Louisiana Pearlshell Mussel
(Margaritifera hembeli)

5-Year Review:
Summary and Evaluation

Louisiana pearlshell mussel

Louisiana pearlshell mussel habitat

U.S. Fish and Wildlife Service
Southeast Region
Louisiana Ecological Services Office
Lafayette, Louisiana

5-YEAR REVIEW
Louisiana Pearlshell Mussel (*Margaritifera hembeli*)

I. GENERAL INFORMATION

A. Methodology used to complete the review

This 5-year status review was completed by the U.S. Fish and Wildlife Service's Louisiana Ecological Services Office. A *Federal Register* notice announcing the review and requesting information was published on September 8, 2006 (71 FR 53127) and a 60-day comment period was opened. No new information was received in response to the notice. Our sources of information for this 5-year review include the final rule listing this species under the Endangered Species Act (Act) , the final rule reclassifying this species from endangered to threatened, the Recovery Plan, peer reviewed scientific publications, unpublished reports, and information and communications from other qualified biologists or experts. No part of this review was contracted to an outside party. This review also underwent peer review (see Appendix A). Comments received were evaluated and incorporated as appropriate.

B. Reviewers

Lead Region: Southeast Region – Atlanta, GA
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C. Background

1. Federal Register Notice citation announcing initiation of this review

September 8, 2006. 71 FR 53127

2. Species status

Uncertain (2010 Recovery Data Call). The U.S. Forest Service (USFS) conducted surveys of selected Louisiana pearlshell mussel beds on Kisatchie National Forest (KNF) lands in Rapides and Grant Parishes, Louisiana in 2001, 2002, 2004, 2006, 2007, 2009, and 2010. Survey results were not conclusive because some beds increased and some decreased over various survey years. Additionally, range-wide surveys of

the Bayou Rigolette and Bayou Boeuf watersheds have recently been completed and will be compared to the 1999 range-wide survey data to assist in determination of population trends. To date, those data comparisons have not been performed.

3. Recovery achieved 2 (2 = 26%-50% recovery objectives achieved)

4. Listing history

Original Listing
FR notice: 53 FR 3567
Date listed: February 5, 1988
Entity listed: species
Classification: endangered

Revised Listing
FR notice: 58 FR 49935
Date listed: September 24, 1993
Entity listed: species
Classification: threatened (reclassification)

5. Associated rulemakings

There have been no associated rulemakings since reclassification in 1993.

6. Review History

Final Recovery Plan: 1990

A previous 5-year review for this species was noticed on November 6, l991 (56 FR 56882). In that review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors, threats, etc. as they pertained to the individual species. In particular, no changes were proposed for the status of the species in that review.

U.S. Fish and Wildlife Service. 1992. Louisiana Pearlshell Status Review. U.S. Fish and Wildlife Service, Jackson, Mississippi. 3pp.

Recovery Data Call: 2010, 2009, 2008, 2007, 2006, 2005, 2004, 2003, 2002, 2001, 2000

7. Species' Recovery Priority Number at start of review (48 FR 43098)

8. This number indicates a moderate degree of threat and a high recovery potential.

8. Recovery Plan

Name of plan: Louisiana Pearlshell Recovery Plan
Date issued: December 3, 1990

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPS to only vertebrate species of fish and wildlife. Because the species under review is an invertebrate, the DPS policy is not applicable.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes, however, the species was downlisted, after meeting the current recovery plan's objective and criteria. The recovery plan states delisting criteria will be developed.

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

No. The objective of the Louisiana pearlshell mussel recovery plan is to reclassify this species from endangered to threatened via improving the status of populations within the Bayou Boeuf drainage.

At the time the recovery plan was finalized in 1990, the state endemic Louisiana pearlshell mussel was known only to occur within the Bayou Boeuf and Bayou Rapides drainages in Rapides Parish, Louisiana. Since the finalization of that plan, the species was discovered in Grant Parish within the Bayou Rigolette watershed of the Red River drainage. While the recovery criteria identified above had not been fully met, the discovery of the Red River drainage populations increased the range of the species significantly, thus making the danger of extinction much less than originally thought. Subsequently, the U.S Fish and Wildlife Service (Service) reclassified the Louisiana pearlshell mussel from endangered to threatened in 1993 (58 FR 49935).

Within that final rule, the Service indicated that the Louisiana pearlshell mussel recovery plan would be revised to include an objective for delisting. To date, that plan has not been updated to address the Bayou

Rigolette drainage populations, current known threats to the species, current recovery actions needed, or to identify delisting recovery criteria.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

As discussed above, the recovery plan does not include delisting criteria.

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.

The 1990 Louisiana Pearlshell Recovery Plan (USFWS 1990) only identifies downlisting (reclassification to threatened) criteria and does not identify delisting criteria. Since the mussel was reclassified in 1993, we will not present reclassification criteria in this section.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

At the time of listing, the Louisiana pearlshell mussel was thought to be restricted to 11 streams in the Bayou Boeuf and Bayou Rapides drainages of Rapides Parish, Louisiana (LNHP 1985). In 1991, Louisiana Natural Heritage Program (LNHP) biologists re-surveyed four of those streams, which contained 88% of the Louisiana pearlshell mussels observed in the 1985 survey (LNHP 1992).

After the initial listing, the Louisiana pearlshell mussel was discovered in the Bayou Rigolette drainage of Grant Parish, Louisiana. The Service conducted surveys of this drainage in 1991 and 1992 in an effort to better define the range of the species (USFWS 1991, Hall 1992). The 1991 survey located the species at 12 sites in 8 streams that are tributaries to the Red River (USFWS 1991). The 1992 survey confirmed these findings, extended the range within those streams, and searched more than 50 streams in Grant, Rapides, and Winn Parishes (Hall 1992); however, no additional populations of the Louisiana pearlshell mussel were identified. After the discovery of the Bayou Rigolette drainage populations in Grant

Parish, the apparent degree of threat was sufficiently diminished to support reclassification; thus, the Service reclassified the species from endangered to threatened in 1993 (58 FR 49935).

LNHP biologists conducted range-wide surveys at known and prospective Louisiana pearlshell mussel locations on both KNF and private lands in Rapides and Grant (LNHP 1998, 1999) Parishes. Although the Recovery Plan calls for surveying all Louisiana pearlshell mussel streams at 3-year intervals to establish population trends, this task has not been accomplished on private-lands, but has been done on the KNF in selected streams, following the 1998 and 1999 comprehensive surveys. Selected Louisiana pearlshell mussel beds within 9 streams on the KNF in Rapides Parish and within five streams on the KNF in Grant Parish were surveyed (LNHP 2001, USFS 2002, USFS 2004). Louisiana pearlshell mussel beds selected for monitoring in those surveys met the following criteria: (1) located on Forest Service owned lands; (2) contained greater than or equal to 100 mussels; and (3) located in representative sections of streams so as to most accurately assess the integrity of the entire stream. Beds that contained less than 100 mussels were surveyed only if they were located in the vicinity of other beds being monitored. As part of a coordinated range-wide survey on the KNF, the USFS surveyed 9 streams in 2006 and 2009 in Grant Parish and 11 streams in 2007 and 10 streams in 2010 in Rapides Parish. During the same general time period, the LNHP conducted comprehensive surveys at known and prospective Louisiana pearlshell mussel locations on private lands in Rapides and Grant Parishes (LNHP 2009). Those private-lands survey data (2007-2009) combined with the 2007 data from KNF, Rapides Parish and the 2009 data from KNF, Grant Parish, represent the most recent range-wide survey. Results of all Louisiana pearlshell mussel surveys are summarized in Tables 1 and 2 in Appendix B.

As indicated in the literature and as summarized in the tables found in Appendix B, the same streams, stream segments, and mussel beds have not been consistently monitored over time. This has resulted in highly variable population indices. Because of the differences in methodology and coverage between Louisiana pearlshell mussel surveys, accurately determining population trend (i.e., increasing, stable, or decreasing) has not been possible to date for this species. Accordingly, the population status has been reported as unknown each year. Data in Tables 1 and 2, however, appear to suggest that streams with large numbers of Louisiana pearlshell mussels are persisting over time. Streams with low numbers of pearlshell mussels may not be viable in the long term (LNHP 1998, 1999, 2009, USFS 2007b).

The ability to assess population trends over time is critical for monitoring this threatened species. Two range-wide surveys have now been

completed for this species; one in1998-1999 and the other in 2007-2009. The overall population trend for the Louisiana pearlshell mussel will remain unknown until those data are analyzed.

No information currently exists regarding sex ratio, juvenile recruitment, or mortality rate for the Louisiana pearlshell mussel; limited data are available regarding age structure. Johnson and Brown (1998) reported shell growth rates at Loving Creek and James Branch approximately three times higher than at Jordan and Beaver Creeks. The slow growth rates at Beaver Creek suggested mussel longevity of 71 years, while the high growth rates at Loving Creek suggested longevity of 45 years. Accordingly, Johnson and Brown (1998) estimated the maximum lifespan of this species to vary between 45 and 75 years.

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

In September 2007, the Service's Natchitoches National Fish Hatchery (NNFH) contracted with Iowa State University's U.S. Geological Survey Cooperative Fish & Wildlife Research Unit to document population genetic structure, the extent of gene flow, and historical connections between populations. This information could be used in identifying unique or genetically distinct populations and serve as guidelines for future conservation related actions, such as hatchery propagation and reintroduction or population augmentation aimed at reversing declines and preventing extinction of the species throughout its range.

The final report "Conservation Genetics of the Freshwater Mussel *Margaritifera hembeli* (Bivalvia: Margaritiferidae), Final Report" was published in November 2009 (Roe 2009). According to the document, ten variable microsatellite loci were identified and used to generate genotypes and conduct the genetic research, examining populations of Louisiana pearlshell mussels in 17 different streams.

Analyses indicate that the Louisiana pearlshell mussel study populations (i.e., streams) are not completely isolated from one another nor do they represent a single panmictic population. Panmictic populations are characterized by an absence of physical, behavioral, or genetic barriers so that all individuals are equally likely to engage in random mating. Within the Louisiana pearlshell mussel study populations (i.e., streams), the greatest degree of isolation and the majority of genetic difference was exhibited between those mussels separated by the Red River, indicating that the Red River represents a significant barrier to gene flow; i.e., there is a clear genetic separation between the populations north of the Red River (Bayou Rapides) and the populations south of the Red River (Bayou Rigolette and Bayou Boeuf). In addition, there are two other man-made

impoundments that create significant physical barriers to host fish passage genetic interchange: Lake Iatt in Grant Parish, constructed in 1957, and Kincaid Reservoir in Rapides Parish, constructed in 1972. There is a weak correlation that Louisiana pearlshell mussels found in Black Creek drainage upstream from Lake Iatt are beginning to show signs of becoming genetically isolated from those found downstream of the impoundment. In contrast, the Louisiana pearlshell mussels found upstream of Kincaid Reservoir in Valentine Creek are showing no evidence of genetic isolation. The author offered no explanations why the Louisiana pearlshell mussels that have been separated by Lake Iatt for 52 years, or 2.65 generations, are beginning to show effects of isolation while the mussels isolated by Kincaid Reservoir for 38 years, or 1.9 generations, are not.

Additional analyses examined data for evidence of recent population bottlenecks using the two-phase mutation model. Results indicated that 3 of the 17 populations showed genetic evidence of a recent bottleneck (Little Bayou Clear, Gray Creek, and Jordan Creek), which is supported by empirical evidence collected during field surveys (USFS 2006; 2007b) that showed a species decline in these three creeks (Roe 2009).

Based on that study, the author made recommendations for future studies regarding the following: (1) the concept that the Louisiana pearlshell mussel may function as a "metapopulation" system, where subpopulations exchange genes through dispersal and where local extinction of subpopulations are followed by recolonization by other subpopulations; (2) specific genetic recommendations for the species pertaining to the potential for future translocation/augmentation research; and (3) recommendations for additional studies that increase sample size by adding genetic samples to the one analyzed to better estimate the effective population size.

c. Taxonomic classification or changes in nomenclature:

The Louisiana pearlshell mussel was described as *Unio hembeli* by Conrad in 1838. This species was placed in the genus *Margaron* by Lea (1870), then in *Margaritana* by Simpson (1900), and finally in *Margaritifera* by Athearn (1970). At that time, the Louisiana and Alabama pearlshell mussel were considered the same species, but the Alabama pearlshell mussel was subsequently elevated to species status (*Margaritifera marrianae*) based upon morphological and anatomical comparisons (Johnson 1983). No changes in taxonomic classification or nomenclature have occurred since.

d. Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

At the time of the original listing, the Louisiana pearlshell mussel was thought to only occur within 11 streams in the Bayou Boeuf and Bayou Rapides drainages (south of the Red River) of Rapides Parish. Since that initial listing, the Louisiana pearlshell mussel was discovered in the Bayou Rigolette drainage (north of the Red River) of Grant Parish. Since that time, several surveys have been conducted in various portions of the species known range. However, there are only two surveys considered to be range-wide, encompassing both privately and USFS owned property in Rapides and Grant Parishes. The first was conducted in years 1998 and 1999 (by LNHP). The second was conducted in years 2007 through 2009 (by LNHP and USFS).

The following compares numerical data and percentages from the first range-wide survey (LNHP 1998, 1999) to that of the second range-wide survey (LNHP 2009; USFS 2007b, 2009b). The first range-wide survey reported a total population size of 46,085 Louisiana pearlshell mussels, of which 35.8% were in Rapides Parish and 64.2 % were in Grant Parish. The latest range-wide survey reported a total population size of 78,132 Louisiana pearlshell mussels, of which 30.8% were in Rapides Parish and 69.2% were in Grant Parish. Although a comparison of these numbers indicate that the total population size has increased by approximately 70% from the time of the initial range-wide survey until the latest, these data still need to be statistically analyzed to test the validity of that assumption. However, it is fair to say that the reported population size of Louisiana pearlshell mussel has generally increased in both Rapides and Grant Parishes since the time of initial survey. This is partly attributable to the observation of Louisiana pearlshell mussels in Brown Creek in Rapides Parish and Glady Hollow in Grant Parish; i.e., mussels were observed in both streams in the range-wide surveys conducted from 2007 through 2009 but not those conducted in 1998 through 1999. Conversely, three streams that supported very small numbers of Louisiana pearlshell mussels during the 1998-1999 range-wide survey no longer supported the species by the time of the 2007-2009 range-wide survey (i.e., Mack Branch in Rapides Parish and Clear Branch and Hudson Creek in Grant Parish). This suggests that the larger populations are more stable and more resistant to impacts from current threats than extremely small ones, and streams with low numbers of pearlshell mussels may not be viable in the long term (see Tables 1 and 2 of Appendix B).

The following represents a breakdown of the most current data for Louisiana pearlshell mussel abundance and distribution across its known

occupied range (LNHP 2009; USFS 2007b, 2009b). In Rapides Parish, the latest range-wide surveys for Louisiana pearlshell mussels reported 24,074 individuals occurring in 12 stream reaches: Brown Creek proper, Patterson Branch of Brown Creek, Burney Branch of Brown Creek (1 mussel), Valentine Creek, Castor Creek, Long Branch, Little Brushy Creek, Loving Creek, Little Loving Creek, "Haikey's" Creek, Little Bayou Clear, and Bayou Clear. Within Rapides Parish, 19,460 individuals surveyed (80.8% of parish total) were found in stream segments crossing the KNF on publicly owned land, with the remaining 4,614 individuals (19.2%) being from stream segments that crossed privately owned lands. In Grant Parish, the latest range-wide surveys for Louisiana pearlshell mussels (LNHP 2009 and USFS 2009b) reported 54,058 individuals occurring in 12 stream reaches: Black Creek, Jordan Creek, Beaver Creek, Gray Creek, Swafford Creek, Moccasin Branch, Coleman Branch, Cress Creek, James Branch, Cypress Creek, Chandler Creek, and Glady Hollow. Within Grant Parish, 3,557 individuals surveyed (6.6% of parish total) were found in stream segments crossing public lands (i.e., KNF), with the remaining 50,501 individuals (93.4%) being from stream segments that crossed private lands.

The Louisiana pearlshell mussel is restricted to small second- and third-order streams in Grant and Rapides Parishes, Louisiana. Those streams drain into two Red River tributaries (i.e., Bayou Rigolette and Bayou Rapides) and one historical tributary of the Red River (i.e., Bayou Boeuf) (Johnson and Brown 2000). The Red River is a tributary to the Mississippi River, while water from Bayou Boeuf eventually enters Vermilion Bay of the Gulf of Mexico. One historical record of the Louisiana pearlshell mussel has been collected outside of the species current known range. That record is reported to have been collected in the early 1900's from Dorcheat Bayou in Columbia County, Arkansas (Arkansas Game and Fish Commission 2006). Currently, the specimen is archived in the American Museum of Natural History (Smith 1988).

Johnson (1995) and Johnson and Brown (2000) further describe the relative connectivity of the drainages within the range of Louisiana pearlshell mussels as follows: Bayou Rapides contains one drainage (i.e., Brown Creek drainage) and Bayou Boeuf contains three drainages (i.e., Valentine Creek, Castor Creek, and Bayou Clear drainages). Within the Bayou Rigolette watershed, there are four drainages (i.e., Black Creek, Gray Creek, James Branch, and Hudson Creek). The Black Creek drainage empties into Iatt Lake and contains five streams (i.e., Black Creek, Beaver Creek, Clear Branch, Cypress Creek, and Swafford Creek). The Gray Creek drainage enters Bayou Rigolette and contains four streams (i.e., Gray Creek, Cress Creek, Chandler Creek, and Jordan Creek). The James Branch and Hudson Creek drainages also enter Bayou Rigolette with the Hudson Creek drainage containing three streams (i.e.,

Hudson Creek, Coleman Branch, and Moccasin Branch). The Service's survey (USFWS 1991) indicates that while the Bayou Boeuf and Red River drainages are normally separate, there is a possible connection between tributaries of Bayou Boeuf and Bayou Rapides during flood flows.

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Louisiana pearlshell mussels require clear, moderately swift-flowing, perennial streams having stable mineral substrate, such as sandy bottom with rocky outcroppings. They often occur in shallow (water 12 to 24 inches deep) (Johnson 1995), wide areas, with well-compacted substrate, or infrequent patches of larger gravel substrate and are rarely found in deep pools that have slower flowing water and silty bottoms (Johnson and Brown 2000). LNHP (1998) reported a canopy closure of 51 to 75 % in areas occupied by Louisiana pearlshell mussels.

Reservoirs, lakes, and other impoundments continue to fragment the spatial distribution of Louisiana pearlshell mussel habitat on the landscape, just as they have done from the time of initial listing. Kincaid Reservoir impounds the uppermost headwaters of Bayou Boeuf. The largest pearlshell populations within that watershed occur in the unimpounded Castor Creek and Bayou Clear drainages, tributaries to Bayou Boeuf. Other impoundments of the Bayou Boeuf system that may have affected this species are Indian Creek Reservoir, Oden Lake, and Cotile Lake. Lake Iatt (an approximate 52 acre reservoir) impounds the headwater region of Bayou Rigolette. Beaver activity has also been documented as a source disruption to species' distribution throughout the range since the beginning of the species' monitoring and survey efforts. Beaver dams create impoundments within Louisiana pearlshell mussel watersheds, thus having the potential to significantly alter hydrology and affect the spatial distribution of the Louisiana pearlshell mussel throughout its range.

f. Other:

Several fish species have been suggested as potential host for the Louisiana pearlshell mussel, including the following species: striped shiner (*Notropis chrysocephalus*), redfin shiner (*Lythrurus umbratilis*), golden shiner (*Notemigonus crysoleucas*), brown madtom (Notorus phaeus), and the black spotted topminnow (*Fundulus olivaceus)* (Hill 1986, Johnson and Brown 1998, Coldiron 2007). However, all reports of potential host fish were made from observing glochidia attached on the gills of wild caught fish, with none confirmed from observation of metamorphosis of glochidia (embryos) into juveniles. Just as no host fish

has been confirmed for this mussel species nor has the actual period of reproduction or glochidial release. The reported reproductive period for Louisiana pearlshell mussels varies among the literature. For instance, Hill (1986) reported observed glochidial infection from early spring through summer, with peak infection occurring from April through July. Smith (1988), however, concluded that spawning takes place between late November and late January with glochidia being released between late December and January, which is congruent with later findings by Johnson and Brown (1998). Because of the time of year that Hill observed infection and because the size of the glochidia described by Hill was larger than that described by Smith; Johnson and Brown (1998) concluded that Hill had likely observed the glochidia of Wabash pigtoe (*Fusconaia flava*). However, Bolden (2000) observed an instance of Louisiana pearlshell mussel glochidial release in mid-February. In addition, she observed less of a weight gain in Louisiana pearlshell mussels in June as compared to February, presuming it was due to the loss of reproductive mass (glochidia). The NNFH has begun research on the species reproductive biology (Brady 2010). The research is designed to provide information on the reproductive period for the species, as well as its host fish. Glochidial metamorphosis into juveniles would be used to confirm the host fish species. Until glochidial metamorphosis is observed, the status of the host fish remains unknown.

2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

a. Present or threatened destruction, modification or curtailment of its habitat or range:

As discussed above, the Louisiana pearlshell mussel was thought to be restricted to 11 streams in the Bayou Boeuf and Bayou Rapides drainages in Rapides Parish at the time of listing (53 FR 3568). The 1985 survey (LNHP 1985) found that the range in those drainages had been reduced and fragmented by impoundments. Further, beaver dams were inundating habitat and had eliminated a population of approximately 1,000 pearlshells in 1985. In addition, populations were being impacted from gravel mining on private lands and from erosion where clear cuts extended to the bank of streams. Clear cuts extending to the stream bank can increase runoff with resultant scouring of the stream bed that creates unstable habitat for mussels (58 FR 49936). Due to the discovery of the Louisiana pearlshell mussel in the Grant Parish, Bayou Rigolette watershed in 1992, the known range of the species was substantially increased. If fact, we now know that the Louisiana pearlshell mussels in Grant Parish outnumber those in Rapides Parish by more than double (LNHP 2009, USFS 2007b, 2009b).

Water quality may be a limiting factor on the local abundance of Louisiana pearlshell mussels among different streams. Johnson (1995) correlated differences in abundance of Louisiana pearlshell mussels among different streams with differences in the specific conductivity, water hardness, pH, and free carbon dioxide concentration.

Historically, beaver activity has been identified as a top threat to Louisiana pearlshell mussels throughout the current known range on both the KNF and on private land and that threat still exists (LNHP 2009, LNHP 1998). Beaver dams create impoundments that alter hydrology by causing artificially high water levels upstream of the dam and artificially low water levels downstream, which has great potential to impact Louisiana pearlshell mussels. In Rapides Parish, losses of Louisiana pearlshell mussels and local extirpations associated with beaver activity have been documented since the beginning of the species' monitoring effort. For instance, the Louisiana Pearlshell Recovery Plan (USFWS 1990) documents a population of approximately 1,000 individuals being eliminated through inundation by a beaver pond. In 1998, the USFS concluded that beaver dams were a significant contributing factor to the functional extirpation of Louisiana pearlshell mussels in Mack Branch. Recently, impacts have been reported to Louisiana pearlshell mussels or their habitat from beaver dams in 82% of the streams in Rapides Parish, as follows: on the KNF, in Brown Creek, Long Branch, Loving Creek, Bayou Clear, Little Brushy Creek, and Patterson Branch (USFS 2004, 2007b, 2010); and on private land, in Bayou Clear, Little Bayou Clear, Castor Creek, Valentine Creek, and Long Branch (LNHP 2009). Recent impacts from beaver dams have been reported in 73% of the streams in Grant Parish, as follows: on the KNF, in Cress Creek, Gray Creek, and Chandler Creek (USFS 2006, 2009b); and on private land, in Beaver Creek, Black Creek, Glady Hollow, Moccasin Creek, and James Branch (LNHP 2009). Thus, recent impacts from beaver dams have been reported in 77% of all streams surveyed.

Louisiana pearlshell mussels and beavers are both endemic to this area of Louisiana and certainly coexisted prior to listing; however, the species' current habitat fragmentation and population isolation from human related activities have exacerbated threats from beaver activity. Thus, beaver control is an important conservation tool in areas where beavers pose a local threat to resident Louisiana pearlshell mussels.

The USFS has an active program to control beavers on their lands within the range of the Louisiana pearlshell mussel on the KNF. Beginning in 2000, the Service contracted with the U.S. Department of Agriculture, Wildlife Services (WS) to conduct beaver damage control on impacted streams on private land in Grant and Rapides Parishes. Over the last 10 years, at least 140 beavers and 127 dams have been removed from the

Louisiana pearlshell mussel watersheds (see Table 3 in Appendix B). Because beaver control activities/efforts have increased (i.e., extended to include private lands) since the time of reclassification, the threat level to the species attributed to beaver dams has decreased.

In addition to threats from beaver activity, multiple land use practices are resulting in fragmentation of Louisiana pearlshell mussel habitat and reductions in water quality. Forestry practices that provide for the harvesting of trees up to the stream line can decrease bank stability, cause direct soil erosion into the stream, and increase runoff with resultant increases in water turbidity and scouring of the stream bed; all of which can create unsuitable or unstable habitat for mussels. In addition, streams that lose trees in the riparian areas suffer a loss in the ability to naturally filter out the sediment and debris that was once captured by the vegetated riparian buffer. Furthermore, when trees are removed from alongside streams, the more open areas are more visible and provide easier access to the channel for humans and animals. Finally, although not having yet been addressed in the literature as a current threat to Louisiana pearlshell mussel streams, the extensive loss of trees from the riparian area along a particular stream exposes more of the surface water to direct sunlight and could potentially lead to an increase in algal blooms and increase in water temperature over time. The USFS is now mitigating potential impacts to riparian areas through the effective use of streamside management zones, in which riparian habitat 100 feet along the banks of perennial and intermittent streams is maintained for benefit of water quality and wildlife habitat. Any timber harvest permitted within those zones is restricted to selective cutting of individual trees for the purpose of wildlife habitat improvement. USFS streamside management zones reduce threat to 29% of the entire Louisiana pearlshell mussel population, which is the percentage of the population that occurs on the KNF. However, streamside management zones do not necessarily extend to private lands. Many industrial timber owners in Louisiana implement streamside management zones to meet Sustainable Forestry requirements (SFI). The Louisiana Forestry Association published a manual on Forestry Best Management Practices for Louisiana (Louisiana Forestry Association, [1997]), which covers streamside protection zones and holds educational landowner workshops; however, not all private landowners follow these guidelines. Therefore, threats to the species attributed to detrimental forestry practices remain for many of the populations found on private lands.

Construction and other soil disturbing activities with inadequate erosion control measures (i.e., bridge replacement, road construction, culvert installation, road maintenance, utility right-of-ways, etc.) within Louisiana pearlshell mussel watersheds can also cause a direct loss of habitat or cause a reduction of habitat quality through project-related water quality

degradation (e.g., increased erosion, increased run-off, increased sediment loading and turbidity, decreased flow and dissolved oxygen, etc.) and changes in stream geomorphology (e.g., headcutting, bank sloughing, perched water tables, etc.). Potential impacts of insufficient erosion control can result from project-related soil disturbance during excavation, vegetation removal, etc., as well as from erosion occurring after construction is complete through failure to implement and maintain long-term erosion control measures, including but not limited to restoring herbaceous groundcover on disturbed soil and armoring the stream bank to protect from scouring.

Various incentive programs are available to landowners interested in conserving high water quality and wetland habitat. Through the Partners for Fish and Wildlife (Partners) program, the Service provides technical assistance and financial incentives for habitat protection, restoration, and enhancement on private lands. However, to date, only two Partners projects have provided on-the-ground benefit to Louisiana pearlshell mussels. One improved water in Coleman Creek, which currently supports more than 5,000 Louisiana pearlshell mussels, by funding the construction of a fence to restrict cattle access to reduce in-stream sedimentation and defecation. The other funded vegetative restoration to increase bank stability in two areas that were experiencing excessive erosion along Jordan Creek, which currently supports more than 6,000 Louisiana pearlshell mussels. The Natural Resources Conservation Service (NRCS) offers the voluntary Wetland Reserve Program (WRP), which provides landowner incentives to help restore and protect natural resources on private lands. To date, no WRP easements have been established in Louisiana pearlshell mussel watersheds (Johnny Cross, NRCS, personal communication).

b. Overutilization for commercial, recreational, scientific, or educational purposes:

The Louisiana pearlshell mussel is not a commercially valuable species nor are the small streams it inhabits subject to harvesting for commercial mussel species. Collecting could pose a threat to this species as was discussed in the final listing rule; however, there is no evidence that this is occurring.

c. Disease or predation:

At this time, there is no evidence of threats from disease. The shallow stream habitat of this species makes it vulnerable to predation by otters, raccoons, muskrats, and possibly feral hogs. There has not been a consistent pattern of predation on this mussel reported; however, the USFS (2009b) reports suspected otter depredation of Louisiana pearlshell

mussels in Gray Creek, Grant Parish, to be a significant contributing factor to the decline of that local population.

d. Inadequacy of existing regulatory mechanisms:

The inadequacy of existing regulatory mechanisms was not identified as a threat to the Louisiana pearlshell mussel in reclassification final rule. The Louisiana pearlshell mussel is currently protected under sections 7 and 9 of the Act, and it is also protected by the Louisiana Department of Wildlife and Fisheries as an endangered species (Louisiana Revised Statutes (La R.S.) 56:1901).

Under section 7(a)(2) of the Act, the Service considers the effects of proposed federal actions on both listed species and their habitats. Federal action agencies are required to consult with the Service on all projects that have the potential to impact the species, including impacts through habitat destruction, modification, or curtailment. For example, the Service consults with federal action agencies that permit, fund, and/or implement proposed projects (i.e., road construction, bridge replacement, and culvert installation projects) within Louisiana pearlshell mussel watersheds to ensure implementation of practicable measures to minimize potential impacts on the Louisiana pearlshell mussel and their habitat (i.e., proper erosion control, maintenance of quality habitat and stream geomorphology, etc.). However, some construction activities go unevaluated, particularly those lacking a federal nexus. Among the most common unevaluated activities in Louisiana pearlshell mussel watersheds are bridge and culvert replacement projects; many of which go undetected by State and Federal biologists managing the species until construction has already been initiated or is completed (LNHP, USFS, Service personnel communication).

Some construction projects in Louisiana pearlshell mussel habitat may have long-term impacts. For example, even though erosion control is required, the improper installation/use and the inadequate maintenance of erosion control measures can lead to failures in project-related erosion control and increased sediment loading of Louisiana pearlshell mussel streams, thus decreasing water quality and potentially impacting Louisiana pearlshell mussels. In fact, the various surveys conducted by both LNHP and the USFS have documented that construction activities continue to adversely affect Louisiana pearlshell mussel habitat. The 2010 survey in Rapides (2010) reported construction related siltation to be impacting water quality within Patterson Branch. To alleviate concerns about potential impacts of construction, it is imperative that all proposed construction or soil disturbing activity within the Louisiana pearlshell mussel watersheds be coordinated with LNHP, USFS, and the Service before construction to reduce project-related erosion and siltation and

minimize potential impacts to Louisiana pearlshell mussels (LNHP 2009; USFS 2007b, 2009b). The consultation process is a way of developing recommendations or alternatives to minimize potential impacts of proposed actions, as practicable. In the case of proposed road crossings, for instance, recommendations for span bridges or bottomless culverts are generally made because these types of structures better facilitate the natural flow of the streams and are less likely to lead to impacts associated with altered hydrology and long-term erosion than traditional culverts (round, box or tank-cars). However, if traditional culverts are still being proposed after consideration of other alternatives, then recommendations for design and installation to minimize potential impact would be developed; such as using oversized culverts, sinking culverts, and installing and maintaining erosion control measures. Additionally, to address these issues, the LNHP hosted a Louisiana pearlshell mussel workshop for Parish officials in 2010 and the KNF also works proactively with Parishes on projects within mussel streams.

The Louisiana Department of Wildlife and Fisheries also has a program called the Natural Areas Registry, which allows the state to honor and recognize owners of outstanding natural areas for their commitment to conservation. The program relies on citizen-based conservation and the willingness of landowners to safeguard natural resources on their property. Landowners with Louisiana pearlshell mussel streams on their property would qualify for the Natural Areas Registry. By joining the Registry, the landowner would agree to protect the areas from damage to the best of their ability and to notify LDWF of any threats to the area. Each year, LDWF contacts the owner to determine whether conditions have changed or new threats have developed. Currently, 75 acres of Louisiana pearlshell mussel habitat have been enrolled in the Registry, all of which is in Grant Parish along Bayou Clear, Jordan Creek, Coleman Branch, and Black Creek (Judy Jones, LNHP, personal communication).

Since downlisting, the USFS has implemented forest-wide restrictions on certain land use practices and modes of recreation to curtail disturbance to Louisiana pearlshell mussels and their associated habitat. Through implementation of the Forest Service's Land and Resource Management Plan (1999, LRMP), restrictions have been placed on forest management activities within Louisiana pearlshell mussel watersheds to maintain stream water quality and protect mussel beds. The LRMP provides for the designation of streamside management zones that provide for the management of riparian habitat 100 feet along the banks of perennial and intermittent streams to maintain water quality and wildlife habitat. Timber harvest within those zones is restricted to the selective cutting of individual trees for the purpose of wildlife habitat improvement.

Implementation of those management guidelines has reduced the threats to the species associated with detrimental forestry practices on public lands (i.e., KNF).

Additionally, the USFS placed restrictions on the use of motorized vehicles within Louisiana pearlshell mussel watersheds on the KNF. In the past, KNF was open to motorized vehicle use, following the policy of "open unless posted closed." New motorized recreation trails have been designated for trail riding, but prior to August of 2008, there were no restrictions on cross-country travel except in developed recreation areas, military use areas, wilderness areas, special interest areas, and other areas posted "closed." Since August 1, 2008, threats from authorized all-terrain vehicle use on the KNF have diminished for 29% of the total known Louisiana pearlshell mussel population because of the forest-wide implementation of new travel management rules that eliminated cross-country motorized travel. This decision followed development of the Kisatchie National Forest Travel Management Environmental Assessment (USFS 2007a) and amendment of Forest Service internal directives (USFS 2009a) regarding travel management (73 FR 74689) to make them consistent with the National Travel Management Rule (70 FR 68264). New Motor Vehicle-Use Maps (MVUM) showing all designated routes that were developed. Operators of motor vehicles that leave the designated route will be in violation and subject to penalty.

A similar level of protection from these threats, however, has not been extended to the remaining 71% of Louisiana pearlshell mussels occurring on private lands. For example, even though best management practices (BMPs) have been developed to minimize environmental impacts and maintain water quality associated with forestry operations in Louisiana, compliance with those BMPs is primarily voluntary. In addition, there is no restriction on the use of recreational all-terrain vehicles on private property specific for protection of Louisiana pearlshell mussels. For these reasons, threats from detrimental forestry practices and use of all-terrain vehicles remain unchanged on private lands. However, landowner education and programs such LNHP's Natural Areas Registry, NRCS's WRP, and the Service's Partners program could play an important role in helping curtail negative impacts to the species from activities on private lands.

As stated above, several of the activities that pose a threat to the Louisiana pearlshell mussel and its habitat are not subject to the regulations of section 7 of the Act; i.e., there is no federal nexus to trigger consultation with the Service. Therefore, many activities that have the potential to impact the species and its habitat are implemented without any prior coordination with the Service. Thus, existing regulatory mechanisms are inadequate to provide full protection to the species, especially when

activities such as the following are conducted within Louisiana pearlshell mussel watersheds without sufficient regulation: bridge and culvert replacement and maintenance projects; road construction and maintenance projects; detrimental forestry activities on private property; and destructive ATV use on private property. Several of these unregulated activities may have already resulted in adverse effects to the species and/or its habitat and could potentially lead to long-term impacts to species' recovery.

e. Other natural or manmade factors affecting its continued existence:

Activities, such as recreational use of all-terrain vehicles in Louisiana pearlshell mussel watershed habitat can decrease bank stability and lead to gully formation and heavy silt loading into the stream, thereby reducing in-stream water quality. In response to the issues caused by the use of all-terrain vehicles in Louisiana pearlshell mussel habitat on the KNF, the USFS (as shared under Factor d) has enacted regulations that limit the use of all-terrain vehicles to established trail systems (USFS 2007a). However, according to recommendations given by the USFS in the 2009 Louisiana Pearlshell Mussel Survey for Grant Parish, there remains a need to establish effective enforcement of the all-terrain vehicle regulation. This indicates that there is still some level of associated threat, as evidenced by recently reported impacts from the use of all-terrain vehicles on several Louisiana pearlshell mussel streams on the KNF (USFS 2007b, 2009b, 2010). Even so, the establishment of the all-terrain vehicle regulations is a significant step in the way ahead for protection of Louisiana pearlshell mussel habitat from recreational activity on the KNF. Unfortunately, there are no such regulations for the use of all-terrain vehicles in Louisiana pearlshell mussel habitat imposed on private lands, which supports 71% of the known Louisiana pearlshell mussel population. However, the LNHP and the Service encourage the judicious use of all-terrain vehicles on private lands with streams harboring Louisiana pearlshell mussels. Landowner education through written public documents, like this five-year review, and through programs like the LNHP's Natural Areas Registry is possibly the best current tool for protecting Louisiana pearlshell mussels from recreational all-terrain vehicle use and other threats on private lands.

In addition to the above-mentioned threats to habitat by the use of all-terrain vehicles via increasing sedimentation, degrading water quality, scouring resulting from stream crossings and trails within streamside habitats; an additional threat exists from direct mortality by crushing if those vehicles cross the stream at the location of Louisiana pearlshell mussel beds (LNHP 2009).

Another threat, identified by both LNHP and USFS in their most recent

survey reports, is the potential for feral hog rutting to cause bank instability and accelerated bank erosion and silt loading. At the current time, there are no published estimates of the level of potential impact of feral hog activity on Louisiana pearlshell mussel streams.

Potential impacts to reproduction or to the host fish are not quantifiable at this time because of a lack of information. However, the fish host and reproductive biology studies for the Louisiana pearlshell mussels are continuing out of the NNFH.

Genetic research indicates that some Louisiana pearlshell mussels streams are isolated from each other (i.e., on each side of the Red River and upstream of Lake Iatt). Continued isolation of Louisiana pearlshell mussel streams could result in increased risks of genetic bottlenecks and inbreeding depression (Roe 2009), possibly resulting in reduced reproductive output and reduced viability of the mussel population within the isolated stream.

The LNHP 2009 survey documented the presence of Asiatic clams (*Corbicula fluminea)* in every stream surveyed on private property. According to a DNR fact sheet on Aquatic Invasive species (found at http://www.in.gov/dnr/files/Asiatic_Clam.pdf), the Asiatic clam prefers similar habitat to that occupied by the Louisiana pearlshell mussel and can reach densities of 10,000 to 20,000 clams per square meter in a very short time. The possibility of Asiatic clams out-competing the Louisiana pearlshell mussel may be a concern in the future, but cannot be accurately assessed at this time due to a deficiency of available data. Streams with known Asiatic clams should be monitored for the abundance of the invasive species and precautions should be taken to prevent the unintentional spread of the species through human activity.

There has been suggestion that raw sewage may be polluting certain Louisiana pearlshell mussel streams; however, that has not been confirmed as of yet (LNHP 2009). If raw sewage is being discharged into the freshwater Louisiana pearlshell mussel streams, those pollutants may cause a decline in water quality and eventually have effects on Louisiana pearlshell mussel. Because it is not a documented occurrence and the level of discharge is unknown, this threat cannot be accurately assessed at this time. Finally, there is the threat that drought conditions could impact the habitat for Louisiana pearlshell mussels, including the potential for long term drying of their shallow streams.

D. Synthesis

Populations of the Louisiana pearlshell mussel continue to be fragmented and isolated by impoundments. Results from a recent genetic study (Roe 2009) indicate genetic

structuring and increased genetic distance between mussels on either side of the Red River, indicating that the Red River is an effective barrier to migration. That study also indicates that future impacts to genetic composition of fragmented and isolated populations are likely, with those populations upstream of Lake Iatt beginning to show signs of genetic isolation. Published survey data from the KNF and private lands show that beaver activity in 77% of all Louisiana pearlshell mussel streams continue to cause direct effects to individuals and populations of Louisiana pearlshell mussels through inundation or stranding. Although the level of threat has been somewhat reduced via beaver control on the KNF and private land, this threat is still significant across the range based on the distribution and number of large beds; i.e., a beaver dam could have a large impact on the total population were it to cause local extirpation of numerous beds or extremely large ones. Feral hog activity is possibly another source of impact to Louisiana pearlshell mussel. Other threats to Louisiana pearlshell mussels result from soil disturbance and sedimentation that occurs from detrimental forestry practices, all-terrain vehicle use, and construction with inadequate erosion control. Without proper installation and maintenance of temporary and long-term erosion control measures; soil disturbance, accelerated erosion, and run-off from project sites have the potential to affect Louisiana pearlshell mussels downstream, whether on private or public land. When working in Louisiana pearlshell mussel watersheds it is imperative that all concerned agencies and individuals work together, in consultation with the Service, throughout all project phases; i.e., the planning, implementation, and maintenance phases, to ensure that water quality is protected from undue project-related erosion and sedimentation to minimize potential impacts to Louisiana pearlshell mussels. Since the Louisiana pearlshell mussel was reclassified, restrictions on forestry activities in the KNF within stream-side management zones (USFS 1999) have been developed to protect Louisiana pearlshell mussel beds and stream water quality. Timber harvest within those zones is restricted to selective cutting for the purpose of wildlife habitat improvement. In addition to those restrictions on timber harvest, all-terrain vehicular use is restricted to designated trails only and cross-country travel is prohibited (USFS 2007a). On private land, there are voluntary BMPs associated with forestry operations but no requirements preventing the use of all-terrain vehicles in or near Louisiana pearlshell mussel habitat. Widespread adherence to the forestry BMPs would reduce the threat to the species associated with forestry practices on private land; however, to date, not all landowners are enacting the BMPs. The Louisiana Forestry Association holds private landowner workshops on forestry BMPs. The LDWF is helping interested private landowners protect Louisiana pearlshell mussel streams on their properties from detrimental uses through education and through programs like the Natural Areas Registry program.

Threats to the species have been reduced on both the KNF and private lands via beaver control and habitat restoration activities; however, those threats identified at the time of reclassification continue to affect the species. Also, there is the potential of new threats on the horizon that warrant further investigation; i.e., feral hog activity, possible increasing predation by otters, possible raw sewage discharge into streams, stream invasion by the Asiatic clam, and possibility of extended, range-wide drought conditions. Furthermore, the overall population trend for this species (i.e., increasing, decreasing, or stable) has not been yet been determined, although the second set of range-wide data

needed to run the trend analysis has recently been collected (2007-2009). The threatened status, rather than endangered, remains warranted because the wide distribution of a large number of Louisiana pearlshell mussel individuals and beds throughout the species range precludes immediate danger of extinction. However, the number and level of current threats to the species preclude any recommendation to delist at this time. Therefore, a change in the classification of the Louisiana pearlshell mussel is not recommended at this time.

See Appendix B. Table 4; Summary of Threats Assessment.

III. RESULTS

A. Recommended Classification:

_X_ No change is needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Statistically analyze available data to estimate long-term population trend.
- Revise the recovery plan to address the Bayou Rigolette drainage populations, the current known threats to the species, current recovery actions needed, to incorporate new studies and data, and to identify delisting criteria.
- Develop a plan to implement in the case of a range-wide drought.
- Develop a scientifically based system of monitoring/surveying Louisiana pearlshell mussel populations to develop trends and identify any new populations or extirpated populations.
- Conduct life history research (i.e., determine host fish, water quality requirements/parameters, etc.).
- Determine the habitat requirements, threats, and status of suitable host fish when it is identified.
- Continue beaver control activities.
- Determine the age structure of extant populations, the rate of juvenile recruitment, and population viability.
- Conduct long-term monitoring to determine if processes indicative of a “meta-population” structure are occurring; i.e., what are rates of population extinction and colonization/recolonization, using genetic techniques to document source pools in colonization/recolonization events.

- Identify areas of suitable habitat within the historic range that are not currently occupied by the species, and determine if augmentation and expansion of the range is necessary to ensure viability. If feasible, develop propagation and augmentation technology/techniques.

- Monitor invasive Asiatic clams in Louisiana pearlshell mussel watersheds. Investigate the need for and, if necessary, develop methodologies for control of the invasive species.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW
Louisiana pearlshell mussel (*Margaritifera hembeli*)

Current Classification __Threatened__

Recommendation resulting from the 5-Year Review

_X_ **No change is needed**

Review Conducted By _Monica Sikes, Service, Louisiana Ecological Services Office, Lafayette & Karen Soileau, Service, Louisiana Ecological Services Office, Lafayette

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 1/31/11

REGIONAL OFFICE APPROVAL:

for

Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 2-22-11

APPENDIX A:
Summary of peer review for the 5-year review of the Louisiana pearlshell mussel (*Margaritifera hembeli*)

A. Peer Review Method:

The Service contacted species experts via letters dated November 7 through 8, 2007, asking for their willingness to peer review the Louisiana pearlshell mussel 5-year status review. Those experts who responded positively were provided an electronic copy of the draft document for their review. Species experts contacted included: Gary Lester and Beau Gregory (Louisiana Department of Wildlife and Fisheries, Natural Heritage Program), David Byrd, Emlyn Smith, and Steve Shively (U.S. Forest Service, Kisatchie National Forest), and Dr. Kevin Roe (Iowa State University). All agreed to participate in the peer review process.

B. Peer Review Charge:

See "Guidance for Peer Reviewers of Five-Year Status Reviews", attachment 1 of this appendix, which was provided to all peer-reviewers.

C. Summary of Peer Review Comments/Report:

Gary Lester and Beau Gregory (Louisiana Department of Wildlife and Fisheries, Natural Heritage Program): Provided minor editorial suggestions.

David Byrd, Steve Shively, and Emlyn Smith (U.S. Forest Service, Kisatchie National Forest): Requested the following: (1) that the 5-year status review include data from the 2007/2008 Louisiana pearlshell comprehensive surveys; and (2) that the Service consider the number of watersheds that contain the Louisiana pearlshell mussel and possibly identify other suitable watersheds for its reintroduction before delisting is considered. The Forest Service also commented that the data provided in Tables 1 and 2 do not allow for accurate population trend estimates.

Dr. Kevin Roe (Iowa State University): Recommended the following: (1) that the 5-year status review include data from the 2007/2008 Louisiana pearlshell mussel comprehensive surveys; (2) that feral hogs be included as a potential threat; and (3) that a statement be included that addresses current impacts to Louisiana pearlshell mussels from cattle crossings, clear cutting, and gravel mining. Dr. Roe also made comments regarding recommended future recovery actions.

D. Response to Peer Review:

Gary Lester and Beau Gregory (Louisiana Department of Wildlife and Fisheries, Natural Heritage Program): All comments were incorporated.

Comments from David Byrd, Steve Shively, and Emlyn Smith (U.S. Forest Service, Kisatchie National Forest) were addressed as follows:

(1) The 2007/2008 Louisiana pearlshell mussel surveys have been completed and those results are included herein; (2) The Service will consider habitat threats and determine if reintroductions are necessary for recovery prior to any delisting proposal. This is consistent with provisions of Section 4(a)(1) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1533(a)(1)); (3) The Service agrees that because of the differences in methodology and coverage between Louisiana pearlshell surveys, accurately determining population trend (i.e., increasing, stable, or decreasing) has not been possible to date for this species. Tables 1 and 2 are meant only to summarize data collected during previous surveys. Standardized, statistically-based, range-wide surveys at all known and potential Louisiana pearlshell mussel locations on the KNF and private lands (where permitted) have recently been completed. Those surveys followed the same methodology from the previous 1998 and 1999 range-wide surveys for the primary purpose of allowing for population trend analysis/comparisons.

Comments from Dr. Kevin Roe (Iowa State University) were addressed as follows: (1) The range-wide Louisiana pearlshell mussel surveys have been recently completed and those survey results are included herein; (2) Adverse impacts to Louisiana pearlshell mussels or their habitats from feral hogs have not been consistently noted during surveys; thus, feral hogs were recognized as a potential threat within the 5-year status review; and (3) statement that addresses impacts to Louisiana pearlshell mussels from cattle crossings, clear cutting, and gravel mining has been incorporated into the 5-year status review.

Appendix A, Attachment 1

Guidance for Peer Reviewers of Five-Year Status Reviews

U.S. Fish and Wildlife Service, Louisiana Ecological Services Office

November 6, 2007

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with Service policy.

Peer reviewers should:

1. Review all materials provided by the Service.

2. Identify, review, and provide other relevant data that appears not to have been used by the Service.

3. Not provide recommendations on the Endangered Species Act classification (e.g., endangered, threatened) of the species.

4. Provide written comments on:

    - Validity of any models, data, or analyses used or relied on in the review.
    - Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.
    - Oversights, omissions, and inconsistencies.
    - Reasonableness of judgments made from the scientific evidence.
    - Scientific uncertainties by ensuring that they are clearly identified and characterized and that potential implications of uncertainties for the technical conclusions drawn are clear.
    - Strengths and limitation of the overall product.

5. Keep in mind the requirement that we must use the best available scientific data in determining the species' status. This does not mean we must have statistically significant data on population trends or data from all known populations.

All peer reviews and comments will be public documents, and portions may be incorporated verbatim into our final decision document with appropriate credit given to the author of the review.

Questions regarding this guidance, the peer review process, or other aspects of the Service's recovery planning process should be referred to Kelly Bibb, U.S. Fish and Wildlife Service, at 404/679-7132 or email: kelly_bibb@fws.gov.

APPENDIX B:

Table 1. Number of Louisiana Pearlshell Mussels Observed During Surveys in Rapides Parish									
Stream`	1985 Survey[KNF]	1991 Survey[KNF]	**1998 Survey[RW]**	2001 Survey[KNF]	2004 Survey[KNF]	2007 Survey[KNF]	2007 -2009 Survey[PL]	**2007 -2009 Survey[RW]**	2010 Survey[KNF]
Brown Creek	*	*	*	*	*	*	293	**293**	*
Brown Creek/ Patterson Branch	300	*	**1,020**	286	1,634	2,194	0	**2,194**	2,310
Brown Creek/ Burney Branch	*	*	*	*	*	*	1	**1**	*
Williamson Branch	*	*	*	*	*	*	0	*	*
Valentine Creek	*	*	**1,403**	950	*	1,591**	580	**2,171****	1,885**
Mack Branch	380	*	**3**	*	*	0		**0**	*
Castor Creek	358	*	**1,109**	1,003	*	828	266	**1,094**	630
Long Branch	3,365	1,804	**2,954**	1,096	3396**	4,667**	0	**4,667****	4,788
Little Brushy Creek	30	*	**945**	303	941	1,027		**1,027**	1,113
Loving Creek	1,865	873	**1,544**	1,161	2,517	3,372		**3,372**	2,951
Little Loving Creek	1,306	2,178	**2,195**	463	1,680	1,347		**1,347**	1,952
Haikey's Creek	*	*	**68**	*	21	29		**29**	12**
Little Bayou Clear	89	*	**165**	*	85	82	9	**91**	43
Bayou Clear	2,507	1,859	**5,077**	2,984	4,694	4,323	3,465	**7,788**	5,318
Total	10,200	6,714	**16,483**	8,246	14,968	19,460	4,614	**24,074**	21,002

* not surveyed, not quantified, or not applicable; ** not completely surveyed; [KNF] Kisatchie National Forest; [PL] Private Land; [RW] Range-wide, where accessible

Table 2. Number of Louisiana Pearlshell Mussels Observed During Surveys in Grant Parish							
Stream	1992 Survey**	**1999 Survey[RW]**	2002 Survey[KNF]	2006 Survey[KNF]	2009 Survey [KNF]	2007 -2009 Survey [PL]	**2007 -2009 Survey [RW]**
Black Creek	*	**9,104**	*	*	*	11,457	**11,457**
Jordan Creek	24	**7,752**	1,136	1,404	1,347	4,875	**6,222**
Beaver Creek	43	**5,776**	521	376	134	6,991	**7,125**
Gray Creek	*	**5,367**	636**	2,496	1,671	5,710	**7,381**
Swafford Creek	*	**658**	*	*	*	14,787	**14,787**
Moccasin Branch	*	**421**	75**	205	226	595	**821**
Coleman Branch	*	**205**	*	*	*	5,027	**5,027**
Cress Creek	41	**141**	222	189	53	*	**53**
James Branch	*	**110**	*	20	33	780	**813**
Cypress Creek	*	**50**	*	49	55	8	**63**
Clear Branch	*	**9**	*	2	0	0	**0**
Chandler Creek	*	**8**	*	62	38	124	**162**
Hudson Creek	*	**1**	*	*	*	0	**0**
Glady Hollow	*	*****	*	*	*	147	**147**
	108**	**29,602**	2,590**	4,803	3,557	50,501	**54,058**

* not surveyed, not quantified, or not applicable; ** not completely surveyed; [KNF] Kisatchie National Forest, [PL] Private Land; [RW] Range-wide, where accessible

Table 3. Summary of Beaver Management Activities																						
	FY 2010		FY 2009		FY 2008		FY 2007		FY 2006		FY 2005		FY 2004		FY 2003		FY 2002		FY 2001		FY 2000	
Creek Name	USFS	Private Land (PL)	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL
Little Brushy Creek	3 beavers removed	n/a	3 beavers removed, 1 dam removed	n/a	1 beaver removed, 5 dams removed	n/a	2 beavers removed, 4 dams removed	n/a	5 dams removed	n/a	n/a	n/a	none	n/a	7 beavers removed, 6 dams removed	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Brown Creek	3 beavers removed, 3 dams removed	n/a	2 beavers removed, 1 dam removed	n/a	8 beavers removed, 2 dams removed	n/a	n/a	n/a	n/a	n/a	7 beavers removed, 5 dams removed	n/a	n/a	n/a	none	4 beavers removed, 1 dam removed	n/d	n/d	n/a	n/a	n/d	n/a
Little Bayou Clear	3 beavers removed, 3 dams removed* (*work conducted KNF and private lumped)		none	8 beavers removed, 8 dams removed	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	none	n/a	n/a	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Bayou Clear	none	none	n/a	n/a	n/a	n/a	1 beaver removed, 1 dam removed	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Long Branch Creek	none	n/a	n/a	n/a	7 beavers removed, 7 dams removed	1 beaver removed, 2 dams removed	2 dams removed	n/a	n/a	n/a	5 beavers removed, 1 dam, removed	n/a	none	n/a	10 beavers removed, 2 dams removed	3 beavers removed, 10 dams removed	n/d	n/d	n/a	n/a	n/d	n/a
Loving Creek	none	n/a	none	n/a	none	n/a	2 beavers removed	n/a	2 beavers removed, 3 dams removed	n/a	n/a	n/a	none	n/a	3 beavers removed, 2 dams removed	n/a	n/d	n/d	n/a	n/a	n/d	n/a

Table 3. Summary of Beaver Management Activities																						
	FY 2010		FY 2009		FY 2008		FY 2007		FY 2006		FY 2005		FY 2004		FY 2003		FY 2002		FY 2001		FY 2000	
Creek Name	USFS	Private Land (PL)	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL
Valentine Creek	none	n/a	n/a	n/a	none	n/a	n/a	n/a	n/a	n/a	n/a	9 beavers removed, 3 dams removed	n/a	n/a	none	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Cress Creek	none	none	none	2 beavers removed, 2 dams removed	n/a	1 dam removed	none	n/a	none	n/a	none	n/a	none	n/a	none	n/a	n/d	n/d	1 beaver removed, 2 dams removed	n/a	n/d	n/a
Gray Creek	2 beavers removed, 2 dams removed	n/a	n/a	n/a	n/a	n/a	none	n/a	1 beaver removed, 3 dams removed	n/a	none	n/a	none	n/a	4 beavers removed, 5 dams removed	n/a	n/d	n/d	none	n/a	n/d	n/a
Moccasin Creek	none			n/a	n/a	n/a	none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Chandler Creek	2 beavers removed, 1 dam removed	n/a	n/a	2 beavers removed, 1 dam removed	4 beaver removed, 1 dam removed	n/a	none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Beaver Creek	none	none	n/a	4 beavers removed, 3 dams removed	n/a	n/a	none	none	n/a	n/a	none	n/a	none	n/a	n/a	n/a	n/d	n/d	none	n/a	n/d	n/a

Table 3. Summary of Beaver Management Activities																						
	FY 2010		FY 2009		FY 2008		FY 2007		FY 2006		FY 2005		FY 2004		FY 2003		FY 2002		FY 2001		FY 2000	
Creek Name	USFS	Private Land (PL)	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL
James Branch	none	n/a	n/a	n/a	n/a	n/a	none	n/a	n/a	n/a	none	n/a	n/a	n/a	n/a	n/a	n/d	n/d	none	n/a	n/d	n/a
Jordan Creek	n/a	1 beaver removed, 1 dam removed	n/a	n/a	n/a	n/a	none	none	n/a	4 beavers removed, 2 dams removed	1 beaver removed, 1 dam removed	n/a	n/a	none	1 dam removed	none	n/d	n/d	none	none	n/d	1 beaver removed, 1 dam removed
Moccasin Creek	n/a	none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	none	n/a	n/a	n/a	n/a	n/a	n/d	n/d	none	none	n/d	none
Hudson Creek	n/a	n/a	n/a	3 beavers removed	n/a	n/a	n/a	1 beaver removed, 1 dam removed	n/a	n/a	n/d	n/a	n/a	n/a	n/a	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Clear Creek	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2 beavers removed, 4 dams removed	n/a	none	n/a	3 beavers removed	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Coleman Creek	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	none	n/a	n/a	n/a	n/a	n/a	n/d	n/d	none	none	n/d	n/a

Table 3. Summary of Beaver Management Activities																						
	FY 2010		FY 2009		FY 2008		FY 2007		FY 2006		FY 2005		FY 2004		FY 2003		FY 2002		FY 2001		FY 2000	
Creek Name	USFS	Private Land (PL)	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL
Cypress Creek	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	none	n/a	n/a	n/a	n/d	n/d	none	none	n/d	n/a
Black Creek	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3 beavers removed, 5 dams removed	n/a	n/a	n/a	n/a	n/a	none	n/a	n/a	n/d	n/d	n/a	none	n/d	1 dam removed
Hospital Bayou	n/a	n/a	n/a	n/a	n/a	2 dams removed	n/a	4 beavers removed, 7 dams removed	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Patterson Branch	n/a	n/a	n/a	n/a	1 beaver removed, 3 dams removed	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Swafford Creek	n/a	n/a	n/a	n/a	n/a	n/a	n/a	none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/d	n/d	n/a	n/a	n/d	n/a
Total Beavers (140)	11.5*	2.5*	5	19	21	1	5	8	3	4	15	9	0	0	27	7	n/d	n/d	1	0	n/d	1

Table 3. Summary of Beaver Management Activities																						
	FY 2010		FY 2009		FY 2008		FY 2007		FY 2006		FY 2005		FY 2004		FY 2003		FY 2002		FY 2001		FY 2000	
Creek Name	USFS	Private Land (PL)	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL	USFS	PL
Total Dams (127)	7.5*	2.5*	2	14	18	5	7	13	11	2	11	3	0	0	16	11	n/d	n/d	2	0	n/d	2
n/a = stream not surveyed or not located on that land category; n/d = no data																						

Table 4. Summary of Threats Assessment						
Factor	**Relevant to species? (Y/N)**	**Threats under factor (list)**	**New or existing threat?**	**New info? (Y/N)**	**Scope? Increased/same/decreased (describe briefly)**	**Severity? Increased/same/ decreased (describe briefly)**
A.	Yes	beaver activity	existing	no	Same – affects all populations	Decreased – beaver control activities expanded to include private lands
A.		Detrimental forestry practices on public lands (i.e., clearcutting, cutting riparian zones, etc.)	existing	no	Decreased for 29% of population. – Forest Service has developed a Forest Plan that restricts management activities within mussel watersheds to maintain stream water quality.	Decreased - Forest Service has developed a Forest Plan that restricts management activities within mussel watersheds to maintain stream water quality.
A.		Detrimental forestry practices on private lands (i.e., clearcutting, cutting riparian zones, etc.)	existing	no	Scope of threat remains unchanged on private lands (BMPs are voluntary).	Severity of threat remains unchanged on private lands (BMPs are voluntary).
A.		impoundments	existing	Yes – new genetic information	Same – affects all populations	Same – continue to fragment habitats/populations
A.		sedimentation	existing	no	Decreased –implementation of Forest Plan decreased sources of sedimentation from forestry practices and cross-country ATV use on KNF lands; however, Scope remains unchanged on private lands.	Decreased – implementation of Forest Plan decreased sources of sedimentation from forestry practices and ATV use on KNF lands; Severity of threat remains unchanged on private lands.
B.	Yes	collecting	existing	no	Same – to date has not posed a problem. Ease of observing individual mussels, however, makes collection of the species very easy.	Same – to date has not posed a problem; however, it could reduce populations below levels necessary for reproduction
C.	Yes	predation	existing	no	Same – potential to affect all populations.	Same - vulnerable to predation, however, there has not been a consistent pattern.

D.	Yes	Unregulated construction projects and land-use activities	Not previously identified as a threat	yes	Increased – ever increasing development with resulting increase in construction projects and land-use activities within Louisiana pearlshell mussel watersheds	Increased –potential impact from increasing number of construction projects and other land-use actions that lack a federal nexus within Louisiana pearlshell mussel watersheds
E.	Yes	ATV use	existing	no	Same – private populations. Decreased for 29% of population-Forest Service developed regulations that restricts off-trail ATV use	Decreased– cross-country ATV travel no longer permitted within the KNF
E.		Feral hogs	yes	Yes – identified by LDWF and USFS as a potential concern in their recent range-wide survey	Unknown - however, surveys indicate evidence of feral hog activity	Unknown – potential threat
E.		loss of genetic variation	unknown	yes	Unknown, however, populations isolated by barriers showing signs of genetic isolation	Unknown, however, populations isolated by barriers showing signs of genetic isolation
E.		status of/threats to host fish	unknown	No – however, the NNFH is conducting research to determine the host fish, after which time threats could be assessed.	Unknown - fish host for the Louisiana pearlshell mussel not known, therefore, threats to this component of the reproductive cycle cannot be accurately evaluated	Unknown - fish host for the Louisiana pearlshell mussel not known, therefore, threats to this component of the reproductive cycle cannot be accurately evaluated
E.		Invasive Asiatic clams	new	Yes – identified by LDWF as a potential concern in their recent range-wide survey	Unknown - however, surveys indicate presence of the invasive species in Louisiana pearlshell mussel streams	Unknown – potential threat
E.		Raw Sewage discharge	new	No- no substantiated reports, but identified by LDWF as a potential concern in their recent range-wide survey	Unknown	Unknown