

**CONSERVATION ASSESSMENT
FOR**

Prophyaon coeruleum,
Blue-Gray Taildropper

**Originally issued
as Management Recommendations**

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by

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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 and Washington 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. The original document for this species included another species, *Prophyaon dubium*, and also contained several management options for use where the species was locally common. Since *P. dubium* is not a Special Status or Sensitive Species, and *P. coeruleum* is considered rare within the portion of its range where it is listed as a Sensitive species, portions of the original document referring to *P. dubium* and management options for locally common species have been removed. For these 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 (USDI and USDA 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.” At the time of the signing of the ROD, this species (in the Washington portion of its range) was in Category A in the Survey and Manage Program.

Management Considerations

Within the following Conservation Assessment, under the “Management 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: *Prophysaon coeruleum* Cockerell, 1890, Blue-gray Taildropper

Taxonomic Group: Mollusks (Phylum Mollusca: Class Gastropoda, Family Arionidae)

Management Status: Forest Service Region 6 Sensitive Species in Washington State. The Washington Natural Heritage Program ranks this species as G4 S1 (Apparently globally secure but with cause for long-term concern, and critically imperiled within the state because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation). Although the species occurs in Oregon, there is little concern for the species (as evidenced by the Heritage rankings) and it is not listed by either Agency as Sensitive or Special Status there. In the Klamath province and eastern Oregon Cascades, *Prophysaon coeruleum* may be part of a complex which includes the undescribed Klamath taildropper, currently recognized as a separate taxa and an OR BLM sensitive species.

Range: *Prophysaon coeruleum* - Western Cascades and Puget Trough of Washington, Oregon Cascades and Coast Range, and Klamath Mountains south to northern California. In the Klamath province and eastern Oregon Cascades, this species may be included in a species complex which includes *Prophysaon* new sp, Klamath taildropper.

Specific Habitat: *Prophysaon coeruleum* is found in a variety of forest types and plant communities, including conifer-hardwood and mixed conifer stands. It is most often found in moist, late-successional forests where it is associated with conifer logs, hardwood species such as big-leaf maple, deep litter, fungi and mosses.

Threats: Primary threats to this species are the loss of habitat and population isolation due to forest management practices, conversion for agricultural, urbanization and other uses, and fire. Other threats may include vertebrate and invertebrate predators (i.e., predatory snails, and beetles), which can concentrate in isolated, small habitat patches where slugs are vulnerable. In some forest stands, bigleaf maples can be suppressed by Douglas-fir and other conifers or lost as a result of selective thinning, leading to a long-term loss of this habitat element and the associated fungi species used by the species. Harvest of special forest products (i.e., harvest of mushrooms, firewood gathering, moss harvest, collection of swordfern and salal plants for ornamental transplant) are potential threats in limited habitats.

Management Considerations: Within Species Habitat Areas moderate fluctuations in temperature and humidity by maintaining favorable shade and limiting adverse impacts of fire. Maintain a variety of tree and plant species, especially hardwoods, critical to provide for fungi food resources used by the species. Maintain or restore microsite conditions and key habitat features at the site, maintain habitat contiguity throughout the surrounding occupied habitat and provide cover used for daily refugia by preserving and recruiting dead and downed woody debris. Avoid compaction of the soil and litter layer, and avoid disturbance to occupied rockslides and talus areas to provide deep seasonal refugia sites.

Information Needs:

Some of the primary information needs are:

- Are the recognized variants of *P. coeruleum* (eg. Klamath tailedropper) separate species or subspecies?
- What is the range of habitat conditions (canopy cover, age, large woody debris, litter and duff, etc.) tolerated by the species or required for populations to remain secure and viable?
- 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 much time is required for recolonization of a site by species from adjacent populations?
- What seasonal refugia sites are used by the species to protect them from catastrophic fire.

I. NATURAL HISTORY

A. Taxonomic/Nomenclatural History

Family: Arionidae

Prophysaon coeruleum Cockerell, 1890

Prophysaon coeruleum was first described by Cockerell.

Molecular analysis was done in 1999 which compared the genetic similarities of specimens identified as *P. coeruleum* from locations in western Oregon, Washington, California and Idaho. The results indicate that the species is not monophyletic in regards to color (ie., body color is not related to genetic similarity) and that there is a divergence in genetic similarity that occurs in southwestern Oregon populations which has resulted in several "clades" or variants in that region (Wilke and Duncan, 2004). None of these subsets of the parent species as yet have been officially named or described as subspecies or separate species, although one group has unofficially been described by Frest and Johannes in several inventory documents as *Prophysaon* new species, commonly known as the Klamath tailedropper (Frest and Johannes, 1999, 2000).

B. Species Description

1. Morphology

P. coeruleum is nearly uniform blue-gray with scattered white flecks in the integument. Adults are 20-40 mm long, although mostly smaller, young animals are usually found in the field. Prominent grooves and ridges on the tail are horizontal and generally parallel, although occasionally interconnecting, and they become obliquely angled on the sides with increasing slope nearer and below the mantle. Low rounded bumps may be seen on the mantle, but these are not nearly as prominent as the papillae on *P. dubium*.

The following is quoted in Pilsbry (1948). Type description, "Length (in alcohol) 22 ½ mill., in motion, 43 mill. Body and mantle clear blue-gray, paler at sides, sole white. Mantle finely granulated, broad, without markings. Length of mantle 7 mm, breadth 5 mm Respiratory orifice 2 ½ mm from anterior border. Body subcylindrical, tapering, pointed. Distance from posterior end of mantle to end of body, 10 ¾ mm The reticulations take the form of longitudinal equidistant lines, occasionally joined by transverse lines, or coalescing. Sole not differentiated into tracts The neck is long and white, or very pale. (Cockerell)". Pilsbry adds, ". . . about 25 mm. long. The general color is clear payne's gray, the head and neck paler. Back with close, deep longitudinal grooves, which, on the

sides, become oblique and more spaced, and more anteriorly they radiate vertically below the mantle."

"*Prophysaon coeruleum* is an exceedingly distinct species, distinguished by its color and the character of its reticulations." (P. B. Randolph quoted in Pilsbry, 1948, page 693). "The very narrow foot-margin, with an unusually distinct border above, is another distinguishing feature." (Pilsbry, 1948, page 693).

A variant of the blue-gray tailedropper occurs in southern Oregon in Jackson and Klamath counties. This variant has been called *Prophysaon* new species, the Klamath tailedropper, by T. Frest and E. Johannes, who originally discovered it. They report apparent external differences from typical *P. coeruleum* in the color and habitat. Its color is more blue-brown than blue-gray, and the sole color is grey rather than white. It occurs in drier habitats in the Southern Oregon Cascades, extending down the east slopes. Other than that, it appears the same, exteriorly, as typical *P. coeruleum*, but a description of its internal morphology has not yet been published.

An analysis of mitochondrial DNA of *P. coeruleum*, including specimens identified as the Klamath tailedropper, indicates that color is not a reliable character with which to distinguish between these two groups (Wilke and Duncan, 2004). The conclusion of this study is that these taxa cannot be distinguished from each other based on color, or on any other external features. The color markings of individuals found to be similar genetically to the Klamath tailedropper do not all conform to the written description of Frest 2000. Blue specimens from western Oregon (Kelsey Creek in the Rogue River drainage, approximately five miles from the southern boundary of the Roseburg District BLM) fall into the same molecular clade as dark specimens from Winema National Forest identified as the Klamath tailedropper. Other specimens from the Roseburg District, which were identical in external appearance to the Kelsey Creek specimens, were found to be genetically similar to the large clade of nominal PRCO found from Roseburg north through western Oregon. Genetic information currently forms the sole basis for separation of the two taxa. There is no way, short of molecular analysis, to know whether sites recorded as PRCO may be the Klamath tailedropper. Both taxa may be more properly ascribed to one large species complex.

Another blue variant, possibly a separate species of *Prophysaon*, is found in Douglas and Jackson counties of southern Oregon. This slug varies externally from *P. coeruleum* by a lighter, more translucent blue color caused by a greater abundance of the white pigments in the integument, but more distinctly by a different pattern of tubercles on the tail. This variant has low, not deeply delineated rectangular tubercles opposed to the well defined ridges

and grooves of typical *P. coeruleum*. Wilke 2000, did not find that this variant was genetically different from nominal PRCO.

2. Reproductive Biology

Like most Terrestrial gastropods, *Prophysaon* are hermaphroditic, having both male and female organs. Although not confirmed specifically for *P. coeruleum*, self-fertilization has been demonstrated in some species of gastropods, but cross-fertilization is the norm. Bayne (1973) discussed the complexities of the Pulmonate reproductive system, and studied mechanisms by which allosperms (sperm from another) exert dominance over autosperms (sperm from oneself) during fertilization. Thus, ". . . self-fertilization is normally avoided, but remains a possible alternative to cross-fertilization." The advantage is in normally avoiding potentially deleterious inbreeding, yet retaining the option to reproduce if a mate is not available.

Slugs are generally oviparous (egg laying). Eggs of *Prophysaon* slugs can be found in groups of several to many in cool damp spots such as under logs or pieces of wood on the shaded forest floor.

3. Ecology

Prophysaon coeruleum normally occurs in late-successional forests of moist plant associations, or at least in stands with an abundance of late-successional attributes (i.e., cool moist sites with large and small woody debris, and relatively thick layers of litter and duff). It is known to be mycophagous (feeding on fungi) at least in part, and through its foraging, it disseminates spores and hyphal fragments of mycorrhizal and other fungi on which it feeds (McGraw, Duncan and Cazares, 2002). Within stands in which it occurs with other mollusk species (*P. dubium*, *Cryptomastix devia*, or *Megomphix hemphilli*), *P. coeruleum* appears to be generally more closely associated with conifers and conifer debris, than these species, which appear to prefer hardwoods.

This slug is preyed upon by a variety of vertebrates and other invertebrates. Tail-dropping is an effective means to escape predators such as the haplotreme snails.

Nearly all gastropods are alternate hosts for a variety of parasites (e.g., lung worms), but specific symbiotic relationships of this species have not been documented, probably because it has been seen rarely in the past.

C. Range, Known Sites

Prophysaon coeruleum has been found at scattered sites in British Columbia, and

western Washington, and rather frequently in the Coast Range and western Cascades of Oregon. Frest and Johannes (1996) add that the range of this species may extend as far east as Upper Klamath Lake and potentially along the eastern flank of the Cascades in Washington and Oregon. Three examples have been found at one location in Siskiyou County, California. One specimen from Idaho, included in the DNA analysis, indicated that an additional population of *P. coeruleum* genetically similar to the northern Oregon clade also occurs in the Blue Mountains of Idaho (Wilke and Duncan, 2004).

The type locality is Olympia, Washington. Pilsbry (1948) reported records of it from: Olympia, Thurston County, and Seattle, King County, Washington; and Portland, Multnomah County; Oswego, Clackamas County; and Corvallis, Benton County, Oregon. Branson and Branson (1984) collected one from each of 6 sites in Oregon (2 sites from each of Clackamas and Lane counties, and 1 from each of Marion, and Jackson counties).

There were few records of it prior to the Northwest Forest Plan (NFP) Record of Decision in 1994, and most of those records were from the northern part of its range. However, surveys done in response to the NFP have discovered this species to be much more common in the southern part of its range in southwestern Oregon, especially in Douglas and Lane counties. The blue-brown variant, or Klamath taidropper of Frest and Johannes, may be found in southern Douglas County, and in Curry, Josephine, Klamath and Jackson counties. The Klamath and the blue-white variant (possibly a different species) have not been recorded separately from the typical blue-gray taidroppers during the recent surveys by Federal land management agencies. We have no records as to the relative abundance and exact range of each of these variants. Typical *P. coeruleum* is the species found in Washington.

Since surveys began, these slugs have been found in localized populations in specific areas of their ranges. *P. coeruleum* is fairly abundant in southwestern Oregon, and is found in locally abundant, though scattered in distribution over other parts of its range in Oregon. However, in northwestern Oregon and in Washington, it is only known from a few sites, and appears to be quite rare.

D. Habitat Characteristics and Species Abundance

1. Habitat Characteristics

This species appears to be confined primarily to old-growth forests in the northern part of its range, but it is apparently more abundant and may occur in moist second-growth stands in western Oregon, as long as late-successional attributes remain in sufficient quantity. In Washington, Burke and Hanson found it in a western hemlock/sword fern plant association, under bark and among mosses under conifer logs and under bits of small, usually conifer debris. According to P. B. Randolph, “it occurs solitary in dark fir woods under damp logs” (Pilsbry 1948). In

southern Oregon, it may be found among forest floor litter and debris usually in stands where the ground is moist and well shaded.

The blue-gray tailed slug is apparently primarily mycophagous, eating fungus (Mcgraw, Duncan and Cazares, 2002). Slugs of this species have been observed consuming above-ground fungal fruiting bodies and using the hollowed stipes of several species as protected sites for mating and temporary refugia. Fecal analysis revealed spores from numerous underground mycorrhizal truffle species, especially during the fall season. Mycorrhizal fungi species require a variety of different plant species as hosts.

Habitats in which the typical variety of this slug is found are moist forest, normally late-successional or, second growth with late-successional attributes. For *P. coeruleum*, these forests are usually dominated by conifers, but there is often a strong hardwood component. They are usually in moist plant associations, the forest floor being moist but not wet or saturated. The ground is shaded, and covered by moist, fairly deep layers of litter and duff. The species has been found in a range of forest canopy closure levels. In an analysis of data from Coos Bay and Roseburg BLM Districts, approximately 10% of known locations occurred in areas where canopy closure averaged less than 50%. In this study, the majority of sites were in areas with canopy closure greater than 70%. Sites located in the Klamath/Siskiyou province occurred in less dense canopy than those in more northern provinces. There is an abundance of large and small woody debris (conifer and hardwood) scattered over the ground, large logs (greater than 20 inches average diameter) in sites with large populations, covering 1000 or more linear feet per acre. Logs of decomposition class 2-4 appear to be used most often. Low vegetation may be patchy. Vegetation listed at the sites includes: Douglas-fir, western hemlock, western red cedar, white pine, sugar pine, maples, alders, ferns, scouring rushes, and mosses. It is associated with decaying wood, logs or rocks. Elevations are 300-1370 meters (1000-4500 feet) (Branson and Branson 1984).

In the eastern part of its range in southern Oregon, it is apparently replaced by a different color variety, the Klamath tailed slug of Frest and Johannes, which occurs in drier environs, extending even into the edges of grasslands. It would appear that this Klamath variety may have been what Branson and Branson (1984), ". . . encountered in dry, volcanic areas" These sites include drier forested areas than noted by other authorities. However, they also mention that at the higher sites, snows remained until into July, the month that they surveyed these areas. Specific circumstances other than those described above may also provide suitable habitat.

Many snails and slugs, including *P. coeruleum*, use talus, rock fissures and/or riparian habitats where, under certain conditions, suitable

microsites may occur as a result of combinations of environmental features. These deep rock refugia sites also provide protection to individuals during intense fire events, which form the nucleus of newly expanding colonies after such events (Duncan, 2004).

2. Species Abundance

Records of the blue-gray tailedropper were scarce prior to implementation of the Northwest Forest Plan, Branson and Branson (1984) providing the only published sightings since Pilsbry (1948). It has since been found to be quite common in parts of southwestern Oregon, especially Lane and Douglas counties. There are very few locations in California, from Siskiyou County. Where found, individuals are usually widely separated from each other and appear to be solitary.

In Washington, which includes the type locality, the blue-gray tailedropper appears to be rare. Branson (1977, 1980) did not find this species at 353 locations surveyed in the Washington Cascades or the Olympic Peninsula. Branson (1977) wrote, "Although reported from Olympia (type locality) by Henderson (1929a) and Dall (1910), I did not secure slugs with the characters of this species." Frest and Johannes (1993) reported it not found recently by them prior to 1993. Burke found 3 specimens at a single site in the Randle Ranger District, Washington Cascades. Other specimens have since been found in the vicinity. Currently, the interagency species database records 4 locations for the species in Washington State. Random grid surveys in Washington, conducted under the Survey and Manage program, did not locate this species in any plots searched.

II. CURRENT SPECIES SITUATION

A. Status History

This species was listed under both the "Protect Sites From Grazing" Standard and Guideline, and Table C-3, Survey Strategies 1 and 2 of the Survey and Manage Standard and Guidelines (USDA, 1994). In 1999, it was considered to be a rare species in Washington, based on the low number of occurrences, and its low detection rate in suitable habitat and was placed in Survey and Manage Category A. The Washington Natural Heritage Program gives the species Global ranking G4, State ranking S1 (Apparently globally secure but with cause for long-term concern; critically imperiled within the state because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation). In 2004, Region 6 of the Forest Service classified this species as a Sensitive Species in Washington state.

Although the species occurs in Oregon, there is little concern for the species there

(as evidenced by the Heritage rankings) and it is not listed by either Agency as Sensitive or Special Status in Oregon. However, in the Klamath province and eastern Oregon Cascades, *Prophysaon coeruleum* may part of a complex which includes the undescribed Klamath tailedropper, currently recognized as a separate taxa and an OR BLM sensitive species.

B. Major Habitat and Viability Considerations

Analysis is needed on the morphology and ecology of the variants that could be similar species or subspecies. Before anything can be concluded about the security of this (or these) species, their relationship needs to be determined, and differences distinguished between their habitats and ecology.

For species of patchy distribution, concerns for viability increase as habitat areas decrease in number and size toward a critical threshold. As population size decreases there is a greater possibility of catastrophic loss of local or limited populations. The quality of remaining habitats becomes more critical. With a smaller population, there is a greater potential for isolation of populations which could lead to the potential for the deleterious effects of inbreeding. There is also increased chance of population loss from predation, pathogens or other causes.

Loss of suitable conditions for mycorrhizal fungal populations in managed forests is a concern for the continued viability of this species. It is known that severe burning and exposure to hot, dry conditions results in the loss of these critical elements of forest ecosystems. It is expected that forest practices that result in the loss of the fungal community, reduced plant diversity and less than suitable conditions for slug species, which aid in fungal dispersal, could ultimately result in less productive and unhealthy forests.

C. Threats to the Species

Further loss of habitat to support the species across the landscape - Much of the formerly known range of *P. coeruleum* in Washington has been developed for urbanization or agriculture. Currently, habitat disturbances and modifications such as timber harvest, fire, and development appear to be the greatest threats to this species.

Reduction in quality of existing habitat - Quality habitat is important to these slugs for maintaining a balanced biotic community to support them, and for escaping predators. While they are known to be mycophagous, at least in part, the lack of detail on their ecology points out the importance of a diversity of vegetation needed within their habitats to provide a variety of fungi and other potentially required but as yet unknown elements.

Predation - In adequate habitat, natural predators rarely threaten a population. Concern about predators increases as habitat quality decreases. Up to three

species of *Haplotrema* and *Ancotrema* (predatory snails that feed on snails, slugs and other invertebrates) occur in the same habitats in greater numbers than *Prophysaons*. Ground beetles (*Scaphinotus* sp.) specifically adapted for preying on snails are common in northwest forests, and other insects as well as reptiles, amphibians, birds, and mammals also prey on them. Hiding and escape cover is provided by forest floor litter, including fine and large woody debris.

Competition from exotic mollusks - Exotic slugs are increasing within the range of *P. coeruleum*. To what extent these introduced species might compete with the native gastropods or buffer them from predation has not been demonstrated. Exotic species should be of concern because of the rapidity with which their populations increase. The mollusk fauna in most urban and suburban areas is now almost exclusively exotic species, and they are spreading into the forests.

High intensity fire - High intensity fire is particularly damaging to gastropod populations, as it destroys both the animals and their habitats.

Inadvertent losses because of other management activity - For example, harvest of special forest products can be a threat in limited habitat areas. Raking the forest floor for mushrooms, or removal of logs for firewood could be particularly damaging.

D. Distribution Relative to Land Allocations

The three sites on the Cowlitz Valley (Randle) Ranger District are in Late-Successional Reserves. The fourth site (the type locality) is/was in Olympia, Washington, while another poorly documented location from 1913 was in Seattle.

III. MANAGEMENT GOALS AND OBJECTIVES

Management for this species follows Forest Service Region 6 Sensitive Species (SS) policy. 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

Once extirpated from a site, populations of most gastropods are slow to recover. Fire is a natural disturbance factor which has occurred over many centuries. Even as a natural process, its effects can be harmful to existing populations. The

effects of fire depend on several variables, including intensity, available deep refugia, season and relationship to the life cycle of the species. Fire, especially intense fire events, can be very destructive to snails and slugs. Fire can kill the mollusks (if they are unprotected), and it can destroy logs and other woody debris that hold moisture and create microsites necessary for survival of these animals. The time required for the abundance and diversity of the molluscan fauna to be restored to these sites is indicated by the much greater numbers of species and individuals found in old growth than in stands in which signs of fire (and other management in some cases) are still evident but not necessarily obvious. In these burned stands, we have an ecosystem that is lacking the components and functions provided by the mollusk fauna.

In a study examining survival of this species after a low-moderate intensity wildfire event in southern Oregon, it was found that pre-fire sites were lost in areas where there was no deep rock refugia or riparian moisture, while sites in situations with deep rock refugia and subsurface moisture survived for at least two years after the fire (Duncan, 2004).

B. Identification of Species Habitat Areas

All known sites on federal lands administered by the Forest Service and/or BLM in 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 range from a few acres to 25 acres or more, depending on the extent of contiguous habitat and the amount of surrounding habitat needed to maintain suitable moisture conditions. Of central concern is protecting the site from mechanical damage and conserving temperature and humidity regimes at the site. Drier, more open stands, southerly or westerly aspects, upper slopes, etc., generally indicate the need for larger Habitat Areas. As new data is compiled, consideration should be given to daily and yearly activity cycles of the species as this data is collected.

At the smallest scale, within each 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 may 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.

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.

C. Management Within Species Habitat Areas

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

Management considerations should focus on maintaining the favorable daily and seasonal temperature and moisture regimes of the microsites in which these gastropods occur (i.e., ground level microclimates and cover components). Sufficient overstory crown cover and understory vegetation should be retained to shade the ground, provide humidity through evapotranspiration, and impede air movement that would tend to displace the cool moist air. Maintenance and recruitment of large and small woody debris is important, as is a layer of litter and duff on the forest floor. These components provide cool moist places in which the animals spend the days, hide from predators, deposit their eggs, and find food.

Attempt to maintain habitat contiguity by extending boundaries of Species Habitat Areas to meet other reserve areas such as Riparian Reserves, LSRs etc., to minimize fragmentation of populations.

Within Species Habitat Areas consider the following:

- Minimizing disturbance of the forest floor litter, duff, and woody debris.
- Maintaining existing canopy closure of trees within a large enough area to moderate fluctuations of temperature and humidity on the site.
- Maintaining a component of hardwood trees and shrubs, including big-leaf maple trees (oldest preferred) and other hardwoods, to provide a constant supply of logs, leaves, and leaf mold. Site specific conditions will normally determine the optimum mix of tree species, but mixed stands of conifer and hardwoods may provide the best habitat.
- Maintaining or enhancing 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.
- Maintaining important cover and microhabitats by preserving dead and downed woody debris (especially Class 2 - 4). 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. Falling trees to provide logs in stands where insufficient numbers occur may be done, but is not recommended unless the resulting canopy cover will provide sufficient shade to maintain cool, moist conditions.

- Avoiding prescribed burning within Species Habitat Areas, and protecting them from wildfire by fuels management in adjacent areas and other means.
- As feasible, protect Species Habitat Areas from exotic snails and slugs, and control exotic species where they occur.
- Protecting occupied rockslides and talus areas from road construction, quarrying, and other major site disturbing activities that may cause temperature and/or humidity changes within the interspaces or instability within the slope.

D. Other Management Issues and Considerations

Variants of the blue-grey taildroppers in southern Oregon, and northern California, may be separate species. There is a recognized difference in the habitats occupied by the dark variant (Klamath taildropper) which generally uses drier areas and more open habitats. Characteristics of habitats used by the Klamath variant and typical *P. coeruleum* should not be combined for analysis because that would confuse habitat descriptions. Each of the different variants and their habitat data need to be recorded separately in order to evaluate species (or subspecies) status and clarify management needs and recommendations when these differences are resolved. For management purposes, until a taxonomic revision of the *P. coeruleum* complex is published, it is recommended that all variants should be treated as one species.

V. RESEARCH, INVENTORY AND MONITORING OPPORTUNITIES

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

A. Data Gaps and Information Needs

Taxonomy of the blue-gray taildropper needs to be clarified, and published. Until this is done, the true range and habitat data for *P. coeruleum* cannot be validated.

Assuming the taxonomy is defined;

-What is the specific range of each of these taxa/species?

-What is the range of habitat conditions tolerated by each taxa/species? What is

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

-What stand conditions are used?

- 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.)?
- Distance moved in a lifetime?
- Elevations of habitat used;
- Soil types, geology, rock crevice use, trace elements;
- Temperature, humidity.

B. Research Questions

Are the recognized varieties of *P. coeruleum* separate species or subspecies?

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

What is the response of the species to fire under various intensities and seasons?

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

What are the seasonal movement patterns and how long is required for recolonization of a site by species from adjacent populations?

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

C. Monitoring Opportunities

Monitoring is recommended to determine impacts on habitats and populations from management activities, natural disturbances, and vegetative succession. Monitor managed sites for implementation and effectiveness of prescriptions.

Where a species is rare, no more than 5% of its occupied habitat should be disturbed during monitoring.

Conduct surveys in spring after the ground has thoroughly thawed, and in fall after the first week of heavy rainfalls or frosts (if before significant rains).

Record all environmental conditions where these species are found to better understand their habitats and management needs.

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