

Conservation Assessment
for
Deroceras hesperium,
Evening fieldslug

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Management Recommendations
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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 B 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: *Deroceras hesperium*, Evening fieldslug

Taxonomic Group: Mollusks (Phylum Mollusca: Class Gastropoda, Order Pulmonata, Family: Limacidae)

Management Status: *Deroceras hesperium* is a Bureau Sensitive Species for OR BLM; and a Forest Service Region 6 Sensitive Species. Oregon Natural Heritage Program ranks this as a List 1 species, “critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation”, with Global ranking G1, State ranking S1.

Range: Scattered sites have been documented for this species in several provinces in Oregon, including both sides of the Oregon Cascades from Hood River to the Klamath River basin in Jackson County; and from the Elliot State Forest north in the northern Coast Range. The majority of currently documented sites occur on the eastern slopes of the Oregon Cascades. The type locality was in Oswego, OR, the paratype locality in Hood River. The range extends through western Washington and on to Vancouver Island, B.C.

Specific Habitat: The Evening Fieldslug is associated with perennially wet meadows in forested habitats; microsites include a variety of low vegetation, litter and debris; rocks may also be used as refugia. Little detail is known about exact habitat requirements for the species, due to the limited number of verified sites. However, this species appears to have high moisture requirements and is almost always found in or near herbaceous vegetation at the interface between soil and water, or under litter and other cover in wet situations where the soil and vegetation remain constantly saturated. Because of the apparent need for stable environments that remain wet throughout the year, suitable habitat may be considered to be limited to moist surface vegetation and cover objects within 30 m. (98 ft.) of perennial wetlands, springs, seeps and riparian areas. Areas with coastal fog may allow the species to occupy habitats farther from open water. Down wood may provide refugia sites for the species that remain more stable during drier periods of the year than the general habitat.

Threats: Primary threats to this species are habitat loss from draining and conversion of wet meadows for agricultural, urbanization, grazing, forest management and other uses; and from fire. Natural threats may include ingrowth of conifer or hardwood tree and shrub species in historically herbaceous habitats, changes in hydrology that reduce the availability of water in wetlands, and exposure to vertebrate and invertebrate predators (i.e., predatory snails and beetles), especially in locally restricted areas.

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

- Minimizing alterations in microsite characteristics, including management of areas large enough to moderate fluctuations in humidity and temperature.
- Maintaining existing cover by preserving dead and downed woody debris. Within habitats for these species an abundance of large woody debris may be necessary; the quantity naturally available for a given site could be determined by use of the DecAID model or other predictor of down wood amounts for the plant community.
- Protecting occupied rockslides and talus areas from road construction, quarrying, and other activities.
- Maintaining the canopy closure of trees within the habitat area to moderate fluctuations of temperature and humidity on the site.

- Maintaining the hardwood tree component (i.e., maples, cottonwood, red alder, aspen) and native plant diversity to provide a constant supply of logs, leaves, and leaf mold.
- Maintaining riparian areas according to ROD guidance (pgs. C30-C38) and, if necessary, increasing Riparian Reserve widths.
- Avoiding burning within occupied habitats and managing to minimize adverse effects of fire.
- 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.
- Protection from grazing.
- Avoiding activities that would cause soil compaction. Litter and porous soil will provide cover and insulation against temperature extremes.

Research, Inventory and Monitoring Opportunities: Specific questions for which there is a lack of or insufficient data include:

What is the specific range of this species?

What is the range of habitat conditions tolerated by the species and the specific biological and physical attributes of suitable habitat:

- Plant associations;
- Specific plant species required/used;
- Specific foods;
- Amount of large woody debris desired;
- Optimum forest crown cover to maintain desired conditions;
- Other stand structure and components (canopy cover, age, large woody debris, litter, and duff, etc.)
- Soil types, geology;
- Temperature, humidity.

How do the required stand characteristics vary under different circumstances (elevation, slope, aspect)?

What habitat patch size is required to provide sufficient area of suitable habitat for viable populations?

How long is required for recolonization of a site by individuals from adjacent populations?

Monitoring of known sites could be applied to:

- track trends in populations (numbers, density, and distribution), reproduction, quantity, and quality of habitats;
- determine impacts on habitats and populations from management activities, natural disturbances, and vegetative succession;
- maintain a database to document trends in populations and habitats.

I. NATURAL HISTORY

A. Taxonomic/Nomenclatural History

Deroceras hesperium was first described by Pilsbry, in 1944.

Generic history includes: *Chorolimax* Westerlund, 1894; *Hydrolimax* Malm, 1868; *Agriolimax* Morch, 1865; *Malino* Gray, 1855; *Krynickyllus* Kaleniczenko, 1851; *Krynickyia* Kaleniczenko, 1839; and *Deroceras* Rafinesque, 1820. Although *Agriolimax* had been in universal use, it was preceded by several earlier names, *Deroceras* taking precedence by being the earliest.

B. Species Description

1. Morphology

Pilsbry (1948) provided the following descriptions and comments from observations of preserved specimens:

... the back is rounded except close to the end, where the tail is very shortly carinate above. Mantle brown with small scattered light spots. The back elsewhere rather light with some faint brown spots; flanks light, paler below the mantle. Sole tripartite, the areas of equal width, the middle one a shade darker than the sides. Length 16 mm.

This is certainly a distinct species, most easily recognized by the enlarged duct of the spermatheca, which may be seen quite easily on opening the anterior end of the animal, without further dissection....

Similar species include *D. laeve* which is found throughout North America from the Arctic to Central America, and *D. monentolophus* which has been recorded from southern California and Seattle.

D. laeve is:

... usually various shades of amber, without spots or markings, sometimes blackish; head and tentacles smoky. Body cylindrical, ...terminating in a very short carina at its posterior extremity.... Back covered with prominent elongated tubercles and furrows. Foot narrow, whitish.... Length about 1 inch (Pilsbry, 1948).

D. monentolophus is similar to *D. laeve*:

The mantle is closely speckled with black or very dark brown, and there is more or less marking on the circular area around the pneumostome. Back behind the mantle also closely but somewhat less intensely marked with black, the markings disappearing towards the foot and anteriorly. The pedal margin is more or less speckled with gray. Top of the head and tentacles dark. Length (as preserved) 21 mm (Pilsbry, 1948).

The shells of these three species are unique as described and illustrated in Pilsbry (1948):

D. hesperium - "Shell thin, somewhat squarish, the nucleus terminal but a trifle to the left of middle, the posterior outline convex on the left of it, straightly sloping to the right. Lateral margins straight and parallel. Anterior margin broadly arcuate. It is a little convex along the left third of the width; the surface marked with close but extremely slight growth lines. Interior concave. Length 3.3 mm." The shell appears somewhat

rectangular, the sides nearly parallel, the front slightly rounded, the rear quite so. The

growth lines follow the shape of the shell, but are quite oval in the early stages.

D. laeve - about 4 mm long; oblong, the nucleus not quite terminal on the left side of the posterior end. It is elongated with nearly parallel sides, round anteriorly, somewhat pointed posteriorly. Growth lines approximate the shell shape, growth apparently from the left rear corner to the right front.

D. monentolophus - about 4.5 mm long; oblong with terminal apex and parallel sides. Rather deeply rounded in front; the posterior end a little truncate, and sloping at the sides. It appears slightly curved, the left side slightly convex, the right side concave. Growth lines oblique across the older half of the shell, appearing that there is a torsion to the right during growth.

Branson (1977) reported 3 specimens from the northern side of the Olympic Peninsula that he believed to be this species. He described them as "... light brownish with scattered light spots, and the pneumostome is surrounded by a pigmentless halo. Measurements: 18.7 mm (range 17.5-20.0 mm) in length, foot width 3.3 mm (range 2.8-3.8 mm), and 5.8 mm (range 5.0-6.5 mm) from anterior tip of mantle to anterior edge of breathing pore."

2. Reproductive Biology

Nearly all of the terrestrial gastropods in the Pacific Northwest, including *Deroceras*, are hermaphroditic, having both male and female organs. Self fertilization has been demonstrated in some species, although cross fertilization is probably the norm. Bayne (1973) discussed problems encountered with self and cross fertilization in Pulmonates, and the dominance of allosperms (sperm from another) over autosperms (sperm from oneself). Slugs, such as *Deroceras* are oviparous (egg laying).

3. Ecology

Deroceras hesperium is one of the least known slugs in the Western United States. Nothing specific is known on the ecology of the species other than a broad description of the habitat in which it has been found. Branson (1977) found it in low elevation, moist conifer forest meadows with a hardwood tree and shrub component. *Deroceras* species generally are associated with herbaceous forbs and meadow habitats. Food is thought to consist of microorganisms and plant matter scraped from the surfaces of rocks, decaying wood, leaf litter and green vegetation. Recently documented sites with verified voucher specimens are located in wet meadows, and appear limited to those habitats with perennially stable, wet moisture conditions. *Pristiloma arcticum crateris* is an associated species in some sites.

C. Range, Known Sites

The historic range of *D. hesperium* is northwestern Oregon through Western Washington, to Vancouver Island, British Columbia, Canada. Pilsbry (1948) said, "It is to be expected throughout the humid coastal region of the northwest." Recent documented locations indicate that the range also includes the western and eastern Oregon Cascades from Hood River to The Klamath River basin.

Prior to the intensive survey effort under the Survey and Manage program, this slug was reported from three general areas, northwestern Oregon, the northern Olympic Peninsula, and the northeast

coast of Vancouver Island. The type locality is Oswego, Clackamas Co., OR. It was also reported from Portland, Multnomah Co., and 11 miles east, Hood River, Wasco Co., OR., and from Comox, B.C. on the northeast coast of Vancouver Is., 140 miles north of Victoria, B.C. (Pilsbry, 1948). Branson (1977) reported it from 2 locations on the northern Olympic Peninsula, Clallam Co., WA.

As a result of additional recent discoveries of this species in the Jenny Creek drainage of the Klamath basin in Jackson County, OR and also in Lake and Klamath Counties, the range is believed to also include the remainder of the Oregon Cascades and the Oregon Klamath Basin. Sites documented in the vicinity of the Elliot State Forest near Reedsport by T.J. Frest indicate that the species range extends south farther on the Oregon Coast than thought earlier.

D. Habitat Characteristics and Species Abundance

1. Habitat Characteristics

The Evening Fieldslug is associated with perennially wet meadows in forested habitats; microsites include a variety of low vegetation, litter and debris; rocks may also be used as refugia. Little detail is known about exact habitat requirements for the species, due to the limited number of verified sites. However, this species appears to have high moisture requirements and is almost always found in or near herbaceous vegetation at the interface between soil and water, or under litter and other cover in wet situations where the soil and vegetation remain constantly saturated. Because of the apparent need for stable environments that remain wet throughout the year, suitable habitat may be considered to be limited to moist surface vegetation and cover objects within 30 m. (98 ft.) of perennial wetlands, springs, seeps and riparian areas. Typical landscape features that may provide constant moisture conditions include springs and seeps, as well as wetlands in depressions and around perennial ponds. Water levels in many streams in western Oregon may fluctuate too much and too quickly to provide streamside habitat with constant enough moisture conditions for this species.

Elevations of occupied sites range from coastal meadows to sites near the Cascade Crest. Branson (1977) found two slugs of this species in hemlock, grand fir, maples, ferns and mosses at 610 meters (2000 feet) elevation, and one among hemlock, black cottonwood, spruce and salmon berry at 8 meters (26 feet) above sea level. In general, gastropods are found under rocks or logs and among talus, litter, debris, and ground vegetation, and these microsites should be considered the places in which to expect this species.

2. Species abundance

Pilsbry (1948) referred to many specimens opened by him, and at least multiple specimens from each locality, but all "collected over 50 years ago...." However, Branson (1977) found only three specimens in his surveys of the Olympic Mountains and none in his surveys of the Washington Cascades (Branson, 1980) or Oregon Cascades and Coast Ranges (Branson and Branson, 1984). Random grid surveys across the Northwest Forest Plan area in Oregon and Washington, conducted under the Survey and Manage program, did not locate this species in any of 498 plots searched. There are currently 19 sites documented in the interagency species database.

II. CURRENT SPECIES SITUATION

A. Status History

Findings under the FEMAT assessment implied that, under the preferred alternative (Option 9), *Deroceras hesperium* had a 30% chance of being well distributed across Federal lands, a 30% chance of being locally restricted (i.e., with significant gaps between populations), a 20% chance of being restricted to refugia, and 20% of being extirpated. Based on current knowledge there are significant gaps between populations. If additional surviving populations are discovered, as seems likely, the probability of a more favorable outcome might increase. (USDA, 1994a)

Appendix J2 of the Forest Plan EIS "Summary" states, "The rating reflects uncertainty about the number of species locations that would be protected by riparian reserves or LSRs under the proposed action or any other alternative. Given this uncertainty, there is some likelihood that the species may be extirpated from some parts of its range." (USDA, 1994b)

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, 1994c). It was considered to be a rare species, based on the low number of occurrences, its low detection rate in suitable habitat and its limited range. This species was placed in Survey and Manage Category B, due to difficulty in identification of specimens. Equivalent effort surveys were required, with collected specimens submitted to identification experts. The Oregon Natural Heritage Program 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 a Sensitive Species.

B. Major Habitat and Viability Considerations

Current information indicates that this is truly a rare species. Although many of the areas in which it should be expected have been surveyed (lightly), *D. hesperium* has been found poorly represented relative to other gastropods. This may be due, in part, to the very general habitat model previously used to identify suitable habitat and in part due to the minimal survey effort conducted in wet meadow habitats. The status of the 4 historic sites that occurred in the Portland and Hood River area are unknown, but are presumed non-extant. Discussion in Appendix J2 seems to speculate that the species still occurs in many more areas than have been confirmed. Although this assumption is reasonable, that conclusion can not be made until more wet meadow habitat has been surveyed and additional populations have been found.

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 and Coast Ranges. 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 occupied sites is considered to be the major threat to the species. The trend in condition of the habitats at the sites where it has been found is uncertain. 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.

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 known and 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

One of the sites from which *D. hesperium* is known is near a campground in Olympic National Park. Another of the sites is on the Makah Indian Reservation. The current situation of four historic locations that occurred in the Portland area is unknown, but they are not presumed extant. None of the other currently known sites are in Late Successional Reserves or other withdrawn lands; federal land sites are all located within Matrix land allocations with most 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 management as do larger water bodies. In these sites the species may occur outside of the area where riparian reserve management is generally applied.

III. MANAGEMENT GOALS AND OBJECTIVES

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

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, 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” for any identified SS (Forest Service Manual 2670.32).

IV. HABITAT MANAGEMENT

A. Lessons from History

Management of springs and small wetlands 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.

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 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.

In addition to managing this species within species habitat areas, attempts should be made to connect habitat areas to each other or to other reserves such as riparian reserves and LSR's; either directly, by locating them adjacent to occupied habitat within reserves, or indirectly, by retaining suitable quantities of key habitat elements in harvest or project areas to provide a potential bridge or temporary "bank account" to accelerate future habitat development.

At the smallest scale, within each habitat area, some habitat elements, such as large down wood and rock features, should be protected from disturbance, to provide for the critical periods in the animals' life history (aestivation, hibernation, reproduction). The remainder of the species habitat area can be managed to provide foraging and dispersal habitat during the active seasons. 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.

This species is quite vulnerable to heat and desiccation and uses logs and other large woody debris, forest floor litter and spaces under or between rocks as refugia - areas that maintain low temperature and moderate to high humidity. Management considerations should focus on maintaining the temperature and moisture regime of these microsites. Overstory crown cover and

understory vegetation should be retained to shade the ground, provide humidity through evapotranspiration, condense fog and dew, intercept underground water and hold it on the site, and impede air movement that would tend to displace the cool moist air. Available crown cover information for these habitats is meager, but observations recorded in some western hemlock/Douglas-fir stands indicated summer crown cover of 70%-90% plus.

Maintain or enhance the naturally occurring diversity of plant species in Species Habitat Areas. 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 insurance 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.

Maintenance and future recruitment of large and small woody debris is important, as is a thick layer of litter and duff on the forest floor. These components provide cool moist places in which these animals spend the days, hide from predators, deposit their eggs, and find food. These animals use a wide variety of sizes of large woody debris. Logs appear to provide dispersal corridors as well as the above mentioned essential habitat elements. Habitat quality probably improves in direct proportion to the amount of large woody debris to a point where the debris interferes with the shade and humidity regulating function of the forest canopy cover.

As possible, protect species habitat areas from fire events which cause direct mortality and loss of habitat. Prescribed fire treatments could be used to maintain the herbaceous vegetation and to reduce fuel loading outside of species habitat areas to protect those areas from catastrophic wildfire events.

Activities which cause soil compaction or disturbance to forest floor litter should be restricted within species habitat areas, (ie. exclude livestock in heavily grazed areas)

Occupied rockslides and talus areas could be managed to prevent effects from road construction, quarrying, and other major site disturbing activities that may cause temperature and/or humidity changes within the interspaces. These sites should be considered potential habitat when they lie within or near to suitable moist forest habitat areas, or at the edges of moist or wet mountain meadows.

Within species habitat areas, avoid activities that could lower the water table or alter the hydrologic regime of the wetland, thus reducing soil moisture below that required by the species, or possibly altering vegetative communities. Consider increasing the width of occupied riparian reserves as part of management for these mollusk species.

D. Other Management Issues and Considerations

At the time of the FEMAT Analysis this species was known from very few sites and few animals had even been seen by living malacologists. Much of the habitat from which they had previously been known had been developed into urban or agricultural areas, or extensively managed.

Deroceras hesperium is a species needing much more careful study. Because it is known from very few sites, disturbance to occupied habitats for surveys or monitoring should be limited to no more than 5% of the area or be strictly regulated to prevent inadvertent extirpation by researchers and other curious people.

Sites for *Deroceras hesperium* 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 possibly salvage or other silvicultural activities, as well as recreation that might establish high use (dispersed or developed) campsites on the occupied habitat of a small population. Documentation of species occurrence is typically necessary before the riparian buffers are increased. 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

What is known of the habitat and ecology of this species is from few, generally poorly documented observations. That it is found in generally undisturbed wet meadows in moist forests can be pieced together from the available descriptions of the locations in which it has been found. Literature sources (Pilsbry, 1948; Branson 1977, 1980; Branson and Branson, 1984; Frest and Johannes, 1993, 1996) give general site information at best, but detailed records of specific plants or other micro-habitat elements are primarily from personal knowledge. Although, we can recognize some potential environments, we have too few observations to understand the full range of habitats or the ecological relationships of these animals. Historic sites need to be relocated and occupancy confirmed since the older known sites were located from museum records which may be 50 or 100 years old. Since site locations may not be accurately described, or habitats may have been modified over the years, adjacent sites that appear to be suitable habitat should also be searched for the species.

B. Research Questions

What is the specific range of this species?

What is the range of habitat conditions tolerated by the species?

What is the range of conditions required for populations to remain secure and viable?

Biological attributes:

- Plant associations;
- Specific plant species required/used;
- Specific foods;
- Amount of large woody debris desired;
- Optimum forest crown cover to maintain desired conditions;
- Other stand structure and components (e.g., small woody debris, litter, duff, water, etc.)?

Physical attributes:

- Elevation;
- Soil types, geology, trace elements;
- Temperature, humidity.

What are the stand characteristics (canopy cover, age, large woody debris, litter and duff, etc.) required to support the conditions required?

How do the required stand characteristics vary under different circumstances (elevation, slope, aspect, etc.)?

What stand size is required to provide sufficient area of suitable habitat?

How long is required for recolonization of a site from adjacent populations?

What are the effects of herbicides and other chemicals used in forest management on mollusk species.

C. Monitoring Opportunities

Monitoring of known sites is recommended to track trends in populations (numbers, size and density), reproduction, quantity and quality of habitats.

Monitoring is also recommended to determine impacts on habitats and populations from management activities, natural disturbances, and vegetative succession. Monitoring could include:

- Conducting surveys in spring and fall after the first heavy rainfall or frost.
- Recording all environmental conditions where these species are found to better understand their habitats and management needs.
- Through surveys and studies, determining the extent of the species range, and the habitats and ecology of the species.
- Monitoring sites for conditions and trends of populations.

IV. REFERENCES

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