Yellow-blotched map turtle
(*Graptemys flavimaculata*)

5-Year Review:
Summary and Evaluation

Yellow-blotched map turtles; adult female on the left and adult male on the right. Photo: © Will Selman

U.S. Fish and Wildlife Service
Southeast Region
Mississippi Ecological Services Field Office
Jackson, Mississippi

5-YEAR REVIEW
Yellow-blotched map turtle / *Graptemys flavimaculata*

I. GENERAL INFORMATION

A. Methods used to complete the review: In conducting this 5-year review, we relied on the best available information pertaining to historical and current distributions, life histories, and habitats of this threatened species. We announced initiation of this review and requested information in a published *Federal Register* notice on April 9, 2010 (75 FR 18233). We reviewed information in our files and solicited information from all knowledgeable individuals including those associated with academia and State conservation programs. Our sources include the final rule listing this species under the Endangered Species Act (ESA); the Recovery Plan; peer reviewed scientific publications; unpublished field observations by Service, State and other experienced biologists; unpublished survey reports; and notes and communications from other qualified biologists or experts. The completed draft was forwarded to four peer reviewers for their review. Their comments were reviewed and incorporated into this final document as appropriate (see Appendix A).

B. Reviewers

Lead Region: Southeast Region: Kelly Bibb, 404-679-7132

Lead Field Office: Mississippi Ecological Services: Linda V. LaClaire, 601-321-1126

C. Background

1. **Federal Register Notice citation announcing initiation of this review:** April 9, 2010 (75 FR 18233)

2. **Species status:** Unknown. The current and most comparable survey data from the Leaf River and the Chickasawhay River indicate a decline in the yellow-blotched map turtle populations that occur there. Results from recent survey work have documented that numbers of turtles in the lower Pascagoula River population, which is the largest and historically most robust, appear to be improving after a precipitous decline after Hurricane Katrina. Further monitoring, with standardized survey techniques, is needed to verify the status of all yellow-blotched map turtle populations.

3. **Recovery achieved**: 2 (26-50% recovery objectives achieved)
The trend in yellow-blotched map turtle population densities is not well understood. However, segments of terrestrial habitat, adjacent to

the Pascagoula River where the turtles occur, have been provided a measure of habitat protection in conservation areas. Multiple threats, similar to those at the time of listing, are still occurring within the riverine habitat.

4. **Listing history**
   Original Listing
   FR notice: 56 FR 1459
   Date listed: January 14, 1991
   Entity listed: Species
   Classification: Threatened

5. **Review History**:
   Final Recovery Plan: 1993

   Each year the Service reviews and updates listed species information to benefit the required Recovery Report to Congress. Through 2013, we did a recovery data call that included status recommendations such as "Unknown" for this turtle. We continue to show this species status recommendation as part of our 5-year reviews. The most recent evaluation for this turtle was completed in 2017.

6. **Species' Recovery Priority Number at start of review (48 FR 43098)**: 14
   Degree of Threat: Low
   Recovery Potential: High
   Taxonomy: Species

7. **Recovery Plan:**
   Name of plan: Yellow-blotched Map Turtle (*Graptemys flavimaculata*) Recovery Plan
   Date issued: March 15, 1993

II. REVIEW ANALYSIS

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

1. Is the species under review listed as a DPS? No

2. Is there relevant new information that would lead you to reconsider the classification of this species with regard to designation of DPSs? No

B. Recovery Criteria

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

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. Revision of the minimum basking density requirements under Criterion (1) is necessary to determine the appropriate recovery criterion that reflects total population densities. Additional populations located since the turtle's listing need to be assessed and considered in formation of recovery criteria.

   b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? Yes

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.**

   The yellow-blotched map turtle will be considered for delisting when:

   Criterion (1): Evidence of a stable or increasing population in the Leaf, Chickasawhay, and Pascagoula Rivers for a period of at least 15 years. A stable population is defined as one having the reproductive capability to sustain itself without immigration of individuals from other populations. Minimum density estimates from basking counts should average at least 44 yellow-blotched map turtles per river kilometer (km) (70 turtles per river mile (mi)) in the Pascagoula River, and at least 22 yellow-blotched map turtles per km (35 turtles per river mi) in both the Leaf and Chickasawhay Rivers over the 15-year period.

   Status: Criterion is not met. At the time the yellow-blotched map turtle was listed, baseline population data were limited. The basking counts used as density estimate standards in the recovery plan were based on presence/absence data collected prior to 1993 (Stewart 1989). Subsequent surveys have provided data based on a population analysis using a number of different techniques that are not directly comparable. These include: three different types of basking surveys (document presence) of unmarked individuals (from bridge crossings, sandbars that provided potential as nesting sites, and moving boat/canoe); trapping at basking sites; mark-recapture or mark-resight studies (estimate population abundance) of turtles marked with tags or paint with group or individual marks. Standardized data collection to determine population abundance, rather than document presence, is

critical to evaluate population trends, the degree of threat imposed by various factors, and the outcomes of conservation management. Evidence of meeting this criterion would be data from basking counts, which maintain the benchmark density estimates over a 15-year period. Although there are current records of yellow-blotched map turtles from a number of Pascagoula River, Chickasawhay River, and Leaf River tributary streams, as well as the lower reach of the Escatawpa River, the turtle's status in these areas was unknown at the time the species' recovery plan was written; for this reason these areas were not included in Criterion 1, but the value of these populations to the recovery of the species needs to be assessed.

a. The Yellow-blotched Map Turtle Recovery Plan suggested that specific study populations be designated and monitored using a standard protocol for basking surveys across 18 monitoring stations. At least six different yellow-blotched map turtle surveys, some separated by as long as 8 years, have occurred since the species was listed. Unfortunately, because of differences in techniques and specific study sites, the data are generally not comparable and currently we cannot determine if the population densities set forth in the recovery plan under Criterion 1 have been met (see discussion under **II. C. 1. b. Abundance, population trends, demographic features, or demographic trends**). There has been no long-term monitoring study to validate population trends in any of the river systems occupied by the species. We have described the species' status as "unknown" because we currently do not have the data to adequately assess the current status of the species.

Criterion (2): Protection of yellow-blotched map turtle habitat on the entire Pascagoula River and the lower 129 km (80 mi) of both Leaf and Chickasawhay Rivers. The areas to be protected begin, on the Leaf River, at the U.S. 84 bridge in Covington County, and on the Chickasawhay River, in the vicinity of Quitman, Clarke County. Protection is defined as having sufficient control over the watershed that adverse environmental impacts are unlikely to occur.

Status: Criterion is partially met. Protection of the Pascagoula River began in the 1970s, prior to Federal listing of the yellow-blotched map turtle. Riverine and upland habitat was purchased by The Nature Conservancy (TNC) and transferred to the State of Mississippi as the Upper/Lower Pascagoula Wildlife Management Area (WMA). By 2002, TNC had acquired habitat from the confluence of the Leaf and Chickasawhay Rivers that connected to the Upper Pascagoula WMA. Also subsequent to Federal listing, the U.S. Army Corps of Engineers (Corps) acquired habitat along the lower Pascagoula River that became the Ward Bayou WMA and developed a management plan for the

yellow-blotched map turtle on the site (U.S. Army Corps of Engineers 2004). In 2016, TNC transferred property along the Leaf and Pascagoula Rivers in George and Green County to the Mississippi Forestry Commission for future management and protection (TNC 2017). Yellow-blotched map turtles occur throughout this protected corridor and are particularly abundant in the Ward Bayou and Lower Pascagoula WMAs. As a result of these areas, which are adjacent to approximately 112 river km (70 river mi) of the Pascagoula River, a large segment of the riverine habitat occupied by the yellow-blotched map turtle has the potential to be under some form of protection. The same cannot be said of the Leaf and Chickasawhay Rivers. Less than 10 river km (6 river mi) of the Chickasawhay River has been protected (TNC property); no conservation areas currently exist along the Leaf River. Areas that are unprotected and should be prioritized for conservation include yellow-blotched map turtle habitat north of Hattiesburg on the Leaf River (the northernmost substantial population in the Leaf River) and occupied sections of the Chickasawhay River and the Escatawpa River.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. New information on the species' biology and life history:

There is significant sexual size dimorphism in the yellow-blotched map turtle; adult females reach over twice the length and ten times the mass of adult males (Selman and Jones 2011). Growth and development is rapid during the first five years of life for both males and females; at five years, growth in males drops off and females continue to grow (Jones 1994). The minimum age at maturity for males is 4 years and for females it is 10 years (Jones 1994). Longevity in yellow-blotched map turtles has been estimated to be 30+ years for males and 50+ years for females (Selman and Qualls 2005, 2006).

Jones (1996) conducted a study of the home range and seasonal movements of yellow-blotched map turtles. He estimated the male mean home range area to be 1.12 ha (2.77 ac) with a mean home range stream length of 1.8 km (1.13 mi) and female mean home area to be 5.75 ha (14.2 ac) with a mean home range stream length of 1.5 km (0.94 mi) (Jones 1996). Yellow-blotched map turtles were found to be active all year. Seasonal movements appeared to be associated with nesting (females), searching for mates (males), and /or avoiding increased currents during winter (both males and females) (Jones 1996). Most turtles were associated with the outer cutbank, where the river was deeper and had a

higher abundance of deadwood (downed logs and snags that have fallen into the river) for basking. Some individual turtles had fidelity to small stretches of one side of the river with many turtles recaptured on the same logs where they were originally captured (Jones 1994, 1996). During flooding events, individual turtles moved away from the main river channel to accessory channels or associated cypress/oxbow ponds.

Yellow-blotched map turtles are primarily active during the day when they are commonly observed basking on deadwood from early morning to evening during all months of the year. Basking is a thermoregulatory activity. Studies have shown that during the spring, females bask at higher frequencies than males, presumably to accelerate egg development (Selman and Jones 2011). In the fall, which coincides with male gonadal growth (Shelby *et al.* 2000), males bask more frequently than females (Selman and Jones 2011). Human activity has a dramatic impact on turtle basking behavior. Moore and Seigel (2006) found that passing boats disturbed yellow-blotched map turtles from their basking locations on the lower Pascagoula River 33 percent of the time. Fisherman (74 percent) and speedboats (67 percent) caused the highest rates of disturbance and females were more likely to leave their basking locations than males (Moore and Seigel 2006). Selman, Qualls, and Owen (2013) expanded on Moore and Seigel's study to include a comparison of a recreationally disturbed site to an undisturbed upstream site (control). When comparing the disturbed site with the control, measurements of physiological response to disturbance indicated increased levels of stress and significantly poorer shell condition (Selman, Qualls, and Owen 2013). They also found that females were more negatively affected by disturbance (Selman, Qualls, and Owen 2013). Basking turtles were startled by the visual presence of a disturbance as well as being swept from basking sites by the wakes of passing boats (Selman, Qualls, and Owen 2013). In addition, Selman, Qualls, and Owen (2013) found dead turtles that had been hit by recreational boats.

Data on food habits of yellow-blotched map turtles have been reported by Seigel and Brauman (1994) and Selman and Lindeman (2017). Food items have been described from both dissected preserved turtles and fecal samples. The results from the studies indicate that yellow-blotched map turtles feed mainly on sponges (which grow on submerged objects), mollusks (clams/mussels), insects, and algae (Seigel and Brauman 1994, Selman and Lindeman 2017). Diets varied significantly between the sexes; females appeared to shift their diet to more clams/mussels in the spring and fall, likely associated with more energy and calcium needs in preparation for egg laying (Selman and Lindeman 2017). An interesting aspect of the Selman and Lindeman (2017) study was the presence of wood fragments and polystyrene in feces. The wood indicates that foraging is associated with deadwood (which may also provide basking

sites), while the polystyrene indicates that turtles are foraging on unnatural substrates, possibly houseboats that are commonly moored along the Pascagoula River and use polystyrene blocks for floatation (Selman and Lindeman 2017).

Horne *et al.* (2003) reported results from their 4-year study of reproduction and nesting of the yellow-blotched map turtle. They found females were gravid and nested from between 18 (first gravid female) and 28 (first nest) May to 31 July (last gravid female) through 14 August (last nest); thus, the reproductive season lasts from 80 to 87 days. The mean clutch size measured over a 3-year period was 4.7. The size of gravid females varied little among years. However, a significant relationship was found between carapace length and clutch size; for each 2 cm (0.79 in) increase in carapace length there was an increase of one additional egg per clutch (Horne *et al.* 2003). Study of the reproductive frequency indicated that most females laid only one clutch per year although some females laid a second clutch (Shelby *et al.* 2000, Horne *et al.* (2003). A study of yellow-blotched map turtles in the lower Pascagoula River, an area of known historical industrial pollution, found that the turtles exhibited apparently abnormal steroid hormone levels which could potentially alter their reproductive frequency (Shelby *et al*. 2000, Shelby and Mendonca 2001). Seigel and Brauman (1995) found that indeed female yellow-blotched map turtles from the lower Pascagoula River produced smaller clutch sizes and had the lowest clutch frequency when compared to other species of *Graptemys*. This is confounded by the fact that populations in the lower reaches of the Pascagoula River attain a significantly larger size than individuals in the upper reaches of the drainage (reported in Selman and Jones 2011). A cause for this discrepancy could be a result of lingering effects of dioxin pollution that are negatively affecting hormone levels but not growth rates.

Horne *et al.* (2003) found nest sites were located on sandbars (79.4 percent), or in small clearings along the banks of the river (20.6 percent). Sources of mortality of unprotected nests varied among years, with predation rates of 41.9 to 100 percent and nest flooding rates of 0 to 48.4 percent (Horne *et al.* 2003). Predators directly observed eating eggs from yellow-blotched map turtle nests included fish crows (*Corvus ossifragous)*, nonnative fire ants (*Solenopsis invicta*), and speckled kingsnakes (*Lampropeltis getula*); other predator sign observed included that from raccoons (*Procyon lotor*) and feral pigs (*Sus scrofa*) (Horne *et al.* 2003). Females selected non-vegetated areas of sandbars over vegetated areas. An important aspect of nest site selection is that yellow-blotched map turtles have temperature-controlled sex determination as in other *Graptemys* (Vogt and Bull 1982, Vogt and Bull 1984); males develop at lower temperatures than females. The percent of eggs

producing hatchlings from successful (unpredated) nests ranged from 56.1 to 82.8 percent (Horne *et al.* 2003).

b. Abundance, population trends, demographic features, or demographic trends:

The Yellow-blotched Map Turtle Recovery Plan (U.S. Fish and Wildlife Service 1993) calls for ongoing monitoring of the status of the turtle populations to detect trends. Since the turtle was federally listed, surveys have been conducted over four specific time periods (Jones 1994, 1996; Lindeman 1998, 1999; Selman and Qualls 2008, 2009; Brown *et al.* 2016). Yellow-blotched map turtle numbers were obtained by observing turtles on basking substrates and used to generate basking densities as a minimum population estimate (since not all turtles are basking at any one time). In addition, turtles were also trapped and multiple mark/resight or recapture techniques were used to generate estimates of total population densities at a given site. Estimates for numbers of turtles at study sites on the Pascagoula, Chickasawhay and Leaf Rivers varied, sometimes considerably, during and across years of these studies. The above referenced studies also reported observations of yellow-blotched map turtles in the small Escatawpa River population and documented range extensions for the species in a number of Pascagoula River tributaries; few data are available on the viability of populations in these areas.

The most recent population estimates in the Pascagoula, Chickasawhay and Leaf Rivers are from surveys completed by Brown *et al*. (2016). These surveys were conducted at the same sites used for the most recent previous surveys (Selman and Qualls 2009, Selman *et al.* 2009). Three sites, one each in the Leaf River, Chickasawhay River, and the lower Pascagoula River, were systematically resampled in the same manner as Selman *et al.* (2009) and the same program (NOREMARK) was used to estimate population size. A comparison of the two population estimates per river km (river mi) (Selman *et al.* 2009: Brown *et al*. 2016) are as follows: Chickasawhay River- 93 turtles/river km (149/river mi):26 turtles/river km(42/river mi); Leaf River- 96 turtles/river km(154/river mi):60/ river km(96/river mi); and lower Pascagoula River- 292 turtles/river km(467/river mi): 543 turtles/river km (869/river mi). The Brown *et al*. (2016) data indicate a decline in population estimates from those of 8 years earlier at two of the three sites. These density estimates are not comparable to those designated in the recovery criteria (see **Criterion 1**) based on basking counts which can be 10 to 30 percent lower than the total population numbers (Jones 1994). The initial population estimate shown above for the lower Pascagoula River is for the year following Hurricane Katrina (2005-2006) when the population declined by 47 percent when compared to pre-hurricane numbers (Selman and Qualls 2008; Selman, Qualls, and Mendonca 2009). No similar decline was

observed upstream in the Leaf River where the impacts from the hurricane were presumably less severe (Selman and Qualls 2005, 2006). Based on data in Brown *et al*. (2016), it appears that population numbers in the lower Pascagoula River have improved since their decline following Hurricane Katrina.

Preliminary population viability analysis indicated populations studied by Horne *et al.* (2003) were very sensitive to changes in adult survival and moderately sensitive to changes in juvenile survival. This has important implications for sensitivity of yellow-blotched map turtle populations to mortality and threats to specific age classes of turtles.

c. Genetics, genetic variation, or trends in genetic variation:

In initial studies of the molecular systematics of map turtles (genus *Graptemys*), mitochondrial DNA (mtDNA) were used to estimate the levels of variation between species. The results of these studies revealed relatively low levels of variation between species in this group when compared to other vertebrate genera (Lamb *et al.* 1994). However, results from more recent work using nuclear DNA (nucDNA) strongly support the traditional "sawback" clade (yellow-blotched map turtle, black-knobbed map turtle (*G. nigrinoda*), and the ringed map turtle (*G. oculifera*)) and the species-level relationships within it (Wiens *et al.* 2010). This is important because the almost identical mtDNA sequences of these species might lead to the mistaken assertion that they were not, in fact, distinct species (Wiens *et al.*, 2010). Ennen *et al.* (2010) studied mtDNA in yellow-blotched and ringed map turtles. Their data supported previous findings of limited genetic differentiation between the two species; however, the results of their morphological analyses, in conjunction with the above referenced nucDNA data, supported the continued recognition of the two species (Ennen *et al.* 2010).

Levels of genetic variation and population structure among yellow-blotched map turtle populations have been studied. Selman, Kreiser, and Qualls (2013) used microsatellite data to analyze population genetic structure, assess historical demography, and determine effective population size at six sites throughout the Pascagoula River system. Considerable genetic diversity was found within each site and an analysis of molecular variance indicated that most variation was partitioned within rather than among sites. No evidence of genetic bottlenecks was found. The largest genetic differences were found in the Escatawpa River population when compared to all other populations and likely reflect that population's historical isolation from those in the Pascagoula River (Selman, Kreiser, and Qualls 2013).

d. Taxonomic classification or changes in nomenclature:

A recent publication on the diversity of North American map and sawback turtles has suggested that the *Graptemys* genus is taxonomically oversplit and may need to be revised (Praschag *et al*. 2017). This position had also been presented in a previous review of freshwater turtle systematics (Walker and Avise 1998); however, see discussion above under **II. C. 1. c. Genetics, genetic variation, or trends in genetic variation**. Nevertheless, because Praschag *et al*. (2017) did not present explicit taxonomic revisions, a subsequent annotated checklist of turtles of the world provided no changes to existing *Graptemys* systematics (Turtle Taxonomy Working Group 2017). In addition, Praschag *et al*. (2017) has been refuted by many taxonomists because samples for the study originated from captive specimens of unknown origin (W. Selman, pers. comm. 2017). Phylogenetic work described in a soon to be published paper (Thomson *et al*. In Press) suggests that the yellow-blotched map turtle lineage is recently isolated (in geologic time), and is a result of divergence from *Graptemys* populations in adjacent, but no longer connected, river systems (Pearl River and Alabama River systems).

e. Spatial distribution, trends in spatial distribution or historic range:

The yellow-blotched map turtle is restricted to the Pascagoula River system including the Leaf, Chickasawhay, and Escatawpa Rivers and their larger tributaries (Cagle 1954, Cliburn 1971, McCoy and Vogt 1980, Selman and Qualls 2009, Floyd and Floyd 2013). The majority of yellow-blotched map turtles occur in approximately 567 km (354 m) of riverine habitat; 99 km (61.9 m) of the Pascagoula River, 219 km (136.9 mi) of the Leaf River, and 249 km (155.6 m) of the Chickasawhay River (Selman and Jones 2011). They are not found in the tidally influenced section of the lower Pascagoula River; the downstream limits for the turtles, as currently understood, are 13.5 river km (8.4 mi) north of the mouth of the Pascagoula River (Selman and Jones 2011). The small population of yellow-blotched map turtle populations in the Escatawpa River appears to be disjunct from the main population within the lower Pascagoula River because of the unsuitable brackish marsh habitat that separates them (Selman and Jones 2011).

The yellow-blotched map turtle's distribution has been monitored periodically since its listing under the ESA. The highest densities of this turtle tend to occur in the mainstem Pascagoula River from Vancleave north to Hattiesburg, with lower densities in the Chickasawhay River and the Leaf River. Recent surveys indicate that the species continues to occupy all historical drainage localities to the distributional limits originally described, including portions of the Escatawpa River (Cliburn 1971, Selman and Qualls 2009, Brown *et al.* 2016). New drainage localities have been documented from the Leaf River and its tributaries, as

well as northern range expansions (Lindeman 1998, Selman and Qualls 2009). Since the time of listing, new county records for yellow-blotched map turtles have been documented in Lauderdale County (Okatibbee Creek, a tributary of the Chickasawhay River) and Smith County (Leaf River) (Selman and Qualls 2009, Lindeman 2017). Pollution from industrial discharges at some of these areas where the turtle has been newly observed has likely declined, and water quality improved, as a result of the Clean Water Act (CWA) and other regulations implemented since the early surveys by Cagle (1954) and Cliburn (1971).

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

Yellow-blotched map turtles are most abundant in large to medium-sized rivers that provide open canopies for sunlit basking opportunities; contain abundant deadwood snags for basking and foraging; and numerous sandbars for nesting. Medium to large creeks (15 to 30 meters (m) (49 to 98 feet (ft)) wide) may also be occupied if they offer similar habitat characteristics (Selman and Qualls 2009).

Available current data on the Pascagoula River system indicate that since the time of listing there have been both improvements and additional degradation in the quality of yellow-blotched map turtle habitat (Lindeman 1998, Shelby and Mendonca 2001, Selman and Qualls 2005, 2006, 2009; Brown *et al*. 2016, Lindeman 2017). However, due to the limited data set on habitat conditions at the time of listing, it is difficult to determine if current ecosystem conditions represent an overall improvement in habitat amount and suitability. New records of yellow-blotched map turtles document a wider distribution than that known at the time of listing (see discussion above under **II. C. 1. e. Spatial distribution, trends in spatial distribution or historic range** regarding new records), however these are primarily from localities not previously surveyed for the species.

Changes that have occurred in the Pascagoula River system since the listing of the yellow-blotched map turtle include reduction in permitted sand and gravel mining; reduction in the number of de-snagging projects; expansion of use of Best Management Practices during timber harvest; and recovery of water quality from dioxin contamination due to a spill from a paper mill. Water quality improvements can also be inferred from the numbers of yellow-blotched map turtles on the lower Leaf and Pascagoula Rivers in areas which were previously unoccupied (Selman and Qualls 2009). Although water quality appears to be improved in an area of the lower Pascagoula River contaminated by dioxin, steroid hormones and reproductive frequencies of the yellow-blotched turtle population that occurs there are different from other populations, and negative impacts to

the turtle from this pollution may be continuing (Shelby and Mendonca 2001) (see discussion under **II. C. 1. a. New information on the species' biology and life history**). Yellow-blotched map turtle habitat degradation continues, especially near larger cities and towns. Issues include degradation of sandbars used for nesting, especially in the lower Pascagoula River drainage; reduction in numbers of basking sites; and declines in water quality due to runoff.

2. Five-Factor Analysis

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

The yellow-blotched map turtle is endemic to rivers and large creeks of the Pascagoula River system of southeastern Mississippi. Along the river, this turtle requires structures (logs, snags, deadwood) on which it can safely bask and obtain food while being protected from predation, and suitable nesting habitat (large, high, sandbars adjacent to the river). At the time the yellow-blotched map turtle was listed, its decline was attributed to habitat modification and water quality deterioration resulting from runoff from cities, streets, and agriculture; reservoir construction (impoundments); channelization; desnagging for navigation and flood control; siltation; and the subsequent loss of invertebrate food sources resulting from habitat degradation (U.S. Fish and Wildlife Service 1991).

Map turtles (*Graptemys* sp.) are the most habitual baskers among aquatic turtles and rely on basking logs and branches for temperature regulation, feeding, and nocturnal resting sites (summarized in Lindeman 1998 and 1999) (see additional discussion under **II. C. 2. e. Other natural or manmade factors affecting its continued existence** regarding basking). The use of basking sites for temperature regulation, and as a source of food resources (which occur as attachments on the sites), is especially important for egg development in female turtles as both the direct development of eggs and clutch size are affected. Most of the prey species of the yellow-blotched map turtle appear to be associated with deadwood substrates where turtles forage (Selman and Lindeman 2017) (see discussion under **II C. 1. a. New information on the species' biology and life history**). Deadwood removal for navigation, flood control, and/or bank stabilization via rip-rapping is an issue that remains a threat, especially near larger cities and towns (A. Carson and D. Felder, U.S. Fish and Wildlife Service, pers. comm. 2017). Removal of mature trees close to riverbanks is a threat as it reduces the source of future basking habitat (snags) and also increases sedimentation that negatively impacts mollusk species (Neves *et al.* 1997) that are seasonally important food items for female yellow-blotched map turtles.

Although water quality has improved in some areas, efforts by the State of Mississippi to improve water quality in the Pascagoula River basin to meet

benchmarks for levels of particular pollutants have not been completely successful (Mississippi Department of Environmental Quality (MDEQ) 2016a, 2016b). Areas of the lower Pascagoula River may still be affected by an historic dioxin spill which is possibly impacting reproduction in the yellow-blotched map turtle (see discussion under **II. C. 1. a. New information on the species' biology and life history)**. Although a plan is under development to build a wastewater treatment system that will prevent polluted waters from being discharged into the Leaf and Bouie Rivers (deadline of September 2018), runoff at Hattiesburg remains an issue; yellow-blotched map turtles are currently reduced in number in a 1.5 river km (0.94 m) section of the Leaf River between sewage treatment lagoons and outflow sections (Selman and Qualls 2009, Brown *et al.* 2016). Thirty-nine percent of the Pascagoula River Basin tributaries have been rated fair or poor due to pollution impacts. Nonpoint source pollution is a localized threat to the yellow-blotched map turtle and is most prevalent in areas where Best Management Practices for forestry, industry, and municipal wastewater are not utilized.

Two proposed reservoirs for recreation/economic stimulus are being proposed for drainages of the Pascagoula River in George and Jackson Counties, Mississippi (U.S. Army Corps of Engineers 2015). These reservoirs would be created by damming Little Cedar Creek and Big Cedar Creek; Big Cedar Creek is a direct tributary to the Pascagoula River. Portions of riverine habitat occupied by the yellow-blotched map turtle on the lower Pascagoula River would be destroyed by the creation of these reservoirs. An Environmental Impact Study will be completed to analyze the social, economic, and environmental impacts to the area resulting from the proposed projects and alternatives. The America's Most Endangered Rivers report highlights rivers confronted by critical decisions concerning projects that will impact them during a given year and determine their future (American Rivers 2016). The Pascagoula River was included in the 2016 report specifically because of this proposed reservoir project. In November 2015, the Environmental Protection Agency wrote a letter to the Corps explaining that they consider the Pascagoula River to be "a resource of national importance", that the project is not necessary for drought resiliency and that it will have substantial and unacceptable adverse impacts on downstream waters (American Rivers 2016). In January 2016, the Jackson County Board of Supervisors voted to remove support for the project and no longer co-sponsors the wetland fill application that would be required for the construction of the reservoirs. Although the future of this project is unknown, it is still supported by the Pat Harrison Waterway District and George County Board of Supervisors. If these reservoirs are completed, portions of habitat on the lower Pascagoula River occupied by the very best yellow-blotched map turtle population could be severely impacted.

River channel erosion is continuing to change the structural dynamics of the Pascagoula River system, especially in the Leaf River system where floodplain and instream sand and gravel mining have resulted in river channel erosion

(Mossa and Coley 2004). Erosion results in a wider and shallower channel due to stream bank destabilization. River channel erosion has negative effects on yellow-blotched map turtle basking and nesting sites. Live trees and dead logs are removed during mining and, as a result, sandbar habitat becomes permanently flooded. As the river channel widens, the number of basking sites decreases. In this area, the channel is shallower and appears scoured which has created what resembles a chain of lakes within the river banks (Mossa and Coley 2004). The Leaf River tributary, Thompson Creek, a current locality for the yellow-blotched map turtle, has also experienced floodplain mining with flooded pits and eroding banks as resulting impacts which may have negative consequences for the yellow-blotched map turtle population that currently occurs in the creek (Mossa and Coley 2004). These localities with historical impacts will likely continue to cause adjustments to the Leaf River upstream of the tributaries junctures (Mossa and Coley 2004) with additional negative consequences for the yellow-blotched map turtle. Geomorphic changes are additionally related to navigation and flood-control improvements, regional land use, and other human activities (Patrick *et al.* 1993). The threat of river channel erosion is reduced in the Chickasawhay River which is a stable river for the most part, and in the mainstem Pascagoula River which is the most stable of the three rivers discussed here, especially in its lower portion (Mossa and Coley 2004).

Invasive exotic vegetation such as cogon grass (*Imperata cylindrica*) and Chinese tallow tree (*Triadica sebifera*) continues to reduce the quantity and quality of yellow-blotched map turtle nesting habitat on sandbars (Selman and Jones 2011). The suitability of these sites is also threatened by erosion and human recreation that disturbs female turtles attempting to nest (Selman and Jones 2011). Invasive species are problematic because they cover sandbars at the highest elevation thus forcing turtles to nest in suboptimal areas that are more flood-prone, while also lowering nest temperatures by shading nest sites (Janzen 1994, Kolbe and Janzen 2002). The lower net temperatures could ultimately impact demographics by altering sex ratios (see discussion under **II. C. 1. a. New information on the species' biology and life history** regarding temperature-dependent sex determination).

The quality of basking sites are also degraded by the presence of two exotic invasive aquatic plants, water hyacinth (*Eichhornia crassipes*) and alligator weed (*Alternanthera philoxeroides*). These species can cover snags used for basking which are then avoided by the turtles (Selman *et al.* 2007). In a study conducted by Selman *et al.* (2007), exotic vegetation was removed from basking sites and the turtles were observed to return to them for basking.

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

Shooting of basking yellow-blotched map turtles for recreation and collecting turtles for commercial purposes were described as threats to the species in the

listing rule (U.S. Fish and Wildlife Service 1991). These types of direct take by humans are on-going threats. Shooting of yellow-blotched for target practice still continues (Selman and Jones 2011). Since adult turtles are the most likely targets due to their larger size, this type of mortality can have negative effects to population viability since changes in adult survival of these long-lived turtles have the largest proportional effect on population fitness (Spencer and Janzen 2010). There is also evidence that collecting for a recreational or commercial purpose continues. In 2005, an individual in Georgia was apprehended with 28 yellow-blotched map turtles which were being held illegally (Jensen 2005). A recent review of two decades of international trade of wild tortoises and freshwater turtles across the world estimated that the trade involved over 8 million turtles annually (Luiselli *et al*. 2016). Turtles in the trade included both CITES-listed and non-listed turtles; *Graptemys* sp. are included in trade, but it is not known whether wild yellow-blotched map turtles populations are being affected.

c. Disease or predation:

There was no known threat from disease at the time of listing. Research on disease in reptiles in the wild is in its infancy. Studies are just beginning to look at disease issues beyond captive turtles to those in wild turtle populations. Research on ranavirus and herpesvirus in wild turtles has been reported in the literature (Winzeler *et al.* 2015, Kane *et al*. 2017). Further research will be needed to determine if disease represents a current threat to wild populations of the yellow-blotched map turtle.

Predation is a current threat. Nest predation rates of 41.9 to 100 percent were documented by Horne *et al.* (2003). Impacts of nest predation on the yellow-blotched map turtle occur from both vertebrate and invertebrate predators, and historic and new, "invasive, human-subsidized" predators. Fish crows were found to be the most significant nest predators by Horne *et al.* (2003) and they suggested that high predation rates on map turtle nests may be the result of fish crow populations apparently increasing as a result of overwintering near garbage dumps (Madge and Burn 1994). Fish crows are intelligent and highly aggressive. They have been observed probing sandbars for nest cavities, targeting searches for nests along fresh turtle tracks, and opening and consuming eggs before the female turtle has had time to re-enter the river after nesting (Horne *et al.* 2003). In addition, the fish crows sometimes drive away females before they can finish nesting and have been observed grabbing an egg from a nesting turtle before she can finish oviposition (Horne *et al.* 2003). The increased invertebrate predator populations of nonnative fire ants which attack and consume turtle nests may also be a result of human-induced habitat deterioration in the vicinity of the river. Turtles are likely long-lived animals as a result of naturally high levels of predation, especially predation on eggs and juveniles. They require extended years of reproduction to ensure the survival of their species under optimum conditions. Yellow-blotched map turtles likely have naturally high levels of egg predation. However, the increase in numbers of human-subsidized predators may represent

an increase in mortality that makes yellow-blotched map turtle survival less sustainable (Congdon *et al.* 1993).

d. The inadequacy of existing regulatory mechanisms:

Listing under the ESA affords protections under sections 7 and 9 of the legislation. This includes protection against take (as defined by section 4 of ESA) and transportation of the yellow-blotched map turtle out of the state of Mississippi. The State of Mississippi lists the turtle as Endangered which provides protection from collection (Mississippi Natural Heritage Program 2015). As a result of Federal listing in 1991, a number of research projects have been funded by the U.S. Fish and Wildlife Service and the Mississippi Department of Wildlife, Fisheries, and Parks, and these studies have provided most of the data that has contributed to our current understanding of the life history, ecology, and distribution of the yellow-blotched map turtle. Critical habitat has not been designated for this species; therefore regulations to protect the loss or alteration of habitat are limited.

No State laws in Mississippi protect the yellow-blotched map turtle against the loss or alteration of its habitat. However, monitoring of water quality is conducted by Mississippi under Section 305(b) of the CWA. Monitoring results indicate that water quality and quantity are not fully supporting a minimum designated use of fishing or fish and wildlife habitat in many of the river reaches where the yellow-blotched map turtle occurs (MDEQ 2006b). MDEQ has developed lists of impaired waters in Mississippi to satisfy the requirements with respect to Section 303(d) of the CWA (MDEQ 2016a). Reaches of the Pascagoula River and its tributaries are included on these lists as well as the pollutants causing or potentially causing impairment of designated uses. Pollutants include excessive nutrients, organic enrichment/low dissolved oxygen, pesticides, mercury and other toxics, sedimentation/siltation, and pathogens. Mercury in the Escatawpa River and the entire length of the Pascagoula River continues to result in advisories for limiting human consumption of fish from these areas (MDEQ 2008). These lists and reports are valuable tools to monitor the impacts to water quality in the Pascagoula River. However, pollutants are continuing to affect water quality in the drainage. Benchmarks for improving water quality are not supported by enforceable regulation and thus there has been limited success in reducing water quality degradation within the yellow-blotched map turtle's habitat.

Direct mortality through shooting and boat collisions, and indirect harm through disturbance of nesting turtles on sandbars and sandbar habitat degradation caused by speeding boats with excessive wakes, are very difficult to regulate even when these events occur in conservation areas. The Corps has designated four nesting sandbars on Ward Bayou WMA as off limits to human recreation during yellow-blotched map turtle nesting season (May 1 through October 31), however the current level of law enforcement presence has not been wholly adequate to

prevent threats to these areas, including the direct take of turtles (W. Selman, pers. comm. 2017). On the other hand, Corps efforts to manage these sandbars for invasive plant species have been productive and improved some degraded nesting areas.

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

The primary threat to survival of yellow-blotched map turtles is the impact of human population growth in southeast Mississippi. Boating and other recreational uses of the tributaries and the mainstem of the Pascagoula River during the summer months are threats to basking turtles and turtle nests, as well as causing direct mortality through collisions with boats, especially in the lower Pascagoula River. Direct mortality from boat collisions represents a threat that may disproportionally affect females since they are more commonly found in open areas of the channel than males (Jones 1996). Yellow-blotched map turtles frequently abandon their perches when people boat or float by their sites (Lindeman 1999, Moore and Seigel 2006, Selman and Qualls 2011, Selman, Qualls, and Owen 2013). A study conducted on the impacts of boating on basking by the yellow-blotched map turtle in the Pascagoula River indicated that the turtles are startled off their basking structures and back into the water, with associated indications of chronic stress and apparent negative effects on their health (Selman *et al.* 2010, 2012). In order to reduce the negative impacts to basking behavior that they documented, the authors of the study suggested that a limit be enacted on the size of boats allowed to access the river (Selman *et al.* 2010). *Graptemys* species bask with a greater frequency than many other turtles (Lindeman 1998). Alterations in basking frequencies may affect the general health of yellow-blotched map turtles, and because basking may be integral to the maturation of eggs, lower basking frequencies may reduce the ability of females to mature their clutches of eggs (see also discussion of basking under **II. C. 2. a. The present or threatened destruction, modification, or curtailment of its habitat or range**).

Moore and Seigel (2006) studied yellow-blotched map turtle nesting and human disturbance by observing sandbars from a blind and found that the turtles were highly sensitive to the presence of humans on the nesting beach. Even the very low-level disturbance of an observer trying to remain inconspicuous in a blind still impacted females and reduced the number of nest attempts. The more common forms of sandbar disturbance, such as boats passing at high speeds, camping and picnics on the beaches, caused the observed turtles to wait several hours for humans to leave the beach before attempting to nest. During summer weekends in June and July most sandbars had human activity throughout the day, including ATV use, thus making these sites effectively unusable by nesting females. Humans also directly impacted nests by trampling them and by digging up eggs. In addition, boat traffic, especially boats moving at high speed, causes damaging wakes which induce erosion and destruction of sandbar nesting sites.

The number of humans using the Pascagoula River system as a recreation outlet has increased dramatically since the mid-1990's (Selman *et al.* 2007). Selman, Qualls, and Owen (2013) reported that in Jackson County, where the yellow-blotched map turtle has the highest densities, the number of registered boats had increased 300 percent over the previous 22 years period. Also during this period, the percentage of registered small boats (less than 4.9 m (16 ft)) has decreased from 57 percent to 48 percent, while the percentage of registered medium to large size boats (5 to 65.6 m (16 to 65 ft)) has increased from 43 to 52 percent (Selman, Qualls, and Owen 2013). This increase in larger boats increases the negative impacts of disturbance to basking and nesting turtles, including increased stress levels and poorer shell condition; direct turtle mortality; and erosion of nesting sandbars.

In addition to fishing boats and speedboats, houseboats are frequently used and moored in the lower Pascagoula River. The boats are supported by polystyrene floats. Polystyrene has been found among the food items found during studies of the yellow-blotched map turtle's diet (Selman and Lindeman 2017). It is assumed that turtles are foraging on material growing on these floats and secondarily ingesting the polystyrene with food items. Possible lethal or sublethal impacts of polystyrene ingestion have been described for sea turtles (for review see Schuyler *et al*. 2014), however the effects to the yellow-blotched map turtle are unknown.

A reproductive study of the yellow-blotched map turtle indicated that this turtle apparently has a low annual reproductive potential (Jones 1994, 1996). Females mature at the relatively late age of 10 years (Jones 1996). They may nest only once during the year and some female yellow-blotched map turtles may skip reproduction in certain years (Horne *et al.* 2003). Since these are long-lived turtles, these are demographic traits that evolved with longevity. However, alterations in reproductive parameters may result from chemical stressors in the environment (Shelby and Mendonca 2001, Selman and Qualls 2005, 2006). In either case, this low reproductive potential which limits the species' ability to adapt to increases in mortality, combined with the known high levels of predation in yellow-blotched map turtle nests, represents a serious threat.

Another threat to the yellow-blotched map turtle is its very small range within the Pascagoula River drainage. Any catastrophic event to this system, such as an oil spill, failure of a sewage system, etc., could heavily impact the turtle and halt its current movement towards recovery.

Hurricanes pose a current but unpredictable threat. A severe population decline occurred in the most abundant yellow-blotched map turtle population in the vicinity of Vancleave, Mississippi following Hurricane Katrina (Selman and Qualls 2008). Recent surveys completed by Brown *et al.* (2016) indicated that this population has returned to pre-hurricane numbers, however, similar hurricane events are likely to occur in the future and the resulting impacts to the yellow-blotched map turtle could be severe.

Climate change may have negative effects on the yellow-blotched map turtle from increases in rainfall, temperature, and sea level. Models of climate change in the southeastern U.S. indicate that precipitation will increase in intensity and frequency, thus increasing flooding events (Trenberth 1998, U.S. Global Change Research Program 2017). Increased flooding has the potential to increase the number of nests destroyed as a result of these flooding events. Increases in average daily temperatures may cause negative effects on population demographics, since yellow-blotched map turtles have temperature-controlled sex determination (Vogt and Bull 1982). Increased air temperatures from climate change can result in higher water temperatures (Kaushal *et al.* 2010). Higher water temperatures may result in deleterious effects on distribution and abundance of freshwater organisms that are food sources for the yellow-blotched map turtle (Heino *et al.* 2009). A sea level rise of 5 m (16.4 ft, envisaged by moving upstream along the Pascagoula River in Google Earth and noting elevational gradient), would move a salt wedge up the lower reach of the Pascagoula River in Jackson and George Counties and would eliminate the largest yellow-blotched map turtle population (Lindeman 2013).

D. Synthesis

The data collected on the yellow-blotched map turtle since listing have been a combination of documenting presence using various types of basking surveys and calculations of population densities using several methods of mark/recapture or mark/resight. Since there has been a lack of standardization, it is impossible to understand the current status of the yellow-blotched map turtle with these data.

Over the 8-year period between 2008 and 2016, using data from the only two studies that have used comparable techniques, it appears yellow-blotched map turtle populations in the Leaf River and Chickasawhay River have declined slightly while the lower Pascagoula River population has rebounded from its decline after Hurricane Katrina. The status of the yellow-blotched map turtle in the Escatawpa River is not known; the turtle occurs there but no studies have focused on studying the population.

Although comparisons using basking surveys may be made between sites, or time periods at specific sites, only calculation of population estimates can actually quantify abundance. A standardized technique for calculating population estimates needs to be developed. Since female yellow-blotched map turtles do not begin breeding until 10 years of age, and they have a 50+ life span, techniques developed for monitoring known populations will need to be continued for at least 10 to 15 years to give an adequate picture of population trends. Providing a significant time period to assess population trends is also important due to the high level of mortality of eggs in yellow-blotched map turtle nests; this reduced recruitment may ultimately drive down adult population densities.

The purchase of conservation lands has provided a measure of habitat protection for the yellow-blotched map turtle. Conservation lands include properties along the mainstem Pascagoula River frontage and along both the Leaf River and Chickasawhay River drainages. No conservation lands currently occur within areas of the Escatawpa River known to be occupied by the yellow-blotched map turtle. The protection of conservation lands is very important but it does not eliminate many of the existing threats to the yellow-blotched map turtle. The management of these preserves focuses on terrestrial habitat; management plans need to be expanded to include protections for the turtle, especially the production of a steady supply of deadwood for use as basking sites and source of food items preferred by the yellow-blotched map turtle.

Threats to the species are ongoing with many of those present at the time of listing likely to continue into the future. River channel erosion with subsequent habitat loss, potential reservoirs, water quality degradation, "recreational" shooting, and commercial collecting continue to be problems. Not addressed specifically in the final rule, but a current threat, is the increasing amount of boating and other recreational uses of the Pascagoula River drainage, particularly the lower Pascagoula River, which have direct and indirect effects on yellow-blotched map turtle populations and their habitat. Another newly-identified threat is the increase in the already high level of nest predation. This may represent a factor that when added to the other threats and the current low reproductive potential, will seriously impact yellow-blotched map turtle populations.

In summary, based on recent surveys yellow-blotched map turtles appear to recovering to pre-Hurricane Katrina levels in the lower Pascagoula River. However, their numbers are decreasing in the Leaf River and the Chickasawhay River while threats to the species and its habitat are continuing rangewide. Appropriate techniques need to be developed and implemented to quantify species' abundance. Progress has been made towards partially achieving recovery goals in regards to habitat protection, however, the recovery criteria have not been met and the yellow-blotched map turtle continues to meet the definition of a threatened species under the Act.

III. RESULTS

A. Recommended Classification:

No change is needed.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Designate specific yellow-blotched map turtle populations in the Leaf, Chickasawhay, and Pascagoula Rivers for regular monitoring of population

densities and the habitat that supports them. Focus on populations at sites across the species' range (i.e., Hattiesburg, Leakesville, and Vancleave).

2. Develop a standardized protocol for data collection to determine turtle population density/viability, demography, growth, long-term movements, and longevity.

3. Reassess how best to define "stable" or "increasing" populations and determine if density numbers as currently defined in recovery criteria of the existing recovery plan are appropriate.

4. Conduct an analysis of potential effects to the yellow-blotched map turtle from proposed impoundments of Big Cedar Creek and Little Cedar Creeks, tributaries to the Pascagoula River in George and Jackson Counties, Mississippi.

5. Educate the public about the protected status of the yellow-blotched map turtle in order to reduce the direct take of turtles by shooting and encourage support of limiting public use of nesting sandbars.

6. Study effects of high nest predation on selected populations.

7. Pursue land acquisition of selected river reaches in order to achieve further protection of critical yellow-blotched map turtle populations.

8. Conduct follow-up research to determine if clutch frequency differences between north and south Pascagoula River populations are affecting long-term population viability.

9. Compare water quality data from habitat occupied by stable yellow-blotched map turtle populations with data from habitat occupied by declining populations.

10. Provide training to Law Enforcement personnel on identifying turtles of conservation concern and the threats they face from disturbance and collecting while encouraging enforcement of existing laws and regulations.

11. Develop (when necessary), adopt, and implement Best Management Practices for different land use/land cover categories, including those of timber activities, cropland and pastureland agricultural practices, urbanization, and/or other development activities in order to prevent runoff and sedimentation of the Pascagoula River drainage.

12. Evaluate the size and status of the Escatawpa yellow-blotched map turtle population and conduct a telemetry study in this region to assess this population's spatial use of coastal environments.

13. Conduct a comparative ecological study of upper Pascagoula River drainage populations since focus has been on work on the lower Pascagoula River population. The availability data on upper Pascagoula River populations indicate there are differences in size and possibly reproductive output that could influence future management decisions.

14. Work with partners to limit threats to the yellow-blotched map turtle such as restricting the size of boats that access occupied river reaches and enforcing speed limits to reduce the negative impacts of excessive boat wakes.

15. Revise the yellow-blotched map turtle recovery plan to more accurately reflect the current data on life history, ecology, and distribution, and revise the recovery criteria.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW of *Graptemys flavimaculata* (Yellow-blotched map Turtle)

Current Classification: Threatened

Recommendation resulting from the 5-Year Review

__X__ No change is needed

Review Conducted By: Linda V. LaClaire, Mississippi Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 1/30/18

REGIONAL OFFICE APPROVAL:

for **Lead Regional Director, Fish and Wildlife Service**

Approve _____ Date 4/25/18

APPENDIX A
Summary of peer review for the 5-year review of
Yellow-blotched Map Turtle *Graptemys flavimaculata*

A. Peer Review Method:

The document was reviewed internally by Cary Norquist, Jackson, Mississippi Field Office. Once the comments were added to the document, it was sent to four outside peer reviewers via email (see below). The outside peer reviewers were chosen based on their qualifications and knowledge of the species and its habitat. Individual responses were received from two of the four peer reviewers.

Peer Reviewers:

Dr. Bob Jones
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B. Peer Review Charge: See attached guidance.

C. Summary of Peer Review Comments:

Dr. Peter Lindeman, Edinboro University of Pennsylvania:

Dr. Lindeman pointed out that the minimum density estimates used as recovery criteria in the *Yellow-blotched Map Turtle Recovery Plan* are basking densities and not total population densities. Based on the existing mark-resight datasets for the species, he suggested that 10 to 30 percent of marked turtles are observed during basking surveys conducted in warm, sunny weather. He emphasized the importance of season and temperature in determining accurate estimates of population numbers, and the need to standardize survey techniques.

Dr. Lindeman also brought up the issue of global sea level rise and the prediction that portions of the lower Pascagoula River, where the largest population of yellow-blotched map turtles presently occurs, may be inundated and the turtle's habitat destroyed.

Dr. Lindeman provided his most recent publication on the yellow-blotched map turtle for our records.

Dr. Will Selman, Millsaps College:

Dr. Selman also addressed the need to standardize survey methods that are used as the basis for recovery criteria. He stressed that minimum basking densities can dramatically change across time of day, season, and environmental conditions. Using his dataset on the yellow-blotched map turtle, he demonstrated that using mark-resight study provides a more consistent estimate of population numbers and suggested that the Service use a similar technique to develop more defensible recovery criteria.

He provided a recent research paper (Thomson *et* al. In Press) that describes this turtle's likely isolation and speciation based on current taxonomic data.

Dr. Selman provided his insights on threats to the turtle based on his field research. He stressed that the additive predation from human-subsidized predators is a serious threat to yellow-blotched map turtle populations. He is also concerned about adult mortality from shooting, commercial/recreational fishing, pet trade collection, and boat strikes.

Dr. Selman commented on his belief that Law Enforcement provides inadequate protection of the turtle. Based on his 5+ years of field research he only was approached twice when he was trapping turtles and was not required to produce a permit for his work or explain in any detail what he was doing. He believes Law Enforcement training is needed to provide details about turtles of concern and the threat they face from collecting.

D. Response to Peer Review -- Peer reviewer comments were evaluated and incorporated into the revised document as appropriate.

Guidance for Peer Reviewers of Five-Year Status Reviews
U.S. Fish and Wildlife Service, Mississippi Ecological Services Field Office

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with U.S. Fish and Wildlife Service (Service) policy.

Peer reviewers should:

1. Review all materials provided by the Service.

2. Identify, review, and provide other relevant data apparently not 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 any potential implications of uncertainties for the technical conclusions drawn are clear.
   - Strengths and limitations of the overall product.

5. Keep in mind the requirement that the Service must use the best available scientific data in determining the species' status. This does not mean the Service 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 the Service's final decision document with appropriate credit given to the author of the review.

Questions regarding this guidance or the peer review process should be referred to Linda LaClaire, Wildlife Biologist, Mississippi Ecological Services Field Office, at (601) 321-1126, e-mail: linda_laclaire@fws.gov.