CANDIDATE ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: Elliptio spinosa (I. Lea.)

COMMON NAME: Altamaha spinymussel

LEAD REGION: 4

INFORMATION CURRENT AS OF: March 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: ___
        ___ Is the petition requesting a reclassification of a listed species?
    ___ 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: Mollusca -- Unionidae

HISTORICAL STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Georgia

LEAD REGION CONTACT (Name, phone number): Rick Gooch, 404/679-7124.

LEAD FIELD OFFICE CONTACT (Office, name, phone number): James Rickard, Athens, Georgia Field Office, 706/613-9493, extension 23

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

The Altamaha spinymussel (Elliptio spinosa) is a freshwater mussel endemic to the Altamaha River drainage of southeastern Georgia (Johnson 1970). It was described from the Altamaha River from a site near its mouth at Darien in 1836. The Altamaha spinymussel is associated with stable, coarse to fine sandy sediments of sandbars and sloughs and appears to be restricted to swiftly flowing water (Sickel 1980). Johnson (1970) reported that Altamaha spinymussels are found buried approximately 2 to 4 inches below the substrate surface.

The Altamaha spinymussel is medium to large in size, reaching a shell length of approximately 110 millimeters (4.3 inches). The shell is subrhomboidal or subtriangular in outline and moderately inflated. In young specimens, the outside layer or covering of the shell (periostracum) is greenish-yellow with faint greenish rays, but as the animals get older, they typically become a deep brown. Some raying may still be evident in older individuals. The interior layer of the shell (nacre) is pink or purplish. As the name implies, the shells of these animals are adorned with one to five prominent spines. These spines may by straight or crooked, reach lengths from 1-2.5 cm, and are arranged in a single row that is somewhat parallel to the posterior ridge (Johnson 1970).

Adult freshwater mussels are filter-feeders, siphoning phytoplankton, diatoms, and other microorganisms from the water column. For their first several months juvenile mussels employ foot (pedal) feeding, and are thus suspension feeders that feed on algae and detritus. Mussels tend to grow relatively rapidly for the first few years, then slow appreciably at sexual maturity (when energy is being diverted from growth to reproductive activities). As a group, mussels are extremely long-lived, living from a few decades to a maximum of approximately 200 years. Large, heavy-shelled riverine species tend to have longer life spans. No age specific information is available for the Altamaha spinymussel. However, considering that it is a fairly large, heavy-shelled riverine species, it would seem probable that it is relatively long-lived.

Most mussels, including the Altamaha spinymussel, have separate sexes. Males expel clouds of sperm into the water column, which are drawn in by females through their incurrent siphons. Fertilization takes place internally, and the resulting zygotes develop into specialized larvae termed glochidia inside the water tubes of her gills. Glochidia must come into contact with a specific host fish(es) and parasitize that fish for a short time in order for their survival to be ensured. Without the proper host fish, the glochidia will perish. After a few weeks parisitizing the host fish=s gill tissues, newly-metamorphosed juveniles drop off to begin a free-living existence on the stream bottom. Unless they drop off in suitable habitat, they will die. Thus, the complex life history of the Altamaha spinymussel and other mussels has many weak links that may prevent successful reproduction and/or recruitment of juveniles to existing populations.

The historical range of the Altamaha spinymussel was restricted to the Coastal Plain portion of the Altamaha River and the lower portions of its three major tributaries, the Ohoopee, Ocmulgee, and Oconee rivers (Johnson 1970; Eugene P. Keferl, Bruswick Jurior College, pers. comm. 2001). The Altamaha River is formed by the confluence of the Ocmulgee and Oconee rivers and lies entirely within the State of Georgia. Since its description, the Altamaha spinymussel has been sought by many collectors and is found in numerous public and private collections. However, large scale, targeted surveys for the mussel have been conducted only since the 1970's (Keferl 1994). Recent surveys have revealed a dramatic decline in the number of populations and number of individuals within populations throughout the species= historical range.

Ohoopee River

In a survey of the Ohoopee River, Keferl (1981) found the Altamaha spinymussel in thinly scattered beds in the lower five miles of the river, and live specimens were found at seven of eight collection sites there. By the early 1990's, however, only two live specimens were found at the same sites in the lower Ohoopee River (Keferl 1993). Stringfellow and Gagnon (2001) re-surveyed these sites using techniques similar to those used by Keferl (1981), but they did not find any live Altamaha spinymussels in the Ohoopee River. Therefore, it is either extirpated from the system or present in such low numbers that it is undetectable. Ironically, Keferl (1981) initially considered the Ohoopee River to be a possible refugium for the Altamaha spinymussel and other endemic Altamaha River mussel species.

Ocmulgee River

In the Ocmulgee River, the Altamaha spinymussel was known historically from its confluence with the Oconee River to an area about 35 miles upstream, near Jacksonville, Georgia (Stringfellow and Gagnon 2001). This reach of river was surveyed by Keferl in the mid 1990's and again by Georgia Department of Natural Resources (GDNR) personnel in 2000 and 2001. Nearly 50 sites have been surveyed in this reach since 1993, but Altamaha spinymussels were found at only eight of those sites. From those eight sites, fewer than 20 live Altamaha spinymussels were found.

Dr. Grace Thomas, of the University of Georgia, documented the Altamaha spinymussel at its farthest known upstream location at Red Bluff in the early 1960's. She and others collected a total of 40 individuals from two visits to the area (Chris E. Skelton, Georgia Natural Heritage Program, GDNR, pers. comm. 2001). These collections are deposited at the University of Georgia=s Museum of Natural History.

Dr. David Stansbery, of Ohio State University, made a collection of 11 live individuals from the Ocmulgee River at the U.S. Highway 441 bridge near Jacksonville in 1986. However, in their 2001 surveys, GDNR personnel found no live Altamaha spinymussels at Red Bluff or at U.S. Highway 441 (C. Skelton, pers. comm., 2001). They did, however, find three Altamaha spinymussels approximately one mile upstream of the U.S. Highway 441 bridge.

Similarly, early collecting efforts in the Ocmulgee River near its confluence with the Oconee River yielded many live Altamaha spinymussels. Herb Athearn, of the Museum of Fluviatile Mollusks in Cleveland, Tennessee, made a single collection of 40 live spinymussels downstream of U.S. Highway 341 near Lumber City in 1962. In the 2001 GDNR surveys, eight surveyors found only six live Altamaha spinymussels at a sandbar in the same general area.

Oconee River

There are few historical records of Altamaha spinymussels from the Oconee River (Johnson 1970). The species has not been collected there since the late 1960's, and it is probably extirpated from the Oconee River system (E. Keferl, pers. comm., 2001). No Altamaha spinymussels were found during surveys conducted by the GDNR over the past two years.

Altamaha River

Most surveys for Altamaha spinymussels have been conducted in the Altamaha River. Early surveys at the U.S. Highway 301 crossing produced documented individuals, including collections of 20 individuals in 1963, seven in 1965, and 43 in 1970. In the fall of 1994, Keferl (1994) surveyed 180 sites throughout the Altamaha River and its tributaries. The Altamaha spinymussel was found at 27 of the surveyed sites; 41 live mussels and shells representing 53 dead mussels were reported. During the fall of 2001, O=Brien and Brim Box (in prep.) surveyed 48 sites on the Altamaha River from the confluence of the Ocmulgee and Oconee Rivers to just downstream of U.S. Highway 301 near Jesup, Georgia. Of these 48 sites, 18 of them had historical records of Altamaha spinymussels. Five of these sites yielded one or two live individuals, including three individuals that were considered juveniles approximately five years old. Of the 13 remaining historic populations surveyed, two sites yielded one freshly dead (i.e., flesh was still present) Altamaha spinymussel each, six sites yielded only shells, and five sites showed no evidence of Altamaha spinymussels.

Summary

Although Altamaha spinymussels were found in the past two years from the Ocmulgee and Altamaha Rivers, the recent surveys reveal some disturbing trends. First, no Altamaha spinymussels were found in the Ohoopee River. Second, most of the historical collection sites on the Ocmulgee and Altamaha rivers no longer have Altamaha spinymussels. Third, the historical locations that had extant populations of Altamaha spinymussels had significantly reduced numbers. Fewer than 25 live mussels were found in over 250 person hours of searching throughout the historical range, which is in sharp contrast to historical collections where as many as 60 individuals were found in a single bed (Sickel 1980). Fourth, although juvenile mussels are generally difficult to find, historic surveys were successful at finding some juvenile Altamaha spinymussels (Keferl 1981). Recent surveys utilized the same sampling techniques as previous surveys failed to find many juveniles (Christine A. O=Brien, Consulting Biologist, pers. comm., 2001; C. Skelton, pers. comm., 2001). This indicates that it is likely that little recruitment is occurring within the populations.

The survey results detailed above present strong evidence that the range and numbers of individuals of the Altamaha spinymussel have declined over the past 30 years. The species appears to be extirpated from the Ohoopee and Oconee rivers, and its numbers are greatly reduced in the Ocmulgee and Altamaha Rivers. Collectors in the 1960's were able to find more Altamaha spinymussels at a single site than researchers in the past two years were able to find in more that 250 hours of searching.

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.

Altamaha spinymussels face severe habitat degradation from a number of sources. Primary among these are threats from sedimentation and contaminants within the streams that the Altamaha spinymussel inhabits. These threats to the Altamaha spinymussel are further compounded by its limited distribution and the low populations sizes identified in recent survey efforts.

Sedimentation, including siltation from surface runoff, has been implicated as the primary factor in water quality impairment in the United States (Neves et al. 1997) and has contributed to the decline of mussel populations in streams throughout the country (Ellis 1931, 1936; Imlay 1972; Coon et al. 1977; Marking and Bills 1979; Wilber 1983; Dennis 1985; Aldridge et al. 1987; Schuster et al. 1989; Wolcott and Neves 1991; Houp 1993; Richter et al. 1997). Specific impacts on mussels from sediments include reduced feeding and respiratory efficiency, disrupted metabolic processes, reduced growth rates, increased substrata instability, and the physical smothering of mussels (Ellis 1936; Stansbery 1971; Markings and Bills 1979; Kat 1982; Aldridge et al. 1987; Hartfield and Hartfield 1996, Brim Box and Mossa 1999). In addition, sediment can eliminate or reduce the recruitment of juvenile mussels (Negus 1966; Brim Box and Mossa 1999), act as a vector in delivering contaminants to streams (Salomons et al. 1987), and interfere with feeding activity (Dennis 1984).

Sickel (1980) characterized the habitat of the Altamaha spinymussel as coarse to fine grain sandbars, and suggested that this may make the Altamaha spinymussel susceptible to adverse effects from sediment (i.e., siltation). Sediments deposited on the stable sandbars required by the Altamaha spinymussel could make sandbars unstable, suffocate Altamaha spinymussels, or simply change the texture of the substrate. These alterations to the sandbars make them unsuitable for the species. There are numerous potential sources of sediment within the Altamaha River basin including unpaved roads, kaolin mines, and agriculture, silviculture, and construction sites.

Many southeastern streams have increased turbidity levels due to siltation (van der Schalie 1938). Some mussels attract host fishes with visual cues, luring fish into perceiving that their glochidia are prey items. This reproductive strategy depends on clear water during the time of the year when mussels are releasing their glochidia (Hartfield and Hartfield 1996). Therefore, since turbidity is a limiting factor that impedes the ability of sight-feeding fishes to forage (Burkhead and Jenkins 1991), turbidity within the Altamaha River basin during the times that Altamaha spinymussels attempt to attract host fishes may have contributed and may continue to contribute to the decline of the spinymussel by reducing its efficiency at attracting the fish hosts necessary for reproduction.

Industrial forest management is practiced on approximately 40,000 acres (33 percent) of the floodplain of the Altamaha River (Lambert 2001). Although land use studies are not available for the remainder of the Altamaha River basin, large portions of the basin are under forest management. Typical forest management regimes in the Altamaha River basin use timber harvest methods and conduct other activities that result in ground disturbances. These ground disturbances can result in transport of sediment to streams during and after precipitation events. In addition to the sediment that is produced by ground-disturbing timber harvesting activities, forest management operations often require miles of unpaved roads to extract timber and to provide access for management activities. These roads, in conjunction with existing unpaved county roads that are prevalent throughout the Altamaha River basin, may also contribute significantly to sediment loading in streams after precipitation events. In addition, a number of kaolin mines are located along the Fall Line within the Oconee and Ocmulgee river basins. The operation of these mines and their supporting infrastructure has the potential to increase downstream sediment loads if adequate erosion control measures are not maintained to stabilize areas subjected to mining-associated ground disturbances.

The operations of the Edwin I. Hatch Nuclear Power Plant (Plant Hatch), located on the Altamaha River in Appling County, pose a threat to the Altamaha spinymussel. In a letter dated November 27, 2001, regarding the relicensing of Plant Hatch, we expressed concerns about potential adverse impacts to aquatic fauna through entrainment of potential host fishes and thermal discharges and concluded that Plant Hatch had not adequately studied these potential impacts. Thermal discharges could negatively impact the Altamaha spinymussel from heat stress, algal blooms, and oxygen depletion in the Althmaha river. These effects would be exacerbated during years of low rainfall, when less water would be available to dissipate the heat of the Plant Hatch effluent. Each of these effects, if severe, could result in increased Altamaha spinymussel mortality downstream of Plant Hatch.

The expansion of operations at Plant Hatch is another threat to the Altamaha spinymussel in this reach of the Altamaha River. On September 14, 2001, the Service received Joint Public Notice 940003873 from the U.S. Army Corps of Engineers, Savannah District, describing a project to expand Plant Hatch=s intake basin within the Altamaha River. Implementation of this permit would re-authorized maintenance dredging of the plant intake basin and would authorize an AL@ shaped dredged area that extends 900 feet parallel to the bank and 388 feet channelward. This project will more than double the size of the intake basin and will dredge 44,424 cubic yards of material annually from the intake basin. Dredging of this type and extent is expected to alter flows in the Altamaha River causing stream bed and bank destabilization that would further alter Altamaha spinymussel habitat and potentially result in Altamaha spinymussel mortality and/or loss of populations.

Dredging contributes to stream channel instability because flowing water seeks its base level of gravitational flow. The destructive effects of extensive dredging, such as that proposed at Plant Hatch, include accelerated erosion, substratum instability, and the loss of habitat heterogeneity for fishes and benthic invertebrates both immediately upstream and for a greater distance downstream due to alterations in the river=s morphology and resulting flow patterns. The Plant Hatch intake basin will likely affect the river in a similar manner as other in-stream operations such as channelization and gravel mining. Channelization impacts a river's physical (e.g., accelerated erosion, reduced depth, decreased habitat diversity, geomorphic instability, riparian canopy loss) and biological (e.g., decreased fish and invertebrate diversity, changed species composition and abundance, decreased biomass and growth rates) characteristics (Stansbery and Stein 1971, Hartfield 1993, Hubbard et al. 1993). Channel maintenance may also result in downstream impacts (Stansbery 1970), such as increases in turbidity and sedimentation, which tend to smother benthic organisms like the Altamaha spinymussel. In-stream gravel mining, which has similar effects to channelization, has been implicated in the destruction of mussel populations (Stansbery 1970, Yokley and Gooch 1976, Grace and Buchanan 1981, Schuster et al. 1989, Hartfield 1993). Negative impacts include stream channel modifications (e.g., geomorphic instability, altered habitat, disrupted flow patterns, sediment transport), water quality modifications (e.g., increased turbidity, reduced light penetration, increased temperature), macroinvertebrate population changes (e.g., from elimination, habitat disruption, increased sedimentation), and changes in fish populations (e.g., impacts to spawning and nursery habitat, food web disruptions) (Lagasse et al. 1980, Kanehl and Lyons 1992). Therefore, if Altamaha spinymussels become eliminated from portions of the Altamaha River due to physical changes caused by dredging and stream channel alterations associated with Plant Hatch, it may be difficult for the species to recolonize the degraded areas. Studies have shown that once mussels have been eliminated, a decade or more may pass before recolonization occurs (Stansbery 1970, Grace and Buchanan 1981). The low population sizes and disjunct distribution of the species makes recolonization even more unlikely.

The Plant Hatch intake basin would also disrupt the natural morphology of the point bars that provide habitat for the Altamaha spinymussel. The intake basin would prevent a portion of the large, coarse sand that is essential for Altamaha spinymussel habitat formation from traveling downstream. In addition, the annual maintenance of the intake basin would release large quantities of fine sediment that could cover the coarse sandy point bars that provide Altamaha spinymussel habitat if transported downstream. In the long term, the effects of this intake basin project could eliminate Altamaha spinymussel habitat in much of the Altamaha River downstream of Plant Hatch. Depending on the extent of the downstream effects of the intake basin, the Altamaha spinymussel may be extirpated from half of its current range, but, at a minimum, it is expected that this project will result in a zone downstream from Plant Hatch were Altamaha spinymussel habitat is destroyed. This would effectively separate the current Altamaha River population into two, smaller populations.

Contaminants entering the Altamaha River basin are another factor that negatively impacts the Altamaha spinymussel. In laboratory experiments, mussels suffered mortality when exposed to 2.0 ppm cadmium, 5.0 ppm ammonia, 12.4 ppm chromium, 16 ppm arsenic trioxide, 19 ppm copper, and 66 ppm zinc (Mellinger 1972; Havlik and Marking 1987). Contaminants contained in point and non-point discharges can degrade water and substrate quality and adversely impact, if not destroy, mussel populations (Horne and McIntosh 1979, McCann and Neves 1992, Havlik and Marking 1987). The effects of various contaminants on mussels were reviewed by Havlik and Marking (1987), Naimo (1995), and Keller and Lydy (1997).

Mussels appear to be among the most intolerant organisms to heavy metals (Keller and Zam 1991), and several heavy metals are lethal, even at relatively low levels (Havlik and Marking 1987). Most metals are persistent in the environment (Miettinen 1977), remaining available for uptake, transportation, and transformation by organisms for long periods (Hoover 1978). Metals stored in the tissues of freshwater mussels indicate recent or current exposure, while concentrations in shell material indicate past exposure (Imlay 1982, Havlik and Marking 1987). Highly acidic pollutants, such as metals, are capable of contributing to mortality by dissolving mussel shells (Stansbery 1995).

Numerous municipal wastewater treatment plants discharge large quantities of effluent into the Altamaha River or its tributaries. For example Bibb County, Georgia, which includes the City of Macon, was permitted to discharge 39.70 million gallons per day (MGD) of domestic waste water into the Ocmulgee River in 1990 (Marella and Fanning 1990). The cumulative effects of this effluent on Altamaha spinymussel habitat have not been quantified, but it is likely that the effluent has degraded the Altamaha spinymussel=s habitat through changes in water chemistry and the effects of eutrophication. Furthermore, it is not clear if the effluent discharged into these stream systems can be assimilated.

Contaminants associated with industrial and municipal effluents (e.g., heavy metals, ammonia, chlorine, numerous organic compounds) may cause decreased oxygen, increased acidity, and other water chemistry changes that may be lethal to mussels, particularly the highly sensitive early life stages of mussels (Rand and Petrocelli 1985, Sheehan et al. 1989, Keller and Zam 1991, Dimock and Wright 1993, Goudreau et al. 1993, Jacobson et al. 1993, Keller 1993). The adults of certain species may tolerate short-term exposure (Keller 1993), but low levels of some metals may inhibit glochidial attachment in some species (Huebner and Pynnönen 1992). Mussel recruitment may be reduced in habitats with low but chronic heavy metal and other toxicant inputs (Yeager et al. 1994, Naimo 1995, Ahlstedt and Tuberville 1997). Although effluent quality has improved with modern treatment technologies and a ban on phosphate detergents, municipal treatment plants were permitted in 1990 to discharge more than 43 MGD of waste water into the Altamaha River basin below the Fall Line, a geologic land form that separates the Piedmont and Coast Plain physiographic provinces (Marella and Fanning 1990). These discharges are likely to increase as human populations increase, which is expected to have negative long-term effects on the Altamaha spinymussel if contaminant levels within the discharges are not controlled.

A number of recent illegal effluent discharges into the Altamaha River basin that could have impacted the Altamaha spinymussel. For instance, the wastewater treatment discharge from Reidsville State Prison enters the Ohoopee River approximately six miles upstream of the largest historical population of Altamaha spinymussels known in the Ohoopee River. The Altamaha Riverkeeper, a watchdog group that works to maintain the quality of the Altamaha River system, reports discharge violations, and sues the violators in court, reported fecal coliform discharges from the prison that exceeded the prison=s National Pollutant Discharge Elimination System (NPDES) permit. In addition, the Altamaha Riverkeeper has recently won three court cases for violations of NPDES permits in the Altamaha River basin. In the first, it won a summary judgment against Amercord Inc. for numerous violations of Amercord=s NPDES permit at its Lumber City tire plant for discharges into the Ocmulgee River. In this case, Amercord was alleged to discharge quantities of cyanide, copper, zinc and lead in excess of its NPDES permit, and Amercord did not dispute the allegations. The second case was regarding alleged discharges into the Ocmulgee River from Lumber City=s waste treatment pond in excess of Lumber City=s NPDES permit. The Altamaha Riverkeeper won the case, and Lumber City agreed to implement several short term and long term waste water treatment improvements, which are expected to protect a population of Altamaha spinymussels. In the third case, the Altamaha Riverkeeper won a summary judgement after it disclosed discharges from the City of Cochran=s waste treatment pond from July 1995 to August 2000 in excess of the city=s NPDES permit. The City of Cochran has been releasing ferris sulfate (used to treat fecal coliform) into Jordan Creek, a tributary of the Ocmulgee River approximately 80 kilometers (50 miles) upstream of known populations of Altamaha spinymussels.

Agricultural sources of contaminants in the Altamaha River basin include nutrient enrichment from poultry farms and livestock feedlots, which occur primarily in the Piedmont portion of the basin, and pesticides and fertilizers from row crop agriculture, which occur primarily in the Coastal Plain portion of the basin (Couch et al. 1996, Frick et al. 1998). Stream ecosystems are negatively impacted when nutrients are added at concentrations that can not be assimilated

(Stansbery 1995). The effects of pesticides on mussels may be particularly profound (Fuller 1974, Havlik and Marking 1987, Moulton et al. 1996), and commonly used pesticides have been directly implicated in a North Carolina mussel die-off (Fleming et al. 1995). The Oconee, Ocmulgee, and Ohoopee River systems contain significant acreage in cotton and onion farming. One of the most important pesticides used in cotton farming, malathion, is known to inhibit physiological activities of mussels (Kabeer et al. 1979) that may decrease the ability of mussels to respire and obtain food.

The Altamaha Park is a marina on the Altamaha River approximately 10 miles downstream from State Route 301. A number of large houseboats are moored on the river throughout the year and release contaminants, such as fecal coliform, directly into the Altamaha River. The Georgia General Assembly recognized the adverse impacts on water quality that can be caused by recreational boats and recently passed legislation that increased the minimum requirements of boat sanitation systems to include either a holding tank or a U.S. Coast Guard-certified Marine Sanitation Device for all boats. Although this will potentially reduce the quantity of contaminants entering the river, the threat from this contaminant source has not been eliminated, and the Altamaha spinymussel has already been extirpated from this reach of the river (E. Keferl, pers. comm., 2001).

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

The Altamaha spinymussel is not a commercially valuable species nor are the streams that it inhabits subject to commercial mussel harvesting activities. This species has been actively sought for scientific and private collections. Such activity may increase as the species= rarity increases. Over-collection may have been a localized factor in the decline of this species, particularly in the Ohoopee River where a 1986 collection consisted of at least 30 live individuals (E. Keferl, pers. comm., 2002). The localized distribution and small size of known populations renders them extremely vulnerable to overzealous recreational or scientific collecting.

B. Disease or predation.

Diseases of freshwater mussels are poorly known. Juvenile and adult mussels are prey items for some invertebrate predators (particularly as newly metamorphosed juveniles) and parasites (e.g., nematodes, trematodes and mites), and provide prey for a few vertebrate species (otter, raccoon and turtles). Although predation by naturally occurring predators is a normal aspect of the population dynamics of a healthy mussel population, predation may amplify declines in small populations of this species.

C. The inadequacy of existing regulatory mechanisms.

Point source discharges within the range of the Altamaha spinymussel have been reduced since the inception of the Clean Water Act, but this may not provide adequate protection for filter feeding organisms that can be impacted by extremely low levels of contaminants. Several wood processing mills located in the Altamaha River basin discharge effluent directly into the basin=s streams. For example, Rayonier=s plant in Jesup, Georgia, is permitted to discharge approximately 60 MGD of treated wastewater into the Altamaha River. In addition, municipal wastewater plants continue to discharge large amounts of effluent and, in some circumstances (see section A above), in excess of permitted levels.

Although Best Management Practices for sediment and erosion control are often recommended and/or required by local ordinances for construction projects, compliance, monitoring, and enforcement of these recommendations are often poorly implemented. Furthermore, there are currently no requirements within the scope of Federal environmental laws to specifically consider the Altamaha spinymussel during Federal activities, or to ensure that Federal projects will not jeopardize its continued existence.

D. Other natural or manmade factors affecting its continued existence.

Non-indigenous species such as the flathead catfish (Pylodictis olivaris) and the Asian clam (Corbicula fluminea) have been introduced to the Altamaha Basin and may be having an adverse effect on the Altamaha spinymussel and other native species. Although the host fish or fishes of the Altamaha spinymussel have not been identified, in other native freshwater mussels, various centrachids have been identified as hosts of the larvae. Since the introduction of the flathead catfish in the Altamaha River, potential centrachid host fish such as the largemouth bass (Micropterus salmoides), redbreast sunfish (Lepomis auritus), and bluegill (L. macrochirus) have all suffered significant population declines (Harrison, pers. comm., 2001). If one of these species is the host for the Altamaha spinymussel, its breeding success and recruitment could be reduced (E. Keferl, pers. comm., 2001; C. Skelton, pers. comm., 2001), which might help explain the limited evidence of recruitment in recent surveys.

In contrast to the indirect effect of removing the spinymussel=s host fish, Asian clams may be a direct threat to native species through competition for available resources (i.e., space, minerals, or food) (Williams et al. 1993). Surveys have found large numbers of Asian clams in the Altamaha Basin for more than 25 years (Gardner et al. 1976; Stringfellow and Gagnon 2001; O=Brien, pers. comm., 2001).

Withdrawal of surface water within the Altamaha Basin for thermoelectric power generation, public water supplies, commercial industrial uses, and agriculture has a dramatic effect on flow rates. For example, Laurens County, Georgia, which includes the City of Dublin, withdrew 2.64 MGD for public water supplies, 12.79 MGD for commercial industrial use, and 5.57 MGD for agricultural uses in 1990 (Marella and Fanning 1990). In general, urban counties withdraw more water than rural counties. In 1990, the total amount of surface water withdrawn from the Altamaha River basin was 1315.88 MGD (Marella and Fanning 1990), and development pressures continue to grow which will lead to increased water withdrawals. Currently, the State of Georgia is considering additional water withdrawals from the Oconee River for a golf course (11 MGD) and the City of Greensboro (3 MGD) which would further reduce the amount of water available to the Altamaha spinymussel.

No major dams occur on the Altamaha River system within the known historical range of the Altamaha spinymussel. However, the dams that form Sinclair Reservoir on the Oconee River and Jackson and Tobesofkee Reservoirs in the Ocmulgee River basin can influence mussels and their populations through changes in flows that result from electrical power generation and water storage. Such removals can cause drastic flow reductions and alterations that may strand mussels on sandbars resulting in mortality of individuals and harm to populations. Within the Altamaha River basin, 1149 MGD was withdrawn for thermoelectric power generation in 1990 (Marella and Fanning 1990).

Drought conditions have persisted in Georgia since 1998 and have likely amplified the threats to the Altamaha spinymussel. Georgia averages 127 centimeters (50 inches) of precipitation annually (U.S. Geological Survey 1986) but has received less than 102 centimeters (40 inches) of precipitation annually since 1998. The Ohoopee River and many other streams in the basin are currently suffering reduced flow rates, and the Ohoopee River was reported to have an estimated average depth of 15 centimeters (6 inches) in the main channel during recent summer surveys (Stringfellow and Gagnon 2001). Normally, mussels will bury themselves in the river bottom as a mechanism to survive a drought, but many mussels may have desiccated (i.e., died) during this prolonged drought (E. Keferl, pers. comm., 2001).

The prolonged drought has resulted in other negative effects to the Altamaha spinymussel. For instance, the drought has opened the stream beds to all-terrain and four-wheel drive vehicle access (Stringfellow and Gagnon 2001), so mussels that might have survived the drought are now in danger of being crushed by heavy vehicular traffic in the river bed itself. Additionally, the low flow rates that have resulted provide lower volumes of water to dilute potential contaminants and, therefore, effectively increase the concentrations of contaminants in streams. Federally listed mussels in Spring Creek, which is part of the Flint River basin in southwest Georgia, were severely impacted (e.g., hundreds of mortalities) by drought and low stream flows, and similar impacts may be expected in the smaller tributaries of the Altamaha River basin if they become ephemeral.

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):

Approximately one-third of the Altamaha River floodplain is under State ownership and two-thirds is owned by private individuals and forest product industries. The State of Georgia manages several Wildlife Management Areas (WMA) along the river; however, some of this acreage is leased to the State by forest industries and is heavily logged. The following is a breakdown of ownership patterns in the floodplain of the Altamaha River: 1) private (41,613 acres or 34 percent); 2) forest industry (40,512 acres or 33 percent); 3) State (33,684 acres or 27 percent); 4) subdivision (2,848 acres or 2 percent); 5) non-forest industry (1,271 acres or 1 percent); 6) The Nature Conservancy (TNC) (1,105 acres or approximately 1 percent); 7) county (59 acres or approximately 1 percent); and 8) other/unknown (24 acres or approximately 1 percent). Detailed land use information for the Oconee and Ocmulgee rivers is not currently known.

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

Although few specific activities aimed at protecting the Altamaha spinymussel have been initiated, the Service works with several organizations, such as TNC, GDNR, and the Altamaha River Keeper, to protect the Altamaha River floodplain and adjacent uplands, which would be beneficial to the Altamaha spinymussel. TNC actively purchases lands within the river basin that exhibit unique biological values and works with landowners to restore and preserve other areas. The Altamaha River Keeper acts as a watchdog group by reporting potential violations of the Clean Water Act to appropriate agencies. Additionally, the Service, through it=s Partners for Fish and Wildlife program, has worked with private landowners within the watershed to restore wetlands and adjacent uplands, such as longleaf pine forests. The GDNR has received funds under section 6 of the Endangered Species Act to conduct surveys for the Altamaha spinymussel in the Ocmulgee River and to determine its host fish. Monies have also been awarded to the GDNR to explore the possibility of developing Candidate Conservation Agreements between the State and private landowners to help conserve the imperiled fauna of the Altamaha River.

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

Ahlstedt, S.A., and J.M. Tuberville. 1997. Quantitative reassessment of the freshwater mussel fauna in the Clinch and Powell Rivers, Tennessee and Virginia. Pages 72-97 In: K.S. Cummings, A.C. Buchanan, C.A. Mayer, and T.J. Naimo, eds. Conservation and management of freshwater mussels II: initiatives for the future. Proceedings of a UMRCC symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Aldridge, D.W., B.S. Payne, and A.C. Miller. 1987. The effects on intermittent exposure to suspended solids and turbulence on three species of freshwater mussels. Environmental Pollution 1987:17-28.

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

Burkhead, N.M., and R.E. Jenkins. 1991. Fishes. Pages 321-409 In: K. Terwilliger, coordinator. Virginia's endangered species. McDonald and Woodward Publishing Co., Blacksburg, Virginia.

Cammack, S.E., C.E. Skelton, and E.E. Van De Genachte. 2000. Altamaha Spinymussel Surveys. Altamaha Riverkeeper Newsletter. Winter 2000-2001.

Clench, W. J. 1962. Collecting freshwater mollusks in south central Georgia. Shells and Their Neighbors, 12: 1-7.

Clench, W.J. and R.D. Turner. 1956. Fresh-water mollusks of Alabama, Georgia, and from the Escambia to the Suwannee River. Bulletin of the Florida State Museum 1:97-239.

Coon, T.G., J.W. Eckblad, and P.M. Trygstad. 1977. Relative abundance and growth of mussels (Mollusca: Eulamellibranchia) in pools 8, 9, and 10 of the Mississippi River. Freshwater Biology 7:279-285.

Couch, C.A., E.H. Hopkins, and P.S. Hardy. 1996. Influences of environmental settings on aquatic ecosystems in the Apalachicola-Chattahoochee-Flint River basin. U.S. Geological Survey, National Water Quality Assessment Program. USGS Water Resources Investigations Report 95-4278.

Dennis, S.D. 1985. Distributional analysis of the freshwater mussel fauna of the Tennessee River system, with special reference to possible limiting effects of siltation. Tennessee Wildlife Resources Agency Report No. 85-2, Nashville, Tennessee. 171 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.

Dimock, R.V., Jr., and A.H. Wright. 1993. Sensitivity of juvenile freshwater mussels to hypoxic thermal and acid stress. Journal of the Elisha Mitchell Scientific Society 109(4): 183-192.

Ellis, M.M. 1931. Some factors affecting the replacement of the commercial fresh-water mussels. U.S. Bureau of Fisheries Circular 7. 10 pp.

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

Fleming, W.J., T.P. Augspurger, and J.A. Alderman. 1995. Freshwater mussel die-off attributed to anticholinesterase poisoning. Environmental Toxicology and Chemistry 14 (5):877-879.

Frick, E.A., D.J. Hippe, G.R. Buell, C.A. Couch, E.H. Hopkins, D.J. Wangsness, and J.W. Garrett. 1998. Water quality in the Apalachicola-Chattahoochee-Flint River basin, Georgia, Alabama, and Florida, 1992-95. U.S. Geological Survey Circular 1164. 38 pp.

Fuller, S.L.H. 1974. Clams and mussels (Mollusca: Bivalvia). Pages 215-273 In: C.W. Hart and S.L.H. Fuller, eds. Pollution ecology of freshwater invertebrates. Academic Press, New York.

Grace, T.B., and A.C. Buchanan. 1981. Naiades (mussels) of the Lower Osage River, Tavern Creek, and Maries River, Missouri. Unpublished report, Missouri Department of Conservation, Jefferson City. 147 pp.

Gardner, J.A., Jr., W.R. Woodall, Jr., A.A. Staats, Jr., and J.F. Napoli. 1976. The invasion of the Asian clam (Corbicula manilensis Philippi) in the Altamaha River, Georgia. Nautilus, 90:117-125.

Goudreau, S., R.J. Neves, and R.J. Sheehan. 1993. Effects of wastewater treatment plant effluents on freshwater mollusks in the upper Clinch River, Virginia, USA. Hydrobiologia 252(3):211-230.

Harrison, D., 2001. Fisheries Biologist, Georgia Department of Natural Resources.

Unpublished data. Personnel communication, December 2001.

Hartfield, P. 1993. Headcuts and their effect on freshwater mussels. Pages 131-141 In: K.S. Cummings, A.C. Buchanan, and L.M. Koch, eds. Conservation and management of freshwater mussels. Proceedings of an UMRCC symposium, 12-14 October 1992, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Hartfield, P.D., and E. Hartfield. 1996. Observations on the conglutinates of Ptychobranchus greeni (Conrad, 1834) (Mollusca: Bivalvia: Unionoidea). American Midland Naturalist 135:370-375.

Havlik, M. E. and L. Marking. 1987. Effects of contaminants on naiad mollusks (Unionidae): a review. U.S. Fish and Wildl. Serv., Resource. Publ. 164. 20 pp.

Hoover, T.B. 1978. Inorganic species in water: ecological significance and analytical needs. U.S. Environmental Protection Agency, EPA-600/3-78-064.

Horne, F.R., and S. McIntosh. 1979. Factors influencing distribution of mussels in Blanco River, of central Texas. The Nautilus 93:119-133.

Houp, R.E. 1993. Observations on long-term effects of sedimentation on freshwater mussels (Mollusca: Unionidae) in the North Fork of Red River, Kentucky. Transactions of the Kentucky Academy of Science 54:93-97.

Hubbard, W.D., D.C. Jackson, and D.J. Ebert. 1993. Channelization. Pages 135-155 In: E.F. Bryan, and D.A. Rutherford, eds. Impacts on warmwater streams: guidelines for evaluation. Warmwater Stream Committee, Southern Division, American Fisheries Society, Little Rock, Arkansas.

Huebner, J.D., and K.S. Pynnönen. 1992. Viability of glochidia of Anodonta exposed to low pH and selected metals. Canadian Journal of Zoology 70:2348-2355.

Imlay, M.J. 1972. Greater adaptability of freshwater mussels to natural rather than to artificial displacement. The Nautilus 86(2):76-79.

Imlay, M.J. 1982. Use of shells of freshwater mussels in monitoring heavy metals and environmental stresses: a review. Malacological Review 15:1-14.

Jacobson, P.J., J.L. Farris, D.S. Cherry, and R.J. Neves. 1993. Juvenile freshwater mussel (Bivalvia: Unionidae) responses to acute toxicity testing with copper. Environmental Toxicology and Chemistry 12:879-883.

Johnson, R. I. 1970. The systematics and zoogeography of the Unionidae (Mollusca: Bivalvia) of the Southern Atlantic Slope Region. Bull. Mus. Comp. Zool. 140: 263-449.

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. Wisconsin Department of Natural Resources Research Report 155. 32 pp.

Kat, P.W. 1982. Effects of population density and substratum type on growth and migration of Elliptio complanata (Bivalvia: Unionidae). Malacological Review 15(1-2):119-127.

Keller, A.E. 1993. Acute toxicity of several pesticides, organic compounds and a wastewater effluent to the freshwater mussel, Anodonta imbecillis, Ceriodaphnia dubia and Pimephales promelas. Bulletin of Environmental Contamination and Toxicology 51:696-702.

Keller, A.E., and M. Lydy. 1997. Biomonitoring and the hazards of contaminants to freshwater mollusks. Unpublished report In: Freshwater mollusks as indicators of water quality: a workshop. U.S. Geological Survey, Biological Resources Division and National Water Quality Assessment Program. 55 pp.

Keller, A.E., and S.G. Zam. 1991. The acute toxicity of selected metals to the freshwater mussel, Anodonta imbecilis (sic). Environmental Toxicology and Chemistry 10:539-546.

Lagasse, P.F., B.R. Winkley, and D.B. Simons. 1980. Impact of gravel mining on river system instability. Journal of the Waterway, Port, Coastal, and Ocean Division 13:389-404.

Marking, L.L., and T.D. Bills. 1979. Acute effects of silt and sand sedimentation on freshwater mussels. Pages 204-211 In: J.R. Rasmussen, ed. Proceedings of the UMRCC symposium on upper Mississippi River bivalve mollusks. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Kabeer, A. I., M. Sethuraman, M.R. Begum, and R.K. Ramana. 1979. Effect of malathion on ciliary activity of fresh water mussel, Lamellidens marginalis (Lamarck). Comp. Physiol. Ecol. 4:71-73.

Keferl, E. P. 1993. The status of freshwater mussels in some Georgia, South Carolina, and North Carolina waters. In: Proceedings of the 1993 Georgia Water Resources conference, K. J. Hatcher, Ed., Institute of Ecology, University of Georgia, Athens. pp. 298-302.

Keferl, E. P. 1981. A survey of the naiades of the Ohoopee River, Georgia. The Bulletin of the American Malacological Union, Inc. 11-15.

Marella, R. L., and J.L. Fanning.1990. National Water Quality Assessment of the Georgia-Florida Coastal Plain Study Unit-Water Withdrawals and Treated wastewater Discharges. U. S. Geological Survey. 76 pp.

McCann, M.T., and R.J. Neves. 1992. Toxicity of coal-related contaminants to early life stages of freshwater mussels in the Powell River, Virginia. Unpublished report, U.S. Fish and Wildlife Service, Asheville, North Carolina. 92 pp.

Meeks, G., and L.C. Runyon, 1990, Wetland Protection and the States, National Conference of State Legislatures, Denver Colo., 26 pp.

Mellinger, P. J. 1972. The comparative metabolism of cadmium, mercury, and zinc as environmental contaminants in the freshwater mussel, Margaritifera margaritifera. Ph.D. thesis, Oregon State University, Corvallis. 129 pp.

Moulton, C.A., W.J. Fleming, and C.E. Purnell. 1996. Effects of two cholinesterase-inhibiting pesticides on freshwater mussels. Environmental Toxicology and Chemistry 15:131-137.

Naimo, T.J. 1995. A review of the effects of heavy metals on freshwater mussels. Ecotoxicology 4:341-362.

Neves, R.J. 1997. A national strategy for the conservation of native freshwater mussels. Pages 1-10 In: K.S. Cummings, A.C. Buchanan, C.A. Mayer, and T.J. Naimo, eds. Conservation and management of freshwater mussels II: initiatives for the future. Proceedings of the UMRCC symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

O=Brien, C.A. and J. Brim Box. in prep. Status survey of the Altamaha spinymussel (Elliptio spinosa) in the Altamaha River. Final Report for GDNR.

Rand, G.M., and S.R. Petrocelli. 1985. Fundamentals of aquatic toxicology. Hemisphere Publishing Corporation, New York. 666 pp.

Richter, B.R., D.P. Braun, M.A. Mendelson, and L.L. Master. 1997. Threats to imperilled freshwater fauna. Conservation Biology 11:1081-1093.

Salomons, W., N.M. de Rooij, H. Kerdijk, and J. Bril. 1987. Sediments as a source for contaminants? Hydobiologia 149:13-30.

Schuster, G.A., R.S. Butler, and D.H. Stansbery. 1989. A survey of the unionids (Bivalvia: Unionidae) of Buck Creek, Pulaski County, Kentucky. Transactions of the Kentucky Academy of Science 50:79-85.

Sheehan, R.J., R.J. Neves, and H.E. Kitchel. 1989. Fate of freshwater mussels transplanted to formerly polluted reaches of the Clinch and North Fork Holston rivers, Virginia. Journal of Freshwater Ecology 5:139-149.

Sickel, J. B. 1980. Correlation of unionid mussels with bottom sediment composition in the Altamaha River, Georgia. The Bulletin of the American Malacological Society. 10-13 pp.

Stansbery, D.H. 1970. Eastern freshwater mollusks (I): the Mississippi and St. Lawrence River systems. Pages 9-21 In: A.H. Clarke, ed. Proceedings of the American Malacological Union symposium on rare and endangered mollusks, Malacologia 10(1).

Stansbery, D.H. 1971. Rare and endangered molluscs in the eastern United States. Pages 5-18 In: S.E. Jorgensen and R.W. Sharpe, eds. Proceedings of a symposium on rare and endangered mollusks (naiads) of the United States. U.S. Fish and Wildlife Service, Twin Cities, Minnesota.

Stansbery, D.H. 1995. Comments on AResults of a status survey of eight freshwater mussels (Bivalvia: Unionidae) endemic to eastern Gulf Slope drainages of the Apalachicolan Region of southeast Alabama, southwest Georgia, and north Florida@[Butler 1993]. Unpublished report, Museum of Biological Diversity, The Ohio State University, Columbus. 5 pp.

Stringfellow, C. and P. Gagnon. 2001. Final Report of the Altamaha Spiny Mussel Survey in the lower Ohoopee River. Submitted to US Fish and Wildlife Service. 10 pp.

van der Schalie, H. 1938. Contributing factors in the depletion of naiades in eastern United States. Basteria 3(4):51-57.

Want, W.L., 1990, Law of Wetland Regulation (release #1/7/90), Clark-Boardman Company, Ltd, New York.

Wegert, R.G., J.O. Blanto, M. Alber, and A.G. Chalmers, 1999, Human impacts on the Salinity regimes of coastal Georgia Estuaries, Final Report, Dept. Of Marine Sciences, UGA, Athens, GA, 13 pp.

Wilber, C.G. 1983. Turbidity in the aquatic environment: an environmental factor in fresh and oceanic waters. C.C. Thomas, Springfield, Illinois.

Williams, J. D., M. L. Warren, Jr., K. S. Cummings, J. L. Harris, and R. J. Neves. 1992. Conservation Status of freshwater mussels of the United States and Canada. Fisheries 18 (9): 6-22.

Wolcott, L.T., and R.J. Neves. 1991. Impacts of siltation on mussel fauna of the Powell River. Unpublished report, U.S. Fish and Wildlife Service, Asheville, North Carolina. 7 pp.

U.S. Geological Survey. 1986. National water summary 1985-Hydrologic events and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, 506 pp.

Yeager, B.L. 1994. Impacts of reservoirs on the aquatic environment of regulated rivers. Tennessee Valley Authority, Resource Group Water Management, TVA/WR-93/1.

Yokley, P., Jr., and C.H. Gooch. 1976. The effect of gravel dredging on reservoir primary production, invertebrate production, and mussel production, July 1, 1974 - June 30, 1976. Tennessee Wildlife Resources Agency Technical Report 76-56. 32 pp.

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: Although the species were found in the past two years from the Ocmulgee and Altamaha Rivers, the recent surveys only found 25 live mussels were found in over 250 person hours of searching throughout the historical range.

Imminence: The core of the remaining population of this species occurs within the influence of the Plant Hatch (Nuclear Power Plant). The Service and the State of Georgia have begun the process of engaging this entity in the hopes of developing a Candidate Conservation Agreement to address the species, the identified threats, and its habitat requirements.

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, annual retentions of candidates, 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:

-

-

Date of annual review: March 2003

Conducted by: James Rickard - Athens, Georgia FO

Comments:

-

-

-