

CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

Other proposals

A. PROPOSAL

Inclusion of the entire turtle genus *Graptemys* in Appendix II as follows:

*Graptemys barbouri*  
*Graptemys caglei*  
*Graptemys ernsti*  
*Graptemys flavimaculata*  
*Graptemys gibbonsi*  
*Graptemys nigrinoda*  
*Graptemys oculifera*  
*Graptemys pulchra*  
*Graptemys versa*

in accordance with Article II 2 (a), and

*Graptemys geographica*  
*Graptemys ouachitensis*  
*Graptemys pseudogeographica* (includes *Graptemys kohnii*)

in accordance with Article II 2 (b).

B. PROPONENT

The United States of America

C. SUPPORTING STATEMENT

1. Taxonomy

1.1 Class:Reptilia

1.2 Order:Testudines

1.3 Family:Emydidae

1.4 Species*Graptemys geographica* (Le Suer, 1817)*Graptemys barbouri* (Carr and Marchand, 1942)  
*Graptemys pulchra* (Baur, 1893)*Graptemys ernsti* (Lovich and McCoy, 1992)*Graptemys gibbonsi* (Lovich and  
McCoy, 1992)*Graptemys caglei* (Haynes and McKown,  
1974)*Graptemys pseudogeographica* (Gray,  
1831)*Graptemys ouachitensis* (Cagle, 1953)*Graptemys*  
*versa* (Stejneger, 1925)*Graptemys oculifera* (Baur,  
1890)*Graptemys flavimaculata* (Cagle, 1954) *Graptemys*  
*nigrinoda* (Cagle, 1954)

1.6 Common Names:

English: *G. geographica* Common map turtle  
*G. barbouri* Barbour's map turtle  
*G. pulchra* Alabama map turtle  
*G. ernsti* Escambia map turtle  
*G. gibbonsi* Pascagoula map turtle

*G. caglei* Cagle's map turtle  
*G. pseudogeographica* False map turtle  
*G. ouachitensis* Ouachita map turtle  
*G. versa* Texas map turtle  
*G. oculifera* Ringed map turtle  
*G. flavimaculata* Yellow-blotched map turtle  
*G. nigrinoda* Black-knobbed map turtle

## 2. Biological Parameters

### 2.1 Distribution:

Phylogenetically, the species of *Graptemys* are more closely related genetically than those of most genera of vertebrates that have been examined, based on mitochondrial DNA analyses (Lamb et al. 1994). Two morphologically distinct groups can be recognized among the *Graptemys* that occur in Gulf coastal rivers east of the Mississippi River. The "sawbacks" (*G. oculifera*, *G. flavimaculata*, and *G. nigrinoda*) are medium-sized *Graptemys* with narrow heads and hypertrophied vertebral spines. The second group of Gulf Coast species includes *Graptemys pulchra* and *Graptemys barbouri* (Lovich, 1992).

*Graptemys geographica*: According to Ernst et al. (1994) the common map turtle ranges from southern Quebec and northwestern Vermont in the St. Lawrence drainage west through the Great Lakes into southern Wisconsin and eastern Minnesota, and, west of the Appalachians, south to Kansas, northeastern Oklahoma, Arkansas, Tennessee, Alabama (above the fall line), and northwestern Georgia. It also occurs in the Susquehanna River system of Pennsylvania and Maryland and in the Delaware River. An isolated population apparently exists in the Hudson River.

*Graptemys barbouri*: Barbour's map turtle is restricted to the Apalachicola River and larger tributaries including the Chipola, Chattahoochee, and Flint Rivers in eastern Alabama, western Georgia, and western Florida (Ernst et al. 1994).

*Graptemys pulchra*: The Alabama map turtle is restricted to the Mobile Bay drainage system in Alabama, Georgia, and possible Mississippi. Individuals have been collected in the Alabama, Cahaba, Tombigbee, Coosa, and Black Warrior Rivers, but it is apparently absent from the Tallapoosa River above the fall line in Alabama. The species is expected to be present in the Tombigbee River system of Mississippi, since the sympatric *G. nigrinoda* has been collected there (Ernst et al. 1994).

*Graptemys ernsti*: The Escambia map turtle is restricted to rivers flowing into Pensacola Bay, including the following in Alabama and Florida: Yellow River, Escambia River, Conecuh River, and Shoal River (Ernst et al. 1994).

*Graptemys gibbonsi*: The Pascagoula map turtle is restricted to the Pascagoula and Pearl rivers and their major tributaries (including the Chickasawhay, Leaf, Bogue Chitto) in Mississippi and Louisiana (Ernst et al. 1994).

*Graptemys caglei*: Cagle's map turtle was restricted to the Guadalupe and San Antonio river watersheds of south-central Texas, but may now be extirpated in the San Antonio drainage (Ernst et al. 1994).

*Graptemys pseudogeographica*: The false map turtle occurs primarily in large streams of the Missouri and Mississippi river systems from Ohio, Indiana, Illinois, Wisconsin, Minnesota, and the Dakotas southward possibly to extreme southwestern Alabama, southern and western Mississippi, Louisiana, and eastern Texas (Ernst et al. 1994). Two subspecies of *G. pseudogeographica* are currently recognized: *Graptemys pseudogeographica pseudogeographica* (Gray, 1831), the false map turtle, occurs from Ohio, Indiana, Illinois, Wisconsin, Minnesota, and the Dakotas southward to western Kentucky, Missouri and Tennessee; *Graptemys p. kohnii* (Baur, 1890), the Mississippi map turtle is found in the Mississippi watershed from western Tennessee, central Missouri, and possibly southeastern Nebraska south to eastern Texas, Louisiana, and southern and western Mississippi (Ernst et al. 1994).

*Graptemys ouachitensis*: The Ouachita map turtle ranges from Texas and Louisiana north and eastward to eastern Kansas, eastern Iowa, Minnesota, Wisconsin, Illinois, Indiana, Kentucky, Tennessee, and northern Alabama. Disjunct populations also exist in Mitchell and Pawnee counties in Kansas (Ernst et al. 1994). There are two subspecies of *Graptemys ouachitensis*: *Graptemys o. ouachitensis* (Cagle, 1953) ranges from the Ouachita River system of northern Louisiana west to Oklahoma and northward to Kansas, Iowa, Minnesota, Wisconsin, Illinois, Indiana, and Ohio; *Graptemys o. sabinensis* (Cagle, 1953) is restricted to the Sabine River system of Texas and Louisiana (Ernst et al. 1994).

*Graptemys versa*: The Texas map turtle is primarily restricted to the Edwards Plateau of central Texas, where it occurs in the Colorado River drainage (Ernst et al. 1994).

*Graptemys oculifera*: The ringed map turtle is restricted to the Pearl River and its major tributaries in Mississippi and Louisiana, but is not found in the tidally influenced lowermost section of the west Pearl River (Ernst et al. 1994).

*Graptemys flavimaculata*: The yellow-blotched map turtle is restricted to the Pascagoula River and its major tributaries in Mississippi, to within 25 km of the mouth of the Pascagoula River (Ernst et al. 1994).

*Graptemys nigrinoda*: The black-knobbed map turtle occurs below the Fall Line in the Alabama, Tombigbee, Black Warrior, Coosa, Tallapoosa, and Cahaba rivers of Alabama and Mississippi (Ernst et al. 1994). Two subspecies are recognized: *Graptemys nigrinoda nigrinoda* (Cagle 1954), the black-knobbed map turtle, is restricted to the upper parts of the Tombigbee and Alabama river systems of Alabama and Mississippi; *Graptemys n. delticola* (Folkerts and Mount 1969), the delta map turtle, inhabits the interconnecting streams and lakes in the delta of the Mobile Bay drainage, in Baldwin and Mobile counties, Alabama (Folkerts and Mount 1969). This subspecies prefers relatively large streams. In the Alabama River system its range is limited sharply by the Fall line in the Alabama, Coosa, and Tallapoosa rivers (Folkerts and Mount 1969).

## 2.2 Habitat Availability:

For all *Graptemys* species, habitat modifications, such as removal of logs or snags, channelization or impoundment, may eliminate habitat elements, such as basking sites, and nesting beaches, that are essential to the survival of the species (McCoy and Lovich, 1993).

*Graptemys geographica*: The common map turtle is typically an inhabitant of large bodies of water such as rivers and lakes. Areas with abundant basking sites are preferred. Habitat preferences in a Pennsylvania river, as measured by frequency of capture, were as follows: deep, slow-moving areas, 52.9%, shallow areas, 2.3%, and riffles and other areas, 27.0%. Large adults avoided areas with emergent vegetation, but congregated in areas with fallen limbs (Ernst et al. 1994). Pollution, which destroys the species' molluscan prey, waterfront development which destroys nesting habitat, and automobile traffic which kills females traveling overland to nests, have reduced populations in some parts of the species' range (Ernst et al. 1994).

*Graptemys barbouri*: Barbour's map turtle is found in clear, limestone-bottomed streams and large rivers with abundant basking sites in the form of snags and fallen trees (Ernst et al. 1994). Pollution is having a detrimental effect on *Graptemys barbouri*. Large numbers of dead adult females have been found along the Flint River in Georgia in recent years, possible victims of pollution (Ernst et al. 1994). Habitat alteration along the banks of the Chipola was identified by Sanderson (1992) as a potential cause of decreased water quality and reduction of suitable nesting habitat. Toxic industrial discharge by paper companies into Lake Blackshear on the Flint River in Georgia, has been indicated as the cause of extreme pollution, not only resulting in extensive deformities and shell ulceration in freshwater turtles, but also widespread mortality of the mollusks upon which the females of *G. barbouri* habitually feed (Pritchard 1993).

*Graptemys pulchra*: The Alabama map turtle is an inhabitant of relatively large, swift creeks and rivers. Stream sections with abundant basking sites in the form of logs and brush are preferred. In rocky piedmont habitats males are usually found in shallow stretches, but females seem to be restricted to deep pools or impoundments (Ernst et al. 1994). Water pollution, which adversely affects the

species' molluscan prey, and other degradation of its waterways, may be reducing *Graptemys pulchra* populations (Ernst et al. 1994). Lovich and McCoy (1992) state that habitat degradation or destruction are the greatest threats to *Graptemys pulchra* populations. Habitat modifications having a detrimental impact on the species include strip mining for coal, stream channelization, the removal of snags, and the impoundment of rivers. (Lovich and McCoy 1993).

*Graptemys ernsti* The Escambia map turtle is found in relatively large, swift creeks and rivers, with sandy or gravelly bottoms. Stream sections with an abundance of basking sites in the form of snags, logs, and brush are preferred (Ernst et al. 1994).

*Graptemys gibbonsi*: The Pascagoula map turtle lives in the main channels of rivers, often in swift currents. Sand or gravel bottoms and an abundance of basking sites in the form of logs and brush contribute to ideal habitat. The species' range is restricted to the Pearl and Pascagoula Rivers in Mississippi and Louisiana. These rivers have been degraded by industrial pollution. In 1986, a lengthy section of the Leaf River, below the outflow of a pulp processing plant was conspicuously devoid of *Graptemys*, while upstream they were plentiful (Ernst et al. 1994).

*Graptemys caglei*: Habitat in the Guadalupe River system consists of limestone- or mud-bottomed streams with moderate current, and numerous pools of varying depth. The species may also live in the slow-moving waters 1-3 m deep behind impoundments (Ernst et al. 1994).

*Graptemys pseudogeographica*: This species primarily lives in large rivers and their backwaters, but also occupies lakes, ponds, sloughs, bayous, oxbows, and occasionally marshes. It prefers water with abundant aquatic vegetation, places to bask, and slow currents, but can be found in swiftly flowing main channels of large rivers. The underground entrance of a muskrat lodge or bank burrow is often used by this species as an overwintering site (Ernst et al. 1994). The greatest threats to the survival of this species are the destruction of nesting habitat and nest by campers and by agricultural practices, and pollution (Vogt 1993). Commercial fishermen noted that *Graptemys pseudogeographica* was abundant 25 or more years earlier in the Missouri and Mississippi rivers, but had become uncommon. They attributed the decline to stream pollution and asserted that an increase in pollutants in recent years had virtually eradicated the turtle for many miles below Kansas City and St. Louis (Ernst et al. 1994). *Graptemys p. kohnii* is declining in Missouri, probably as a result of several factors, including water pollution, river channelization, reduction of suitable nesting sites, and siltation (Ernst et al. 1994).

*Graptemys ouachitensis*: Though the Ouachita map turtle is primarily a riverine turtle, inhabiting areas with swift currents and submerged vegetation, it also lives in impoundments, lakes, oxbows, and river-bottom swamps. Sand and silt bottoms are preferred over those of gravel, stone or mud. Stream width, the amount of algae growth on logs and the availability of basking sites are factors limiting the upstream distribution of this species (Ernst et al. 1994).

*Graptemys oculifera*: The ringed map turtle prefers wide rivers with strong currents, adjacent white sand beaches, and an abundance of basking sites in the form of brush, logs and debris (Ernst et al. 1994). Due to habitat modification and water-quality degradation, *Graptemys oculifera* has been reduced to the point where it merited a listing as threatened under the U.S. Endangered Species Act (Ernst et al, 1994).

*Graptemys flavimaculata*: The yellow-blotched map turtle prefers wide rivers with strong currents, sandbars, and nesting beaches, and an abundance of basking sites in the form of snags, brush and debris (Ernst et al. 1994). This species is absent from some areas of the Pascagoula River system where it formerly occurred (Seigel and Brauman 1995). The reason for this apparent decline is not known, but it may have involved a disruption of the reproductive biology of local populations resulting from the alteration or elimination through flood control projects of sand bars where turtles nest, extremely high rates of nest predation and water quality degradation (Seigel and Brauman 1995). In 1986 Lovich visited the Leaf River in Perry County, Mississippi and found *G. flavimaculata* and *G. gibbonsi* to be common upstream from a pulp processing plant, but absent below the point of discharge for an undetermined distance (Ernst et al. 1994).

*Graptemys nigrinoda*: The black-knobbed map turtle prefers sand and clay-bottomed streams with moderate currents and abundant basking sites of brush, logs, debris (Ernst et al. 1994). Recreational use of

some areas which this species inhabits is harmful to the populations. Adults are drowned in gill nets, nests are destroyed by picnickers and hikers, and two *G. nigrinoda* were discovered by Lahanas with their carapaces cracked open from the propellers of outboard motors (Ernst et al. 1994).

*Graptemys versa*: No habitat information available.

### 2.3 Population Status:

*Graptemys geographica*: In a study of a *Graptemys geographica* population along a 6.6-km section of a Pennsylvania river, researchers Pluto and Bellis captured 92 males (51%), 76 females (42%) and 11 juveniles (6%), an adult male to female ratio of 1.2:1, and a juvenile to adult ratio of .06:1 (Ernst et al. 1994). Little is known regarding the attainment of sexual maturity by this turtle. Newman (1906) reported that none of the females he found nesting was smaller than 19 cm or less than 14 years old. Females in Wisconsin are still immature at 10-12 years. Courtship and mating occur both in spring and autumn, with the nesting period lasting from late May to mid-July, depending on the location. Preferred nest sites are soft soil or sand and sunshine (Ernst et al. 1994). Most nesting is early in the day. Clutch size is usually 9-17 eggs, but nests containing 20 eggs have been reported. As many as three clutches may be produced within a year. Assuming 10 eggs per a clutch, researchers (White and Moll 1991) estimate that the annual reproductive potential of 100 typical, fertile females to be 23.3 eggs per female. Hatchlings may emerge from the nest in August-September or overwinter, depending on locality. As with other species of turtles, the eggs and hatchlings of *Graptemys geographica* are preyed upon by a wide variety of vertebrates and females may be attacked by vertebrate predators when they leave the water to oviposit. Wild individuals may live at least 20 years (Ernst et al. 1994).

*Graptemys flavimaculata*: IUCN classifies *Graptemys flavimaculata* as "indeterminate", meaning that it is a taxon known to be "endangered", "threatened" or "rare", but there is not enough information to determine in which of these categories the species belongs. In a one-year study of the density and structure of a *Graptemys flavimaculata* population on the Pascagoula River in Jackson County, Mississippi, the Lincoln-Peterson estimate of the total population size was 3,266, or 370 *Graptemys flavimaculata* per river km (Jones, 1993). Nests were constructed from May until August on sand bars along the edge of the river. The mean clutch size, determined from X-radiographs of 71 females, was 4.83 (range 3-9) and clutch size was positively related to female size. The majority of females in the study group did not produce multiple clutches and some females may not have reproduced. Mortality of eggs and hatchlings from predation (mainly fish crows, but also raccoons, king snakes, fire ants and armadillos) and flooding was very high; of the 384 nests observed, only 10 produced hatchlings (Seigel and Brauman 1995).

*Graptemys barbouri*: Though *Graptemys barbouri* is included on the IUCN's "Red List of Threatened Animals", it is listed among the species for which there is insufficient knowledge of whether the species should be on the list, and if so, on which list it should be placed. In Florida, a ranking of wild vertebrate taxa according to biological vulnerability, extent of current knowledge of population status, and management needs, gave *Graptemys barbouri* an extremely high biological score, indicating greater vulnerability to extirpation (Enge 1992). The various facets considered in this evaluation were distribution, abundance, and life history (Enge 1993). Sanderson (1974) reported population densities for this species as ranging from one turtle per 33.3 m to one turtle per 9.1 m of shoreline on the Chipola River in Florida. Assuming that marked turtles composed 65% of the population, the adjusted density is one turtle per 9 m of shore. The sex ratio reported by Sanderson was 57.7% males and 42.3 % females. Only 20% of the females captured were mature (Ernst et al. 1994). Females may require 15 to 20 years to reach sexual maturity, while males are sexually mature at a plastron length of about 6.9 cm and an age of four years. The nesting season on the Chipola River in Florida lasts from June through early August. Two clutches of eight and nine eggs were found on the Flint River in Georgia on 27 August by Wahlquist and Folkerts (1973). Eggs and hatchlings are preyed upon by a variety of vertebrate predators. Neill (1951) reported that a scarlet snake was observed raiding a turtle nest on the banks of the Chipola River (Ernst et al. 1994). Based upon the known growth rates of adult females and the observed maximum size, Sanderson (1974) concluded that the adult females may reach an age of over sixty years (Pritchard 1993). A Barbour's map turtle survived 31 years, eight months and nine days at the National Zoo (Ernst et al. 1994).

*Graptemys pulchra*: Nesting activity for this species begins in late April or early May, peaks in June, and then continues through July and August. Six to seven clutches of four to six eggs are laid each year. However, as Ernst et al. (1994) reported, many nests are destroyed by predators. Field observations of nests indicate that nest destruction probably exceeds 90% in most seasons (meaning very few eggs develop and contribute hatchlings to the population). These observations are consistent with those of other workers (Allen 1938, Cagle 1950, Gibbons 1968, Moll and Legler 1971), who found egg mortality to be as high as 99.8 percent (Shealy 1976). *Graptemys pulchra* has lived in captivity for more than 15 years (Ernst et al. 1994).

*Graptemys ernsti*: In the Conecuh River, Alabama, the density of *Graptemys ernsti* is estimated to be one turtle per 3-4 m of channel length. Males reach maturity three or four years after hatching at a minimum carapace length of 80 mm and females mature around 14 years. Nesting season lasts from late April to late July. Most nests are dug in large sandbars located at sharp bends in rivers. Nesting holes, which are dug in the sand, often have stones, leaf litter, roots and other potential obstacles at the bottom. The mean clutch size is 7.2 eggs and the mean estimated number of clutches per season is four (Ernst et al. 1994). The nest predation rate for this species is 95%. Fish crows prey on nests by day and raccoons at night (Seigel and Brauman 1995).

*Graptemys gibbonsi*: Males are believed to mature at four years (Ernst et al. 1994). On the Pearl and Chickasawhay rivers in Mississippi in 1978 and 1979, gravid females were found from 3 May until August. Nest sites are located on sandbars near the water's edge. Average clutch size was 7.5 in the Chickasawhay population and 6.4 in the Pearl population. Individual females probably produce several clutches each year (McCoy and Lovich 1993).

*Graptemys caglei*: This species' clutches contain one to six eggs, which are deposited near the water in a cavity approximately 15 cm deep. Possibly two or three clutches may be laid by a single female each year (Ernst et al. 1994). Though *Graptemys caglei* is included on the IUCN's "Red List of Threatened Animals", it is listed among the species for which there is insufficient knowledge of whether the species should be on the list, and if so, on which list it should be placed.

*Graptemys pseudogeographica*: The female *Graptemys p. pseudogeographica* begins its reproductive cycle between late June and mid-July. Mating for this subspecies in Wisconsin occurs in April and again in October and November. *Graptemys p. kohnii* usually lays its eggs in June. A nesting community of three species of *Graptemys* that were researched in Wisconsin lasts from mid-May to late-July, with the first clutch of the season laid from mid-May to mid-June. Nests may be located in open sand areas or in areas dominated with low shrubs. Most are dug adjacent to clumps of *Carex* or other herbaceous plants. Two or possibly three clutches are laid per year. Clutch sizes range from 8-22 eggs in *G. p. pseudogeographica* to 2-8 eggs in *G. p. kohnii* (Ernst et al. 1994). Maggots devoured 36% of the hatchlings found in 23 Wisconsin clutches, however, nests and eggs are also destroyed by red foxes, raccoons, and river otters. Over 90% of the nests can be destroyed by predators within the first 24 hours after laying. Emerging hatchlings are subject to predation by gulls, red-winged blackbirds, grackles, crows, and, possibly great blue herons. Bass, catfish and pike are potential predators of hatchlings once they reach the water. A male *G. p. kohnii*, wild-caught as a juvenile, lived for 35 years, five months at the Columbus Zoo (Ernst et al. 1994).

*Graptemys ouachitensis*: The reproductive cycle of the Ouachita map turtle is similar to that of *Graptemys pseudogeographica*. Males mature in their second or third year, while females are believed to reach maturity in their sixth or seventh year. Research of a Wisconsin population revealed that mating probably takes place in April, October and November and the nesting season starts in mid-May and ends in late July, with the first clutch of the season laid from mid-May to mid-June. Two or three clutches are laid per year in Oklahoma and Wisconsin. The mean clutch size ranges from 6 to 15 eggs for various classes of females, with an overall mean of about 10.5 eggs per clutch, or an annual reproductive potential of 21 eggs, assuming females produce two clutches a year. In Wisconsin maggots of the fly *Metoposarcophaga importans* may devour developing embryos. *Graptemys ouachitensis* are reported to live more than eight to ten years in captivity (Ernst et al. 1994).

*Graptemys oculifera*: Though *Graptemys oculifera* is included on the IUCN's (1990) "Red List of Threatened Animals", it is listed among the species for which there is insufficient knowledge of whether the species should be on the list, and if so, on which list it should be placed. Population sizes of

*Graptemys oculifera* were estimated at five sites on the Pearl River in Mississippi. Using data from the Schnable mark-recapture model, population estimates of *Graptemys oculifera* were obtained and compared with estimates taken in 1988-1989 using the same method. Estimates in 1994 of *G. oculifera* densities ranged from 356/km at Ratliff Ferry to 48/km at Carthage. Population estimates of *G. oculifera* were approximately 40% smaller at four of the five study sites in 1994. It is unlikely that differences in population estimates between studies conducted in 1988-1989 and 1994 resulted from methodological differences in the studies because the same trapping method, recapture method, observer and mark-recapture procedure were used. After eliminating possible reasons for the discrepancies in population figures, the only option which the researchers were left with was that the changes in population sizes at the four study areas are real. Possible reasons for the declines included deterioration of water quality or other habitat parameters, increased predation on adults, juveniles, or nests, disease, natural fluctuations in population sizes, illegal collecting, presumably for the pet trade or gross movements of the turtles out of the study area (Jones, 1995). Male maturity is attained in the fourth or fifth year. Estimates for the age at which females reach maturity range from seven to eleven years. Eggs are deposited on sandbars in early June (Ernst et al. 1994).

*Graptemys nigrinoda*: The males are sexually mature at 68 mm in plastron length in their third season of growth. Research conducted by Lahanas and published in 1982 on a *Graptemys nigrinoda delticola* population in the Tensaw River Gravine Island in southern Alabama provides valuable information on the reproductive biology of this species. The nesting season on Gravine Island begins in late May, peaks from mid-June to mid-July and ends in early August. The nesting season is approximately 72 days long. Most nests are located within 50 m of the water line in open, sunny areas with widely separated clumps of short grass. Eighty-three percent of the nests are constructed in fine quartz sand with no organic matter. Lahanas suspected that three or four clutches could be oviposited by a female in a single year. After depositing the eggs, females camouflage the nests by covering it with dry sand and then immediately return to the water. The clutch size of eight nests ranged from three to seven eggs (Ernst et al. 1994).

#### 2.4 Population Trends:

*Graptemys geographica*: Human activities that eliminate the species' molluscan prey, such as pollution; waterfront development that destroys nesting habitats; and automobile traffic that kills females traveling overland to nest, have reduced populations in some parts of the species' range (Ernst et al. 1994).

*Graptemys pseudogeographica*: Commercial fishermen noted that *Graptemys pseudogeographica* was abundant 25 or more years earlier in the Missouri and Mississippi rivers, but had become uncommon. They attributed the decline to stream pollution (Ernst et al. 1994). *Graptemys pseudogeographica kohnii* numbers in Missouri are decreasing, possibly as a result of several factors including water pollution, river channelization, reduction of suitable nesting sites, siltation and unlawful shooting (Ernst et al. 1994).

*Graptemys flavimaculata*: The U.S. Fish and Wildlife Service stated that population densities of this species seemed to have declined in recent years (Ernst et al. 1994).

*Graptemys nigrinoda*: The species has declined in Mississippi and is now listed as endangered by the state (Ernst et al. 1994).

*Graptemys oculifera*: Due to habitat modification and water-quality degradation, *Graptemys oculifera* has been reduced to the point where it merited a listing as threatened under the U.S. Endangered Species Act (Ernst et al, 1994). Populations seem to be declining throughout much of the Pearl River in Mississippi (Jones 1995).

*Graptemys barbouri*: Though formerly abundant, *Graptemys barbouri* populations, which are restricted to the Apalachicola river system of Florida and Georgia, are now declining (Pritchard 1993). Recent quantitative data are unavailable to document the decline of populations of the species, but some useful early baseline data have been published. Marchand reported collecting 18 specimens within 50 yards in the Chipola River in 1941, and within 100 yards of suitable habitat he saw about 30 individuals. Cagle documented the results of his 1950 collecting efforts in some detail; using the hand-collecting techniques described by Chaney and Smith (1950), 393 specimens were collected in the Chipola River in three days. Such a feat would be impossible today (Pritchard 1993).

No information was available on the remaining six *Graptemys* species.

#### 2.5 Geographic Trends:

*Graptemys caglei*: Cagle's map turtle was restricted to the Guadalupe and San Antonio river watersheds of south-central Texas, but may now be extirpated in the San Antonio drainage (Ernst et al. 1994).

*Graptemys flavimaculata*: *Graptemys flavimaculata* is absent from some areas of the Pascagoula River system where it formerly occurred (Seigel and Brauman 1995).

No additional information was available on geographic trends of *Graptemys* species.

#### 2.6 Role of the Species In Their Ecosystems:

- Graptemys geographica*: According to unpublished field notes of the late Fred Cagle, males from the White River, Arkansas population of this species eat small snails and some insects, including trichopterans. The stomach contents of females contained large crushed snails and some earthworms. No other prey items were detected in spite of an abundance of other invertebrates in the habitat. Ernst and Barbour (1972) listed freshwater snails, clams, insects, crayfish, water mites, fish and aquatic vegetation as natural foods. Penn (1950) reported that crayfish made up 24% of the diet in the eastern United States. In Wisconsin, the species consumes mostly mollusks (81% of the stomachs examined), fish, , mayflies, damselflies, and some plant material (Ernst et al. 1994). Opossums, raccoons, skunks, and coyotes feed on *Graptemys geographica* (Ernst et al. 1994).
- Graptemys barbouri*: Large *Graptemys barbouri*, particularly females, feed primarily on mollusks, including snails and some clams. Two adult males collected on the Chipola River contained mostly small insect larvae, including trichopterans and lepidopterans. Other prey found in the stomachs included wings of adult trichopterans, shell fragments of aquatic snails, and some plant material. The digestive tract of a larger male contained well over 1,000 insects. The females feed mostly on bivalves, snails and crayfish (Ernst et al. 1994).
- Graptemys pulchra*: The introduced Asian mussel may be an important food source for this species, especially females. However, the species also feeds on insects and vegetation (Ernst et al. 1994). Eggs and hatchlings are preyed upon by a wide variety of vertebrate predators. Skunks, raccoons, snakes, fish crows are the main predators of *Graptemys pulchra* nests (Ernst et al. 1994).
- Graptemys ernsti*: Individuals less than 199 mm in carapace length are essentially insectivorous. The fecal samples from turtles of this species, including adult males, contained Trichoptera, Coleoptera, Odonata, Hymenoptera, and millipedes. Females shift to mollusks, including gastropods, and the imported mussel *Corbicula maniliensis* at a carapace length of 90-100 mm. *Corbicula* composes at least 95% of all food consumed by adult females. The remainder of the female diet is composed of native mussels, aquatic snails, and occasionally crayfish. Adult males are primarily insectivorous (Ernst et al. 1994). Fish crows prey on *Graptemys ernsti* nests during the day and raccoons do so by night (Ernst et al. 1994).
- Graptemys gibbonsi*: Unpublished field notes of the late Fred Cagle indicate that this species eats insects, snails and clams (Ernst et al. 1994). Raccoons and other predators undoubtedly eat the eggs and hatchlings (Ernst et al. 1994).
- Graptemys caglei*: The stomach contents of several juveniles and adult males and subadult females were examined. Large amounts of plant and animal material were found in each specimen. Plant matter consisted mostly of bark, and algae that may have been ingested incidentally while feeding on insects and snails. Fragments of snail shells and caddisfly larvae were also found (Ernst et al. 1994).
- Graptemys pseudogeographica*: This species is a generalist omnivore. In the northern part of its range *Graptemys pseudogeographica* overlaps two other species in prey types and feeding habits, but in some more southern areas, where the other two species are absent, *G. p. pseudogeographica* is a mollusk specialist, possibly because of a lack of competition. Females collected in Wisconsin contained the following prey items: mollusks (19%), plant material (42.4%), and insects, including caddisfly cases, mayfly larvae, and damselfly larvae (21.9%). Males eat the same insects as females, as well as beetles, flies and other insect larvae, mollusks, fish carrion and trace amounts of vegetation. *G. p. kohnii* is also considered omnivorous. Prey for this subspecies included aquatic plants, muscadine grapes, bivalves, snails, crayfish, dragonfly and damselfly nymphs, and a skink (Ernst et al. 1994). Nests and eggs of this species are consumed by red foxes, maggots, raccoons, and river otters. Emerging hatchlings are subject to predation by gulls, red-winged blackbirds, grackles, crows, and, possibly great blue herons. Bass, catfish and pike are potential predators of hatchlings once they reach the water (Ernst et al. 1994).
- Graptemys ouachitensis*: The species, which is restricted in its consumption of mollusks due to the narrow crushing surfaces on its jaw, is primarily omnivorous. Females collected in Wisconsin during June, July and August contained the following percentages of food items: mollusks (2.8%), plant material

(31.5%), and insects, including caddisfly cases, mayfly larvae, and damselfly larvae (51%). Males eat the same insects as females, as well as, beetles, flies, and other insect larvae, mollusks, fish carrion, and trace amounts of vegetation. In Louisiana, Sabine map turtles consume green algae, aquatic insects bryophytes, trichopterans, beetles, dipterans, megalopterans, dragonflies, mayflies and clams. Prey consumed in other parts of the range include leaves, seeds and fruits of various plants, wet grasses, various dicots, bryozoans, snails, crayfish, spiders, ants and other hymenopterans, dead fish and fledgling birds (Ernst et al. 1994).

*Graptemys oculifera*: Analysis of the stomach contents of 29 *Graptemys oculifera* contained 1,078 items in the following amounts: adult and larval caddisflies (27%), diptera flies (35%), mayflies (23%), beetles (6%) and plant material (6%) (Ernst et al. 1994).

*Graptemys flavimaculata*: This species feeds predominantly on insects, including caddisfly and chironomid larvae and on mollusks (Ernst 1994). Ernst (1994) reported that in his laboratory a juvenile alligator snapping turtle, *Macrochelys temminckii*, consumed two adult male *G. flavimaculata*. Nothing has been published on predators in the wild, but it is probable that raccoons destroy many nests (Ernst et al. 1994).

*Graptemys nigrinoda*: The most detailed study of food habits for this species was conducted by Lahanas, who reported that the species grazes primarily on sessile organisms, such as bryozoans, sponges and freshwater algae. The percent volume of various food types dissected from the gastrointestinal tracts of fifteen males were as follows: animal matter (58.3%) including 36.5% sponges, 11.7% bryozoans and 9.6% mollusks; plant matter (40.4%). Values obtained from 17 females were: animal matter (69.2%), including 23.7% *Plumatella*, 27.6% sponges, and 17.9% mollusks; plant material (28.1%), including 17.3% *Spirogyra* and 7.8% *Cladophora*. According to Fred Cagle's field notes, *G. nigrinoda* eats insects, including mayflies, damselflies, midges, dragonflies, beetles (adults and larvae), chironomids, clams, spiders, insect eggs, and small fish (Ernst et al. 1994). Fish crows consume *Graptemys nigrinoda* eggs (Ernst et al. 1994).

## 2.7 Threats:

According to Lovich (1995) members of the genus *Graptemys* have restricted ranges that place them at extreme risk of extinction. In addition, the popularity of many species as pets contributes to the decline of wild populations, as well as disease. Another factor that must be taken into consideration is that all map turtles studied to date possess temperature-dependent sex determination (TSD). The conservational ramifications of TSD have received much attention in connection with endangered turtles because of the problems associated with the alteration of nesting habitat or the protection and incubation of eggs. Alterations to a single river system could potentially change nesting areas and, thus, nest temperatures. This, in turn, could alter this species' reproductive success by changing population sex ratios. Any proposed changes to the primary habitat of *Graptemys*' must be evaluated relative to the effects on nesting locations and nest temperatures (Wibbels et al. 1991).

*Graptemys geographica*: Human activities that eliminate its molluscan prey, such as activities that contribute to water pollution; waterfront development that destroys nesting habitat, and automobile traffic that kills females traveling overland to nest, have reduced populations in some parts of the species' range (Ernst et al. 1994).

*Graptemys barbouri*: According to Ernst et al. (1994) *Graptemys barbouri* is losing its battle for survival against the ravages of pollution of its waterways and overcollecting for the pet trade, and recommended that the species be federally listed at least as threatened, as well as a listing by CITES, to assist in the control of the international pet trade. Humans occasionally eat this turtle. Also, large numbers of dead adult females have been found along the Flint River in Georgia in recent years, possible victims of pollution (Ernst et al. 1994).

Pritchard (1993) also stated that the outlook for *Graptemys barbouri* is not good and that the species has been depleted by very large-scale collection, by hobbyists and suppliers to the pet trade, and for human consumption. Habitat alteration along the banks of the Chipola and toxic industrial discharge was identified by Sanderson (1992) as threats to *Graptemys barbouri*. *Graptemys barbouri* are also

victims of incidental capture by snagging on "brushhooks" (a type of fishhook) in the Chipola River (Pritchard 1993).

*Graptemys pulchra*: Conversations with local fishermen revealed that turtles were thought of as vermin, or at least as competitors for fish. Some residents, while drifting downstream or wandering along the banks, use turtles for rifle targets (Shealy 1976). Ernst (1994) reported that water pollution, which adversely affects the species' molluscan prey, and other degradation of its waterways may be reducing *Graptemys pulchra* populations.

*Graptemys ernsti*: Humans are the most serious predator of this species. Local fishermen incorrectly regard turtles as vermin, or as competitors for fish. Basking individuals are sometimes shot for target practice. Habitat destruction is the greatest threat to this species (Ernst et al. 1994).

*Graptemys pseudogeographica*: Humans are the main predators of adults *Graptemys pseudogeographica*. Mortality of adults results from drowning in gill nets, shooting, and setlines for fish. In the south, *G. pseudogeographica* are collected and eaten, primarily in Louisiana. The greatest threats to the survival of this species are destruction of nesting habitat and nest by camping tourists, agricultural practices, and as with all aquatic turtles, pollution of the waters in which they live (Vogt 1993). In Missouri, *Graptemys pseudogeographica* numbers are decreasing, possibly as a result of several factors, including water pollution, river channelization, reduction of suitable nesting sites, siltation and unlawful shooting. In the past, the pet trade also has adversely affected some Mississippi map turtle populations (Ernst et al. 1994). The winter months can also be an important mortality factor, especially during dry winters, when a drop in the water level during this time of year may cause some individuals of *Graptemys pseudogeographica* to freeze (Ernst et al. 1994). Also threatening *Graptemys pseudogeographica* are maggots of the fly *Metoposarcophaga importans*, which devoured 36% of the hatchlings found in 23 Wisconsin clutches (Ernst et al. 1994).

*Graptemys ouachitensis*: Maggots of the fly *Metoposarcophaga importans* may devour developing embryos in Wisconsin (Ernst et al. 1994).

*Graptemys oculifera*: Humans are responsible for some forms of adult mutilation and mortality, especially in areas with high boat traffic, and fishermen often kill the turtles when they become hooked on their lines. The species is also impacted detrimentally by habitat modification and water-quality degradation (Ernst et al. 1994).

*Graptemys flavimaculata*: Hundreds of these turtles are shot and killed each year by individuals who use them for target practice. The discharge of highly tannic effluents into river systems also threatens this species (Ernst et al. 1994). Reason for declines in *Graptemys flavimaculata* numbers is not known, but may involve a disruption of the reproductive biology of populations. Potential causes of this disruption might include flood control projects that may have altered or eliminated sand bars where turtles nest, extremely high rates of nest predation and water quality degradation (Seigel and Brauman 1995). Floods, which might be a result of river channelization and modification, as well as increased run-off, also impact the species (Seigel and Brauman 1995).

*Graptemys nigrinoda*: The human is the greatest enemy of this turtle. Lahanas (1982) reported that delta residents used to collect and eat large numbers of turtle eggs on Graving Island and a market existed for adult turtles in the region as late as the early 1980s. Recreational use of the delta region of the Alabama River also takes its toll on the population. Adults are drowned in gill nets, nests are destroyed by picnickers and explorers, and two *G. nigrinoda* were discovered by Lahanas with their carapaces cracked open by the propellers of outboard motors (Ernst et al. 1994).

### 3. Utilization and Trade

#### 3.1 National Utilization:

Hatchlings of *Graptemys* species are popular as pets and many enter the pet trade through uncontrolled commercial collecting (Lovich and McCoy 1993). Two methods of collecting *Graptemys* are employing unbaited fyke nets with long leads and driving turtles into trammel nets by the use of a carphorn (Vogt 1980).

*Graptemys flavimaculata*: The remarkable beauty of this species makes it one of the most sought after turtles in the world. Adult females may sell for as much as US\$100.00 each (Floyd 1973).

*Graptemys barbouri*: *Graptemys barbouri* is collected from the wild for the pet trade and for human consumption (Ernst et al. 1994). In Florida because the harvest of turtles for personal consumption is not reported, valuable information on the take of this species is lacking (Enge 1992). Ernst et al. (1994) stated that these turtles are over-overcollected for the pet trade and Newman (1970) reported that three people collected 50 *Graptemys barbouri* from a one-mile section of the Chipola River in a single afternoon (Ernst et al. 1994).

*Graptemys pseudogeographica*: In Missouri *Graptemys pseudogeographica* numbers are decreasing. Among other things, the pet trade has adversely affected some Mississippi map turtle populations (Ernst et al. 1994).

*Graptemys nigrinoda*: Lahanas (1982) reported that residents in the delta area of the Alabama River used to collect and eat large numbers of *Graptemys nigrinoda* eggs on Gravine Island and a market existed for adult turtles in the region as late as the early 1980s (Ernst et al. 1994).

*Graptemys pulchra*: Although not as colorful as other species of *Graptemys*, hatchlings and juveniles of this species are popular in the pet trade. A portion of the commercial harvest is used for dissection in physiology labs (Lovich and McCoy 1993).

### 3.2 Legal International Trade:

Table I contains data from recent years on *Graptemys* (not identified by species) exports from the U.S. supplied by the U.S. Fish and Wildlife Service's LEMIS system.

**Table I: *Graptemys* Exports from 1989-1993**

Year	Numbers Exported	Destination (number imported by each country)
1989	673	Belgium (100), France (450), Dem. Rep. of Germany (2), Japan (55), Netherlands (66)
1990	4,573	Australia (13), Austria (29), Canada (454), Denmark (5), Demo. Rep. of Germany (416), Federal Rep. of Germany (1,975), Italy (10), Japan (1,651), Spain (20)
1991	8,695	Belgium (30), Caiman Islands (16), France (1,213), Demo. Rep. of Germany (1,336), Federal Rep. of Germany (2,465), Italy (168), Japan (2,127), Rep. of Korea (1,060), Netherlands (103), Spain (2), Switzerland (135), United Kingdom (40)
1992	20,378	Argentina (250), Belgium (10), Czechoslovakia (600), Denmark (25), France (3,812), Dem. Rep. of Germany (978), Fed. Rep. of Germany (9,710), Hong Kong (183), Hungary (15) Italy (1,057), Japan (2,223), Mexico (30), Netherlands (791), Spain (540), Switzerland (134), United Kingdom (10), Unknown (10)
1993	37,233	Argentina (12), Belgium (10), Czechoslovakia (650), Denmark (45), France (2,187), Dem. Rep. of Germany (514), Fed. Rep. of Germany (21,831), Hungary (450), Indonesia (51), Italy (1,823), Japan (5,213), Mexico (40), Netherlands (3,794), Peru (30), Singapore (70), Spain (26), Switzerland

		(145), United Kingdom (142), Unknown (200)
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It should be emphasized that the above trade figures are for exports from the U.S. only (not world trade) and are likely to be incomplete in the latter years (because completion of export data entry into LEMIS is typically three years delayed).

*Graptemys* were valued by exporters to be worth US\$.98 each in 1989, US\$2.28 each in 1990; US\$2.97 each in 1991; US\$2.79 each in 1992 and US\$2.52 each in 1993.

The following is information provided by LEMIS on the origination and destination of *Graptemys* shipments:

Exports:

In 1989, the two major exporters of *Graptemys*, the quantity and port of export were: Tangi Turtle Farm, 450, New Orleans; and Pet Farm Inc., 124, Miami.

In 1990, the three major exporters of *Graptemys*, the quantity and port of export were: International Wildlife, Inc., 1933, Newark; Robert Guthrie, 1138, Seattle; and Concordia Turtle Farm, 500, Chicago.

In 1991, the four major exporters of *Graptemys*, the quantity and port of export were: International Wildlife, Inc., 2035, Newark; Robert Guthrie, 1470, Chicago; Charles Sullivan Co., Inc., 1111, Atlanta; and South Florida Reptile Exchange, 510, Miami.

In 1992, the major exporters of *Graptemys*, the quantity and port of export were: Concordia Turtle Farm, 3810, Chicago; International Wildlife, Inc., 3796, Newark; Robert Guthrie, 3194, Chicago; King's Turtle Farm, 3113, Chicago; and Black River Turtle Farm, 2000, Miami.

In 1993, the major exporters of *Graptemys*, the quantity and port of export were: Concordia Turtle Farm, 8240, Chicago; Robert Guthrie, 6746, Chicago; International Wildlife, Inc., 5445, Newark; King's Turtle Farm, 4468, Chicago; Black River Turtle Farm, 2884, New Orleans; Green Acre Pets, 1375, Chicago; and Tangi Turtle Farm, 1097, New Orleans.

In 1994, the major exporters of *Graptemys*, and with the quantity and port of export were: King's Turtle Farm, 12002, Chicago; Concordia Turtle Farm, 8820, Chicago; Robert Guthrie, 4415, Chicago; Reptile Mania, 3339, Portland; Black River Turtle Farm, 2700, New Orleans; International Wildlife, Inc., 2689, Newark; WM. A. Lemberger Company, Inc., 2555, Chicago; and Green Acre Pets, 2388, Chicago.

Imports:

In 1989, the major importers of *Graptemys* species, along with the quantity imported and country in which the importer is located, are as follows: Fantasia, 100 turtles, Belgium; La Ferme Exotique, 450, France; Creative Zoo, 24, Japan; Shoji Naotsugo, 31, Japan; Intersekt, 66, Netherlands.

In 1990, the major importers of *Graptemys* species, along with the quantity imported and country in which the importer is located, are as follows: Bauer, 29, Australia; Sean Nichols, 250, Canada; Tropical Fish, 200, Canada; Import/Export Peter Hoch, 423, Germany; Insektenfarm, 747, Germany; Stolzenberg, 1181, Germany; Japan Pet Fish Trade, 500, Japan; and Naotsugu Shoji, 1138, Japan.

In 1991, the major importers of *Graptemys* species, along with the quantity imported and country in which the importer is located, are as follows: Reptilen & Zoo Fachhandel, 87, Switzerland; Aquarium Dietzenbach, 188, Germany; Hardt Guenter, 714, Germany; Peter Hoch, 421, Germany; Schaudi Leonhard, 155, Germany; Stolzenberg GMBH, 775, Germany; Aquarium Diezenbach, 126, Germany; Gunter Bildsein, 204, Germany; Insektenfarm, 755, Germany; Tropic Zoo Center, 222, Germany; Aquarelite, 500, France; Comptoir du Poisson Exotique,

500, France; Reba France, 127, France; Kobayashi Shoji Co., 475, Japan; Naotsugu-Shoji, 1470, Japan; Kyungbum & Company, 760, Republic of Korea; and Sejin Trading Company, 300, Republic of Korea.

In 1992, the major importers of *Graptemys* species, along with the quantity imported and country in which the importer is located, are as follows: Daniel's Mar Acuario, 250, Argentina, Tropic Centrum, 600, Czechoslovakia; Exoterra, 225, Germany; Hardt Guenter, 195, Germany; Peter Hoch, 558, Germany; Aquarium Dietzenbach, 1391, Germany; Arnst Insect Farm, 1346, Germany, Import/Export, 546, Germany; Kemperman Gendringen, 2000 Germany; Tropic Centrum Pribram, 1200, Germany; Jakob Stolzenberg Werner, 1000, Germany; Zoo Export, 500, Germany; Pajaros Arnaiz, 540, Canary Islands; Aquarelite, 1500, France; Aubengali, 600, France; Herpetofauna, 950, France; Reba France, 662, France; Traverso Loredana, 500, Italy; Hiroshi Takano, 1239, Japan; Naotsugu Shoji, 754, Japan; and M.B. Ruysbroek, 500, Netherlands.

In 1993, the major importers of *Graptemys* species, along with the quantity imported and country in which the importer is located, are as follows: Tropic Centrum, 650, Czechoslovakia; Peter Hoch, 4289, Germany; Aquarium Turtle Farm, 740, Germany; Aquarium Dietzenbach, 10,207, Germany; Aquarium, Fritz Mueller, 1250, Germany; Hardt Zoo Experts, 1090, Germany; Stolzenberg, 2770, Germany; Aubengali, 1758, France; Fish House, 485, Italy; Fish House Milano, 634, Italy; Asada Choju Trading Company, 744, Japan; Hiroshi Takano, 3409, Japan; Handelsond Gerb de Boone, 870, Netherlands; Kemperman Grendingen 1000, Netherlands; and Wim Janssens, 914, Netherlands.

In 1994, the major importers of *Graptemys* species, along with the quantity imported and country in which the importer is located, are as follows: Aquarium Fritz Mueller, 1500, Germany; Aquarium Dietzenbach, 12,272, Germany; Dieter Gaidzik, 2,525, Germany; Peter Koch, 7788, Germany; Frank Mueller, 500, Germany; Stolzenberg, 638, Germany; Zoofauna, 4200, Germany; Aubengali, 728, France; Kemperman, 810, Great Britain; Aqualife, 1100, Hungary; Euraaquarium Spa, 700, Italy; Fish House, 1000, Italy; Asada Choju Trading Company, 4090, Japan; Hiroshi Takano, 1752, Japan; Japan Pet Fish Trade Company, 1000, Japan; Shuji Yoshino, 4115, Japan; and Kemperman, 1955, Netherlands.

### 3.3 Illegal Trade:

*Graptemys oculifera*: Jones (1995) speculates that illegal collecting, presumably for the pet trade, might be responsible in part for the declines in *Graptemys oculifera* numbers. Rumors of such activities have been received by the Mississippi Department of Wildlife, Fisheries, and Parks for a number of years. All of the localities are readily accessible from nearby boat ramps, and all study areas except at Ratliff Ferry, the only site where there was not a decline in numbers, are relatively isolated. Knowledgeable collectors could easily have removed significant numbers of *G. oculifera* over a relatively short period of time. The Ratliff Ferry area is heavily used by recreational boaters and fishermen, and is thus patrolled more frequently by law enforcement personnel than other study areas (Jones 1995).

3.4 Actual or Potential Trade Impacts: The export figures from 1989-1993 reveal that international trade in *Graptemys* species for consumption and as pets increased dramatically during recent years. It is known that hatchlings of *Graptemys* species are popular as pets. Although most of these are believed to be produced in captivity at turtle farms, it is not known to what extent such farms draw on wild populations to supplement parental stock. Many turtles enter the pet trade through uncontrolled commercial collecting (Lovich and McCoy 1993). . . Other than export figures, very little is known about the effect of international commercial trade on *Graptemys* populations.

However, it is known that like most other turtle species, *Graptemys* tend to have small ranges restricted to a single drainage system (Ernst et al. 1994) Results from a preliminary population viability analysis showed that *Graptemys* populations were very sensitive to changes in adult survival and moderately sensitive to changes in juvenile survival. The study, which focused on *Graptemys flavimaculata* along the Pascagoula River in southern Mississippi, found that the reproductive biology of this

species--low reproductive frequency, relatively low clutch size, and a low proportion of nests that successfully produce offspring--makes the species somewhat vulnerable. The model used--Population Viability Analysis--suggested that the high nest mortality rates seen in the two years of this study cannot be sustained without substantial (and improbable) increases in adult or juvenile survival (Seigel and Brauman, 1995).

Given the biological characteristics of turtle species, and the increasing numbers exported, it is probable that collecting *Graptemys* from the wild for international commercial trade is having a detrimental impact on the species by either exceeding, over an extended period, the level that can be continued in perpetuity, or reducing it to a population level at which its survival could be threatened by other influences. Because the distinguishing characteristics in the external morphology of the various *Graptemys* species are in many cases subtle, all species included in this genus must be placed on Appendix II. Once removed from the wild, it would be extremely difficult for non-experts to distinguish among the *Graptemys* species.

### 3.5 Captive Breeding or Artificial Propagation for Commercial Purposes:

Most species of *Graptemys* do well in captivity. Captive specimens of molluscivorous *Graptemys* can be successfully maintained on an artificial mollusc diet composed of a mixture of bone meal, oyster shell, trout chow and agar. Captives are known to court and reproduce regularly, and may live in captivity for over 15 years (McCoy and Lovich 1993).

*Graptemys geographica*: This species does not usually do well in captivity, but an adult lived for 18 years, 21 days at the Brookfield Zoo.

*Graptemys barbouri*: Pritchard (1993) reported that captive maintenance of *Graptemys barbouri* is not difficult, and many specimens have lived for many years in captivity. A Barbour's map turtle survived 31 years, eight months and nine days at the National Zoo (Ernst et al. 1994).

*Graptemys pseudogeographica*: This species grows and reproduces well in captivity at temperatures of 25-30C. They thrive on canned sockeye salmon. They can grow to reproductive size and produce fertile eggs on a diet of Purina trout chow mixed with bone meal, oyster shells, cod liver oil, and multiple vitamins (Vogt 1993).

## 4. Conservation and Management

### 4.1 Legal Status

#### 4.1.1 National:

*Graptemys oculifera*: Primarily as a result of habitat modification and water-quality degradation, this species listed as threatened on the U.S. Endangered Species Act in December 1986.

*Graptemys flavimaculata*: In 1986 *Graptemys flavimaculata* was listed as threatened on the U.S. Endangered Species Act by the U.S. Fish and Wildlife Service.

Regulation at the State Level:

The following is a summary of state regulations as they pertain to reptiles. The source for this information is "A Guide to North American Herpetology: 1994-1995 Directory."

*Graptemys geographica*:

**Alabama:** For this species, it is unlawful to take, capture, kill, or attempt to take, capture, kill; possess, sell, trade for anything of monetary value, or offer to sale.

**Arkansas:** The taking of nongame reptiles for commercial purposes is prohibited.

**Illinois:** It is unlawful to take, possess, buy, sell, offer to buy or sell or barter any reptile, amphibian, or their eggs.

- Indiana:** Permits are issued for take only for scientific purposes.
- Iowa:** All species of amphibians and reptiles are protected in Iowa, with the exception of the common garter snake and the Timber rattlesnake.
- Kansas:** The species is listed as threatened in Kansas. The state requires a hunting license is to take any wildlife species. No more than five of any one species of reptile may be possessed, other than for use as fishing bait.
- Kentucky:** It is illegal to buy, sell, possess, propagate, exhibit, import, or transport any wildlife (includes reptiles) without a permit. License is required for take. (?)
- Louisiana:** The species is listed as a Species of Special Concern. All persons engaged in buying, acquiring, or the handling by any means, any species of native reptile or amphibian in Louisiana for resale, or any person engaged in the shipping or transporting of any native reptile species either into or out of the state must possess a reptile wholesale/retail dealer's license.
- Michigan:** There is a daily limit of two turtles and a possession limit of six turtles; there is no closed season.
- Minnesota:** For noncommercial use, any person permitted by law to take fish by angling may take, possess, buy, sell, and transport turtles. For commercial use, a Commercial Turtle License is necessary to take, transport, purchase, and possess for sale unprocessed turtles within the state, without limit.
- Missouri:** Take is prohibited. A resident may take up to five, live nongame specimens for personal use or for captive study, however they may not be sold or given away.
- New York:** No reptiles may be collected in the state without a license, which will only be issued for propagation, scientific or exhibition purposes. Turtles with a carapace length of greater than 4 inches may be sold.
- Ohio:** Turtles may be bought or sold. It is unlawful for any person to take a turtle, other than softshell, snapping and Midland painted turtles, from property owned, controlled or maintained by the Wildlife Division.
- Oklahoma:** *Graptemys geographica* is listed as a species of special concern. Take is prohibited. Persons wishing to raise, bred, collect for hobby, or commercial purposes or possess reptiles must obtain the appropriate license. Anyone shipping or otherwise transporting wildlife into or out of the state must apply for authorization.
- Pennsylvania:** It is unlawful to take, catch, or kill any amphibian or reptile for the purpose of selling. A fishing license is required by persons age 16 and older to take reptiles and amphibians. There is a daily limit and possession limit of two.
- Tennessee:** None.
- Virginia:** It is unlawful to capture and possess live, for private use and not for sale, no more than five individuals of any single native or naturalized species of reptile.
- West Virginia:** *Graptemys geographica* is listed as a Species of Special Concern. The possession of reptiles and amphibians requires a state fishing license. There is no permit to allow commercial collection.
- Wisconsin:** Turtles may be taken by trapping or hooking during open season (June 16-April 30) from areas except the Wisconsin-Minnesota and Wisconsin-Iowa boundary waters. Prior to take, the individual must be in compliance with: licensing, regulation of trap construction; transportation and with the regulations of neighboring states. On the Mississippi, turtles may be taken all year round.

*Graptemys barbouri:*

**Alabama:** For this species, it is unlawful to take, capture, kill, or attempt to take, capture, kill, possess, sell, trade for anything of monetary value, or offer to sale.

**Florida:** *Graptemys barbouri* is listed as a Species of Special Concern. It is illegal to buy, sell, or possess for sale turtles of this species.

**Georgia:** The species is listed as threatened; collection and possession requires a permit.

*Graptemys pulchra:*

**Alabama:** For this species, it is unlawful to take, capture, kill, or attempt to take, capture, kill, possess, sell, trade for anything of monetary value, or offer to sale.

**Georgia:** The species is listed as rare; collection and possession requires a permit.

*Graptemys ernsti:*

**Alabama:** None

**Florida:** Any person who wishes to exhibit live reptiles to the public or to possess for sale, or sale live reptiles, must obtain a license.

*Graptemys gibbonsi:*

**Louisiana:** All persons engaged in buying, acquiring, or handling by any means any species of native reptile or amphibian in Louisiana for resale, or any person engaged in the shipping or transporting of any native reptile species either into or out of the state must possess a reptile wholesale/retail dealer's license.

**Mississippi:** This species is recognized as being in need of management. Commercial trade is prohibited unless the specimens have been propagated in captivity by an individual holding a captive propagation permit. Species deemed in need of management may be possessed for personal use by an individual with the appropriate hunting license. The bag limits for personal use are four specimens of any species or subspecies of reptile, not to exceed more that a total of 20 reptiles.

*Graptemys caglei*

**Texas:** None.

*Graptemys pseudogeographica*

**Alabama:** None.

**Arkansas:** The taking of nongame reptiles for commercial purposes is prohibited.

**Illinois:** It is unlawful to take, possess, buy, sell, offer to buy or sell or barter any reptile, amphibian, or their eggs.

**Indiana:** Permits for take are only issued for scientific purposes.

**Iowa:** All species of amphibians and reptiles are protected in Iowa, with the exception of the common garter snake and the Timber rattlesnake.

**Kansas:** The species is listed as threatened. A hunting license is required to take any wildlife species. No more than five of any one species of reptile may be possessed, other than for use as fishing bait.

**Kentucky:** It is illegal to buy, sell, possess, propagate, exhibit, import, or transport any wildlife (includes reptiles) without a permit. License is required for take. (?)

**Louisiana:** All persons engaged in the sale of native reptiles collected in Louisiana must possess a collector's license. All persons engaged in buying, acquiring, or handling by any means any species of native reptile or amphibian in Louisiana for resale, or any person engaged in the shipping or transporting of any native reptile species either into or out of the state must possess a reptile wholesale/retail dealer's license

**Minnesota:** For noncommercial use, any person permitted by law to take fish by angling may take, possess, buy, sell, and transport turtles. For commercial use, a Commercial Turtle License is necessary to take, transport, purchase, and possess for sale unprocessed turtles within the state, without limit.

**Mississippi:** This species is recognized as being in need of management. Commercial trade is prohibited unless the specimens have been propagated in captivity by an individual holding a captive propagation permit. Species deemed in need of management may be possessed for personal use by an individual with the appropriate hunting license. The bag limits for personal use are four specimens of any species or subspecies of reptile, not to exceed more that a total of 20 reptiles.

**Missouri:** Take is prohibited. A resident may take up to five, live nongame specimens for personal use or for captive study, however they may not be sold or given away.

**Nebraska:** None.

**North Dakota:** For this species, it is unlawful to take, capture, kill, or attempt to take, capture, kill: The species is included on a list entitled "Peripheral Species" (native species with a small or unknown population whose breeding or reproduction ability within the state is often severely limited by a lack of suitable habitat or climate). Turtles may not be taken without the appropriate permit or contract. No person may engage in the commercial taking, trapping, hooking of turtles without obtaining a permit for the Director of the Game and Fish Department, who may issue permits at his/her discretion.

**Ohio:** Turtles may be bought or sold. It is unlawful for any person to take turtles, other than softshell, snapping and Midland painted turtles from property owned, controlled or maintained by the Wildlife Division.

**Oklahoma:** There is a bag limit on reptiles of six per day or in possession. Persons wishing to raise, bred, collect for hobby, or commercial purposes or possess reptiles must obtain the appropriate license. Anyone shipping or otherwise transporting wildlife into or out of the state must apply for authorization.

**South Dakota:** Licensed anglers may take turtles from January 1 to December 31 by hook, and line, legal minnow seines, gaff hooks, spears, or legal turtle traps. There is a limit on take of twelve turtles.

**Tennessee:** None.

**Texas:** None.

**Wisconsin:** Turtles may be taken by trapping or hooking during open season (June 16-April 30) from areas except the Wisconsin-Minnesota and Wisconsin-Iowa boundary waters. Prior to take, individuals must be in compliance with: licensing, regulation of trap construction; transportation and with the regulations of neighboring states. On the Mississippi turtles may be taken all year round.

*Graptemys ouachitensis:*

**Alabama:** None

**Arkansas:** The taking of nongame reptiles for commercial purposes is prohibited.

**Illinois:** It is unlawful to take, possess, buy, sell, offer to buy or sell or barter any reptile, amphibian, or their eggs.

**Indiana:** Permits are issued for take only for scientific purposes.

**Iowa:** All species of amphibians and reptiles are protected in Iowa, with the exception of the common garter snake and the Timber rattlesnake.

**Kansas:** The species is listed as threatened. A hunting license is required to take any wildlife species. No more than five of any one species of reptile may be possessed other than for use as fishing bait.

**Kentucky:** It is illegal to buy, sell, possess, propagate, exhibit, import, or transport any wildlife (includes reptiles) without a permit. License is required for take. (?)

**Ohio:** Turtles may be bought or sold. It is unlawful for any person to take turtles, other than softshell, snapping and Midland painted turtles, from property owned, controlled or maintained by the Wildlife Division.

**Oklahoma:** There is a bag limit on reptiles of six per day or in possession. Persons wishing to raise, bred, collect for hobby, or commercial purposes or possess reptiles must obtain the appropriate license. Anyone shipping or otherwise transporting wildlife into or out of the state must apply for authorization.

**Louisiana:** All persons engaged in the sale of native reptiles collected in Louisiana must possess a collector's license. All persons engaged in buying, acquiring, or the handling by any means any species of native reptile or amphibian in Louisiana for resale, or any person engaged in the shipping or transporting of any native reptile species either into or out of the state must possess a reptile wholesale/retail dealer's license.

**Minnesota:** For noncommercial use, any person permitted by law to take fish by angling may take, possess, buy, sell, and transport turtles. For commercial use, a Commercial Turtle License is necessary to take, transport, purchase, and possess for sale unprocessed turtles within the state, without limit.

**Mississippi:** This species is recognized as being in need of management. Commercial trade is prohibited unless the specimens have been propagated in captivity by an individual holding a captive propagation permit. Species deemed in need of management may be possessed for personal use by an individual with the appropriate hunting license. The bag limits for personal use are four specimens of any species or subspecies of reptile, not to exceed more that a total of 20 reptiles.

**Missouri:** Take is prohibited. A resident may take up to five, live nongame specimens for personal use or for captive study, however they may not be sold or given away.

**Tennessee:** None.

**Texas:** None.

**Wisconsin:** Turtles may be taken by trapping or hooking during open season (June 16-April 30) from areas except the Wisconsin-Minnesota and Wisconsin-Iowa boundary waters. Prior to take, individuals must be in compliance with: licensing, regulation of trap construction; transportation and with the regulations of neighboring states. On the Mississippi turtles may be taken all year round.

*Graptemys versa:*

**Texas:** None.

*Graptemys oculifera:*

**Louisiana:** *Graptemys oculifera* is listed as a Species of Special Concern. All persons engaged in the sale of native reptiles collected in Louisiana must possess a collector's license. All persons engaged in buying, acquiring, or handling by any means any species of native reptile or amphibian in Louisiana

for resale, or any person engaged in the shipping or transporting of any native reptile species either into or out of the state must possess a reptile wholesale/retail dealer's license.

**Mississippi:** The species is listed as Endangered. Endangered species may not be possessed without special permits from the Department of Wildlife, Fisheries and Parks.

*Graptemys flavimaculata:*

**Mississippi:** The species is listed as Endangered. Endangered species may not be possessed without special permits from the Department of Wildlife, Fisheries and Parks.

*Graptemys nigrinoda:*

**Alabama:** None

**Mississippi:** The species is listed as Endangered. Endangered species may not be possessed without special permits from the Department of Wildlife, Fisheries and Parks.

4.1.2 International: None

4.2 Species Management:

4.2.1 Population Monitoring: None, in terms of on-going studies at this time. However, several population studies conducted during the past fifteen years were described throughout the proposal.

4.2.2 Habitat Conservation: None. Although many states have protected waterways, these are not specifically designed to protect turtle habitat.

4.2.3 Management Measures: Other than restrictions on the number of take in some states, as delineated in Section 4.1.1, no known efforts at managing wild populations of *Graptemys* are known.

4.3 Control Measures:

4.3.1 International Trade: None.

4.3.2 Domestic Measures: None, except the state laws described above.

5. Information on Similar Species

*Trachemys scripta elegans* is similar in appearance to both *Graptemys caglei* and *Graptemys versa*, but lacks a pronounced vertebral keel and has black smudges on the plastron (Ernst et al. 1994).

Distinguishing among *Graptemys* species:

*Graptemys geographica:* All other *Graptemys* species have well-developed vertebral keels with prominent spines. Other distinguishing characteristics are that *G. pseudogeographica kohnii* has a crescent-shaped postorbital mark that separates the neck stripes from the orbit; *G.p. pseudogeographica* has a narrow postorbital mark; and *G. ouachitensis* has large postorbital marks and prominent large white spots on each side of the face, one just below the orbit and another on the lower jaw (Ernst et al. 1994).

*Graptemys barbouri:* *Graptemys ernsti*, *G. gibbonsi* and *G. pulchra* lack the curved or traverse bar on the underside of the chin, and also the heart- or Y-shaped pattern on the dorsal aspect of the head. In addition, the interorbital and postorbital blotches on the head of *G. ernsti* are not connected (Ernst et al. 1994).

*Graptemys pulchra:* *Graptemys nigrinoda* has a narrow head and round, knoblike projections on the vertebrae, and *G. geographica* lacks the distinctive mask. *G. ernsti* differs in that it has an interorbital blotch that is not connected to the pair of postorbital blotches. *G. gibbonsi* has a single wide bar of yellow pigment on each marginal, and *G. barbouri* has a narrow interorbital blotch that ends anteriorly in

a narrow point, a curved or transverse bar under the chin, and in small specimens, a conspicuous bump on each of the anterior pleural scutes.

*Graptemys ernsti*: *Graptemys pulchra* and *G. gibbonsi* have an interorbital blotch that is connected to the lateral postorbital blotches. *Graptemys barbouri* has a narrow interorbital blotch that ends anteriorly in a narrow point, a curved or transverse bar under the chin, and in small specimens, a conspicuous bump on each of the anterior pleural scutes (Ernst et al. 1994).

*Graptemys gibbonsi*: *Graptemys flavimaculata* and *G. oculifera* both have narrow heads and more extensive yellow pigmentation, and *G. pseudogeographica kohnii* has a crescent-shaped yellow mark behind each eye. A similar broad-headed species, *G. barbouri* has a curved or transverse bar under the chin and a narrow bar between the eyes instead of a broad interorbital blotch (Ernst et al. 1994).

*Graptemys caglei*: *Graptemys versa*, *G. pseudogeographica kohnii*, *G. ouachitensis* all have a longitudinal yellow mark at the symphysis of the lower jaw instead of a transverse cream-colored bar, and lack the characteristic V-shaped dorsal head pattern (Ernst et al. 1994).

*G. pseudogeographica*: *Graptemys ouachitensis* may have a pair of light spots on each side of the face, one just under the eye and another on the lower jaw; *G. geographica* has a low, spineless vertebral keel and relatively broad head; and *G. gibbonsi* has a wide, light interorbital mark (Ernst et al. 1994).

*Graptemys ouachitensis*: *Graptemys pseudogeographica kohnii* has a curved bar behind the eye that prevents neck stripes from contacting the orbit, a white iris, and broad-headed females. *G. p. pseudogeographica* has a small, but variable, postorbital mark consisting of a narrow downward extension of a neck strip behind the orbit, and four to seven neck stripes commonly touching the orbit. *Graptemys versa* has a low keel and commonly light J-shaped postorbital mark extending backward from the eye. *Graptemys geographica* has a low, relatively spineless vertebral keel, the postorbital mark reduced to a spot, and a relatively broad head (Ernst et al. 1994).

*Graptemys versa*: *Graptemys pseudogeographica kohnii* has a crescent-shaped postorbital mark that prevents any neck stripes from reaching the eye. *Graptemys ouachitensis* and *G. p. pseudogeographica* are larger and the lack of the horizontal or J-shaped postorbital mark. *Graptemys caglei* has a cream-colored transverse bar across the lower jaw (Ernst et al. 1994).

*Graptemys oculifera*: *Graptemys flavimaculata* has olive-green skin, a light cream-colored plastron, the postorbital mark connected to the longitudinal dorsal neck stripes, and a large yellow blotch on each pleural. *Graptemys nigrinoda* has broad, rounded, knoblike projections on the vertebrae, postorbital marks connected dorsally to form a Y-shaped mark, and four yellow neck stripes entering the orbit. *G. pulchra*, *G. ernsti*, and *G. gibbonsi* have a wider head and a longitudinal light bar on the chin. *Graptemys pulchra* has narrow yellow markings on each marginal (Ernst et al. 1994).

*Graptemys flavimaculata*: *Graptemys oculifera* usually has the postorbital mark separated from the longitudinal dorsal stripes, black skin, a broad yellow or orange circle on each pleural and a yellow plastron. *Graptemys nigrinoda* has broad, rounded, knoblike vertebral projections, postorbital marks connected dorsally to form a Y-shaped mark, black skin, a narrow yellow or orange semicircle or circle on each pleural, and a yellow plastron. *Graptemys pulchra*, *G. ernsti* and *G. gibbonsi* have wider heads and a longitudinal light bar on the chin; *G. pulchra* also has a narrower yellow markings on the marginals (Ernst et al. 1994).

*Graptemys nigrinoda*: *Graptemys oculifera* commonly has the postorbital mark separate from the broad longitudinal dorsal stripe; the carapace rim only slightly serrated, and laterally compressed, spine-like vertebral projections. *Graptemys flavimaculata* has olive skin; the carapace rim slightly serrated; laterally compressed, spinelike vertebral projections; a large yellow blotch on the side of each pleural; and a cream-colored plastron. *Graptemys pulchra* has a large head and a longitudinal light bar on the chin, and *G. ernsti* and *G. gibbonsi* have a large head, a longitudinal light bar on the chin, and relatively wide yellow markings on the marginals (Ernst et al. 1994)

## 6. Other Comments:

The nine species of *Graptemys* proposed here for inclusion in Appendix II under the provisions of Article II 2 (a) qualify for Appendix II under Annex 2a of Resolution Conf. 9.24, because it is inferred that harvesting of specimens from the wild for international trade may have a detrimental impact on the species by reducing their populations to levels at which their survival would be threatened by other influences. The remaining three species being proposed for inclusion in Appendix II under the provisions of Article II 2 (b) qualify under Annex 2b of Resolution Conf. 9.24, because their inclusion in Appendix II is necessary to bring trade in the aforementioned species under effective control. Scientific Authority export findings for these three species will be based only upon the potential impact of their trade on any of the nine species listed under Article II 2 (a).

7. Additional Remarks:

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