Conservation Assessment
for
***Helminthoglypta hertlieni*,**
Oregon Shoulderband

Originally issued
as Management Recommendations
November 1998
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reconfigured July 2004
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USDI Bureau of Land Management, Oregon and Washington

TABLE OF CONTENTS

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) (USDA and USDI 2004a) and Record of Decision (ROD) to Remove or Modify the Survey and Manage Standards and Guidelines (USDA and USDI 2004b), 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 not within the Survey and Manage program at the time of the signing of the ROD, as the species was determined to not be associated with late-successional and old-growth associated forests during the 2003 Annual species Review. Prior to removal from the Survey and Manage Program, this species was in Category B.

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: Helminthoglypta hertleini Hanna & Smith (Oregon Shoulderband)

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

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

Range: This species is endemic to northern California and southwest Oregon. In California, this species has been reported in Siskiyou County, in the Klamath River Basin from the vicinity of Happy Camp east to the Shasta and Little Shasta River Drainages in the Klamath National Forest. The range extends south into Trinity County, with the westernmost edge of the range on the eastern slopes of the Trinity Mountains in the Weaverville Ranger District of Trinity National Forest. Additional sites occur to the east in Shasta County, within the Shasta National Forest. In Oregon, the range includes Jackson, Josephine, and Douglas Counties, with verified locations in Roseburg and Medford BLM Districts and the Umpqua National Forest. The Type Locality is along Route 66 east of Ashland, Oregon on BLM Medford District.

Specific Habitat: The species is associated with rocks and woody debris in rocky areas within forest habitats, often adjacent to areas with substantial grass or seasonal herbaceous vegetation. Seasonal deep refugia include talus deposits and outcrops, which contain stable interstitial spaces large enough for snails to enter. These seasonal refugia also provide protection from fire and predation during inactive periods. Within rocky habitat, the species is also associated with subsurface water, herbaceous vegetation and deciduous leaf litter, generally within 30 m. (98 ft.) of stable talus deposits or rocky inclusions. Vegetation types where the species has been located include dry conifer and mixed conifer/hardwood forest communities as well as oak communities. Forest canopy cover moderates the extremes in environmental conditions and may provide additional moisture to the site in the form of condensation drip. Woody debris and deciduous leaf litter is often used as daily refugia during foraging and dispersal in the moist seasons. No strong riparian association has been identified.

Threats: Habitat alteration and fragmentation leading to isolated populations is considered to be the major threat to the species. In general, land snails cannot tolerate extremely dry (xeric) conditions, have restricted ranges, and are slow to disperse. This species is found in habitats which are more xeric than most other species in western Oregon and California. Maintaining environmental conditions within refugia in these habitats may be especially critical to survival of local populations, and the species is vulnerable to activities which increase temperature, decrease moisture, or decrease food supplies available in populated sites. Habitat alteration by either human or natural means (including fire, herbicide use, recreation development, quarry development, road construction, and timber harvest), over-collecting and disturbance during aestivation may constitute threats to local populations. Catastrophic wildfire causes direct mortality in high intensity fires and may result in loss of populations over large areas.

Management Considerations: Within species habitat areas, maintain cool moist temperatures during fall and spring, stable refuge sites for summer and winter aestivation, and a food supply including seasonal herbaceous vegetation, leaf and needle litter, and fungi. This includes maintaining undisturbed talus and adjacent forested areas with vegetative cover sufficient to maintain suitable environmental conditions. Due to the rarity of known populations, protect sites 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 to determine the range of the species, the location of other populations, the stability of the known populations, and the effects of fire and land management activities on population stability.

I. NATURAL HISTORY

A. Taxonomic/Nomenclatural History

Helminthoglypta was first described by Ancey in 1887 (June) in The Conchologist's Exchange, 1: 76, with *Helix tudiculata* Binney (1843) as the type species. The family Helminthoglyptidae was proposed by Pilsbry (1939), which he divided into four subfamilies. One of them is the Helminthoglyptinae, which is confined to the Pacific States and includes the genera *Helminthoglypta*, *Monadenia*, and *Micrarionta*. Most subsequent authors have followed Pilsbry's classification. However, Burch and Pearce (1990) used an older name, Xanthonychidae, and van der Laan (1980) used Helicidae. Others have used Helicoidea as the superfamily (e.g., Smith et al., 1990). Roth (1996) recently provided a phylogenetic analysis and new system of classification for the Helminthoglyptidae.

The genus *Helminthoglypta* is a large genus in which Pilsbry (1939) recognized 46 species plus 43 additional subspecies. These snails primarily inhabit California. Two of the species range north into Oregon and, according to Smith et al. (1990), 7 species range into or are limited to Baja California. This extensive speciation seems to reflect the low mobility of these snails combined with the complex topography and generally dry climate of California. This complex has been divided into four subgenera that were redefined by Roth and Hochberg (1992).

Helminthoglypta hertleini was first described as a distinct species by Hanna & Smith in 1937 (Nautilus, 51: 16, pl. 1, fig. c).

An investigation of the phylogenetic relationships between *Helminthoglyptas* in Oregon and California, based on mitochondrial DNA, concluded in 2002 that "Samples from Siskiyou and Shasta counties initially identified as *H. cypreophila* or *H. hertleini* (with the exception of the questionably identified sample 38) form a relatively homogeneous clade (34-36, 39, 40, 41) that is the sister-group of presumptively typical *H. cypreophila* from Stanislaus County (sample 37). The sequence divergence between these sister-groups is at a level (19.8-20.0%) elsewhere associated with separate species. The Siskiyou-Shasta clade includes a near-topotype (sample 41) of *H. hertleini*; the name *Helminthoglypta hertleini* applies to this clade. The range of *H. hertleini*, which was thought previously to be limited to the area north from the confluence of the Shasta and Klamath rivers, is now seen to extend southward at least to the vicinity of Shasta and Lewiston lakes." (Lindberg, 2002, Roth, 2002).

B. Species Description

1. Morphology

The species was described by Pilsbry (1939) as follows: "Helices of moderate or large size, the shell globose or depressed with conic or low spire and open or covered umbilicus; periphery rounded at all stages of growth. Embryonic shell 1 ½ to 1 ¾ whorls; after the smooth tip and a few radial ripples it has sculpture of close, microscopic, waved, radial wrinkles, over which there are papillae in forwardly descending trends (often indistinct or practically absent). Adult sculpture of simple growth lines or with spiral engraved lines, malleation, papillae or granulation also. A dark band revolves above the periphery (sometimes absent). Peristome narrow, expanded outwardly, usually reflected at base, dilated at columellar insertion."

Pilsbry places this species in the subgenus *Helminthoglypta sensu stricto* and further defines it as a member of the *H. tudiculata* series. This series is described as follows: "Globose or globose-depressed, with sculpture of growth wrinkles below the suture, generally malleate in the peripheral region or throughout; not granulose, but sometimes with some granulation behind the lip; last whorl wide."

According to Hanna & Smith (1937) the shell morphology for this species is as follows: "Shell thin and delicate, pale golden brown, with a very narrow band of a darker shade, bounded below by an equally narrow band of a lighter shade; whorls five, regularly increasing in size; surface marked with fairly coarse growth ridges, and very irregularly scattered papillae; nuclear whorl with faint growth lines and a finely roughened surface; aperture not expanded; peristome simple and scarcely reflected (except in the umbilical region) and slightly thickened interiorly; umbilicus narrow, half covered by the reflected basal wall. Max. diameter 18.5 mm.; min. diameter 15.3 mm.; altitude 12.5 mm.;diameter umbilicus about 2 mm."

Further collecting from the type locality by Pilsbry indicates that the species diameter is up to 22.6 mm. He goes on to say that in comparing this species to other members of the *H. cypreophila* group, it is noted that it has lost the reflected peristome, and most of the surface markings; the bands are much less prominent and the shells are thin and delicate, somewhat like *tularensis* (Hemphill).

According to A. G. Smith *H. hertleini* lacks any distinct evidence of papillation, even on the nuclear whorls (in the Chace lot from Siskiyou County); otherwise it has all the earmarks of relationship to *tularensis*.

Pilsbry reported that "The umbilicus is far wider than in *H. napaea*, which also lacks papillae, and it seems to be an independent northern derivative of the *cypreophila* stock." Soft body anatomy is not required for field identification work. Refer to Hanna & Smith, 1937 and Pilsbry (1939) for the descriptions.

2. Reproductive Biology

No data has been published on this species' reproductive biology. *Helminthoglypta* are hermaphroditic and lay eggs. Most species live several years and may reproduce multiple times. Some inferences for the reproductive biology of this species can, however, be drawn from a study of a coastal species (*Helminthoglypta arrosa*) by van der Laan (1971, 1980). For example, within 24 hours after the first soaking rain in October the adult snails would emerge from aestivation and begin mating, both at night and on overcast and rainy days. Although the coastal species was active at temperatures as low as 4°C, they only mated at ambient temperatures of 10 to 15°C. Their eggs were deposited in shallow holes in the soil below the leaf litter; the eggs averaged 2.2 mm in diameter and the mean number of eggs per egg mass was 75.6 (range 45-171). The young snails hatched in March and April.

3. Ecology

The species is normally crepuscular (active during dawn and dusk) during the spring and fall seasons when humidity is higher. Condensation in frost and dew may provide an important source of water for this species in otherwise dry habitats. During the wet seasons, individuals may be found away from rock refugia, foraging for green vegetation and fruit, feces, old leaves, leaf mold, and fungi. Each day when the humidity drops, individuals typically retreat

under cover objects such as woody debris or loose rock. Daily refugia used during moist seasons can also simply be loose soil or accumulations of litter. The arrangement and abundance of such surface features play a role in determining dispersal rates and patterns of the species.

Less than half of each year is spent actively growing, reproducing and dispersing. During the summer and winter, snails become dormant and may be found deep within stable accumulations of rocks, usually in association with a moisture source such as a seep or riparian drainage, 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 suitable stable rock refugia sites across the landscape may determine or at least help to explain the distribution of the species. Mollusks which inhabit talus slopes also utilize the surrounding forest areas during moist, cool conditions, ranging out from the refugia to forage in litter of the adjacent forest floor. 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 and most suitable 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. Shading over these refugia sites helps to moderate environmental extremes.

The species probably has a digestive efficiency rate in the high forties for assimilation of food materials, a low rate which results in the viable spores and fragments of fungal hyphae to be excreted with the feces. Thus, snails and slugs represent an important dispersal mechanism for fungal species throughout the year when these mollusks are active. Birds, beetles, shrews, mice, raccoons, carnivorous mollusks, and snakes are likely predators. Species of *Vespericola, Monadenia, Trilobopsis, and Haplotrema* commonly occur in the same geographic area as *Helminthoglypta.*

C. Range and Known Sites

This species is endemic to northern California and southwest Oregon. In California, this species has been reported in Siskiyou County, in the Klamath River Basin from the vicinity of Happy Camp east to the Shasta and Little Shasta River Drainages in the Klamath National Forest. The range extends south into Trinity County, with the westernmost edge of the range on the eastern slopes of the Trinity Mountains in the Weaverville Ranger District of Trinity National Forest. Additional sites occur to the east in Shasta County, within the Shasta National Forest. In Oregon, the range includes Jackson, Josephine, and Douglas Counties, with verified locations in Roseburg and Medford BLM Districts and the Umpqua National Forest. The Type Locality is along Route 66 east of Ashland, Oregon on BLM Medford District.

D. Habitat Characteristics and Species Abundance

The species is associated with rocks and woody debris in moist, rocky areas within forest habitats, often adjacent to areas with substantial grass or seasonal herbaceous vegetation. Seasonal deep refugia include talus deposits and outcrops, which contain stable interstitial spaces large enough for snails to enter. Often subsurface water is present near such refugia. Temperature is lower and humidity is higher under talus than in the surrounding environment. These seasonal refugia also provide protection from fire and predation during inactive periods. Within rocky habitat, the species is also associated with herbaceous

vegetation and deciduous leaf litter, generally within 30 m. (98 ft.) of stable talus deposits or rocky inclusions. Vegetation types where the species has been located include dry conifer and mixed conifer/hardwood forest communities as well as oak communities. 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 and may provide additional moisture to the site in the form of condensation drip. Woody debris and deciduous leaf litter is often used as daily refugia during foraging and dispersal in the moist seasons. No strong riparian association has been identified, but many sites are located in areas which have at least seasonal surface water, typically in the form of small springs and seeps, which may only be apparent during the dry season due to the increase in herbaceous vegetation in the vicinity.

While the specific food requirements of this species are not known, *Helminthoglyptas* in general are known to forage on a variety of green, herbaceous vegetation, subsurface roots, fungi, and organic debris, typically found in talus slopes. Small invertebrates that may serve as food sources also inhabit the talus environment. Forest litter and coarse woody debris in the semi-dry areas in which these species occur is considered necessary to provide food (shelter and substrate for fungi) and temporary cover when foraging.

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. The distribution of stable rock refugia in conjunction with moisture sources across the landscape may determine or at least help to explain the distribution of the species in areas with short fire-return intervals. The species occurs with *Monadenia chaceana* at some sites.

Several sites in Roseburg BLM have been located in rock quarries and riparian areas adjacent to them. Additional sites were found on roadsides where large material from those quarries was used for the construction of culvert crossings, riprap for slope stabilizing, and other road-related uses. It is not known whether populations at these roadside locations are natural or were colonized by individuals transported there with quarry material. Road cuts which require removal of rock outcrops and talus, on the other hand, may result in loss of some natural sites, or transport of individuals from those sites to new remote locations which may not be suitable.

II. CURRENT SPECIES SITUATION

A. Status History

According to the FEMAT report, Table IV-22, 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 32% probability that this species would be well-distributed across Federal lands, a 27% probability that the species would remain viable but with gaps in distribution, a 30% probability that populations would be restricted to refugia, and a 12% probability that it would be extirpated.

Helminthoglypta hertleini 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. This species was removed from the Survey and Manage Standards and Guidelines in 2003, due to an apparent lack of association with late-successional and old-growth forests, but remained on the Oregon Natural Heritage Program List 1; 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 and CA BLM classified this species as Sensitive. Region 5 of the Forest Service did not classify this species as a sensitive species.

B. Major Habitat and Viability Considerations

Maintaining deep refugia areas with appropriate microclimate conditions during the summer and winter within and around occupied habitat is considered critical. 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 species. Retaining large woody debris, herbaceous vegetation, leaf litter, uncompacted soil, and canopy cover may assist in maintaining summer shade, food, and daily surface refugia sites used during dispersal in spring and fall.

The survival of mollusk species in semi-xeric (dry) conditions is especially dependent upon the presence of adequate refuge sites during the hot summer and cold winter months. The range of environmental conditions that this species can tolerate is not known, however they must be protected from freezing during the winter and from desiccation in the summer. An increase in temperature or decrease in moisture during the hot summer months is much more likely to adversely affect xeric species than those that live in a mesic (moist) environment, as they are often already living at the extremes of their tolerance limits.

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, which has not changed much over time. While the current geographic distribution of these 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 plantations of conifer forest have replaced many of the original open herbaceous 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. 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, habitat alteration and fragmentation leading to isolated populations is considered to be the major threat to the species. This species is very vulnerable to high-intensity fire 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 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 (including fire, herbicide use, recreation development, quarry development,

road construction, and timber harvest), alteration of the hydrologic patterns which provide moisture, and disturbance during aestivation may constitute major threats to this species.

D. Distribution Relative to Land Allocations

Approximately 3% of known sites for this species are located in withdrawn or reserved land allocations on federal lands. Another 7% of sites are on private lands. The majority of known sites, however, are located on federal lands managed for timber production and other extractable resources. It is unknown how many occurrences are located within riparian reserves, but no strong riparian association has been identified.

III. MANAGEMENT GOALS AND OBJECTIVES

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

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 SSS 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

Fire management that increased the intensity, duration, or frequency of fire; forest management activities that reduced shade; and quarry development and road construction that directly disturbed sites have significantly impacted land snails in the Pacific Northwest.

B. Identification of Habitat Areas for Management

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 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. 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. The size required to sustain a population of interacting individuals may range from a few acres to 25 acres or more, depending on the surrounding habitat. As new data is compiled, consideration should be given to daily and annual movements of the organisms when delineating the extent of this area.

At the smallest scale, within each of these habitat areas, it is important to maintain undisturbed deep refugia sites such as large rock talus piles 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.

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 within the Species Habitat areas provide for the conditions necessary to maintain cool moist temperatures during fall and spring, refugia sites for summer and winter aestivation, and a food supply including herbaceous vegetation, 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. The following suggestions should be considered within species habitat areas:

- Maintain uncompacted soil in and near populated sites.

- Maintain undisturbed talus and rocky outcrops (most important in the lower third of the slope and where moisture sources provide shallow underground or surface water).

- Manage vegetative community and shading in the species habitat areas within the natural range of variation for the habitat type. 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 species 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.

- Maintain current volume of coarse woody debris as food sources (substrate for fungi) and refuge sites and manage for future sources of coarse woody debris in the habitat area, using the DecAID model or other appropriate method for estimating the natural amounts found in the habitat type.

- Maintain soil temperature and moisture regime of the refugia sites by retaining vegetation cover over these sites (cool and moist during the summer).

- 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.

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, 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 could 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 to obtain 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 opportunities are not required, these recommendations should be addressed by a coordinating body at the Regional level.

A. Data Gaps and Information Needs

The species' present and former distribution, and the factors which have controlled distribution, diet, reproductive rates, and dispersal rates – including road construction and quarry development - 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 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.

B. Research Questions

What are the food requirements of this 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?

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

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

What is the species' natural life span?

What adaptations has the species made that allows it to be more xeric tolerant than other species?

What is the actual range of the species?

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

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. Objectives for monitoring include:

1. Verify existing known populations:
   - describe macro and micro-habitat conditions; and
   - determine the extent of the populations.

2. Conduct surveys to locate additional populations in areas identified as potential habitat.

3. Monitor known population sites following land management activities for effectiveness of management recommendations applied.

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