CANDIDATE ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: Lampsilis rafinesqueana

COMMON NAME: Neosho mucket

LEAD REGION: 4

INFORMATION CURRENT AS OF: January 2, 2003

STATUS/ACTION (Check all that apply):
___ New candidate
_X_ Continuing candidate
    _X_ Non-petitioned
    ___ Petitioned - Date petition received: ___
        ___ 90-day positive - FR date: ___
        ___ 12-month warranted but precluded - FR date: ___
    ___ Listing priority change
        Former LP: ___
        New LP: ___
Latest date species first became a Candidate: _____
___ Candidate removal: Former LP: ___ (Check only one reason)
    ___ A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
    ___ F - Range is no longer a U.S. territory.
    ___ M - Taxon mistakenly included in past notice of review.
    ___ N - Taxon may not meet the Act=s definition of Aspecies.@
    ___ X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Clams and Mussels - Unionidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Arkansas, Kansas, Oklahoma, Missouri

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Arkansas, Kansas, Oklahoma, Missouri

LEAD REGION CONTACT (Name, phone number): Lee Andrews, Atlanta, GA, 404/679-7217.

LEAD FIELD OFFICE CONTACT (Office, name, phone number): Conway, Arkansas Field Office, Susan Rogers, 501/513-4481.

BIOLOGICAL INFORMATION (Describe habitat, historic vs. current range, historic vs. current population estimates (# populations, #individuals/population), etc.):

The Neosho mucket is a freshwater mussel known only from the Illinois, Neosho, and Verdigris River basins in Arkansas, Kansas, Missouri, and Oklahoma. These basins flow into the Arkansas River in northeastern Oklahoma. The Neosho mucket has been historically reported from the Illinois River in Oklahoma and Arkansas; the Neosho River in Oklahoma and Kansas; Neosho River tributaries, including the Elk River in Missouri, Cottonwood River in Kansas, and the Spring River in Oklahoma, Kansas, and Missouri, and Spring River tributaries, North Fork Spring River and Indian Creek in Missouri, and Shoal and Center Creeks in Kansas and Missouri; the Verdigris River in Oklahoma and Kansas, and its tributaries, Caney River in Oklahoma and Kansas, and Fall River in Kansas (Harris and Gordon 1988, Obermeyer et al. 1997a, Mather 1990, Vaughn 1996).

The Neosho mucket is associated with stable runs, shoals, and riffles with gravely bottoms and moderate currents (Oesch 1984, Obermeyer 1999). Most unionid mussels are obligate parasites on fishes as larvae (glochidia). Neosho mucket glochidia have been successfully transformed on smallmouth and largemouth bass, indicating these species as possible glochidia hosts (Barnhart and Roberts 1997). Gravid female Neosho muckets have been collected in June, July, and August, and females displaying mantle lures have been observed in July, August, and September. Mantle lures mimic small fish (Obermeyer 1999). Beyond this limited information, the habitat requirements and ecology of the species are poorly known.

A number of surveys have recently been conducted to determine the current range and status of the Neosho mucket. In Arkansas, the Neosho mucket was found at 19 of 22 survey sites in the Illinois River, Washington/Benton Counties. Although the Neosho mucket was the third most abundant species collected from the approximately 50-kilometer (km)(30-mile (mi)) surveyed reach of river, there was little evidence of recent recruitment (i.e., small, young mussels were seldom collected) (Harris 1998). The species has not been found in surveys of other tributaries of the Arkansas River in Arkansas (Harris and Gordon 1988).

In Oklahoma, living Neosho muckets were found to be locally common in about 92 km (55 mi) of the Illinois River from the Oklahoma/Arkansas state line, downstream to the headwaters of Tenkiller Lake, Cherokee County, Oklahoma (Mather 1990). The population within the survey reach was estimated at more than 1,200 individuals. Population demographics were skewed toward older aged cohorts, and only 3 animals were encountered during the survey that could be considered juveniles (i.e., evidence of recent recruitment). Neosho muckets were not found within or below Tenkiller Lake. More recent surveys in northeastern Oklahoma (Vaughn 1995, 1996, 1997) found Neosho muckets locally common at 9 of 42 sites on the Illinois River. Vaughn (1997) estimated the population within the Oklahoma portion of the Illinois River (the same reach surveyed by Mather in 1990) at between 500 and 1,000 Neosho muckets. Although some evidence of reproduction was observed (i.e., gravid females displaying mantle lures), there was little evidence of recruitment into the population (i.e., very few small, young Neosho muckets were collected). Searches in other historically occupied drainages in Oklahoma found no live Neosho muckets at 10 sites on the Spring River, 17 sites on the Neosho River, 32 sites on the Verdigris River, and 29 sites on the Caney River. However, relic Neosho mucket shells confirmed the historic presence of the species at many of these sites, and fresh dead Neosho mucket shells were found at 2 sites on the Spring River. The results of these recent surveys suggest the Neosho mucket has been extirpated from the Caney, Verdigris, Neosho, and Spring Rivers in Oklahoma (Mather 1990; Vaughn 1995, 1996, 1997).

During recent mussel surveys of historically occupied streams in Kansas and Missouri, living Neosho muckets or fresh dead shells were found in the lower Fall River, Greenwood and Wilson Counties, Kansas; the Verdigris River between the Toronto Lake Dam and the confluence of the Elk River, Wilson and Montgomery Counties, Kansas; the Neosho River between the John Redmond Reservoir Dam and the Parsons City Dam in Coffey, Allen, and Neosho Counties, Kansas; and the Spring and North Fork Spring Rivers, and Center and Shoal Creeks in Cherokee County, Kansas, and Jasper County, Missouri (Obermeyer et al. 1997a, Obermeyer 1999). Neosho muckets were relatively rare in the Fall, Verdigris, Neosho, and North Fork Spring Rivers, and Shoal Creek, representing from 0.2-1.7 percent of all live mussels collected, and were not found at all stations surveyed. Neosho muckets were most abundant in a short reach (~10 km (6 mi)) of the Spring River, between the Missouri/Kansas state Line and the confluence of Center Creek, where it was the most abundant species found at 11 collection sites. In Center Creek, Jasper County, Missouri, only a single fresh dead shell was found. At all sites where living Neosho muckets were found, there was little evidence of recruitment. Based upon Obermeyer et al. (1997a) and others (Cope 1979, Cope and Distler 1985, Metcalf 1980), the Neosho mucket has been extirpated from the Elk, Caney, Cottonwood, and South Fork of the Cottonwood Rivers, the Neosho River above John Redmond Reservoir, the Verdigris River above Toronto Lake, the Fall River above Fall River Lake, and the lower reaches of the Spring River, Shoal and Center Creeks in Kansas, and Indian Creek in Missouri.

In summary, the Neosho mucket has been extirpated from approximately 70 percent of its historic range. Most of this extirpation has occurred within the Oklahoma and Kansas portions of its range. Causes of the disappearance of the species from many areas have been attributed to impoundment, mining, and pollution (Mather 1990, Obermeyer et al. 1997b). The Neosho mucket survives in four river drainages, however, only two of these, the Spring and Illinois Rivers, currently support potentially viable populations of the species due to the presence of a relatively large number individuals. However, recruitment is either very low or not occurring in all of the extant populations.

THREATS (Describe threats in terms of the five factors in section 4 of the ESA providing specific, substantive information. If this is a removal of a species from candidate status or a change in listing priority, explain reasons for change.):

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

The reduction of habitat and range of the Neosho mucket has been attributed to impoundment, sedimentation, agricultural pollutants (Mather 1990, Obermeyer et al. (1997b), and mining (Obermeyer et al. 1997b). At least 11 major dams have been constructed that have impounded significant portions of the historic range of the Neosho mucket, effectively resulting in fragmented Neosho mucket populations and habitats. The species does not tolerate lentic conditions and has not been collected from those portions of its historic habitat that have been impounded. In addition, it is believed that the operation of these dams will continue to negatively affect the Neosho mucket. For instance, Obermeyer et al. (1997b) noted extensive bank scouring in the Neosho River below John Redmond Dam and made observations that suggest channel instability as a primary factor in mussel distribution below this dam.

Several types of pollution are also thought to affect Neosho mucket populations. Sediment is probably the most abundant pollutant currently affecting the Neosho mucket (Obermeyer 1999).

Excessive sedimentation is known to cause direct mortality of freshwater mussels by deposition and suffocation (Ellis 1936) and can eliminate or reduce the recruitment of juvenile mussels (Negus 1966, Box and Mossa 1999). High suspended sediment levels can also interfere with feeding activity (Dennis 1984). Sediment sources within the current range of the Neosho mucket include cultivated fields, cattle grazing, and urban, suburban, and rural construction activities. Sediment levels within the range of the Neosho mucket are higher than historic levels and are likely to increase. For example, the Illinois River in Arkansas drains portions of the two fastest growing counties in Arkansas. Continued development and growth within this basin will likely result in increased sediment and nutrient impacts to this river and to the Neosho mucket population found there.

Eutrophication, caused by the introduction of excess nutrients to a water body, has been shown to result in periodic low dissolved oxygen levels that are detrimental to mussels (Sparks and Strayer 1998). Excess nutrients also promote heavy growth of blue-green and other algae that can eliminate habitat for juvenile mussels. Nutrients, usually phosphorus and nitrogen, can emanate from agricultural, urban, and suburban runoff, including cultivated fields and pastures, livestock feedlots, leaking septic tanks, residential lawns, etc., in levels that result in eutrophication and reduced oxygen levels. At least one example of this has been documented within the range of the Neosho mucket where extirpation of mussel species from the Cottonwood River during the 1960's was attributed to feedlot runoff (Obermeyer et al. 1997b).

Pesticide residues from agricultural, residential, or silvicultural activities may also impact Neosho mucket populations, however, there is currently no available information on the sensitivity of this species to common pesticides. Nonetheless, chemical run-off or spills have resulted in mussel mortalities in various regions of the country, and we believe that the Neosho mucket would be similarly susceptible to pesticide residues. In fact, toxic contamination, including oil and saltwater spills, and heavy metals from mine tailings, have resulted in mussel mortality in the Cottonwood and Spring Rivers in the past (see Obermeyer 1999), within the range of the Neosho mucket. Also, pesticides and high fecal coliform counts have been reported for the Verdigris River downstream of Independence, Kansas, (Kansas Department of Health and Environment 1994) which are likely to affect the quality of Neosho mucket habitat.

In-stream and floodplain sand and gravel mining has been shown to cause channel degradation and is associated with mussel declines and extirpations in a number of river basins (Box and Mossa 1999, Hartfield 1993, Kanehl and Lyons 1992). Sand and gravel mining operations exist within the historic range of the species, and it is likely that other operations will be initiated in the future as the demand for gravel for roads and construction-related activities increases. Since Neosho muckets inhabit gravel/sand stream beds that are vulnerable to mining activities, it is expected that this particular threat to Neosho mucket habitat will increase. Gravel mining has already been implicated in the extirpation of all mussel species, including the Neosho mucket, from the lower Spring River in Kansas (A. Roberts, in litt. 2000).

B. Overutilization for commercial, recreational, scientific, or educational purposes.

The Neosho mucket was once valuable in the pearl button industry, and historic episodes of over-harvest in the Neosho River may have contributed to its decline (Obermeyer et al. 1997b). Commercial harvest of the species is now prohibited in Kansas and Oklahoma. Arkansas does not permit mussel harvest in the counties in which the Neosho mucket is found, and Missouri

prohibits commercial mussel harvest but allows up to five Neosho muckets per person per day to be collected for private purposes (e.g., bait, shell collection, etc.). It is not known what effect the legal harvest of Neosho muckets is having on the populations of the species in this state, but harvest for the cultured pearl industry is either prohibited or restricted to some degree in those states. Overall, the Neosho mucket=s limited distribution and small population sizes makes it vulnerable to potential illegal commercial harvest.

C. Disease or predation.

Diseases of freshwater mussels are poorly known, and are unknown as a factor in the decline of the Neosho mucket. Juvenile and adult mussels are prey items for some invertebrate predators and parasites (e.g., flatworms, trematodes, mites, etc.), and provide prey for a few vertebrate species (e.g., racoons, muskrats, minks, freshwater drum, etc.).

Escape of the non-native black carp, a molluscivore currently grown and used for mollusk control in fish farm operations, could present a threat of increased predation to native mollusks, including the Neosho mucket, but it is not known whether or not this species is being utilized by fish farmers within the range of the Neosho mucket. There is one record of an accidental release of black carp in Missouri (Paul McKenzie, USFWS, personal communication). In April 1994, 30 or more black carp were released from an aquaculture facility near Lake of the Ozarks/Bagnell Dam when the fish were washed into the Osage River during a flood event. To date, none of these fish have been recaptured. The fish were reported to be triploid (non-reproductive). The Missouri Department of Conservation also recently made a decision to propagate certified triploid black carp for use in aquaculture facilities to control the yellow grub, a pest of aquaculture facilities throughout the Midwest and Gulf Coast states. Even if these fish are non-reproductive, accidental releases into streams could still impact native mussels, including Neosho mucket, as a result of increased predation.

Recently, considerable predation of Neosho muckets by otters or raccoons has been documented in the Spring River in Cherokee County, Kansas (C. Barnhart, Southwest Missouri State University, personal communication), and likely occurs elsewhere. While predation by naturally occurring predators is a normal aspect of the population dynamics of a healthy mussel population, populations that are already impacted by other factors may be particularly vulnerable to predation.

D. The inadequacy of existing regulatory mechanisms.

Although the negative effects of point source discharges on aquatic communities within the range of the Neosho mucket have been reduced over time by compliance with state and federal regulations pertaining to water quality, there has been less success in dealing with non-point source pollution. Such impacts result from individual private landowner activities (e.g., construction, grazing, agriculture, silviculture, etc.), and public construction works (e.g., bridge and highway construction and maintenance, etc.). Each state within the range of the Neosho mucket has a variety of laws and guidelines (e.g., forestry best management practices) which are intended to minimize non-point sources; however, the efficiency at which these regulations work can vary depending on the strength of the regulation, enforcement capabilities, and other factors. Often the inadequacy of these regulations or their enforcement can lead to stream impacts which may affect the Neosho mucket.

The Neosho mucket is protected under Kansas and Oklahoma state laws as an endangered species. The Illinois River in Oklahoma is a state-designated mussel sanctuary, and no mussel harvest is allowed. The species is not protected in Arkansas and Missouri, beyond general mussel harvest laws. There is currently no requirement within the scope of federal environmental laws to specifically consider the Neosho mucket during federal activities or ensure that federal projects will not jeopardize its continued existence.

E. Other natural or manmade factors affecting its continued existence. The Neosho mucket is now limited to four drainage populations: the Neosho, Verdigris, Illinois, and Spring River drainages. Each is isolated from the others by one or more major impoundments and by extended reaches of degraded river habitat. Isolation renders the four extant drainage populations vulnerable to random catastrophic events (e.g., flood scour, drought, toxic spills, etc.). During the 2000 drought, the Fall River population of Neosho mucket was severely stressed and threatened by low flow conditions and low dissolved oxygen concentrations (Obermeyer in litt. 2000). Limited range also makes these isolated populations vulnerable to land use changes that would result in increases in non-point source pollution impacts within occupied watersheds. Isolation also prevents emigration or immigration between populations in response to adverse or positive environmental changes, and increases the deleterious effects of inbreeding.

Recent collections indicate Neosho mucket recruitment is limited (Mather 1990, Harris 1998, Obermeyer et al. 1997a; Vaughn 1995, 1996, 1997). All extant populations of the Neosho mucket are currently dominated by older aged cohorts, and juvenile muckets are rare. It is currently unknown if recruitment rates offset mortality rates in any population.

FOR RECYCLED PETITIONS:

a. Is listing still warranted? ___
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? ___
c. Is a proposal to list the species as threatened or endangered in preparation? ___
d. If the answer to c. above is no, provide an explanation of why the action is still precluded.

LAND OWNERSHIP (Estimate proportion federal/state/local government/private, identify non-private owners):

Over 90% of the lands draining the watersheds populated by Neosho muckets are privately owned. An extensive reach of the Illinois River in Arkansas flows through Ozark National Forest. With the exception of the Spring River, all river reaches currently supporting Neosho muckets in Kansas and Oklahoma are controlled or affected by U.S. Army Corps of Engineers Reservoirs. The Oklahoma Department of Wildlife Conservation manages a 565-acre primitive area on the Illinois River. The Nature Conservancy is acquiring 15,000 acres on the Illinois River. In addition, the Kansas Department of Wildlife and Parks owns a small parcel of land (representing less than one river mile of streambank) along the Spring River in Cherokee County, which includes a portion of the large remnant population of Neosho Muckets in this stretch of river.

PRELISTING (Describe status of conservation agreements or other conservation activities):

Extensive coordination with state environmental agencies has been conducted during the past decade to determine the range of, and threats to the Neosho mucket. In 1994 and 1995, FWS personnel representing Kansas, Missouri, Arkansas, and Oklahoma met to discuss priority issues with regard to candidate and unlisted species. The Neosho mucket was identified at both meetings as the top priority species shared among the four states, and updated status survey work was identified as the primary need. Survey work encompassing the entire range of the species has been completed in all four states. The Missouri Department of Conservation is working to artificially propagate Neosho muckets for population augmentation and reintroduction. The Kansas Department of Wildlife and Parks has developed a state recovery plan for the Neosho mucket and three other rare mussel species.

REFERENCES (Identify primary sources of information (e.g., status reports, petitions, journal publications, unpublished data from species experts) using formal citation format):

Barnhart, M.C., and A. Roberts. 1997. Reproduction and fish hosts of unionids from the Ozark uplifts. Pp. 15-20 In: K.S. Cummings, A.C. Buchanan, C.S. Mayer, and T.J. Naimo (eds.) Conservation and Management of Freshwater Mussels II. Upper Mississippi River Conservation Committee, Rock Island, IL.

Box, J.B. and J. Mossa. 1999. Sediment, land use, and freshwater mussels: prospects and problems. J. N. Am. Benthol. Soc. 18(1):99-117.

Cope, C.H. 1979. Survey of the Unionidae considered for conservation status in Kansas. Kansas Game and Fish Commission, Pratt. 39 pp.

Cope, C.H. and D.A. Distler. 1985. Assessment of unionid mussel beds in the Spring River Basin. Project Completion Report, Contract No. 40. Kansas Department of Wildlife and Parks. 96 pp.

Dennis, S.D. 1984. Distributional analysis of the freshwater mussels of the Tennessee River system, with special reference to possible limiting effects of siltation. Ph.D. Dissertation, VPI & SU, Blacksburg, Virginia, 171 pp.

Ellis, M.M. 1936. Erosion silt as a factor in aquatic environments. Ecology 17:29-42.

Harris, J.L. 1998. Status survey of Lampsilis rafinesqueana Frierson, the Neosho Mucket, in Arkansas. Revised Draft Final Report. Little Rock, AR.

Harris, J.L., and M.E. Gordon. Distribution and status of rare and endangered mussels (Mollusca: Margaritiferidae, Unionidae) in Arkansas. Proceedings Arkansas Academy of Science 41:49-56.

Hartfield, P. 1993. Headcuts and their effect on freshwater mussels. Pp. 131-141 In: K.S. Cummings, A.C. Buchanan, and L.M. Koch (eds.) Conservation and Management of Freshwater Mussels. Upper Mississippi River Conservation Committee, Rock Island, IL.

Kanehl, P. and J. Lyons. 1992. Impacts of in-stream sand and gravel mining on stream habitat and fish communities, including a survey on the Big Rib River, Marathon County, Wisconsin. Research Report 155. Wisconsin Department of Natural Resources. Madison, WS.

Kansas Department of Health and Environment. 1994. Surface water and groundwater quality summaries for major river basins in Kansas, 1990-93. Kansas Department of Health and Environment. Topeka, Kansas. 24 pp.

Mather, C.M. 1990. Status survey of the western fanshell and the Neosho mucket in Oklahoma. Final Report to Oklahoma Department of Wildlife Conservation, Oklahoma City, OK, Project E-7, 22 pp.

Metcalf, A.L. 1980. Unionacean mussels, past and present, from six streams in Kansas and Oklahoma. Transactions of the Kansas Academy of Science 83:1-19.

Negus, C.L. 1966. A quantitative study of growth and production of unionid mussels in the River Thames at Reading. J. Animal Ecol. *35*:513-532.

Obermeyer, B.K. 1999. Draft Recovery Plan for four freshwater mussels in southeast Kansas: Neosho mucket, Ouachita kidneyshell, rabbitsfoot, western fanshell. Kansas Department of Wildlife and Parks, Pratt, KS. 88 pp.

Obermeyer, B.K., D.R. Edds, C.W. Prophet, and E.J. Miller. 1997a. Freshwater mussels in the Verdigris, Neosho, and Spring River basins of Kansas and Missouri, with emphasis on species of concern. Amer. Malacological Bull. 14(1):41-45.

Obermeyer, B.K., D.R. Edds, E.J. Miller, and C.W. Prophet. 1997b. Range reductions of southeast Kansas unionids. Pages 108-116 In Conservation and Management of Freshwater Mussels II; Initiatives for the Future.

Oesch, R.D. 1984. Missouri naiades, a guide to the mussels of Missouri. Missouri Department of Conservation. 270 pp.

Sparks, B.L. and D.L. Strayer. 1998. Effects of low dissolved oxygen on juvenile Elliptio complanata (Bivalvia: Unionidae). J. N. Am. Benthol. Soc. 17(1):129-134.

Vaughn, C.C. 1995. Determination of the status and habitat preference of the Neosho mucket in Oklahoma. Annual Performance Report submitted to Oklahoma Department of Wildlife Conservation, Oklahoma City, OK. 7 pp.+ app.

Vaughn, C.C. 1996. Determination of the status and habitat preference of the Neosho mucket in Oklahoma. Annual Performance Report submitted to Oklahoma Department of Wildlife Conservation, Oklahoma City, OK. 7 pp.

Vaughn, C.C. 1997. Determination of the status and habitat preference of the Neosho mucket in Oklahoma. Annual Performance Report submitted to Oklahoma Department of Wildlife Conservation, Oklahoma City, OK.

LISTING PRIORITY (place * after number)

THREAT

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5*
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude:

Imminence:

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all additions of species to the candidate list, removal of candidates, and listing priority changes.

Approve: Linda Kelsey March 14, 2003

Acting Regional Director, Fish and Wildlife Service Date

Concur: _____ _____ _____

Director, Fish and Wildlife Service Date

Do not concur: _____ _____

Director, Fish and Wildlife Service Date

Director's Remarks:

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Date of annual review: February 11, 2002

Conducted by: Susan Rogers - Conway, Arkansas FO

Comments:

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