PCWA-L-568

Guide to Sensitive Aquatic Mollusks of the U.S. Forest Service Pacific Southwest Region

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May 2007

Introduction

The phylum Mollusca is one of the most diverse groups of organisms with an estimated worldwide diversity ranging from about 50,000-200,000 valid described and undescribed species (van Bruggen 1995). Freshwater mollusks comprise a major component of many aquatic ecosystems and are often highly sensitive to changes in water quality. Non-marine mollusks (freshwater and terrestrial species) are the most imperiled group of animals on our planet. According to Lydeard and others, since 1500, 288 (or 41 percent) of the 693 recorded extinctions of animal species are nonmarine (aquatic and terrestrial) mollusks. During this same period the number of recorded extinctions for all tetrapod species is 231. While extinctions of vertebrates are well documented, invertebrate extinctions are largely unnoticed by the general public, and most biologists and conservation agencies. Furthermore, the conservation status of less than 2 percent of mollusk species has been properly assessed, so the documented extinctions must be an underestimate of the true total.

There are a variety of reasons why aquatic mollusks have been so devastated. Natural landscapes have been converted by intensive agricultural practices, damming and diversion of surface and ground water, soil erosion, and road building. The cumulative effects of these practices are apparent by the destruction of aquatic habitats and pollution of streams, rivers and lakes that have decimated populations of many freshwater organisms, including freshwater mussels and snails (Karr and Chu 1999). Invasions by introduced species have further impacted many aquatic mollusk species. Finally, several freshwater mollusks are commercially valuable and have been exploited to the brink of extinction. For example, from 1890-1915, 750,000 tons of freshwater mussel shells were harvested from the Mississippi River to provide pearl buttons (Bogan 2004). Today many rare freshwater mussels are poached in North American waters to provide seed pearls for Asian markets, supporting an industry worth three billion dollars (Conover 1998).

Recent research suggests the benefits of protecting and restoring mollusk populations extends beyond the conservation of biodiversity. For example, native freshwater mussels provide important ecosystem services and are a powerful management tool for maintaining and reclaiming water quality (McMahon and Bogan 2001). Mussels have been found to play a significant role in local food webs by increasing the flux of organic and inorganic matter to river beds, which in turn influences macroinvertebrate assemblages (Howard and Cuffey 2003). Where healthy mussel beds still occur, mussel biomass can be sufficiently abundant to reduce suspended particle concentrations in the water column by up to 80% (Kreeger 2004), thereby significantly cleaning the water.

This report provides information on conservation status, distribution, habitat associations and management considerations for the eight species of aquatic mollusks that are currently listed as sensitive species in the Forest Service Pacific Southwest Region. Photographs of some closely related species are also provided. The taxonomic status of some taxa, especially *Anodonta*, *Fluminicola* and *Juga*, is poorly defined and research to elucidate their phylogenetic relationships is ongoing.

Table 1. Pacific Southwest Region Sensitive Aquatic Mollusks Species included in this report.

Scientific Name	Common Name*
Anodonta californiensis Lea, 1857	California floater (freshwater mussel)
Fluminicola seminalis (Hinds, 1842)	nugget pebblesnail
Helisoma (*Carinifex*) *newberryi* (Lea, 1858)	Great Basin rams-horn (freshwater snail)
Juga (*Calibasis*) *acutifilosa* (Stearns, 1890)	topaz juga (freshwater snail)
Juga (*Calibasis*) *occata* (Hinds, 1844)	scalloped juga (freshwater snail)
Pisidium (Cyclocalyx) ultramontanum Prime, 1865	montane peaclam
Pyrgulopsis owensensis Hershler, 1989	Owens Valley springsnail
Pyrgulopsis wongi Hershler, 1989	Wong's springsnail

*Note that the common names are taken from Turgeon and others (1998).

Table 2. National Forests in the Pacific Southwest Region where Sensitive Aquatic Mollusk Species are known or suspected to occur because of historic records and/or the presence of suitable habitat.

Scientific Name	National Forest							
	Inyo	Lake Tahoe Basin	Lassen	Modoc	Shasta-Trinity	Six Rivers	Tahoe	Number of Listings by Species
Anodonta californiensis			x	x	x	x	x	5
Fluminicola seminalis			x		x			2
Helisoma newberryi		x	x				x	3
Juga acutifilosa			x	x				2
Juga occata			x		x			2
Pisidium ultramontanum			x		x			2
Pyrgulopsis owensensis	x							1
Pyrgulopsis wongi	x							1
Number of Listings by Forest	2	1	6	2	4	1	2	

Species Specific Information

Anodonta californiensis Lea, 1857 California floater

Taxonomic Classification:
Class: Pelecypoda
Order: Eulamellibranchia
Family: Unionidae

Figure 1. Top left – right valve of *Anodonta californiensis,* Lectotype* USNM 86393. Shell length = 58 mm.; Top right – mussel bed composed of *A. californiensis* and *Gonidea angulata*, Middle Fork John Day River, Oregon. Photo by Jayne Brim Box; Immediate left - Type specimens of *Anodonta wahlametensis* (USNM 86363, length = 63.2mm) (above) and *Anodonta nuttalliana* (USNM 86391, length = 60 mm) (below). *Anodonta wahlametensis* was placed in the synonymy of *A. nuttalliana* by Turgeon et al. (1998). Shell photos by Shelia Nadimi, 2003. * A lectotype is a specimen selected from the original material to serve as the type specimen when it was not designated in the original description (or to replace a missing holotype).

Abundance: Restricted distribution, can be locally common (Howard and Cuffey 2003). G3, N3, S2.

Range/Distribution: " 'Rio Colorado,' actually a former distributary of the river, approximately New River, Imperial County, CA." (Type locality , Taylor 1981). "Historical distribution lower Willamette and lower Columbia rivers in OR and WA from the Dalles to the mouth. In larger

slow streams of northern CA as far south as the northern San Joaquin Valley. [In CA] the former range includes....Siskiyou, Shasta, Lassen, Modoc and Tehama cos." (Frest and Johannes 1995). In northeastern California, according to Brim Box (2002), this species historically occurred in the Susan River outside of Susanville (Ingram 1948). A search of museum records by Jayne Brim Box (personal communication) yielded a single record from Donner Lake, Placer County. Current distribution: Probably eradicated over much of its range (Taylor 1981). "Still survives in Fall and Pit rivers, Shasta Co....Apparently extinct in the Upper Sacramento River...The species appears to be extinct in UT and NV and is very limited in distribution in AZ." (Frest and Johannes 1995). According to Glenn Clemmer of USFW Service, Carson City, NV (personal communication), *A. californiensis* has been located in Nevada at the following sites: 1) Truckee River, 2) Humboldt River, Humboldt Basin, Elko Co. in 1979, 3) Thousand Springs Valley, 18 mi N and 5.5 mi E of Wells, Elko Co., Lake Bonneville Basin in 1989. Frest and Johannes (1995) collected the species from Blue Lake in Modoc County. A fairly large population (thousands of individuals) occurs in the South Fork of the Eel River, within the Angelo Coast Range Reserve, part of the University of California Natural Reserve System, Mendocino County (Howard and Cuffey 2003).

The phylogenetic relationships and taxonomy of *Anodonta* species in California is presently in a state of uncertainty because few reliable collection records and specimens are available to verify identities. In a genetic study of *Anodonta* populations from the Bonneville Basin and additional scattered records in the western United States, Mock and others (2004) observed that "overall the amount of cytochrome c oxidase subunit I (COI) sequence divergence and resolution among *Anodonta* populations in the western USA was low, although observed levels of divergence (4–5%) did exceed levels of intraspecific divergence in other unionid studies (0–2.82%)." The authors further reported that "…species identifications were not congruent with the observed phylogenetic structure among these populations. Specimens identified tentatively as *Anodonta californiensis*, *A. oregonensis* and *A. wahlamatensis* did not consistently form monophyletic groups in our analyses. This lack of congruence could be due to the generally low level of phylogenetic signal and resolution in the dataset, phenotypic plasticity in conchological features, inappropriate local taxonomic designations, or a combination of these factors."

Figure 2. Specimens of the two other (besides *Anodonta*) genera of unionacean clams found in California. Top panel- *Gonidea angulata* (Lea, 1838), western ridge mussel. Top left , exterior of left valve; top right, interior of left valve. Bottom panel- *Magaritifera falcata* (Gould, 1850), western pearlshell. Bottom left, exterior of left valve. Bottom right, interior of right valve. California Aacademy of Science 154CW. Shell length = 89 mm. All photos by Shelia Nadimi, 2003.

Figure 3. Mussel bed containing *Margaritifera falcata* (Gould, 1850) in the Middle Fork John Day River. Photograph by Jayne Brim Box.

Trend: Historical distribution has been severely restricted. According to Taylor (1981), populations have been extirpated from most of California and several states. The species is declining with respect to the number of sites occupied and abundance at those sites.

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5. The State of California has designated *A. californiensis* as a "special status species".

Threats: Eutrophication due to agricultural runoff and urbanization, sedimentation that smothers mussel beds, water diversions that reduce instream flows, introduction of exotic species, grazing, water impoundments that reduce current velocities and allow for sediment deposition. Also, possibly the decline of an as yet unknown host fish species that serves as a dispersal mechanism for the clams' larvae. Although the fish hosts are presently unknown, Brim Box and others (2004) reported that almost 75% of the speckled dace (*Rhinicthys osculus*) inspected during their study of the Middle Fork of the John Day River had attached and encysted glochidia that appeared to be from *A. californiensis*. The glochidia attached to the gills, fins and body of their hosts and an average of about four glochidia per infected fish was observed. According to Brim Box (2002), "D'Eliscu (1972) reported that *A. californiensis* glochidia successfully transformed on the gills and fins of *Gambusia affinis*, a species not native to the western United States. The subfamily Anodontinae are the least host-specific of unionid mussels, and a wide-range of host fish have been reported for many eastern *Anodonta* species (Watters 1994)."

For aquatic mollusks and many aquatic invertebrates in general, the following types of disturbances should be considered as threats (Furnish and Monthy 1998).

- Chemical spills and other forms of water pollution (e.g., livestock use of springs and spring runs, urban runoff, other agriculture, other industrial) resulting in effects such as: 1) direct mortality of species as evidenced by the recent (1991) Cantara Spill on the Upper Sacramento River, and 2) deleterious habitat alterations resulting from factors such as eutrophication caused by excessive nitrogen and phosphorus levels, reduced dissolved oxygen levels, or elevated water temperatures. Freshwater mussels are filter feeders, with the capability of concentrating contaminants far above ambient levels in the water column.

- Water diversions for such activities as irrigation, hydropower generation and livestock watering, resulting in reduced discharge and loss of suitable habitat.

- Dam construction which submerges cold springs, slows current velocities, lowers the availability of oxygen and allows fine sediments to accumulate. For example, dams on the Sacramento River have submerged and destroyed habitats in many formerly occupied sites.

- Excessive sedimentation from a variety of activities such as logging, mining, road and railroad grade construction, and grazing may smother substrates causing death by preventing feeding and movement, and obstructing gills.

Habitat: Occurs in "lakes and slow rivers" (Taylor 1981). "Generally on soft substrates (mud-sand), in fairly large streams and lakes only, in relatively slow current; a low elevation species" (Frest and Johannes 1995). Howard and Cuffey (2003) found that *A. californiensis* was almost exclusively found in pools with no occurrences in riffles and very few in runs in the South Fork of the Eel River. *Anodonta* of unelucidated identity have been observed and their life histories studied by Ellis and Hadley (2005) in the Pit River, and Fall and Hat creeks.

Fluminicola seminalis (Hinds, 1842) nugget pebblesnail

Taxonomic Classification:
Class: Gastropoda,
Order: Prosobranchia
Family: Hydrobiidae

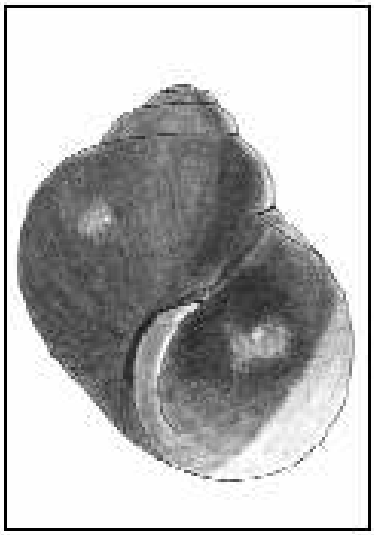

Figure 4. *Fluminicola seminalis* (Hinds, 1842). Drawing, far left - Actual height = 5.6 mm, and photo, immediate left – Actual height = 7.2 mm. Drawing and photo by E. J. Johannes, reproduced from Frest, T.J. and E.J. Johannes. 1999.

Abundance: Locally restricted, uncommon. G2, N2, S unspecified.

Range/Distribution: The type locality is the mouth of the American River, at its confluence with the Sacramento River. Currently found in the Pit and McCloud rivers, California. The species is likely extinct from the mainstem Sacramento River (Hershler and Frest 1996). Based on differences in shell characters, Hershler and Frest (1996) did not assign specimens from the San Joaquin River in California and Klamath basin to this species. Burch (1989), based on Pilsbry (1899), cites it as occurring in a few places in California and Oregon, but Hershler and Frest (1996) restricted it to the Sacramento River basin of California. The specimens reported from Utah by Chamberlin and Jones (1929) were found to be *Fluminicola coloradoensis* by Hershler (1999).

Flumninicola seminalis is moderately common in the Pit and McCloud Rivers and their tributaries. Frest and Johannes collected it from 32 sites, in a confined portion of the Pit drainage (Furnish and others 1997; Furnish and Monthey 1999). Occurs commonly in large limnocrenes (spring pools); populations in such habitats are often small-sized (5- 7 mm height) (Frest and Johannes 1999).

Range on federal lands: According to Furnish and others (1997), this species “occurs in the Pit River and McCloud River basins. It is currently known from two sites in Shasta National Forest

and three sites in Whiskeytown-Shasta-Trinity National Recreation Area. The species has been collected from 32 sites."

Trend: This species has declined precipitously from its historic distribution. It was formerly known from the mainstem Sacramento River in California, from its mouth upstream to Pit River, including large spring-fed tributaries (Taylor, 1981). In a recent survey of 231 sites in the potential area of occurrence, Frest and Johannes (1995) reported that they could not locate it in the Upper Sacramento system. Presumably, this species was extirpated by the Cantara Bend herbicide spill in the mainstem of the Sacramento River downstream from where the spill occurred.

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5 and was formerly managed as a ROD Survey and Manage species under the Northwest Forest Plan (USDA Forest Service and USDI Bureau of Land Management 1994, 2004).

Threats: Human activities associated with mining, logging, and road and dam construction have all had adverse consequences on this species (see above). Indeed, human-related activities in the upper Sacramento River were so extensive as to virtually inundate the lower system with sediment. It is unlikely that much of the original mollusk fauna remained in the lower Sacramento River by the close of the 19th century. In 1991 the Cantara herbicide spill apparently extirpated any remaining populations in the upper Sacramento River. Human activities associated with mining, logging, and road and dam construction have all had adverse consequences on this species (see above). Indeed, human-related activities in the upper Sacramento River were so extensive as to virtually inundate the lower system with sediment. It is unlikely that much of the original mollusk fauna remained in the lower Sacramento River by the close of the 19th century. In 1991 the Cantara herbicide spill apparently extirpated any remaining populations in the upper Sacramento River. Alleviation and/or control of these impacts should result in improvement in some populations.

Chemical spills and other forms of water pollution (e.g., livestock use of stream channels and springs, sewage contamination from recreation use) resulting in effects such as: 1. direct mortality of species as evidenced by the recent Cantara Spill (1991) on the upper Sacramento River, and 2. deleterious habitat alterations resulting from factors such as: eutrophication caused by excessive nitrogen and phosphorus levels, reduced dissolved oxygen levels, or elevated water temperatures.

Dam construction that submerges cold springs, slows current velocities, lowers the availability of oxygen, and allows fine sediments to accumulate. Existing dams on the Sacramento River (e.g., Shasta Dam, dams creating Whiskeytown Reservoir and Siskiyou Lake) and the Pit River have already caused extensive destruction of suitable habitat. Reductions in water flow by water diversions resulting in elimination or reduction of aquatic habitat for this snail. Excessive sedimentation from a variety of activities such as logging, mining, road and railroad grade construction, and grazing may smother preferred substrates and may impair egg-laying or survivorship of eggs or young.

Habitat: According to Hershler and Frest (1996), this species is a typical river-dwelling hydrobiid of the Upper Sacramento River system where it is endemic. Frest and Johannes (1993, 1995) provided a general description of the habitat for *F. seminalis* in the upper Sacramento system: the terrain is steep, moist and comparatively well vegetated. Rivers and creeks are perennial, have relatively large discharges, and flow through deep, incised, shaded canyons. Vegetation is primarily coniferous and soils are thin and nutrient poor. Aquatic environments generally have clear, cold, well oxygenated, flowing waters that have relatively low concentrations of dissolved nitrogen and phosphorus. Macrophytes such as *Potamogeton*, *Rorippa* and *Ceratophyllum* occur in patches at some occupied sites. Substrates are primarily characterized by coarse boulders, cobbles and gravel mostly derived from metamorphic and igneous parent material with some sedimentary lithologies. There are a few occupied lake and marsh habitats. *Fluminicola seminalis* prefers gravel-cobble substrate and clear, cold flowing water. It typically is found in large streams and rivers. However, it is also found in a very few large spring pools with soft, mud substrates (Frest and Johannes 1995).

Helisoma (*Carinifex*) *newberryi* (Lea, 1858) Great Basin rams-horn

Taxonomic Note: Brim-Box (2002) stated that "although the subspecies *Helisoma newberryi newberryi* was commonly reported [from sites in the Upper Sacramento Basin] (e.g., Frest and Johannes 1993 and 1995), this subspecies was not recognized by Turgeon and others (1998). The following species were included in the synonymy presented by Taylor (1981): *Carinifex ponsonbyi* E. A. Smith, 1876, *Carinifex occidentali*s Hanna, 1924, *C. newberryi subrotunda* Pilsbry, 1932, and *C. newberryi malleata* Pilsbry, 1934."

Taxonomic Classification:
Class: Gastropoda
Order: Pulmonata
Family: Planorbidae

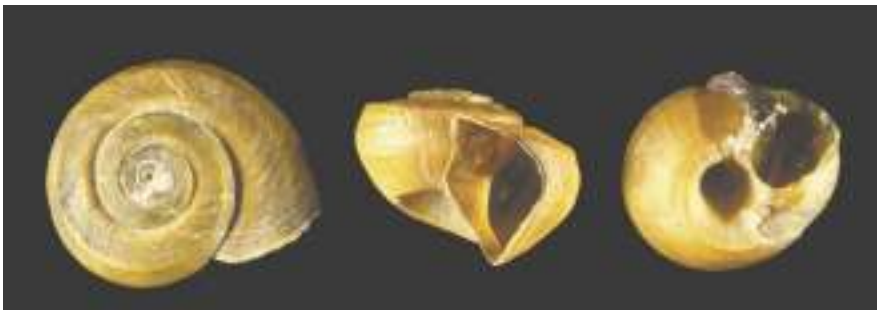

Figure 5. *Helisoma newberryi* (Lea, 1858). CAS 166383.
Left shell diameter = 13 mm. Photo by Shelia Nadimi, 2003.

Abundance: Highly restricted distribution, locally abundant. G1, N1, S1.

Range/Distribution: Type locality: Hat Creek, Shasta County, CA; "the more precise location Rising River... Lakes and larger, slow streams in and around the periphery of the northern Great Basin. In California, known from six local drainages, in which the species survives in probably only four. Lower Klamath Lake, Siskiyou County; possibly extinct in the Lake, but surviving in the spring-fed tributary, Sheepy Creek. Tule Lake, Modoc and Siskiyou counties, where probably extinct. Pit River, including the large spring-pools and their quiet outflows of Fall River and Hat Creek; known downstream to above Squaw Creek, but probably extinct in the lower segment of its range. Eagle Lake, Lassen County. Lake Tahoe and adjacent slow segment of its outflow, Truckee River. Formerly in Fish Springs, Owens Valley, Inyo County; exterminated by construction of a fish hatchery" (Taylor 1981). According to Frest and Johannes (1993) "the UT (Utah Lake) and Owens Valley populations are extinct... Surviving sites are in the Winema National Forest, Upper Klamath Lake National Wildlife Refuge and in Lassen National Forest (i.e. Eagle Lake); others may be located on BLM lands in the vicinity of Fall River Mills, CA." Also recently extirpated from Agency Lake, Klamath Co., OR when the lake went dry (T.J. Frest, personal communication).

Trend: Apparently experiencing major declines in distribution; populations extirpated from many sites. The conservation status for *Helisoma newberryi* throughout its range is G1, critically imperiled (NatureServe 2003).

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5.

Threats: Water diversions, water pollution. Mitigation efforts for sucker species such as adding spawning gravels may harm this species by smothering soft mud habitats. See section on threats to *Anodonta californiensis*.

Habitat: "Larger lakes and slow rivers, including larger spring sources and spring-fed creeks. The snails characteristically burrow in soft mud and may be invisible even when abundant" (Taylor 1981). Brim Box (2002) states that "*Helisoma newberryi* were found in Screwdriver Creek, Shasta County, and Eagle Lake, Lassen County. Shells only were found in Screwdriver Creek, and it is possible those shells washed in from upstream, although the thin and delicate nature of *H. newberryi* shells suggests that they did not travel far. In Eagle Lake, shells only are commonly encountered in shallow waters close to shore. Live animals were only found by SCUBA diving in deeper water (e.g., > 10 feet). Although Taylor (1981) suggested that *H. newberryi* burrowed in soft mud and could possibly be 'invisible even when abundant,' in Eagle Lake live animals were commonly observed on top of the substrate (sand), but only in deeper water. Additional live *H. newberryi* were found at a site outside of the LNF, in Hat Creek, Shasta County."

According to Frest and Johannes (1993), the species "can occur with *Pisidium ultramontanum*, *Lanx klamathensis* or several other endemic mollusks." The species may also co-occur with *Juga acutifilosa* and *Fluminicola seminalis*.

Juga (*Calibasis*) *acutifilosa* (Stearns, 1890) Topaz Juga

Taxonomic Classification:
Class: Gastropoda
Order: Prosobranchia
Family: Pleuroceridae

Note: The common name used here (following Turgeon and others 1998) might better be applied to describe *Juga occata*, which does have a distinctive, imperial topaz (yellow-green) body. The body color for *J. acutifilosa* is generally dark, reddish brown (Frest and Johannes 1995).

Figure 6. Above left, *Juga acutifilosa,* CAS 166383 and JCB01-020. Left shell length = 32 mm.; above right, *Juga occata,* CAS 56930. Left shell length = 18 mm.; lower left, *Juga silicula* (Gould 1847) from Oak Creek, near Corvallis, Oregon. Shell length = 17 mm. Photos of *Juga acutifilosa* and *J. occata* by Shelia Nadimi, 2003. Photo of *J. silicula* by Greg Courtney.

Abundance: Restricted distribution, known from only 12 sites, may be locally abundant. G2, N2, S2.

Range/Distribution: Type locality is "'Eagle Lake,' actually the nearby head of Willow Creek, Lassen County, CA (Taylor 1981). According to Frest and Johannes (1993) this species is known to occur at 12 isolated spring complexes, all but one in northern California (the exception is Shoats Springs, tributary to Jenny Creek, Jackson Co., OR). The species occurs primarily in the Klamath drainage, Jackson Co., OR and Siskiyou Co., CA. A few populations also occur on the periphery of the Great Basin in CA (Modoc and Lassen cos.). Some sites are on National Forest Lands (i.e. Modoc National Forest and Lassen National Forest). Frest and Johannes (1993) also believe that additional occupied sites may be discovered in the vicinity of Fall River Mills and in Lassen National Park east of Hat Creek. U.S. Fish and Wildlife consider *J. acutifilosa* to be a Species of Special Concern.

Trend: Present status is not well known. However, this species is restricted to a few large spring complexes and few additional sites are likely to be discovered (Taylor 1981).

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5.

Threats: Pollution, ponding of springs with elimination of flowing water habitat (Taylor 1981).

Habitat: Restricted to "large springs and their outflows, often narrowly restricted to the source area" (Taylor 1981). According to Frest and Johannes (1993) "occurs only in unpolluted, cold, well-oxygenated water, generally with stable gravel substrate. Low to medium elevations. Often occurs with other endemic molluscs, such as *Fluminicola* spp." These species include *Fluminicola* new sp. 11, *F. seminalis* and *Lyogyrus* new sp. 3, all of which are Northwest Forest Plan Survey and Manage species. These spring habitats are narrowly restricted habitats and are susceptible to degradation from sedimentation, damming, direct diversions and reduced flows due to extraction of ground water.

Juga (*Calibasis*) *occata* (Hinds, 1844) Scalloped Juga (See Figure 6)

Taxonomic Classification:
Class: Gastropoda
Order: Prosobranchia
Family: Pleuroceridae

Abundance: Localized endemic, rare. G1, N1, S2.

Range/Distribution: Type locality: Sacramento River between American River and mouth. Original distribution was Sacramento and Pit Rivers. Current distribution "surviving in the lower Pit River, but status in the Sacramento River unknown- no records in the present century. Changes in the riverbed due to extensive placer-mining in the past century might have eliminated it in most of the Sacramento River" (Taylor 1981). According to Frest and Johannes (1993) "only three river miles in the upper Sacramento River survive relatively unimpacted after the July, 1991 toxic spill; we found the species to be extirpated there; but it still survives in a few widely separated sites in the Pit River below the Falls in Shasta Co., CA, including sites in Shasta National Forest, including area DCA CD-82. Additional sites (in limited numbers) are likely in Shasta National Forest and in lands administered by Lassen National Forest, e.g. east of Rising River."

Trend: Definite declines in range and abundance over the last 150 years. Extirpated throughout much of the Sacramento River system.

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5.

Threats: Water pollution, impoundments, mining.

Habitat: According to Frest and Johannes (1993) "this is a large river form, restricted to swift, unpolluted, well-oxygenated areas with gravel boulder substrate, generally at low elevations. Often found with *Lanx patelloides* or other rare mollusc species." This species also occurs with the nugget pebblesnail *Fluminicola seminalis* and the canary duskysnail, formerly known as the NWFP Survey and Manage species *Lyogyrus* new sp. 3, but recently described as *Colligyrus convexus* by Hershler and others (2003).

Pisidium (Cyclocalyx) ultramontanum Prime, 1865 montane peaclam

Taxonomic Classification:
Class: Pelecypoda
Order: Eulamellibranchia
Family: Sphaeriidae

Figure 7. *Pisidium ultramontanum* Prime, 1865. CAS 157703. Shell length = 6 mm. Photos by Shelia Nadimi, 2003.

Abundance: Rare, locally restricted. G1, N1, SNR.

Range/Distribution: Lassen National Forest. Type locality Canoe Creek (now Hat Creek), probably at Rising River, Shasta Co. Original distribution was periphery of the Great Basin in OR to Klamath River and Pit River, OR-CA, as well as some of the larger lakes (i.e. Upper Klamath Lake, Tule Lake, Eagle Lake and possibly lower Klamath Lake, Klamath Co., OR and Siskiyou, Lassen and Modoc cos., CA. Current distribution: extinct in Tule Lake and Lower Klamath Lake areas. Surviving populations in Upper Klamath Lake area, the middle Pit River, and at Eagle Lake (Lassen National Forest). Sites are suspected in Shasta National Forest, although populations at historical sites appear to have been extirpated.

Trend: This species is definitely declining in number of sites, range and abundance at occupied sites.

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5.

Threats: Lake eutrophication, water diversions that lower water table and reduce spring flows, grazing, capping of springs for livestock, industrial and domestic water supplies, geothermal development.

Habitat: Generally found on sand-gravel substrates in spring-influenced streams and lakes, occasionally in large spring pools. These sites are characterized by a high diversity of aquatic mollusks, some of which are restricted to these habitats (i.e. *Helisoma newberryi*, *Juga acutifilosa* and *Lanx klamathensis*). This species also occurs at sites with *Fluminicola* spp.

Pyrgulopsis owensensis Hershler, 1989 Owens Valley Springsnail
Taxonomic Classification:
Class: Gastropoda
Order: Prosobranchia
Family: Hydrobiidae

Abundance: Restricted distribution, locally abundant. G1G2, N1N2, S1S2.

Range/Distribution: Inyo National Forest. The species is found along escarpments of the White and Inyo Mountains on the east side of the Owens Valley. Type locality: Unnamed spring in canyon south of Piute Creek, Mono Co., CA (T5S, R33E, S23, NE1/4), BLM land; Batchelder Spring at Toll House, just N of Highway 168, in the White Mountains (T8S,R34E,S24,NE1/4, elevation 6,000 ft; from NDDB). Also from Don Sada, private consultant, Bishop, CA: Mule Spring and Warm Springs.

Trend: Appears to be stable.

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5.

Threats: Unknown.

Habitat: This species occurs in small springs and spring runs, typically on watercress (*Rorippa*), travertine deposits and/or stones in the foothills of the eastern Sierra Nevada Mts. This species co-occurs with *P. wongi* at Batchelder Springs.

Pyrgulopsis wongi Hershler, 1989 Wong's Springsnail

Taxonomic Classification:
Class: Gastropoda
Order: Prosobranchia
Family: Hydrobiidae

Abundance: Restricted distribution, locally abundant. G2, N2, S1S2

Range/Distribution: Inyo National Forest (INF). Owens Valley along west side from Pine Creek to Little Lake and along east side from French Spring to Marble Creek, and several endorheic basins to the east and north (i.e. Deeps Springs, Fish Lake and Huntoon valleys, Teels Marsh) in CA and NV. Type locality: Unnamed western spring tributary to Pine Creek, Birchim Canyon, Inyo County (T6S, R31E, S9, SE1/4). Localities: Haiwee Pass; Boron Springs, 4 mi W of Independence, 0.6 mi N of Independence Creek; stream in Charlie Canyon, S of North Fork Oak Creek and 0.8 mi W of Oak Creek Campground, elevation @1600 m; Toll House Spring, near Batchelder Springs and Highway 168, @ 5.2 mi NE of Highway 168 and Death Valley Road junction; Barrel Springs, 0.5 air mi E of Mazourka Canyon, 9.2 mi NE of Independence; Unnamed spring, 1.2 mi NE of Highway 395, in Owens River Gorge; canyon spring 1.5 mi S of Shannon Canyon and 5.4 mi NW of Big Pine, west side of Owens Valley; spring on hill S of Warren Lake (T9S, R33E, S16, NE1/4; UTM-Zone 11, N4114436, E378510). The above records were taken from Hershler (1994).

Trend: Appears to be stable.

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5.

Threats: Historically, there were major impacts to habitats occupied by this species from grazing, and water diversions for mining operations. Water impoundments degrade habitats because this snail requires running water. Present threats are unknown.

Habitat: Perennial seeps and small to moderate-sized springs and spring runs. Commonly found associated with watercress (*Rorippa*), travertine deposits and/or stones. Only occurs in flowing water. This species co-occurs with *P. owensensis* at Batchelder Springs.

Table 3. Summary of distribution of aquatic mollusk species with respect to four general habitat types. Several species occur in more than one habitat type so several boxes may be checked in a row. Asterisks (*) indicate that the habitat is most suitable if it is closely associated with cold springs in the immediate vicinity.

Species	Common Name	Cold Springs	Streams	Lakes	Rivers
Anodonta californiensis	California floater		x	x	x
Fluminicola seminalis	nugget pebblesnail	x	x	x	x
Helisoma newberryi	Great Basin rams-horn	x	x*	x*	x*
Juga acutifilosa	topaz juga	x			
Juga occata	scalloped juga				x
Pisidium ultramontanum	montane peaclam	x	x*	x*	
P*yrgulopsis owensensis*	Owen's Valley springsnail	x			
Pyrgulopsis wongi	Wong's springsnail	x			
Total number of species found in habitat type. * Indicates the habitat is associated with cold springs.		6	4	4	4

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