

Conservation Assessment
for
Monadenia fidelis minor,
Dalles Sideband

Originally issued
as Management Recommendations
December 1998
Ted R. Weasma

reconfigured August 2005
by Nancy Duncan

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

TABLE OF CONTENTS

| | |
|--|-----------|
| EXECUTIVE SUMMARY | 4 |
| I. NATURAL HISTORY | 5 |
| A. Taxonomic/Nomenclatural History | 5 |
| B. Species Description..... | 5 |
| 1. Morphology | 5 |
| 2. Reproductive Biology | 6 |
| 3. Ecology | 6 |
| C. Range/Known Sites..... | 7 |
| D. Habitat Characteristics and Species Abundance..... | 7 |
| II. CURRENT SPECIES SITUATION..... | 7 |
| A. Status History..... | 7 |
| B. Major Habitat and Viability Considerations..... | 8 |
| C. Threats to the Species | 9 |
| D. Distribution Relative to Land Allocations | 9 |
| III. MANAGEMENT GOALS AND OBJECTIVES | 9 |
| IV. HABITAT MANAGEMENT..... | 10 |
| A. Lessons from History | 11 |
| B. Identification of Species Habitat Areas | 11 |
| C. Management within Species Habitat Areas | 11 |
| D. Other Management Issues and Considerations..... | 12 |
| V. RESEARCH, INVENTORY, AND MONITORING OPS..... | 12 |
| A. Data Gaps and Information Needs | 12 |
| B. Research Questions..... | 13 |
| C. Monitoring Opportunities and Recommendations..... | 13 |
| VI. REFERENCES..... | 14 |

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 documents 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.” Prior to removal of the Survey and Manage Program, this species was in Category A.

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: *Monadenia fidelis minor* (Dalles sideband)

Taxonomic Group: Mollusk (Mollusca) land snail (Gastropoda) (Order Pulmonata)

Management Status: Bureau Sensitive Species, OR and WA 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: This species is known from watersheds tributary to the Columbia Gorge from Hood River east to the vicinity of The Dalles on both sides of the river and in upland sites in watersheds tributary to the lower Deschutes River in Wasco County, within Mt. Hood National Forest. The species may have occurred historically in the central and part of the Eastern Columbia Gorge and south up the Deschutes River Valley as far as 50 miles from the confluence.

Specific Habitat: The species has been found in moist talus habitat (especially around seeps and springs), and in forested areas in upland sites near, but outside of, riparian corridors. Mollusks which inhabit rocky habitats also utilize the surrounding forest areas during moist, cool conditions. In some forested sites, the species has been found associated with down wood where no rock substrates occur. Down wood may provide temporary refugia used during dispersal in the wet season, while rock substrates provide more stable refugia used for aestivation during summer and winter. Areas with frequent fire return intervals where rock crevice refugia are available may have historically favored this species over other, larger forms of *Monadenia*.

Threats: Habitat alteration and fragmentation leading to isolated populations is considered to be the major threat to the species. Land snails cannot tolerate extremely dry (xeric) conditions, have restricted ranges, and are slow to disperse. All activities that directly or indirectly alter a site's ecological parameters outside the range of natural conditions, such as moisture (too dry during spring and/or fall, or too wet), shade, temperature, soil compaction (compacted), food supplies, or dispersal routes can adversely affect a population. Loss of local populations can be caused by severe fire, herbicide use, recreation development, over-collecting, and disturbance during aestivation. Catastrophic wildfire causes direct mortality in high intensity fires and may result in loss of populations over large areas. Road-building and road maintenance have been identified as specific threats.

Management Considerations: Species habitat areas should provide a food supply of leaf and needle litter and fungi, within a cool moist environment during fall and spring active periods; and provide refuge sites used during dormant periods in summer and winter which provide constant hibernacula conditions as well as protection from fire and predators. This includes maintaining undisturbed talus and rock substrates, and managing the surrounding vegetative cover to provide shade, coarse woody debris and uncompacted forest litter. Due to the rarity of known populations, sites should be protected from wildfire events to the extent feasible, without degrading the current habitat condition such that the local population is lost.

Data Gaps and Information Needs: Information is needed on the actual range of this species, the location of other populations, the viability and stability of the known populations, and the effects of fire and land management activities on population stability.

I. NATURAL HISTORY

A. Taxonomic/Nomenclatural History

The genus *Monadenia* was first considered to belong to the genus *Aglaia* in part (von Martens, 1860. Die Heliceen, p. 122; Binney, 1869, L. & W. Sh. N. A. 1:161; 1878. Terr. Moll., 5, in Bull. Mus. Comp. Zool., 4: 350.). It became *Aglaia* according to Binney's work in 1890 (Bull. Mus. Comp. Zool., 19: 213).

The genus *Monadenia* was established by Pilsbry in 1895 (Man. Conch., 9: 198) with *Helix fidelis* Gray established as the type for this new genus.

Monadenia fidelis minor (Binney) was described by Henderson in 1936 (Univ. Colo. Studies, 23: 253). He restricted the subspecies to The Dalles form.

B. Species Description

1. Morphology

Burch & Pearce (1990) consider the following to be key characteristics for *Monadenia*. "Embryonic whorl sculpture irregularly granulose, not papillose; embryonic whorls usually carinate and adult shell may be carinate; spiral color band not far above the shell periphery; shell large; reproductive system with one club shaped mucous gland (Fig. 9.189b); . . .". Similar species such as *Helminthoglypta* are not carinate, have radial lines or papillae on the embryonic whorl, and have the spiral color band well above the shell periphery.

Pilsbry (1939) gives the following description: "The shell is smaller and thinner than *fidelis*, colonial buff to cartridge buff, the base dilute russet or dilute chestnut, with a few or many pale radial streaks, the supraperipheral band somewhat darker; between band and suture the color varies from cartridge buff to ochraceous-tawny, in either case with oblique streaks or maculae of brown, and usually one or two faintly traced spiral bands. Under the microscope the upper surface shows patches of minute lineolation over a somewhat irregular surface produced by displaced spirals. The lip is thin, narrowly reflected below." "Diameter of Binney's type figure 25.2 mm.; topotypes measure from height 12 mm., diameter, 20 mm., 5 1/2 whorls, to height 15.2, diameter 24 mm., 6 whorls."

He goes on to say "By microscopic sculpture this small race, at the eastern limit of the genus, resembles the large forms from farther west at Carson and near Mt. Hood, more than the typical *fidelis* from still further west. In the latter microscopic lineolation is almost or quite obsolete."

Soft body anatomy is not required for field identification work and is, therefore, not discussed here. Some researchers have reported bluish pigments in the integument of living specimens.

2. Reproductive Biology

Data have not been published on the reproductive biology of this species. All *Monadenia* have a reproductive system with a dart and a single tubular mucus gland apparatus associated with or in close proximity to the vagina (Miller and Naranjo-Garcia 1991). Species of this genus are hermaphroditic and may copulate continuously for more than 23 hours. The species lay eggs (several 10's), are likely to live 6+ years, and probably mature in 2 years.

Loose soil is considered to be necessary for egg laying.

3. Ecology

The species is mainly crepuscular (active only during dawn and dusk) during the moist spring and fall seasons. During the wet seasons, it may be found in the open, away from refugia, foraging for green vegetation and fruit, feces, old leaves, leaf mold, fungi, or microorganisms found on woody debris. Daily refugia used during moist seasons can be down wood, rock or accumulations of litter. The degree of habitat connectivity for dispersal depends on the density and arrangement of shaded down wood and other cover objects which provide daily refugia during the wet season.

During the summer, snails are found deep in talus accumulations which are adjacent to springs or streams and which serve as refuge sites from desiccation and protection from predators while they are immobile. These deep rock refugia also provide the important, environmentally stable sites needed to survive wildfire events and cold winter conditions. The distribution of these stable rock refugia sites across the landscape may determine or at least help to explain the distribution of the species in areas with short fire-return intervals. Mollusks which inhabit talus habitats also utilize the surrounding forest areas during moist, cool conditions, ranging out from the refugia provided by the rocks to forage in the adjacent forest floor litter. Vegetation within the surrounding forest not only moderates the temperature and moisture conditions within the rock habitats, but provides food, loose soil and litter conditions necessary for egg laying.

Generally, the lower one-third of a talus slope contains the largest, most stable habitat elements. Because of the long-term stability in these areas and larger interstitial spaces between the rocks, microsite conditions are more favorable and provide dependable refugia sites. Other sites with rock-on-rock accumulations, such as are common at the base of rock outcrops, may provide similar crevices.

The species probably has a low efficiency rate for assimilation of ingested food materials, which results in the dispersal of intact fungal spores and hyphae in feces. Snails and slugs represent an important dispersal mechanism for fungal species. Birds, beetles, shrews, mice, raccoons, carnivorous mollusks, and snakes are likely predators. Species of *Vespericola*, *Allogona*, and *Haplotrema* commonly occur in the same geographic area as this species. It has been found with the Larch Mountain Salamander *Plethodon larselli*.

C. Range, Known Sites

This species is a local endemic known from watersheds tributary to the Columbia Gorge on both sides of the river in Wasco, Hood River, Klickitat, Skamania and Sherman Counties, from Hood River east to the vicinity of The Dalles, and in upland sites in watersheds tributary to the lower Deschutes River in Wasco County. The species may have occurred historically in the central and Eastern Columbia Gorge and south up the Deschutes River Valley as far as 50 miles from the confluence.

D. Habitat Characteristics and Species Abundance

The species is known only from relatively few sites within a limited range. It is associated with talus habitat and seasonally moist rocky areas, especially around seeps and springs, though it is not found in the springs or seeps, nor is it considered to be a talus obligate. Rocks and large woody debris serve as refugia during the summer and late winter seasons, as well as during fire events. Temperature is lower and humidity is higher under talus than in the surrounding environment. While the specific food requirements of this species are not known, a variety of vegetation, subsurface roots, fungi, and organic debris is typically found in talus slopes. Small invertebrates that may serve as food sources also inhabit the talus environment. Forest litter and coarse woody debris are considered necessary to provide food (shelter and substrate for fungi) and temporary cover when foraging or dispersing.

Population density at known sites has not been determined, however, only a few individuals have been found at most sites. Known sites are widely scattered across the species' range and separated by non-habitat. The distribution of stable rock refugia sites across the landscape may determine or at least help to explain the distribution of the species in areas with short fire-return intervals.

II. CURRENT SPECIES SITUATION

A. Status History

This species was listed in 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). According to the FEMAT analysis made at the time of the Northwest Forest Plan, the options considered in the species assessments were less effective in providing for mollusks than for any other species group. High degrees of endemism, rareness, and habitat specialization account, in part, for the low ratings. Under the selected management option (Option 9), there would be a 43% probability that this species would be well-distributed across Federal lands, a 35% probability that the species would remain viable but with gaps in distribution, a 22% probability that populations would be restricted to refugia, and a 0% probability that it would be extirpated (Appendix J2, 1994). Management practices within LSRs were considered to have potential negative impacts to the species.

It was considered to be a rare species, under Survey and Manage Category A, based on the low number of occurrences, its low detection rate in suitable habitat and its small range. Although the standard terrestrial mollusk survey methodology was efficient and resulted in discovery of numerous specimens, as a result of the Annual Species

Review in 2002, this species was placed in Survey and Manage Category B, due to difficulty in identification of specimens. After the addition of the requirement to collect vouchers, which can be identified by experts, surveys for this species are no longer considered impractical, and the taxon was returned to Category A in 2003. The 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/WA BLM classified this species as a sensitive.

B. Major Habitat and Viability Considerations

Maintaining deep refuge sites with appropriate microclimate conditions during the summer and winter within and around occupied habitat is considered critical. Retaining large woody debris, leaf litter, uncompacted soil, and canopy cover may assist in maintaining summer shade and dispersal between refuge sites with respect to these habitat conditions.

The survival of mollusk species in semi-xeric (dry) conditions is especially dependent upon the presence of adequate refuge sites during dormancy in the hot summer and cold winter months, and during fire events. Typically these seasonal deep refugia are provided by large scale rock talus piles, which provide access to underground moisture and retain cool, humid conditions deep within their interstitial spaces. An increase in temperature or decrease in moisture during the hot summer months is much more likely to adversely affect this species than those that live in more mesic (moist) environments, as they may be already living at the extremes of their tolerance limits. The range of environmental conditions that this species can tolerate is not known, but they must be protected from freezing during the winter and from desiccation in the summer. This species seems to be generally found in areas with drier conditions than are other subspecies of *Monadenia fidelis*.

The number 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, increasing opportunities for interaction between populations. Landscape management which maintains a distribution of populations and suitable 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. The historic distribution pattern for this species is thought to be related to the coincident occurrence of rock outcrops, talus, and other rock refugia with the availability of surface water within forested stands, which has not changed much over time. While the current geographic distribution of rock and water features is probably not very different from the historic pattern, fire suppression in areas with short fire return intervals may have reduced the habitat quality in some areas and single-species plantations of conifer forest have replaced many of the original diverse flora found in late seral forest habitats. Quarry development and road construction through rock talus areas may also have resulted in loss of some populations, however the use of quarry material in road construction may have resulted in the colonization of new sites and increased the distribution of the species. Timber harvest which results in canopy closure less than 40% is considered to result in detrimental effects to local

populations, especially when residual habitat elements are further damaged by prescribed fire. Small gaps in distribution may continue to limit population interaction somewhat, but without causing 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 this species in Oregon, habitat alteration and fragmentation leading to isolated populations is considered to be the major threat to the species. This species is very vulnerable to wildfire or management activities which increase temperature, decrease moisture, or decrease food supplies available in populated sites. The degree of connectivity for dispersal within and between occupied areas depends on the density and arrangement of shaded down wood and other cover objects within forested habitats which provide daily refugia during the wet season. Maintenance of suitable rock-on-rock refugia in areas with short fire return intervals may be critical to allow the species to survive wild fires. Habitat alteration by either human or natural means, over-collecting, alteration of the hydrologic patterns which provide moisture, and disturbance during aestivation may constitute major threats to this species. Road-building and road maintenance have been identified as specific threats.

D. Distribution Relative to Land Allocations

A large proportion (>50%) of the species' range is on non-federal land. Federal lands in the Mt. Hood and Gifford Pinchot National Forests and within the Columbia River Gorge National Scenic Area, as well as in watersheds tributary to the lower Deschutes River, include management for recreational purposes and commercial forest products, as well as for late-successional habitat. Within the Northwest Forest Plan area, approximately 5% of sites on federal land are within withdrawn or reserved land allocations. It is unknown how many of these occurrences are located within riparian reserves, however an analysis conducted in 2003 showed that 1 in 7 sites fell within estimated riparian reserve boundaries.

III. MANAGEMENT GOALS AND OBJECTIVES

Management for this species follows Forest Service Region 6 Sensitive Species (SS) policy (2670), and/or BLM Oregon and Washington Special Status Species (SSS) policy (6840). For Oregon and Washington Bureau of Land Management administered lands, SSS policy details the need to manage for species conservation. For Region 6 of the Forest Service, Sensitive Species 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 should also not create significant trends towards federal listing, for any identified Sensitive species.

IV. HABITAT MANAGEMENT

A. Lessons from History

Fuels management that increased the intensity, duration or frequency of fire, forest management activities that affect shade, and road construction or rock-removal that directly disturbed refugia sites have significantly impacted other *Monadenia* species in the Pacific Northwest. The use of talus in the construction of dams in the Columbia Gorge is considered to have had a significant impact on individual populations of this species (Appendix J2. 1994, p. 323).

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.

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. A species habitat area is generally defined as an area around known site locations that includes all habitat features that provide food resources, refugia, or contribute to environmental conditions important to the species at the known site, and which is of sufficient size to support a population of interacting individuals. Based on the size and moderate dispersal ability of this species, the area required to sustain a population of interacting individuals may range from a few acres up to 25 acres or more, depending on amount and condition of the habitat (ie. how many individuals it can sustain per acre), and the amount of surrounding habitat needed to maintain suitable environmental conditions. As new data is compiled, consideration should be given to daily and annual movements within the life cycles of the organisms when delineating the extent of this area.

At the smallest scale, within each of these species habitat areas, it is important to maintain some habitat elements from disturbance, to provide for the critical periods in the animals' life history (aestivation, hibernation, reproduction). The remainder of the species habitat area may be actively managed to provide suitable foraging and dispersal habitat.

C. Management within the Species Habitat Area

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. Specific management considerations include:

In general species habitat areas provide for the conditions necessary to maintain cool moist temperatures during fall and spring, refuge sites for summer and winter

aestivation, and a food supply including leaf and needle litter and fungi. This includes maintaining undisturbed talus with deep crevices and vegetative cover. Manage adjacent forested areas to provide shade, coarse woody debris and uncompacted forest litter. Due to the rarity of known populations, protect sites from wildfire events, but manage with prescribed fire to maintain historic conditions. Mitigation measures outlined in Appendix J-2 stress the importance of the proper implementation of Riparian Reserves under option 9 (Appendix J2. 1994). The following suggestions should be considered within species habitat areas:

- Manage undisturbed talus with vegetative cover, within the natural range of variation for the habitat type.
- Manage forested areas adjacent to these talus areas to provide shade, coarse woody debris and uncompacted forest litter. Maintain or enhance the naturally occurring diversity of plant species. This will increase the range of hosts for a variety of species of fungi and make other food substrates available throughout the season. It will also provide assurance that specific plant species, if found to be critical in the life cycle of these mollusk species, are not inadvertently lost. As yet we know too little about the needs of this species to identify an optimum mix of tree species, but it appears that mixed stands of conifer and hardwoods provide the best habitat. Maintaining a mix of conifer and hardwood stands would provide a more diverse and complete set of conditions for multiple species and a more fully functioning ecosystem. A range of canopy closure across the habitat area, with some open areas and other areas of closed canopy and deep shade, will provide opportunities for animals to locate appropriate microhabitats. The degree of connectivity and dispersal within and between habitat areas depends on the density and arrangement of shaded down wood and other cover objects which provide daily refugia during the wet season.
- To the extent practical, protect sites from high-intensity wildfire events. This may involve active forest management in the vicinity of species habitat areas to help reduce the risk of these types of events. When necessary conduct fuels reduction treatments within species habitat areas, however protect cover over critical refugia sites.
- Manage flows from adjacent springs and streams to maintain the moisture regime.
- Manage grazing in species habitat areas, and exclude livestock if possible, especially in areas where they may congregate around water sources or lush vegetation.

D. Other Management Issues and Considerations

While other methods of fuels reduction are preferred, prescribed fire may be considered as a tool to be used to reduce the risk of catastrophic natural fire. Design prescribed burning or other treatments to avoid significant impacts to the habitat

conditions within the habitat area as outlined in Section IV-C. If burning is conducted during seasons when animals are active, care should be taken to ensure that a mosaic of unburned patches is retained. This may provide a measure of confidence that some individuals survive the treatment.

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.

V. RESEARCH, INVENTORY, AND MONITORING OPPORTUNITIES

The objective of this section is to identify opportunities for additional information which 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 coordinating body at the Northwest Forest Plan level.

A. Data Gaps and Information Needs

Current knowledge of this species is limited, and is not based on long-range or site specific studies. Significant data gaps exist in our knowledge of the species' fossil record, its taxonomic relationship to other members of its genus and its biologic and environmental needs. The species' current and former distribution, and the factors which have controlled distribution, diet, reproductive rates, and dispersal rates need further investigation. Local and range-wide population trends are not known.

Field research associated with any mollusk species often results in detections in different habitats than expected based on prior knowledge. Range extensions are also common. Surveys outside of known habitat conditions may be helpful in determining the full range of habitat conditions in which the organisms can survive.

Report documented sites of species through Natural Heritage Program contracts.

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.

B. Research Questions

What are the food requirements of these species and are any of these food requirements unique to the species?

What is the range of environmental conditions that this species can tolerate and how long can extremes be tolerated?

Are there other populated sites?

What factors control the species' rate and distance of dispersal?

What is the species' natural life span?

What is the actual range of the species?

How far does an individual range away from its refuge site?

What are the effects of fire and management activities on population demographics?

What is the population density of the known sites?

C. Monitoring Opportunities and Recommendations

Known sites on public land should be monitored to assess population trends and to attempt to determine the factors which control those trends. Monitoring strategies should be designed to assist in determining if the implementation of the plan is resulting in the protection of habitat for these subspecies. In addition, monitoring should be designed to ensure that site disturbance or collection activities do not extirpate local populations. Specifically, monitoring should:

1. Verify existing known populations:
 - 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 and fire events to determine whether or not recommendations applied for this species protection are effective and sufficient.

VI. REFERENCES

- Appendix J2. 1994. Final Supplemental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl., Appendix J2, Results of Additional Species Analysis. USDA Forest Service and USDI Bureau of Land Management, i-viii, 476 p.
- Binney, W. G. 1869. Land and fresh water shells of North America. Part 1. Pulmonata Geophila. —Smithsonian Miscellaneous Collections, 194:13-21.
- Binney, W.G. 1878. Terrestrial Mollusks, 5, in Bulletin of Museum of Comparative Zoology, 4: 350.
- Binney, 1890. Bulletin of Museum of Comparative Zoology, 19: 213.
- Burch, J. & T. Pearce, 1990. Terrestrial Gastropoda. Chapter 9, in Soil Biology Guide, Daniel Dindal (ed), John Wiley and Sons (NY, xvii + 1349 pp..
- Henderson, 1936. The Non-marine Mollusca of Oregon and Washington, Supplement. University of Colorado Studies 23: 253
- Miller, Walter B. and Edna Naranjo-Garcia. 1991. Familial relationships and biogeography of the Western American and Caribbean helicoidea (Mollusca:Gastropoda: Pulmonata) American Malacological Bulletin Vol. 8(2): 147-153
- Pilsbry, H. 1895. Manual of Conchology., 9: 198.
- Pilsbry, Henry A. 1939. Land Mollusca of North America (North of Mexico). Acad. Nat. Sci. Philadelphia, Monogr. 3, V.1(1): i-xvii, 1-573, i-ix.
- USDI and USDA Forest Service. 2004. Final Supplemental Impact Statement to Remove or Modify the Survey and Manage Mitigation Standards and Guidelines.
- von Martens, E.. 1860. Die Heliceen nach natürlicher Verwandtschaft systematisch geordnet von Joh. Christ. Albers. Zweite Ausgabe. W. Engelmann, Leipzig. p. 122.