MANAGEMENT RECOMMENDATIONS
FOR
TERRESTRIAL MOLLUSK SPECIES

Megomphix hemphilli, the Oregon Megomphix

Version 2.0

by

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EXECUTIVE SUMMARY

Species: *Megomphix hemphilli* (W. G. Binney, 1879) — the Oregon Megomphix (land snail)

Taxonomic Group: Mollusks

ROD Components: 1 and 2

Other Management Status: This land snail is on List 1 of the Oregon Natural Heritage Program and, therefore, is a Bureau Sensitive species for the Bureau of Land Management.

Range: For Washington, records indicate this species has a low-elevation distribution from Olympia to the Columbia River that does not include any National Forest. For Oregon, it is known from the Coos Bay, Eugene, Roseburg, and Salem Districts and is suspected to occur in the Medford District of the Bureau of Land Management. It is known from the Siuslaw, Umpqua and Willamette National Forests and is suspected to occur in the Mount Hood, Rogue River, and Siskiyou National Forests, and the Columbia River Gorge National Scenic Area.

Specific Habitat: The Oregon Megomphix occurs at low to moderate elevations, below the zone of seasonally persistent snow pack. Megomphix snails are most often found within the mat of decaying vegetation under sword ferns and bigleaf maple trees and near rotten logs. Most occupied sites are on well-shaded slopes and terraces, and many are near streams.

Threats:
Primary threats to this species are

-Isolating or losing additional populations
-Further loss of habitat to support the species across the landscape, especially bigleaf maples, associated leaf litter and coarse woody debris
-Predation
-Competition from exotic mollusks
-High intensity fire
-Inappropriate use of chemicals

Management Recommendations:
Megomphix hemphilli sites should be managed by conserving or developing favorable habitat components within identified Habitat Areas. Three management strategies are recommended for *Megomphix hemphilli*, depending on local distribution within the area under consideration. A primary concern in all strategies is to moderate fluctuations in temperature and humidity by maintaining favorable shade and limiting adverse impacts of fire.

- **Strategy 1** is the recommended option where the species is not locally common. The general prescription is to conserve microsite conditions and best habitat features at the site. The Habitat Area is the area needed to maintain favorable microsite conditions at the single site. Habitat disturbance should be only to benefit the species.

- **Strategy 2** can be used when the species qualifies as locally common, and occurs in locally clustered sites which occupy a portion of the project area. The Habitat Area is an area or polygon around all local sites. This approach allows limited disturbance, including thinning and other activities.
- **Strategy 3** can be used where the species qualifies as locally common and when it seems to occur throughout a proposed project area. The Habitat Area is the same as the Survey Area or project area. This approach allows a higher level of disturbance, including thinning and other activities.

Strategies 2 and 3 manage the Habitat Area as a collective site and allow some of the individual sites to be temporarily degraded, while maintaining the population as a whole. They maintain connectivity through the occupied habitat and stipulate that any degradation should recover within two decades. Manipulation may include release of bigleaf maples and reduction in overstory canopy combined with conservation of other important habitat features such as down woody material and hardwood leaf litter.

Information Needs: Explore the distribution and ecology of this species, and monitor the survival of known populations where there are management activities or unplanned events.

I. NATURAL HISTORY

A. Taxonomic/Nomenclatural History

There have been varied opinions about the proper family allocation of *Megomphix hemphilli*. It has been placed in the Zonitidae by Smith (1970), in the Camaenidae by Pilsbry (1946) and Branson (1980), in the Ammonitellidae by Miller et al. (1984) and Turgeon et al. (1988), and in the Thysanophoridae by Burch and Pearce (1990). Regional authorities (Terrence Frest and Barry Roth, personal communications) and Turgeon et al. (1998) now use Megomphicidae, which earlier had been rejected by Pilsbry (1946, page 505) as a subfamily because of flaws in the original definition.

The genus *Megomphix* was proposed by Baker (1930), with *Megomphix hemphilli* (W. G. Binney 1879) as the type species. This genus has been used as valid by all subsequent authors. As discussed by Pilsbry (1946, page 506), *Megomphix* is closely related to the genus *Glyptostoma* Bland and Binney, 1873, which is found in southern California. There is a possibility that *Megomphix* may become a junior synonym of *Glyptostoma*, which is the older name (Barry Roth, personal communication).

This species was originally proposed as *Macrocyclis hemphilli* by W. G. Binney (1879). The type specimen is in the National Museum of Natural History (USNM 38783). The type locality is "Olympia, Washington Territory" (no specific locality but most likely in Thurston County). This species was moved to *Hyalinia* by Ancey (1882), then to *Selenites* by Tryon (1886), to *Circinaria* by Pilsbry (1898, page 128), and to *Haplotrema* by Henderson (1929), before it was made the type species of a new genus, *Megomphix*, by Baker (1930). Ancey (1882) used an unjustified substitute name for this species, *Hyalinia* (*Ammonoceras*) *hemphilliana*. Presently there are two other species in this genus, the Natural Bridge Megomphix (or California Megomphix), *Megomphix californicus* A. G. Smith, 1960, which is known from scattered locations in the Coast Range of northern California, and the Umatilla Megomphix (or Muddy Megomphix), *Megomphix lutarius* H. B. Baker, 1932, which inhabits the Blue Mountains of eastern Washington and Oregon.

As for subspecies, Ancey (1882) described a variety, "var *tenuis*, more pellucid and smaller (7½ mill.); shell thinner," also from Olympia. Pilsbry (1946, page 509) concluded that "var *tenuis*" was based on an immature shell of *Megomphix hemphilli*. Henderson (1936) treated *Megomphix lutarius* as a subspecies of *Megomphix hemphilli*, but Pilsbry (1946) and subsequent authorities have treated *Megomphix lutarius* as a full species. At present, regional authorities (Terrence Frest and Barry Roth, personal communications) recognize no subspecies within *Megomphix hemphilli*. However within Oregon, *Megomphix hemphilli* shells from Lane County seem to be slightly smaller and not as shiny as those from Multnomah County. These slight differences may distinguish varieties that were separated by the old Columbia

River before Mount Hood erupted in the riverbed roughly a million years ago and forced the river north to its present route.

B. Species Description

1. Morphology

The shell of the Oregon Megomphix, *Megomphix hemphilli*, is sometimes difficult to distinguish from shells of certain haplotrematid snails (family Haplotrematidae), especially those of immature *Haplotrema vancouverense* and *Ancotrema hybridum*. The use of comparative material is recommended, both for learning the relative characteristics of *Megomphix hemphilli* shells and for making reliable identifications of collected samples, especially of those shells that are weathered or damaged.

Megomphix hemphilli has a moderately small shell, with the largest example on hand reaching 20.3 mm (0.8 inch) in diameter. Measurements for this species in Branson (1977) are to be disregarded as they are based on misidentified specimens of haplotrematid snails (John Applegarth, personal observation; confirmed by Terrence Frest, personal communication). *Megomphix hemphilli* specimens on hand suggest that this species reaches a slightly larger size in the northern part of its range. When considering only those shells that are 12 mm or more in diameter, 18 shells from Multnomah County average 17.2 mm and the maximum is 20.3 mm, while 159 shells from Lane County average 14.6 mm and the maximum is 19.2 mm (John Applegarth, personal observation). Shells of this species seldom exceed the diameter of a penny (19 mm).

The form of the shell of *Megomphix hemphilli* is a dextral (right hand) spiral. If the side of a shell is viewed and the dorsal side is up, then the aperture or "mouth" will be on the right side. When holding shells in this position, the outer part of the mouth of a Megomphix shell will be close to the horizontal axis of the shell, while that of a haplotrematid shell is more distinctly below the horizontal axis. This character can also be described as a relative flatness of the bottom of a Megomphix shell. This difference is subtle, so it provides a weak character that should be used in conjunction with other features when making identifications. The spire of a Megomphix shell is low (the dorsal side is like a low dome) and there is a large umbilicus (the deep recess on the ventral side). The umbilicus of this species is roughly a third of the total diameter (a sample of 8 shells varied from 28% to 36% with a mean of 32%). The generic name *Megomphix* is based on the Greek word roots *meg* (large) and *omphal* (navel). The shell is relatively thin and when occupied by the snail that made it, the shell is semitransparent. Shells of mature *Megomphix hemphilli*, which may reach maturity at roughly 12 mm in diameter, do not have any thickening or

outward flaring of the margins of the mouth (the lip or peristome of the shell). In contrast to mature haplotrematid snails, which have down turned shell mouths, mature Megomphix shells have a mouth that is normally unmodified; old Megomphix shells may have a very slight peristomal downturn. Unlike shells of many polygyrid snails (family Polygyridae), there are no lamellae or tooth-like excrescences within the mouth of a mature *Megomphix hemphilli* shell.

One of the best characteristics for recognizing a Megomphix shell is the relatively slow rate of augmentation of the innermost coils. This results in a tightly coiled appearance. If a stereo-microscope equipped with an ocular micrometer is available, then this character can be applied quantitatively. With reference to Pilsbry's diagram of a shell viewed from above (Pilsbry, 1939, page xi, figure B, the right-hand set of numbers), coil #2 of a Megomphix shell is less than a third wider than coil #1, whereas coil #2 of the shells of the three species of Oregon haplotrematid snails always seems to be more than a third wider than coil #1. In qualitative terms, the first turn and a half appears to be constant in width. This is in contrast to the first turn and a half of haplotrematid shells, which clearly increase in width.

The texture of a shell of *Megomphix hemphilli* is relatively smooth and shiny when compared to similarly shaped shells of haplotrematid snails (species in the genera *Ancotrema* and *Haplotrema*) that occur within the range of *Megomphix hemphilli*. Of those haplotrematid snails, all species of *Ancotrema* have to some extent tiny bumps or "beads" on their shells. These nearly microscopic bumps may be strongly developed and cover most of the exterior, or they may be weakly developed and limited to certain parts of the shell, in which case they are most easily detected by viewing the sides of the umbilicus under a stereo-microscope (especially if held and moved to allow reflected light to move along the growth ridges). Neither *Megomphix* nor *Haplotrema* have these tiny bumps. The only species of *Haplotrema* known to be within the range of *Megomphix hemphilli* is *Haplotrema vancouverense*, which can be distinguished from *Megomphix hemphilli* by a number of characters. In addition to relative shape of the peristome and the relative size of the embryonic (inner) part of the shell, the texture of the growth ridges within the umbilicus is a character that can be used to separate these two species. Within the umbilicus of *Haplotrema vancouverense* there are strongly developed growth ridges that are reminiscent of water plunging into a circular well. This characteristic appearance is best defined by viewing a specimen known to represent this species (comparative material). This corrugated appearance is absent in the umbilicus of *Megomphix hemphilli*, which has small and weakly developed growth ridges. In addition, *Megomphix hemphilli* shells tend to be smoother and are more glassy in appearance. This shiny texture is a property of the periostracum, the

proteinaceous covering that protects the mineral part of the shell of most land snails, so this feature will be absent to the extent that the periostracum has been lost from damaged or weathered shells. This glassy appearance is a character that can be useful in recognizing Megomphix shells that have been washed and dried (this characteristic seems to be enhanced by drying).

Megomphix shells are pale in appearance, either a pale yellowish-gray or dirty-looking off-white (ivory), and they are usually unevenly colored. They may appear slightly greenish but usually are not as strongly gray-green as the shells of haplotrematid snails. This greenish appearance of some snails seems to be the visual product of an amber-tinted and relatively transparent periostracum overlying the gray-white mineral part of the shell. In addition to vague blotches of darker color, a feature common to the shells of living Megomphix and haplotrematid snails, there is a pale (whitish) coloring around microscopic pits and other injuries that seems more conspicuous on Megomphix than on other shells, especially when magnified.

In contrast to the bodies (anterior to the shell) of live examples in the genus *Ancotrema* and small immature *Haplotrema vancouverense*, both of which tend to have some gray coloration dorsally, the bodies of living *Megomphix hemphilli* and adult *Haplotrema vancouverense* are creamy white and the only trace of gray pigment is in the eye stalks (dorsal tentacles). However, at the microscopic level there is a striking difference between these two species. In living Megomphix there are white "pigment" cells that look like white micro-tubules within the otherwise clear gelatinous surface of the body (but not the foot). These white micro-tubules are absent from the body of all of the living haplotrematid snails that have been examined. Live haplotrematid snails have an opaque creamy white or gray-white body that is strongly divided in a reticulate fashion by grooves. This reticulate texture is weakly present on the dorsal side of living Megomphix.

2. Reproductive Biology

Reproduction in *Megomphix hemphilli* is presumed to be similar to that of other land snails, i.e. snails in this species are hermaphroditic and capable of self-fertilization. Normally a land snail will mate and exchange gametes with another individual of its kind, and then both will lay eggs in damp subsurface situations where the eggs will be relatively safe from predators and desiccation. For this species the appearance and number of eggs have not been reported. Land snails do not tend their eggs or young. There is no larval stage and newborn snails look like miniature adults (the innermost part of the shell develops within the egg). The potential longevity of *Megomphix hemphilli* is unknown but may be as little as two years (Terrence Frest, personal communication).

3. Ecology

Megomphix hemphilli seems to be more secretive and photophobic than other Northwest land snails. Such behavior would be consistent with a body and shell that are virtually devoid of pigmentation. Most other land mollusks seem to be willing to crawl about by day or night, out in the open, and on top of any ground cover. In contrast, no live Megomphix and very few of their shells have been found out in the open. Virtually all Megomphix have been found under the cover of leaf mold or within soft soil or in spaces within rock heaps. The normal activity of Megomphix snails seems to be entirely subsurface. To some extent this species may also be subterranean. The first *Megomphix hemphilli* shells found in Lane County, Oregon, were near the back of a 38-foot adit (John Applegarth, personal observation), and the type series of *Megomphix californicus* was collected from the floor of Natural Bridges Cave in a remote area with total darkness (Smith 1960).

All of the locations for *Megomphix hemphilli* are below the zone of seasonally persistent snow pack. All known sites in Washington State are below 150 meters (500 feet) elevation, and in western Oregon most locations are between 150-450 meters (500-1500 feet) with 774 meters (2540 feet) being the highest elevation at which this species has been found. At this highest location, Megomphix shells were found under sword ferns next to rotten logs on a steep, north-facing slope just below a ridge top where winds coming over the ridge seem to have created a long-term concentration of woody debris. No bigleaf maple or hazel were seen at this high elevation location, but the extensive woody debris could have linked this damp north-facing slope with bigleaf maples at lower elevations on the same slope.

C. Range, Known Sites

For Washington State there are 12 records, based on 45 specimens, that provide 7 mappable locations, which are all at low elevations (below 150 m or 500 ft) in the southwestern part of the state. Six of these locations are in the Puget Trough from Olympia (type locality and most northern locality) south to the Columbia River, plus one location at Oakville in a side valley on the west side of the Puget Trough. Most of these records are old (based on specimens collected 30 to 120 years ago). None of the locations are east of the Cascade Range, and all are remote from mountains and Federal lands. The absence of *Megomphix hemphilli* from the mountains of Washington is also evidenced by negative results of recent surveys. In 1996 and 1997, shells of this species were found at Toledo (midway between Olympia and the Columbia River) where, according to Pilsbry (1946), Button found this species over 70 years ago (Fred L. Button lived 1856-1928).

In contrast, for Oregon there are many known sites for *Megomphix hemphilli* on Federal lands. Roughly 76% of these sites are in Lane County on lands managed by the Eugene District of the Bureau of Land Management. A combination of several years of exploratory surveys plus several seasons of protocol surveys have produced over 850 known sites in the Eugene District. Although efforts to find this species may not have been as great in other parts of western Oregon, at this time less than a fourth of all known sites are in all of the rest of western Oregon. There are scattered records from Clackamas, Clatsop, Coos, Douglas, Linn, Multnomah, and Tillamook counties. As yet there are no records from southwestern Oregon (Curry, Jackson, and Josephine counties) or from east of the Cascade Range. In terms of Federal lands, this species is known from the Coos Bay, Eugene, Roseburg, and Salem districts of the Bureau of Land Management and is suspected from the Medford District. It is known from the Siuslaw, Umpqua, and Willamette National Forests and is suspected to occur in the Mount Hood, Rogue River, and Siskiyou National Forests, and the Columbia River Gorge National Scenic Area.

In Oregon the elevational distribution of *Megomphix hemphilli* is relatively low, with most locations being between 150-450 meters (500-1500 feet), and with 774 meters (2540 feet) being the highest elevation at which this species has been found. All locations are below the zone of seasonally persistent snow pack. Available information suggests the range of *Megomphix hemphilli* is disjunct from that of the other two species in this genus, *Megomphix lutarius* and *Megomphix californicus*.

There are several reports that are not included in the present estimate of the range of *Megomphix hemphilli*. Branson (1977) claimed to have found this species at 14 locations on the Olympic Peninsula, including in the Olympic National Forest and the Olympic National Park. In addition, Branson (1980) claimed to have found this species at 3 locations in the Mount Baker[-Snoqualmie] National Forest. The collections on which those reports were based were recently reexamined, and all of the specimens previously identified as *Megomphix hemphilli* are actually examples of immature haplotrematid snails (John Applegarth, personal observation; confirmed by Terrence Frest, personal communication). The absence of *Megomphix hemphilli* in the Branson collections explains why the shell size, geographic range, elevational range, and ecological situations of the snails reported as *Megomphix hemphilli* by Branson (1977, 1980) were inconsistent with information for this species from other sources. There are no other records for *Megomphix hemphilli* from either the Olympic Peninsula or the Cascade Range of Washington State. Those reports by Branson were the basis for an incorrect range given in Appendix J2 (USDA and USDI, 1994a, page 314).

Another rejected record for *Megomphix hemphilli* is in Eyerdam (1934) who claimed to have found a number of shells near Yakima, Washington, and to have sent them to Henry Pilsbry for identification. Pilsbry (1946) made no mention of this record, and none of the institutions queried for their holdings of Survey and Manage species

reported any *Megomphix hemphilli* from the Yakima area. In the absence of specimens that can be reexamined, the absence of other records from east of the Cascade Range, and the similarity of this species to certain species of haplotrematid snails, this record is viewed as a probable misidentification.

D. Habitat Characteristics and Species Abundance

Except for a few empty shells, all examples of *Megomphix hemphilli* have been found under some form of cover. Live Megomphix have been found within and under the mat of decaying leaves under bigleaf maples, hazel bushes, and sword ferns. They have also been found in leaf mold containing a mix of conifer and bigleaf maple debris, and occasionally under pieces of fallen bark. Live Megomphix are usually in situations that are shaded by a nearly closed canopy and often where there is additional shade provided by sword ferns, bushes, or rotten logs, especially if the log is large or bridging ("supported off the ground by other debris" as noted by Baker, 1930). The presence of rotten logs seems to be important to the local survival of Megomphix snails.

The only live tree with which the Oregon Megomphix seems to associate positively is the bigleaf maple (*Acer macrophyllum*). Unusually large or multiple-stemmed bigleaf maples, or clumps of bigleaf maples, seem to provide the most favorable Megomphix habitat. The more the canopy consists of bigleaf maple, the more likely Megomphix will be present and, if present, then locally concentrated. Bigleaf maples are soil builders and this snail may benefit from soil porosity that is enhanced by the maple. Megomphix are often within the mat of decaying vegetation under a sword fern that is either under a bigleaf maple or roughly within a meter of a rotten log. Megomphix also seems to associate positively with hazel bushes, but no association is apparent with either salal or Oregon grape.

Megomphix have also been found away from the vicinity of bigleaf maples, but in those situations usually rotten logs were present. Damp rotten logs may provide shelter during seasonal drought, and possibly they can function as dispersal corridors between areas with bigleaf maples. Megomphix seem to associate with rotten logs of hardwoods and conifers (except cedars).

Observations indicate that this species tends to concentrate around certain features such as bigleaf maple trees or old logs. Because this species inhabits the forest floor, concentrating around certain features and possibly using others as corridors between features, the forest floor can be viewed as continuous macro-habitat that contains a network of micro-habitat features. In theory the best bridges of favorable conditions from one patch of bigleaf maples to the next are the largest of rotten logs Larger logs may last longer, giving this snail more opportunity to colonize maple patches as they become available. Large logs are also potential refuges where dormant snails have a better chance of surviving severe droughts and stand-replacing fires.

Topography and elevation seem to be important to the distribution of this snail, possibly through their influence on vegetation. The bigleaf maple is native to the forests of the Pacific Northwest where they occur at moderate to low elevation, depending on latitude. Bigleaf maples do best on moist and well-drained alluvial and colluvial soils (Minore and Zasada 1990), and often flourish at the foot of steeper slopes, near seeps and small streams, and on terraces that are not seasonally flooded. Although some bigleaf maples and land snails other than Megomphix live on active flood plains and the Willamette Valley floor, the Oregon Megomphix generally seems to be absent from active and recently active flood plains. Rocky ridges and slopes that are remote from streams and have a relatively thin mantle of soil generally do not favor either this snail or the bigleaf maple. As for aspect, Megomphix snails have been found on slopes of all aspects, but seem to be more often found on north-facing slopes. This snail is only known from low elevations in Washington, and from low to mid-elevations in Oregon, and this suggests that this species may be limited to mesic forests below the zone of seasonally persistent snow pack. At the southern part of its range, this species may be found to be limited to mid-elevations (at lower elevations the forest being too dry), and farther south this species could be excluded where the zone of intolerable summer drought may effectively extend up to the zone of seasonally persistent snow pack.

For most of its range, *Megomphix hemphilli* seems to have a discontinuous (patchy) distribution and is one of the less abundant species where it is present. Two years of exploratory surveys in the Eugene District of the Bureau of Land Management found evidence for a patchy distribution. One or more non-protocol searches for Megomphix were conducted at 75 subjectively chosen sites (from January 1996 to May 1997). The shells of this species were detected at 26, or roughly a third of these sites. As for relative abundance, Megomphix shells represented about 7.7% (65 of 842 shells) at those 26 sites. When the results from all 75 sites were combined, Megomphix shells were about 4% (65 of 1577 shells). When live snails and slugs were included, the result remained close to 4%. Where present, *Megomphix hemphilli* is usually the least common of the larger land snails (with shells larger than 1 cm in diameter when mature).

It should be noted that about three-quarters of the *Megomphix hemphilli* detections have been empty shells. Because Megomphix shells are relatively perishable and likely to be destroyed by scavengers, microorganisms, plant roots, and the weather within a year, empty shells are treated as valid indicators of the presence of this species. However, when the number of known Megomphix sites is compared to the number of sites in the same area for the tail-dropper slugs (Survey and Manage species of *Prophysaon* that leave no detectable shells), there is a detectability bias that makes *Megomphix hemphilli* seem more abundant than it actually is relative to the tail-dropper slugs.

II. CURRENT SPECIES SITUATION

A. Why Species is Listed under Survey and Manage Standard and Guideline

The Oregon Megomphix, *Megomphix hemphilli*, has a known range that is entirely within the range of the Northern Spotted Owl. In the FEMAT analysis (USDA . . ., 1993, page IV-128) this species was judged to have a 17% risk of extirpation under Option 9. Historically *Megomphix hemphilli* has been considered a rare species. It was thought to have been lost from a number of sites (USDA . . ., 1994a, page 314). However, with the rejection of the records (Branson, 1977, 1980) for the Mount Baker[-Snoqualmie] National Forest and the Olympic Peninsula, those losses seem to have been a false conclusion from recent surveys that failed to find this snail where it had never existed. The rejection of the Branson records does reduce the known range and available records for this species. The remaining records indicate a patchy distribution at low elevations in southwestern Washington and moderate to low elevations in western Oregon. Although this species is not as rare as it seemed before recent surveys, most records are from a relatively limited area (the suitable parts of Lane County, Oregon) where it occurs in small numbers relative to other land snails.

B. Major Habitat and Viability Considerations

The health of local ecosystems generally depends on large-scale connectivity with adjacent communities, both terrestrial and aquatic, and through geological time large-scale connectivity may be important to mollusk species. On the other hand, when contrasted to vertebrate species, most mollusk populations are relatively sedentary, and large-scale habitat connectivity seems to be of little importance to their immediate survival. "If protected from catastrophes, snail colonies may not depend on immigration and could conceivably be self-sustaining for centuries, in which case the distance to the next fragment [of suitable habitat] may not be very important" (Roth, 1993). What is most urgent is to detect and conserve this species where it presently exists, realizing that the network of habitat features that this species requires is dynamic.

Bigleaf maple trees and rotten logs are transient features in forest ecosystems. Many bigleaf maples get started as "light gap" invaders but, after a number of decades, they can become limited in size and age by competition with conifers that can grow taller and eventually shade out the bigleaf maples. Old rotten logs are also transient features that can last for many decades, but eventually need to be replenished from a legacy of large-diameter, green trees in the stand.

C. Threats to the Species

Apparent threats to the survival of *Megomphix hemphilli* include the reduction in size and abundance of rotten logs and the suppression of bigleaf maples in areas inhabited

by this snail. Other possible threats to the species include deforestation, fire, floods, exotic species, and the destruction of old bigleaf maples for burl.

The progressive loss of large old rotten logs may be a long-term threat to the local survival of *Megomphix hemphilli*. The Standards and Guidelines (USDA . . ., 1994b, page C-40) call for the conservation of existing coarse woody debris (CWD) and the creation of new CWD. These measures will help the survival of this and other forest floor mollusks to some extent. However, the best bridges of favorable conditions from one patch of bigleaf maples to the next are more likely to be provided by large logs, especially those that are a meter (39 inches) or more in diameter and 60 meters (200 feet) or more in length. These logs are also potential refuges where dormant snails have a chance of surviving severe droughts and stand-replacing fires. Unfortunately for the snails, old logs (in decay classes 3-5) may be damaged during timber harvest and may be degraded by fires. The addition of small, short, firm logs — CWD as small as 50 cm (20 inches) in diameter, as short as 6 meters (20 feet) in length, and relatively new (in decay classes 1-2) — does not provide equivalent replacements of those large old logs. With much of the forest being harvested at intervals of less than 100 years, and few "legacy" trees being left after each rotation, the foreseeable supply of large logs is diminishing.

Any forest management that included the removal of bigleaf maple trees and suppression of their regeneration was probably suppressing those parts of the ecosystem that benefit from these trees. Sometimes in precommercial thinning, bigleaf maple stump sprouts have been cut back to a single stem per stump to produce larger diameter maple logs and reduce competition with the adjacent Douglas-fir seedlings. However, *Megomphix hemphilli* seems to do best where most of the local canopy is predominantly bigleaf maple, under a tree with multiple stems, or several trees close together. Conifers within the adjacent areas contribute to moist environmental conditions and provide large, down woody debris. Thinning prescriptions should include an uneven treatment of bigleaf maples to favor both conifer production plus some dense patches of bigleaf maples, especially if those patches include old bigleaf trees that were reserved from harvest.

When the forest canopy is drastically reduced, the resulting dessication of the forest floor can be a threat to the local survival of mollusk populations. In general the terrestrial mollusks are vulnerable to dehydration and are thought to be negatively impacted when the forest floor becomes more exposed to wind and sunlight. However, those populations that survive in association with key habitat features can recover as the forest canopy recovers. Furthermore, the distribution of Megomphix sites suggests a possible positive correlation with small forest clearings, possibly because bigleaf maples are light gap invaders, but this apparent association has been observed where there are no bigleaf maples, so this species seems to be tolerant to a wide range of canopy closure and may be favored by an intermediate level of shading.

Fire can have direct negative impacts on this and other mollusks. Although this snail may escape the direct effects of summer fires by being dormant within the ground or under large logs, they may suffer loss of suitable forest-floor habitat. If prescribed fires designed to reduce fuel load are conducted in the wet part of spring and fall when mollusks are most likely to be active, Megomphix could be cooked by the warmth if not burned by the fire. Hazardous fuel reduction outside of areas inhabited by this species should provide an indirect benefit of reducing the risk of severe wildfire degrading inhabited areas. Some areas with a history of frequent fires seem to have depressed terrestrial mollusk faunas (fewer species than ought be there) and few Megomphix populations.

Abnormally high floods and debris torrents are a threat because some of the densest populations of *Megomphix hemphilli* are within Riparian Reserves. Unlike most other forest floor snails, this species seems to be absent from areas that have a history of inundation, either from stream-flooding or rain-flooding. In contrast, other forest floor mollusks are often found on active flood plains, possibly because they are willing to climb trees.

Exotic species can degrade a forest ecosystem. Exotic vegetation can carpet sites that would otherwise be suitable for *Megomphix hemphilli*. For example, no native mollusks seem to associate with mats of English ivy (it was encouraging to note that ivy does poorly where the forest canopy is relatively closed). A variety of nonnative terrestrial mollusks have become established in residential and agricultural areas in the Pacific Northwest, and they could spread into adjacent forests where they could displace the native species. This has already happened in Washington State where the European Black Slug (*Arion ater*) has become established in old growth forests and is apparently displacing the native Banana Slug (*Ariolimax columbianus*).

Finally, the collection of burl from bigleaf maple trees can degrade the local habitat for *Megomphix hemphilli*. Although bigleaf maple is common in Northwestern forests, large old trees are becoming scarce. These old bigleaf maples can shelter major local concentrations of *Megomphix hemphilli*. Sometimes old bigleaf maples are injured by having burls sliced off, and sometimes the entire tree is cut down by the burl collector.

D. Distribution Relative to Land Allocations

In western Oregon *Megomphix hemphilli* has been found on Federal land in the Coos Bay, Eugene, Roseburg, and Salem districts and is suspected to occur in the Medford District of the Bureau of Land Management. It is known from the Siuslaw, Umpqua, and Willamette National Forests and is suspected to occur in the Mount Hood, Rogue River, and Siskiyou National Forests, and the Columbia River Gorge National Scenic Area. This species should be anticipated in all Federal land allocations at all elevations below 900 meters (3000 feet), especially where there are bigleaf maples and rotten

logs. In southwestern Washington all known sites for this species are remote from the National Forests, and it is not expected to occur on any Federal forest lands.

III. MANAGEMENT GOALS AND OBJECTIVES

A. Management Goals for the Taxon

Management goals for this species are to assist in maintaining the species' viability.

B. Specific Objectives

1. Maintain and/or restore environmental components to provide for sufficient quantity and quality of habitat which should sustain populations in their existing distribution across the natural range of the species. Favorable habitat features include: stands of mixed conifer, bigleaf maple and sword ferns or hazel bushes where available; uncompacted moist, cool, soils; leaf mold formed in part by bigleaf maple, hazel or sword ferns; and large and small woody debris (both conifer and hardwood).

This species is moderately common in one part of its range while being scarce in other parts. The following two objectives address the difference in density of sites across the landscape.

2. Manage apparently isolated populations by maintaining or improving local habitat conditions. When a species is not found to be locally common, the specific objective for management is to maintain or improve favorable microsite characteristics at each known site by conserving an area large enough to moderate fluctuations in humidity and temperature, and other environmental characteristics. When habitat is in relatively good condition, decisions to enhance it should not be made prematurely. Restoration of suitable habitat is appropriate if it is deteriorating through natural processes or has been degraded by human activities.

3. Where the species is locally common, maintain persistence of populations and a relatively high level of suitable habitat conditions and features that will allow for the continued occupation of the area by the species. In these situations, management activities within their habitats may be done with little long-term impact on the species if certain precautions are observed. Habitat manipulation may occur to improve habitat conditions that should favor local persistence of the species while allowing other management to occur. Restoration of suitable habitat is appropriate if it is deteriorating through natural processes, or has been degraded by human activities.

IV. HABITAT MANAGEMENT

A. Lessons from History

If we have learned anything from history, it should be that management with a single or primary objective can create more problems than it resolves. Therefore, when managing habitat for a survey and manage species, consideration should also be given to other species, other resource objectives, and the ecosystem as a whole, including natural succession, potential natural disturbances within the site, and influences from adjacent lands.

Once extirpated from a site, populations of most gastropods are slow to recover. 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. Areas that appear to be suitable for mollusks, but which have been burned in the recent past, seem to support fewer species even after 50 years and longer. Some of the more abundant, larger species should begin repopulating these areas from adjacent stands soon after suitable habitat for them is restored, but even this may take many years. The long time required for the diversity of the mollusk fauna to be restored to these burned areas is indicated by the greater numbers of species found in nearby old growth stands. In these burned stands, the ecosystem that may be lacking components and functions provided by the mollusk fauna.

An intense burn can be expected to leave the biotic community under moist conifer stands with only a small fraction of its mollusk fauna for many years (possibly a century or more). In contrast to severely burned areas, stands in which numerous large logs were left, and which were not severely charred during the fire, have been found to retain a substantial portion of their mollusk fauna after many years but within a time that evidence of the burn was still apparent at the site (Thomas Burke, personal observation). Remaining logs in these types of areas have been estimated to be greater than 1000 linear feet per acre, and greater than 20 inches average diameter (Thomas Burke, personal communication). It has not been determined if the mollusks remained through the burn, protected by the abundant logs, or if they were able to more rapidly disperse back into the stand because of the cover provided by the logs. What is apparent is that an abundance of large logs is important to many forest snails and slugs. Zero to two or rarely three species may be expected in burned stands without abundant logs remaining; five to seven species may be expected to be found in stands similarly treated but with the logs remaining; and in unburned stands 13 to 20 or more species may be found (Thomas Burke, personal communication).

The statement in Appendix J-2 (USDA and USDI, 1994a, page 314) that this species "has been extirpated from most historic sites" is incorrect. Although Frest and Johannes (1993) were unable to find *Megomphix hemphilli* at some of the sites

reported by Branson (1977, 1980), the Branson records were based on misidentifications (Applegarth, personal observation). Presently there are no documented examples of extirpation. Exploratory surveys (John Applegarth, personal observations) suggest that Megomphix populations decline or disappear in response to local loss of bigleaf maples and woody debris. In areas with a history of frequent fires or logging, this snail seems to be absent or is surviving in small colonies near streams or rotten logs.

To the extent that habitat features survive, this species has demonstrated an ability to persist and recover in the Eugene District of the Bureau of Land Management. In a 4-year-old clear cut this species was still present in small numbers under canopies of stump-sprouting bigleaf maples that are next to rotten logs (John Applegarth, personal observation). In several second-growth stands, this species seems to have responded positively to timber harvest that removed most of the Douglas-fir but left many bigleaf maples and large quantities of woody debris. When released from competition with adjacent conifers, the bigleaf maples became large trees with broad crowns. In nearby late-successional stands many of the bigleaf maples are being shaded out by taller conifers, and Megomphix is a smaller part of the local land snail fauna.

B. Identification of Habitat Areas for Management

In the first few years of implementing the Northwest Forest Plan (NFP), some Survey and Manage species were found to be more abundant in some areas than was known when the Survey and Manage approach was being developed. This has led to questions about whether it is necessary to protect each and every site where the species has been found. If the distribution of a species is widespread, and discovery sites are locally common, it is reasonable to manage multiple sites within a given area collectively as a local population.

Individual mollusks are mobile and may move away from the location where they were discovered. Additional individuals may also be present in nearby areas and remain undetected and unprotected by single site management. Thus management of the entire area apparently occupied by the population should be more beneficial for population survival than management of smaller areas around individual sites. While this approach may cause possible loss of some individuals, all individuals should not be critical to the persistence of a favorably managed population. Managing larger areas of occupied habitat rather than small areas around individual sites should be a better way of gaining local persistence of this species and thus a better way to also maintain its regional distribution.

As our knowledge of habitat requirements and distribution for this species increases, we can move from simply protecting site conditions as they are, to using management prescriptions that allow habitat manipulation while maintaining persistence of the local population. These prescriptions could be applied to a range of different sizes of

management areas, from small islands of habitat around individual discovery sites to multiple site polygons or designated management areas incorporating entire project areas.

Certain criteria need to be considered in order to take the more flexible approach of managing for populations rather than individual sites. Two important considerations are 1) whether a species is well distributed in all or a significant portion of its range, 2) and if there is adequate information about its habitat associations so that general management measures can be expected to maintain or improve its habitat.

Megomphix hemphilli is well-distributed in all or a significant portion of its range. This species is fairly well distributed on Bureau of Land Management lands in Lane County, Oregon, and further surveys may find this to be true for most of the Willamette Province as defined in the Record of Decision (USDA and USDI, 1994, page E-19).

There is adequate information about the habitat associations of *Megomphix hemphilli* to conclude that general management measures can be expected to conserve or improve its habitat. There is an abundance of observations to define habitat associations, and there are numerous situations that evidence how this species should respond to management measures.

Since the two important conditions for this species concerning distribution and habitat are met, the only remaining criterion to meet, in order to manage for populations rather than individual sites, is whether or not the species can be considered "locally common" in the Survey Area. The determination of "locally common" should be based on the results of protocol survey visits to individual project areas, any surveys beyond protocol requirements, incidental discovery of sites, and on historic data. A species may be considered as "locally common" if it meets all of the following four criteria:

1. There is a minimum of at least two sites in the project area or Survey Area. The intent of this criterion is to establish a minimum number of sites in a local area.

2. There should be a ratio of at least one site per 4 hectares or 10 acres averaged for the project area or Survey Area. (In cases where sites are common in a portion of the project area or Survey Area, but not present in another portion of the area being considered, then these areas can be subdivided and managed differently. The minimum size after a subdivision of a Survey Area should be 8 hectares or 20 acres.) The intent of this criterion is to display evidence that the species has an acceptable density of sites relative to the area being considered.

3. The species is known to occur in adjacent forest stands. Known sites within Riparian Reserves or in adjacent habitats outside of the project area, can be

considered as documentation of occupancy in adjacent stands. The intent of this criterion is to display evidence that there are opportunities for repopulation of the Habitat Area from adjacent areas.

4. The species is known to occur in adjacent or nearby watersheds. For purposes of this evaluation, known sites should be documented within at least one adjacent or nearby 6th field watershed. (Sixth field watersheds are expected to be approximately 8100 hectares or 20,000 acres in size.) The intent of this criterion is to display evidence that the species is distributed across a broader landscape.

These criteria should all be addressed when determining if the species is locally common. Biologists should document their consideration of these criteria and the intent of the criteria when determining if the species is locally common. These criteria are not intended to be absolute and inflexible. Other factors, such as the type of activity being proposed and the location of this area relative to other known sites can also be considered. It is important to document the rationale used for developing site specific management proposals.

In reading this section, it is important to keep in mind the distinction between sites, occupied habitats, and Habitat Areas. The detailed discussion describing different strategies should be considered in conjunction with these definitions.

- **Site** -- The "site" has been defined as that point at which the species was found, or a small area where two or more specimens were found within 10 meters (33 feet) of each other (also called a "known site"). A point location can be the marked feature in a Sample Area (or Plot) where one or more examples were found, or the isolated site of a point search, or the center of a group of sightings within 10 meters (33 feet) of each other (and defined by UTM coordinates that are at least 10 meters from the next site). For management purposes, a site may also be a larger but clearly defined area where this species has been found and which is managed in ways that should ensure the local persistence of this species (also termed a Habitat Area).

- **Occupied Habitat** -- For this discussion, the "occupied habitat" is an area of closely similar habitat surrounding each site that is known or presumed to be occupied by the species.

- **Habitat Area** -- The "Habitat Area" is the area managed for the species in the immediate vicinity of one or more known sites. It is that area around one or several known sites that includes habitat features that contribute to favorable environmental conditions for the species at the known site(s). Where this species is managed as locally common, the Habitat Area is the site.

There are three types of Habitat Areas and management strategies that can be used to manage for this species:

1. Habitat Areas for single site locations. Management is to maintain, benefit and enhance the species at the single site.

2. Habitat Areas that are polygons of several site locations. These polygons are subsets within potential project areas. Management should achieve continued occupation by the species within the Habitat Area by maintaining a relatively high level of suitable habitat conditions and features and by limiting disturbance.

3. Habitat Areas covering a disturbance area, which is the entire project or a larger area. The objective of this strategy is to maintain favorable habitat conditions within the Habitat Area in order to maintain occupation by the species while allowing some other management activities to occur.

These three types of Habitat Areas and management strategies are illustrated in the Appendix.

All known sites should be within a Habitat Area. In Strategy 1, known sites will be managed individually within Habitat Areas. In Strategies 2 and 3, known sites will be managed collectively as a population within Habitat Areas.

In areas where these species are locally common, local managers have the option of using Strategies 1, 2, or 3. There can be a combination of Habitat Area types within a single project.

Management activities which manipulate the habitat are allowed in Strategy 1 only to benefit the species. Strategies 2 and 3 allow habitat manipulation for a broader range of benefits. Strategies 2 and 3 are intended to provide additional flexibility while successfully maintaining and/or improving habitat for populations and providing for continued occupation of the area by the species.

This chart summarizes the distinguishing characteristics of the three Management Strategies. A more complete description of recommended management is in the sections following this table.

COMPARISON OF THREE HABITAT AREAS AND MANAGEMENT STRATEGIES

Attribute	Strategy 1	Strategy 2	Strategy 3
Local population	Not locally common	Locally common	Locally common
Distribution of sites	Isolated, single sites	Clusters of multiple sites	Sites scattered across a landscape
Distribution of suitable habitat	Isolated areas	Irregular, mosaic distribution	Relatively uniform
Description of Habitat Area	Area around known site. Portion of Survey Area or project area.	Polygon around cluster of several known sites and habitat features. Portion of Survey Area or project area. Becomes the known site.	Entire Survey Area or project area (or disturbed area). Becomes the known site.
Recommended Management within Habitat Area	Generally no disturbance, except to benefit species. Maintain favorable microsite conditions and best features at site.	Limited disturbance. Some thinning and other activities allowed. Favorable habitat conditions and features at most individual sites maintained.	Limited disturbance. Greater thinning than allowed under strategy 2. Favorable habitat conditions and features at some individual sites maintained.
Fire management in Habitat Areas.	Protect from fire.	Protect from fire in low fire frequency areas. Avoid broadcast burning. Cool, patchy under burns allowed.	Protect from fire in low fire frequency areas. Avoid broadcast burning. Cool, patchy under burns allowed.

C. Management Within Habitat Areas

Management objectives will normally include maintaining a favorable temperature and moisture regime of the microsites in which this mollusk occurs (i.e., the ground level microclimates and cover components). This is usually achieved by conserving a sufficient amount of overstory and understory vegetation to shade most of the ground. It also includes conservation of bigleaf maples, hazel bushes, and sword ferns, where they occur, large and small woody debris, and a relatively undisturbed layer of decaying vegetation on the forest floor.

In Habitat Areas inhabited by several species of concern, management should be for the mix of environmental components that should favor all of them.

Where possible, integrate protection with other allocations, especially Riparian Reserves. When found within Riparian Reserves, consider increasing the width of occupied Riparian Reserves as potential management for habitat requirements for this mollusk species.

Attempt to maintain habitat contiguity by extending boundaries of Habitat Areas to meet other reserve areas such as Riparian Reserves and other Habitat Areas in order to minimize the fragmentation of populations.

Since this species seems to spend different portions of the year at different locations within the forest floor, it is appropriate to consider how management impacts would be different at different times of year.

Three management strategies are available for *Megomphix hemphilli*:

Strategy 1 is the option where this species is not locally common. This is the cautious approach where all new known sites are managed separately by means of individual Habitat Areas. No or very minimal disturbance is generally expected within the Habitat Area. Management within a Habitat Area should be to maintain, benefit and/or enhance the habitat of this species.

The size and quality of each Habitat Area should be sufficient to maintain favorable environmental conditions at the site location, to conserve (or restore) the identified habitat and ancillary features, and to provide conditions that allow this species to persist at this site. The size and shape of the Habitat Area depends on site specific conditions. While the Northwest Forest Plan identifies management on the order of tens of acres (USDA and USDI , 1974, page J2-353), it is recognized that smaller Habitat Areas can be used for this species.

Megomphix hemphilli is neither truly rare (i.e., rare throughout its range or has a precariously small range) nor does a Megomphix site need such a large Habitat Area.

Observations in the Eugene District of the Bureau of Land Management indicate that an adequate Habitat Area for an individual site can be as small as 0.1 hectare (0.25 acre), *if most of the original shading is conserved*. This refers to a simple majority of summer tree foliage intercepting sunlight that would otherwise reach the ground at the site. If the forest canopy outside of the Habitat Area is to be substantially opened, then a larger Habitat Area may be needed to conserve favorable moisture and temperature conditions at the site. Site features and management operations can both be incorporated into the determination of the size and shape of the unit needed. Of central concern is protecting the site from mechanical damage and conserving favorable temperature and humidity regimes at the site. Dryer, more open stands, southerly or westerly aspects, upper slopes, etc., generally will need larger Habitat Areas.

Within Strategy 1, management of Habitat Areas should:

- Minimize disturbance of the forest floor litter, duff, and woody debris. Ancillary features (such as rotten logs or loose rocks) that are nearby may be important as seasonal shelters and should be included within the Habitat Area.
- Maintain the existing canopy of trees within a large enough area to favorably moderate fluctuations of temperature and humidity on the site.
- Conserve available components of bigleaf maple trees (oldest preferred), hazel bushes, and sword ferns to provide a supply of logs and suitable leaf mold. In the interest of ecosystem management a diversity of tree species should be maintained on the site, but emphasis should be placed on the species that favor the persistence of this mollusk. Conifers within a Habitat Area may be converted to snags or felled when they seem to be seriously competing with bigleaf maples, if the remaining trees will continue to provide most of the shading of the site from direct sunlight that existed before this action. This possible need should be considered whenever general snag creation is being planned. Management that would favor the growth of sword fern within the Habitat Area should also favor this mollusk.
- Conserve the naturally occurring diversity of plant species in Habitat Areas. This should conserve the range of hosts for fungi, which may be food for this mollusk. Conserving a mix, such as occurs in natural late-successional stands, would provide a more diverse and complete set of conditions for multiple species and a more fully functioning ecosystem.
- Maintain important cover and microhabitats by conserving dead and downed woody debris (especially in Class 3 - 5). It is recommended that large and small woody debris be maintained in its natural abundance in stands where this snail occurs. 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 favorably cool, moist conditions.
- Avoid prescribed burning within Habitat Areas, and protect them from wildfire by fuels management in adjacent areas and other means. The yarding of whole trees or crowns is encouraged as a way to minimize the need to burn near known sites.

- As feasible, monitor Habitat Areas for exotic snails and slugs, and report a need for management or research if exotic species are discovered.

Outside of the Habitat Areas, management would be done to Northwest Forest Plan management objectives and guidelines.

Strategy 2 is suggested where the species is found to be locally common and the multiple known sites occur in locally clustered areas within a project area, or there is an identifiable concentration of favorable habitat features and conditions that occurs together with those sites. These multiple sites are managed as a collective population. The Habitat Area encompasses the presumed population, but it is less than the entire project area or Survey Area. All new known sites should be within a Habitat Area (older sites do not need to be included if there is reason to believe they are no longer inhabited by this species). For purpose of managing known sites in Strategy 2, the Habitat Area is the site. Management should achieve continued occupation by the species within the Habitat Area by maintaining a relatively high level of favorable habitat conditions and features.

The advantage of the Strategy 2 approach is that while it achieves the basic objective of managing for the benefit of the species, it also allows some timber harvest and other activities within the Habitat Area (including tree removal, yarding corridors, and skid roads), and it gives more flexibility for management of other species within the area. This approach involves some level of risk and implies that the manager knows which habitat features are important to the species in question. The management prescription should maintain some connectivity within the polygon between "hot spots," while allowing some degradation of conditions to occur outside of "hot spots." It is expected that some microsite conditions of the Habitat Area will be affected. However, by following these guidelines, the mollusk population should continue to occupy the Habitat Area after management activities occur.

Use of this strategy would normally begin with identifying and selecting concentrations of known sites and exceptional habitat features, such as old bigleaf maples and large rotten logs. These areas would generally be designated as "hot spots". A polygon drawn around the selected "hot spots," any additional sites, and special habitat features would define the Habitat Area. Not all sites need to be included within a "hot spot." (See illustrations in Appendix.) There can be one or several multi-site Habitat Areas within a survey area, and there may also be one or more single-site Habitat Areas for outlying sites within the same Survey Area.

The Habitat Area should be large enough to generally maintain favorable habitat conditions at selected concentrations of habitat features at and near occupied sites. There should be enough distance between the sites and the Habitat Area boundary that most of the original shading of most of the sites would be conserved. The polygon normally includes the areas that would have been protected if these sites were managed

individually plus the intervening areas and possibly some adjacent areas of habitat features.

Habitat conditions within "hot spots" should be managed with a minimum of disturbance. Management should emphasize habitat protection, maintenance, or enhancement for the benefit of the species. The guidelines for Strategy 1 (other than size of the Habitat Area) would also apply to "hot spots." The number and distribution of these "hot spots" should reflect (but not necessarily match) the existing distribution of habitat features and known sites. The size of each "hot spot" area will depend on the type of potential adverse environmental effects from adjacent areas. In other words, if the cluster or "hot spot" is surrounded by relatively undisturbed habitat, the need for additional protection is reduced. It is recommended that at least one "hot spot" be identified per 4 hectares or 10 acres, averaged for the Habitat Area. The "hot spots" can be relatively small (generally 1 - 2 acres in size) and should make up 10-20% (or more) of the total Habitat Area.

Outside of these "hot spots," but still within the Habitat Area, management may be allowed for other purposes. However, management of the rest of the Habitat Area should maintain a relatively high level of favorable habitat conditions that will allow for some continued occupation by the species. While activities for other objectives may occur, there should be a focus on leaving enough vegetation to moderate the fluctuations in temperature and humidity. Examples of some of these types of activities include skid trails, yarding corridors, road construction, and falling and removal of trees. Management within a polygon Habitat Area defined around a cluster of known sites basically consists of reserving or releasing most of the bigleaf maples or other leaf-litter producing trees and shrubs, protecting clusters of exceptional habitat features, and maintaining a level of environmental conditions and habitat elements that will maintain a population of this mollusk within the Habitat Area. When bigleaf maples are released from competition with conifers, they should develop broad canopies that provide exceptionally favorable habitat for this species. This is a general treatment that should be applied without regard to the actual location of sites within the Habitat Area.

Because large old logs seem to be important to the survival and dispersal of this species, the coarse woody debris standard and guideline should be met or exceeded (USDA and USDI, 1994, pages C-40), and some of the largest available conifers (other than cedar) should be included in the trees reserved to meet the green-tree retention standard and guideline. Ground disturbing or soil compacting activities should be kept to a minimum near any protected features. As needed, conifers near protected features may be converted to snags or felled if they seem to be seriously competing with bigleaf maples and if the remaining trees will still provide most of the original shading.

Many activities and conditions affect the suitability of sites for this species. However, one of the major influencing factors is shade. Shade helps to moderate fluctuations in temperature and humidity. Management activities in the Habitat Area should result in

crown cover sufficient to provide shade over most of the Habitat Area at the completion of the project. The emphasis is to maintain some connectivity within the polygon and between "hot spots." This level of average shading should be present at mid-day in mid-summer. On the average, the stand should maintain favorable temperature and humidity regimes by retaining more shaded areas than open areas. This level of average shading could be achieved by combining open areas with denser areas.

As a general rule, the effects of habitat disturbance from broadcast burning for site preparation or slash disposal should be avoided within Habitat Areas. Generally, keep fire out of Habitat Areas in regions with a longer fire return interval (greater than 50 years). Areas with relatively short fire return intervals (less than 50 years) have a greater need for and opportunity to use prescribed burns to manage fire risk in and around Habitat Areas. Because fire is a more frequent active component of those ecosystems, it is appropriate to use it as a management tool as long as adverse impacts to this species and its habitat are minimized.

Prescribed burning within Habitat Areas is discouraged (including broadcast burning, burning naturally created debris piles and slash piles from management activities). However, it may be acceptable if ground disturbance is limited to a small portion of the Habitat Area and if the intensity of the burn can be minimized. Fire prescriptions should target cool, patchy under burns that leave a major portion of the Habitat Area (preferably 60% or more) unburned. The timing of the prescribed fire should take into consideration the seasonal behavior of this mollusk. Use all acceptable measures to keep fire out of areas designated as "hot spots" for the species.

During site preparation or slash disposal, efforts should be made to reduce ground disturbance and retain large woody debris to the degree possible. Burning piles is generally preferable to broadcast burning. Hand piling is much preferred to machine piling. Piles should be covered and burned in the same season or left unburned to prevent mollusks from being attracted to the piles and killed.

Outside of the Habitat Areas, management would be done to Forest Plan management objectives and guidelines. Mitigations should be designed to reduce the effects of broadcast burning and ground disturbance to any identified Habitat Areas. For example, retaining unburned piles and down wood outside of the Habitat Area is suggested whenever possible to provide additional habitat.

Strategy 3 is suggested if this species is locally common and if the distribution and numbers of sites and habitat features suggest that they are likely to occur more or less throughout the Survey Area. This strategy defines an entire project or Survey Area as a multi-site Habitat Area. All new known sites should be within the Habitat Area (older sites do not need to be included if there is reason to believe they are no longer inhabited

by this species). This area and these sites are managed as a collective population. For purpose of managing known sites in Strategy 3, the Habitat Area is the site.

The objective of this strategy is to maintain favorable habitat conditions in enough of the Habitat Area to maintain occupation by this species while allowing some management to occur. This can be achieved predominantly by reserving and releasing bigleaf maples and protecting other important habitat features. This strategy could also be considered if there are multiple, small Survey Areas that are close together in a continuous area of potential habitat, and there is a possibility of managing them and the intervening land as a single multi-site Habitat Area.

This snail should persist at the protected features that are minimally disturbed, and it should eventually thrive at those sites where bigleaf maples are released from competition.

This strategy, which allows cautious yet manipulative management within multi-site Habitat Areas, should ensure that this species survives on a short-term basis and thrives on a long-term basis. Although this species can be found in very shady situations, it has repeatedly demonstrated an ability to survive major canopy reductions. In its association with the bigleaf maple it is associated with light gaps, and even in the absence of bigleaf maples this species seems to thrive at the edge of clearings such as old skid trails.

By following these guidelines, it is expected that this mollusk will continue to occupy the Habitat Area after management activities occur. A temporary decline in local populations of this and other mollusk species can be expected to follow a major reduction of tree canopy. However, if vegetation diversity persists, most bigleaf maples are reserved and allowed to develop broad crowns, and large woody debris is conserved, then in a few decades the local population of this species should be able to regain its former abundance within the project area. This strategy may result in a short-term reduction of overall habitat quality, but it should maintain some connecting corridors within the Habitat Area (especially between "hot spots") and provide adequate protection of "hot spots" to ensure continued occupation by this species.

"Hot spots" of known sites and habitat features should be identified and managed to emphasize habitat protection, maintenance, or enhancement. To establish these "hot spots," select and delineate polygons around clusters of the most densely occupied sites and the best concentrations of habitat features that are large enough to maintain favorable environmental conditions at the selected sites or features. The number and distribution of these "hot spot" areas should reflect (but not necessarily match) the existing distribution of habitat features and known sites. Not all sites need to be included within a "hot spot." It is recommended that at least one "hot spot" be identified per 4 hectares or 10 acres, on the average for the Habitat Area. The "hot spots" can be relatively small (generally 1 - 2 acres in size) and should make up 10-20% (or more)

of the total Habitat Area. The selection of which areas to treat as "hot spots" may be guided by all expressed concerns, including other uses, forestry operations and conservation of other special status species.

In this management method, timber harvest and other activities would be allowed within the Habitat Area, but would be designed to maintain minimal habitat conditions that allow continued occupation by this species. Examples of some of the types of activities that could occur within the Habitat Area include skid trails, yarding corridors, road construction, falling and removal of trees, and site preparation.

The general habitat manipulation approach of reserving and releasing most of the bigleaf maples and allowing a higher level of timber harvest or other disturbances is used, as long as important habitat components to support a population are present. These habitat components include favorable conifer and hardwood trees, and large down woody material (including a source for future recruitment). The treatment should provide some shading of logs and thereby maintain some connecting corridors within the occupied habitat, especially between "hot spots."

Because large old logs seem to be important to the survival and dispersal of this species, the coarse woody debris standard and guideline should be met or exceeded (USDA and USDI, 1994, pages C-40). Some of the largest available conifers (other than cedar) should be included in the trees reserved.

Many activities and conditions affect the suitability of sites for this species. However, one of the major factors is shade, which moderates fluctuations in the temperature and humidity of the forest floor. Management activities in the Habitat Area should result in crown cover sufficient to shade portions of the Habitat Area at the completion of the project. The emphasis is to maintain some level of connectivity within the Habitat Area and between "hot spots." This level of average shading should be present at mid-day in mid-summer. On the average, the stand should have at least the same amount of shaded areas and open areas. This level of average shading could be achieved by combining open areas with denser areas.

Ground disturbing or soil compacting activities should be kept to a minimum near any protected features. Habitat features, such as hazel bushes and rotten logs, should also be favored, especially where there are few or no bigleaf maples. As needed, conifers near protected features may be converted to snags or felled if they seem to be seriously competing with bigleaf maples, and if the remaining trees will still provide most of the original shading.

At the completion of the project, portions of the stand (generally the "hot spots" and connecting corridors) should meet habitat requirements for this species and the entire stand should partially meet habitat requirements. The potential habitat elements in the

entire project area should regain normal suitability and occupancy within a few decades.

As a general rule, the effects of habitat disturbance from broadcast burning for site preparation or slash disposal should be avoided within Habitat Areas (in this strategy, the entire project area is the Habitat Area). However, the role of fire in ecosystems is also recognized, especially in areas with a relatively short fire return interval (less than 50 years). It is appropriate to use fire as a management tool as long as adverse impacts to the species and its habitat are adequately minimized.

Prescribed burning within Habitat Areas is discouraged (including broadcast burning, burning naturally created debris piles and slash piles from management activities). However, it may be acceptable if ground disturbance is limited to a relatively small portion of the Habitat Area and if the intensity of the burn can be adequately minimized. Fire prescriptions should target cool, patchy underburns that leave a portion of the Habitat Area (preferably 30% or more) unburned. The timing of the prescribed fire should take into consideration the species life cycles and behaviors. While keeping fire out of areas designated as "hot spots" for these species, avoid fire suppression methods that are harmful to mollusks.

During site preparation or slash disposal, efforts should be made to reduce ground disturbance and retain large woody debris to the degree possible. Burning piles is generally preferable to broadcast burning. Machine piling generally creates excessive levels of disturbance, so piles should be hand built. Piles should be covered and burned in the same season or left unburned to prevent mollusks from being attracted to the piles and killed. Retaining unburned piles is suggested whenever possible to provide additional habitat.

D. Other Management Issues and Considerations

During reforestation, it is suggested that the dominance of bigleaf maples at known *Megomphix hemphilli* sites be favored by not planting conifers close to those sites. During precommercial thinning, it is suggested that the reduction of bigleaf maple stump sprouts to a single stem not be applied at known Megomphix sites and that some patches of unthinned bigleaf maples be left routinely, especially if they are tangent to a Riparian Reserve. Management should allow some clumps of bigleaf maples to become dominant, especially in locations where it would be naturally abundant.

The application of fertilizer or other chemicals needs to be done with caution in areas known to be inhabited by this mollusk. The response of this species to urea and other fertilizers is unknown. Areas that are treated could be monitored.

Exotic mollusk species may invade habitats occupied by this species. If exotic species are found, measures to monitor and control them should be implemented as feasible.

V. RESEARCH, INVENTORY AND MONITORING NEEDS

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 Northwest Forest Plan level.

A. Data Gaps and Information Needs

What was known of the habitat and ecology of this snail prior to the Northwest Forest Plan (NFP) was from a few documented observations. However, some literature sources (Branson 1977, 1980) provided misleading information based on incorrect identifications. The vast majority of the credible distributional records and habitat observations have been acquired in the course of protocol mollusk surveys done to meet the requirements of the NFP.

There is still a need to better understand the ecology and distribution of *Megomphix hemphilli*. This species seems to have an upper elevational limit at about 900 meters (3000 feet) in the middle of its range. Its elevational range seems to be lower to the north, higher to the south, and narrower at both extremes of the range, but all of this needs to be verified. Habitat notes from surveys are needed to show more clearly the range of features with which this species can be found, and studies are needed to show how these features relate to this species. Research could test a range of habitat features to measure how individual snails and local populations are distributed relative to those features, and how these distributions might change in response to weather, season, and time of day. The rate at which this species can reproduce and disperse are unexplored.

Megomphix hemphilli is not a species that is easy to identify, so field units are encouraged to retain or obtain some shells of this and similar mollusk species for use as comparative material when making or confirming identifications. Shells can also serve in training new surveyors and in educational displays. Megomphix shells and other specimens *with reliable collection data* that are no longer needed should be offered to a regional expert or scientific institution.

Only a few of the land allocations of the known sites were available at this writing. Others need to be determined and recorded.

Additional data gathered from protocol mollusk surveys would help resolve several questions. These include:

-What are the limits of the range of this species?

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

-What are the species' biological attributes?

- Plant associations;
- Specific plant species required/used;
- Specific foods;
- Amount of large woody debris desired;
- Optimum forest crown cover to provide desired conditions;
- Stand structure and other habitat components?

-What are the physical attributes of known sites?

- Elevations of habitat used;
- Soil types, geology, trace elements;
- Temperature, humidity regimes.

B. Research Questions

What stand characteristics (canopy cover, age, large woody debris, understory, and decay layer) are required to support this species?

How do stand characteristics at known sites vary under different circumstances (elevation, slope, and aspect)?

Are there certain fungi or other food species on which this mollusk depends?

Do rotten logs function as dispersal corridors and refuges?

What stand size should ensure local persistence of this mollusk?

To what extent do local populations of this species normally fluctuate?

How discontinuous (patchy) is the distribution of the species?

Can distribution and management be defined in terms of watersheds or plant associations?

What factors may influence recolonization of a site by snails of this species from adjacent populations?

To what extent can this species attracted to unburned slash piles?

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

Is this species likely to survive fire or deforestation if rotten logs are present?

What are the effects of herbicides and other chemicals used in forest management?

Why is there a range gap between this species and *Megomphix californicus*?

C. Monitoring Needs and Recommendations

Known and newly discovered locations for *Megomphix hemphilli* may be monitored to assess compliance with the Survey and Manage standard and guideline, to evaluate the habitat impacts of all management activities in and near these locations, and to verify the continued existence of this species at managed locations.

Recent clear cuts where this species is still surviving may be monitored to see if it continues to survive and continues to demonstrate a tolerance to loss of canopy. The observed response of this species to timber harvest should be qualified by monitoring of populations in nearby control areas.

There is the possibility of forming research partnerships that address the remaining questions with designed experiments, and there is the possibility of preparing a guidance document for the monitoring this species.

Monitoring should include recording selected environmental conditions with the objective of better understanding this snail's habitat and management needs.

Both survey reports and monitoring forms should use the same terms and definitions for describing the physical and biological properties of known sites.

Where this species seems to be rare, disturbance by surveyors should be limited to once a year or less frequently.

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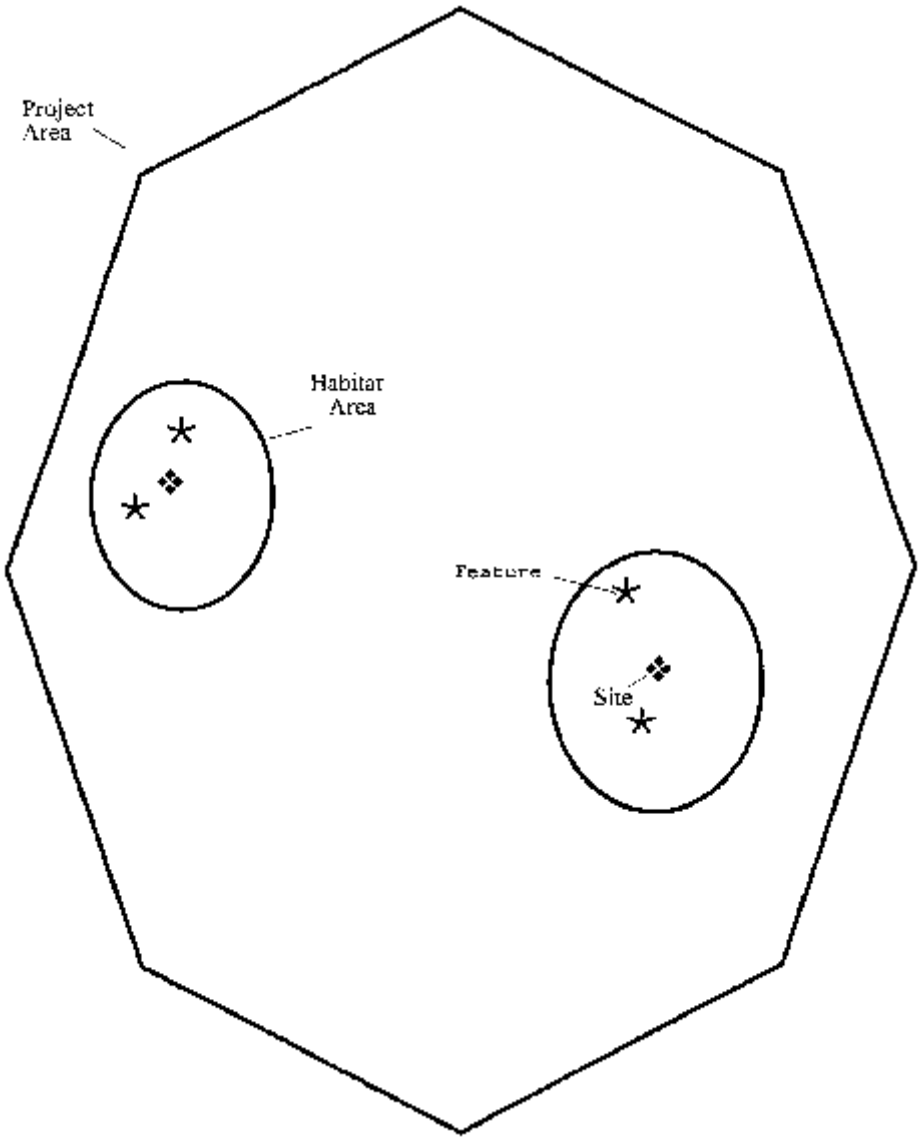
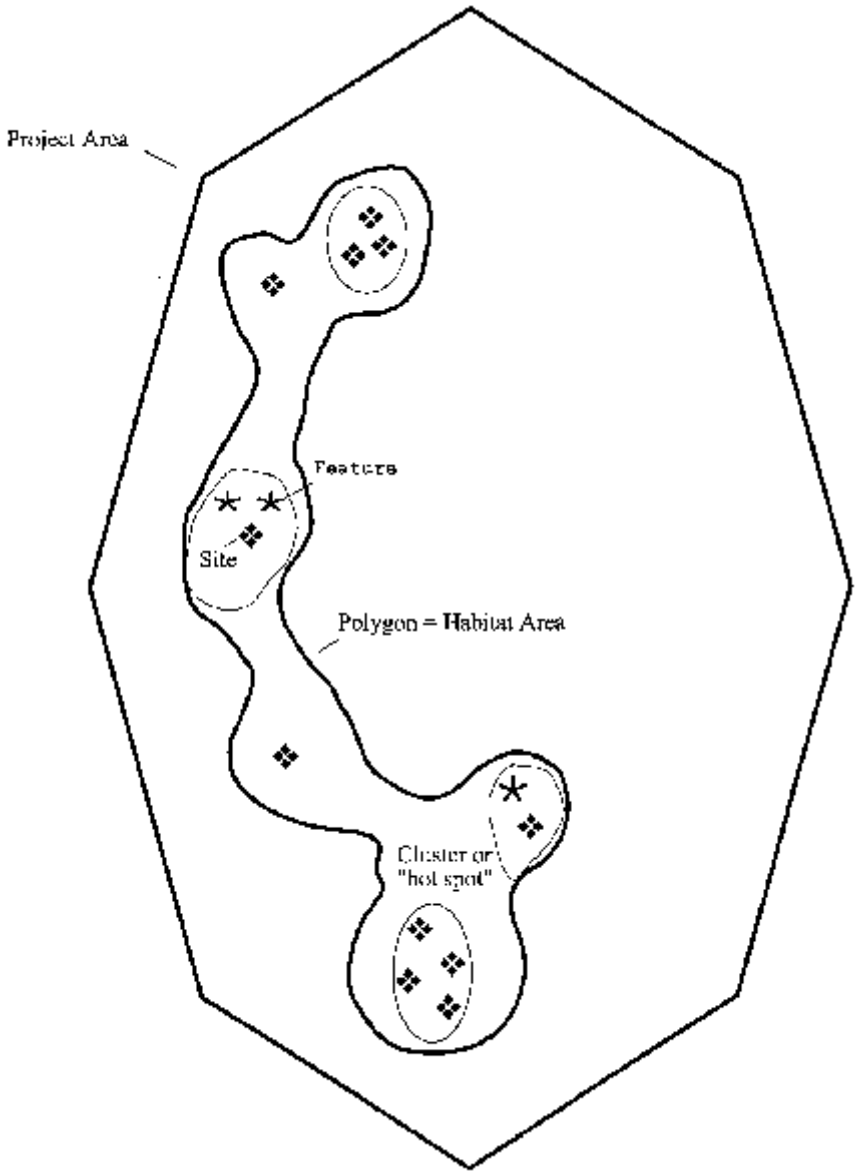
APPENDIX - FIGURES

Strategy 1 is the option where the species is not locally common. This is the cautious approach where individual known sites are managed within designated Habitat Areas. No or very minimal disturbance is generally expected within the Habitat Area. Management within a Habitat Area should be to maintain, benefit and/or enhance the species.



Strategy 2 is suggested where the species is locally common and the multiple known sites occur in locally clustered areas within a project area, or there is an identifiable concentration of favorable habitat features and conditions that occurs together with those sites. These multiple sites are managed as a collective population. The Habitat Area encompasses the population, but it is less than the entire project or survey area. All known sites should be within a Habitat Area. For purposes of managing known sites in Strategy 2, the Habitat Area is the site. Management should achieve continued occupation by the species within the Habitat Area by maintaining a relatively high level of suitable habitat conditions and features.



Strategy 3 is suggested where one or both of these species are locally common and if the distribution and numbers of sites and habitat features suggest that they are likely to occur more or less throughout the survey area. This strategy defines an entire project or survey area as a single multi-site Habitat Area. All known sites should be within the Habitat Area. This area and these sites are managed as a collective population. For purposes of managing known sites in Strategy 3, the Habitat Area is the site.

The objective of this strategy is to maintain primary habitat conditions within the Habitat Area to maintain occupation by these species while allowing some management to occur. This strategy could also be considered if there are multiple, small Survey Areas that are close together in a continuous area of potential habitat, and there is a possibility of managing them and the intervening land as a single multi-site Habitat Area.