local population.

The number and distribution of population sites required to maintain species viability is unknown. However, it can be assumed that the likelihood of species viability increases with the number of populations. The historical distribution of habitat and populations of this species likely included most of the currently existing perennial wetlands in the Oregon Cascades. These habitats are not contiguous, but rather are scattered throughout watersheds where hydrologic and landscape features combine to form perennially wet ecosystems. Landscape management which maintains a distribution of habitat of sufficient quality, distribution, and abundance to allow the species populations to stabilize on federal lands is thought to be necessary for species persistence. Small gaps in distribution may continue to limit population interaction somewhat, but without causing any of the following: isolation or extinction of local populations, loss of genetic or ecological diversity, or loss of ecological function.

C. Threats to the Species

Within the range of the species, loss or degradation of wetland habitat leading to loss of populations at sites occupied by the Crater Lake Tightcoil is considered to be the major threat to the species. Activities that lower the water table, alter the available moisture, compact soils, reduce litter and/or vegetative cover, or impact potential food sources (i.e., spring development or diversions, livestock grazing, heavy equipment use, ORVs, and camping on occupied habitats) could be deleterious to the survival and productivity of this and similar species. Natural porous soils and litter provide cover necessary for protection against temperature and humidity extremes, as well as for hiding or escape from predators. Removal of logs and woody debris from occupied habitats for firewood gathering for campfires, or by fire events would degrade the habitat.

A major concern would be degradation of occupied habitat from activities that alter the normal moisture regime, especially shade and water inputs. Many of the habitats where this species is found are wetlands less than one acre in size, which do not receive the same riparian management as do larger riparian features. In addition, actions occurring at some distance from the riparian area may cause adverse effects to the hydrology. Depending on the type of spring or seep, determination of the recharge area of the aquifer supplying the water to the area may be necessary to determine whether activities outside of the riparian reserve may affect the flow rate of the spring or the water table level. Depending on specific site characteristics, removal of ground-shading overstory would also impact this species by allowing excessive fluctuations in ground temperature and humidity, and also by increasing the accumulation of snow. These effects may be less extreme at higher elevations and on wetter sites, but no studies have been done to evaluate such a theory, or to determine under what conditions the overstory might be less important.

Intense fire that burns through the litter and duff layers is devastating to most gastropods, and even light burns during seasons when these animals are active can be expected to have more serious impacts than burns during their dormant periods. Effects of fire retardant and other chemicals on small snails are not well-documented, but may be deleterious, especially when dissolved in water.

Snowmobiling or skiing could impact these snails if snow over their occupied habitats is compacted, losing its insulating properties and allowing the litter or ground to freeze.

D. Distribution Relative to Land Allocations

Of the known sites within the Northwest Forest Plan boundaries, approximately 46% are in Late Successional Reserves or other withdrawn lands, the remainder of sites are located within Matrix land allocations or within riparian reserves. Many sites occupied by this species are associated with wetlands less than one acre in size, which do not receive the same extent of riparian reserve protection as do larger water bodies. In these types of sites, the species may occur outside of the area where riparian reserve protection is required.

III. MANAGEMENT GOALS AND OBJECTIVES

Management for this species follows Forest Service Region 6 Sensitive Species (SS) policy (2670), and Oregon and Washington BLM Special Status Species (SSS) policy (6840).

For Oregon and Washington BLM administered lands, SSS policy details the need to manage for species conservation. Conservation is defined as the use of all methods and procedures which are necessary to improve the condition of Special Status Species and their habitats to a point where their Special Status recognition is no longer warranted. Policy objectives also state that actions authorized or approved by the BLM do not contribute to the need to list species under the Endangered Species Act.

For Region 6 of the Forest Service, SS policy requires the agency to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands. Management “must not result in a loss of species viability or create significant trends toward federal listing” (FSM 2670.32) for any identified SS.

IV. HABITAT MANAGEMENT

A. Lessons from History

Management of springs and small wetlands in forested landscapes involves a combination of knowledge in hydrology, geology and biology. The habitats that support this species are often centered around small hydrologic features which are relatively rare on the landscape, many of which are not mapped. Such features in dry landscapes will naturally attract heavy use by native wildlife and domestic cattle. Compaction of soil and litter as well as direct mortality to mollusks may result. Damage to unprotected spring and wetland habitats by overgrazing and water diversions has been documented extensively across the western US. The Crater Lake tightcoil is not found in heavily grazed areas.

B. Identification of Species Habitat Areas

All known sites on federal lands administered by the Forest Service and/or BLM in Oregon and Washington are identified as areas where the information presented in this Conservation Assessment could be applied. A species habitat area is defined as the suitable habitat occupied by a known population plus the surrounding habitat needed to support the species at the site.

This document addresses management at two spatial scales. At the local population scale, a species habitat area is designed to support a functional population of interacting individuals. The size of such areas is based on estimates of dispersal distances in similar-sized terrestrial mollusks and estimates of genetic neighborhood, or deme, size and the environmental tolerances of the species. Based on the small size and limited dispersal ability of this species, the size required to sustain a population of interacting individuals may be only a few acres, depending on the extent of contiguous wetland habitat and the amount of surrounding habitat needed to maintain suitable moisture conditions. As new data is compiled, consideration should be given to daily and yearly activity cycles of the species as this data is collected.

At the smallest scale, within each of these habitat areas, it is important to maintain undisturbed refugia sites such as rock and downed wood to provide conditions suitable for aestivation, hibernation and reproduction. The remainder of the species habitat area can be actively managed to provide suitable foraging and dispersal habitat. In all cases, the water source, including its average flow rate and associated aquifer, should be identified and managed.

C. Management Within Species Habitat Areas

The objective of species habitat areas is to maintain habitat conditions such that species viability will be maintained at an appropriate scale, in accordance with agency policies.

Management is needed to maintain microsite conditions for these minute snails, including a large enough area to maintain suitable conditions within the species habitat area and avoid degradation caused by changes to adjacent areas. During grazing, timber management, and other land management activities specific management actions to consider include:

1. Protection of habitat areas against heavy equipment, off road vehicles, heavy livestock use, camping, and other habitat disturbing activities that might injure these snails. Site disturbance for surveys, monitoring, and other activities should be limited to less than 5% of habitat areas.

2. Protection of habitat areas against natural and/or human-caused degradation, by
 - Maintaining overstory vegetation sufficient for ground shading to minimize temperature and humidity fluctuations on and within the ground at the site. The amount and type of shading needed will vary with the elevation and general climatic conditions at the sites. This will depend on the natural overstory and/or other vegetation, the water table or soil moisture content, the normal summer daytime temperatures (aspect, elevation), etc.;
 - Maintaining natural understory vegetation and ground cover of litter and duff;
 - Avoiding activities that would cause soil compaction. Litter and porous soil will provide cover and insulation against temperature extremes;
 - Maintaining existing logs and other down woody debris. Availability of logs will depend on the overall plant community at the site. At sites near or above timberline, other habitat characteristics may replace the function provided by logs at lower elevations. Within lower elevation forested habitats, large woody debris exceeding 1000 linear feet per acre is not excessive. Where overstory is sufficient, trees could be felled to increase logs in habitats where they are limited;
 - Avoiding activities that would lower the water table, thus reducing soil moisture below that required by the species, or possibly altering vegetative communities;
 - Avoiding burning habitat areas, and to the extent practical, protecting sites from wildfire;
 - Excluding livestock in heavily grazed areas;
 - Preventing or controlling noxious weeds in a manner that does not expose these snails to potentially toxic chemicals;
 - Keeping heavy equipment out of the habitat areas;
 - Closing habitat areas to camping and ORV use;
 - Managing fuels in areas adjacent to habitat areas;
 - Modifying vegetation management objectives to comply with the needs of these snails;
 - Closing habitat areas to firewood gathering.

D. Other Management Issues and Considerations

Pristilomas have very thin, fragile shells, and they are easily damaged. Since many streamside sites are in areas where access by fishermen may cause inadvertent damage, signs or other means to control foot traffic may be warranted.

Sites for *Pristiloma arcticum crateris* are mostly on federally-managed lands allocated for riparian protection. While this does not in itself ensure that these

populations will be protected over time, it is a safeguard against their being impacted directly by certain management activities. They are still vulnerable to some activities, however, such as changes in the water table, grazing, prescribed fire, and recreation activities that might establish high use (dispersed or developed) campsites on the occupied habitat of a small population, and possibly salvage or other silvicultural activities. Implementation of the Aquatic Conservation Strategy in Riparian Reserves requires an analysis of habitat conditions and occurrences through watershed analysis to determine if actions within riparian reserves are consistent with the Aquatic Conservation Strategy objectives and should document the effectiveness of these riparian land allocations for conservation of this species' habitat.

Prescribed fire outside of occupied habitats may be considered as a tool to be used to reduce the risk of catastrophic natural fire. Prescribed burning should be designed to avoid significant impacts to the habitat conditions in critical refugia within the management area as outlined in Section II-B.

V. RESEARCH, INVENTORY, AND MONITORING OPPORTUNITIES

The objective of this section is to identify opportunities to obtain additional information that could contribute to more effective species management. The content of this section has not been prioritized or reviewed as to how important the particular items are for species management. While the research, inventory, and monitoring information is not required, these recommendations should be addressed by a Regional coordinating body.

A. Data Gaps and Information Needs

Little is known about the biology of *Pristiloma arcticum crateris*, and additional information would be valuable for understanding how to manage ecosystems that would support this species. Report documented sites of species through Natural Heritage Information Center contracts; also report documented sites in the agency specific SSS databases. Changes to field unit determination of documented or suspected status need to be reported quickly to the Special Status/Sensitive Species Specialist in the Regional/State Office. Specific areas in which there is a lack of or insufficient data include:

- accurate range of the species;
- specific habitat conditions required (i.e., temperature and moisture tolerances, and how these are maintained within the natural habitat);
- biology - breeding season, egg depositories, life span, seasonal habits (e.g., aestivation, hibernation);
- ecology--food, ecosystem functions;
- predators, diseases, and other natural threats.

B. Research Questions

- What is the extent of the range of *Pristiloma arcticum crateris*; where do other populations occur within that range?
- What is the extent of and the density of each population?
- What are its specific habitat requirements; if it is found in different plant communities, how do the specific conditions vary within different communities?
- How long do these animals live and how many times do they reproduce? Where are their eggs deposited?
- How do they overwinter; where do they spend the hot dry seasons?
- What do they eat; does their diet vary by season?
- What preys on these snails; are they threatened by diseases or other pathogens?
- Investigate methods for transplantation of colonies at risk.

C. Monitoring Needs and Opportunities

Any studies or monitoring of populations of *Pristiloma arcticum crateris* should be by sampling methods that effect as few individuals as possible.

1. Verify existing known populations, locate their occupied habitats, and:
 - describe macro and micro-habitat conditions;
 - determine the extent of the populations.
2. Conduct surveys to locate additional populations in areas identified as potential habitat. Prioritize surveys in areas where management treatments or projects are scheduled or proposed.
3. Monitor known populations following land management activities to determine whether or not recommendations applied for this species protection are effective and sufficient.

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