CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Nineteenth meeting of the Conference of the Parties
Panama City (Panama), 14 – 25 November 2022

CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

A. Proposal

Transfer five species of broad-headed map turtles of the Genus *Graptemys: Graptemys barbouri*, *Graptemys ernsti*, *Graptemys gibbonsi*, *Graptemys pearlensis*, and *Graptemys pulchra* from Appendix III to Appendix II in accordance with Article II paragraph 2(a) of the Convention, satisfying Criterion B, Annex 2a of Resolution Conf. 9.24 (Rev. CoP17. All other *Graptemys* spp. remain in Appendix III.

B. Proponent: United States of America*

C. Supporting statement

1. Taxonomy

1.1 Class: Reptilia

1.2 Order: Testudines

1.3 Family: Emydidae (Rafinesque, 1815)

1.4 Genus: *Graptemys* (Agassiz, 1857)

The Checklist of Chelonians of the World (Fritz and Havaš 2007), the CITES Standard Reference, includes the proposed species below, with the exception of *G*. *pearlensis*, described in 2010.

Species: *Graptemys barbouri* (Carr and Marchand, 1942*)*

Graptemys ernsti (Lovich and McCoy, 1992)

Graptemys gibbonsi (Lovich and McCoy, 1992)

Graptemys pearlensis (Ennen, Lovich, Kreiser, Selman and Qualls, 2010)

Graptemys pulchra (Baur, 1893)

1.5 Scientific synonyms: See Fritz and Havaš, 2007, and TTWG 2021.

1.6 Common names: English: Broad-headed Map turtles (Barbour's map turtle, Escambia map turtle, Pascagoula map turtle, Pearl River map turtle, Alabama map turtle

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* *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

Spanish: None found.
French: None found.

2. Overview

Chelonians are among the vertebrates with the highest extinction risk from human-mediated activities and changes including habitat loss and degradation, consumption for food and medicine, invasive species impacts, climate change, and collection for the international pet trade-- species with biological characteristics/life history traits such as late maturity, adult longevity, and extended reproductive lives are particularly vulnerable (reviewed in Stanford et al. 2020). While impacts of climate change on chelonian populations will become clearer over time, there exists concern about its effects on species in low-lying coastal areas that may be subject to inundation by rising seas, and on species which exhibit temperature-dependent sex determination (reviewed in Stanford et al. 2020), as do map turtles (Wibbels et al. 2011).

The five species of broad-headed map turtles of Genus *Graptemys* are endemic to the southeastern United States, a region rich in turtle species (Mittermeier et al. 2015) and are restricted to river systems in the states of Alabama, Mississippi, Louisiana, Florida, Tennessee, and Georgia (Brown 2021, TTWG 2021). The evolutionary history of *Graptemys* is understood to have been influenced by historical sea-level changes and/or stream piracy events that drove dispersal and vicariant speciation events (Lamb et al. 1994). The genus is characterized by significant drainage-specific endemism and is one of the most diverse turtle genera worldwide with 14 recognized species (Buhlmann & Gibbons 1997, TTWG 2021).

However, *Graptemys* has been characterized as one of the most imperiled turtle groups in the United States (Selman & Lindeman 2020). The five species of broad-headed map turtles are threatened by pollution in riverine habitats leading to the loss of primary prey species; habitat loss and alteration; overharvesting for the international pet trade; and other pressures; both *G. pearlensis* and G. *gibbonsi* are classified as Endangered by the IUCN Red List of Threatened Species, while *G. ernsti* and *G. pulchra* are classified as Near Threatened and *G. barbouri* is considered Vulnerable (van Dijk 2011a, van Dijk 2011b, van Dijk 2011c, van Dijk 2011d, van Dijk 2011e). All five species were last assessed by the IUCN Red List in August 2010 and four of five are believed to have declining populations.

The international pet trade has become an increasing threat to the broad-headed map turtles (Ewert et al. 2006, van Dijk 2011a, van Dijk 2011c, van Dijk 2011e). For example, an analysis of Hong Kong-based online marketplace offerings revealed interest in keeping turtles as pets, and North American specimens available for sale; turtles commanding the highest prices were rare, wild-caught or possessed unique morphology (Sung & Fong 2018). The more threatened a species becomes, the higher its market value and intense the collection pressure on remaining wild populations (summarized in Stanford et al. 2020). These five species are difficult to differentiate once removed from the wild (USFWS 2021a) so their collective inclusion and treatment in the Appendices is appropriate.

Accordingly, criterion B, Annex 2a of Resolution Conf. 9.24 (Rev. CoP17), is met for *G. barbouri*, *G. ernsti*, *G. gibbonsi*, *G. pearlensis*, and *G. pulchra,* and the regulation of international trade is required to ensure that the harvest of specimens is not reducing wild populations to a level at which their survival might be threatened by continued harvesting or other influences. Transfer of the five species to CITES II would complement State and other domestic measures and ensure that specimens entering international trade were acquired sustainably and legally and will not be detrimental to the survival of the species.

3. Species Characteristics

3.1 Distribution

3.1.1 *G. barbouri* is distributed in the Apalachicola River system and larger tributaries including the Chipola, Chattahoochee, and Flint Rivers in Alabama, Georgia and Florida. In recent years, Barbour's map turtle was discovered in small drainage systems immediately east and west of the Apalachicola River and has been observed in the Choctawhatchee River, in sympatry with *G. ernsti*, and in the Aucilla, Waciss, and Ochlockonee Rivers (Ernst & Lovich 2009). Range extensions of 17.3 km and 58.9 km have recently been documented in the Choctawhatchee River and Ochlockonee River in Florida, respectively (Mays & Hill 2020).

3.1.2 *G. ernst*i inhabits rivers flowing into Pensacola Bay, including the Yellow, Escambia, Conecuh, and Shoal Rivers in Alabama and Florida. The Escambia map turtle has also been observed in the Pea and Choctawhatchee Rivers of Alabama, a stream system that drains into Choctawhatchee Bay of Florida (Ernst

and Lovich 2009). Escambia map turtle populations in the Pea and Choctawhatchee Rivers are sympatric with and may hybridize with *G.barbouri* (Godwin et al. 2014). This species is apparently absent from the blackwater creeks within its range as these lack native mollusk populations due to high tannin levels (Lovich et al. 2011).

3.1.3 *G. gibbonsi,* previously thought to inhabit the Pascagoula and Pearl Rivers and their major tributaries in Mississippi and Louisiana (Ernst & Lovich 2009), is currently understood to be restricted to the Pascagoula River, following the description of a new species, *G. pearlensis* (Ennen et al. 2010). Currently, *G. gibbonsi* is known to inhabit approximately 1,734 km within the Pascagoula River drainage (Lindeman et al. 2020).

3.1.4 *G. pearlensis* inhabits the main segments and major tributaries of the Pearl and Bogue Chitto Rivers in Louisiana and Mississippi, with an estimated 1,279.6 km of occupied river length. In recent years, 188.3 rkm of range expansions have been documented, although these new range expansions only comprise 9% of the estimated 21,841 *G. pearlensis* (Lindeman et al. 2020).

3.1.5 *G. pulchra* inhabits the Mobile Bay drainage system in Alabama, Georgia, Mississippi, and Tennessee. The Alabama map turtle has been observed in the Black Warrior, Cahaba, Coosa, Tallapoosa, Tensaw and Tombigbee Rivers in Alabama, and in the Tombigbee River in Mississippi. Recent surveys have documented the Alabama map turtle in a single county in Tennessee (Brown 2021), as well as invading the Tennessee River drainage via the Tennessee-Tombigbee Waterway (Berry et al. 2020). Given these new locality records, additional surveys for this species are necessary.

3.2 Habitat

Map turtles have been described as permanently aquatic, generally leaving the water only to nest or bask (Buhlmann & Gibbons 1997). Broad-headed map turtles generally inhabit small to large flowing rivers with abundant coarse woody debris and freshwater mollusks, and substrate ranging from silt and sand to limestone and clay. *G. barbouri*, is often found in clear, limestone-bottomed streams and large rivers with high banks, abundant basking sites and gastropods. Barbour's map turtle may also inhabit waters with silt to sand bottoms, low water clarity and low banks (Ernst & Lovich 2009). *G. ernsti* inhabits the main channels of larger, swift creeks and rivers with sandy bottoms and is absent in estuarine habitats. Habitat requirements of the Escambia map turtle include freshwater mollusks, abundant basking sites and underwater retreats, and are similar to those of other broad-headed species, including the Pascagoula and Alabama map turtles (Ernst & Lovich 2009). *G. pulchra* has been observed using trees brought down during Gulf Coast hurricanes as basking sites and hiding places, and in species surveys, males have been more often found in shallow stretches of river and females in deep pools or impoundments (Ernst & Lovich 2009).

3.3 Biological characteristics

The broad-headed map turtles exhibit sexual dimorphism and adult females generally attain twice the body size of males. Females take many years longer to reach sexual maturity and have conspicuously larger heads. The exaggerated difference in head width between the sexes is understood to be an evolutionary response to different adult diets, in which females consume mostly mollusks, and males, mostly insects (Ernst & Lovich 2009).

3.3.1 *G. barbouri* males are sexually mature at three to four years of age or a plastron length (PL) of about 6.9 cm, and sexually mature females have been reported at a PL of 16.5 cm but may require 15 to 20+ years to reach sexual maturity. Females may produce three to five clutches per year (25-40 eggs). Barbour's map turtle exhibits temperature-dependent sex determination (Ernst & Lovich 2009).

3.3.2 *G. ernsti* males mature at three to four years of age, at a minimum straight-carapace length (SCL) of 80 mm, while females mature at an SCL of 22 cm and approximately 14 years of age. The maximum SCL in Escambia map turtles is reached after approximately 23 years and 8.4 years in females and males, respectively (Ernst & Lovich 2009). The number of clutches per season is correlated with female size, and small females may produce one or two clutches per season, while the largest females produce up to six. Clutches contain 6 to 13 (mean 7.2) eggs, with an average of four clutches per season. (Ernst & Lovich 2009) The primary nesting season occurs May through July, and most nests are dug on sandbars at sharp bends in rivers, excavated under open canopy at elevations 2 to 3 m above the existing water level and 1 to 20 m from the water's edge (Aresco & Shealy 2006).

3.3.3 *G.gibbonsi* males were found to mature in their fourth year, or with a minimum plastron length of 89 mm; of females observed, the minimum plastron length of a sexually mature individual was 15.4 cm (Ernst & Lovich 2009, Selman & Lindeman 2015). Clutch size ranged from 5 to 14 eggs (mean: 7.5 eggs) and large females laid three clutches per year (Vogt et al. 2019). Gravid females were captured from April to July (Selman & Lindeman 2015).

3.3.4 The Pearl River map turtle has long been a cryptic species and was considered part of *G. pulchra* until 1992, and then part of *G. gibbonsi* until 2010, when the species was described as *G. pearlensis*; comparatively little is known about the natural history and ecology of this species. The Pearl River map turtle is carnivorous, and the sexes exhibit the different dietary preferences and sexual dimorphism characteristic of this clade (Ennen et al. 2016). The smallest known gravid female had a carapace length of 20.5 cm, although this larger size is likely an artifact of little reproductive research conducted on the species. Clutch size ranged from three to nine eggs (mean: 6.4 eggs, Vogt et al. 2019), with evidence of multiple clutches per year (Ennen et al. 2016).

3.3.5 *G. pulchra* males are thought to become sexually mature at about 8 to 10 years, and females at 14 years of age (Ernst & Lovich 2009). Mature Alabama map females may lay six to seven clutches of four to six eggs in the wild annually (Coleman 2020). Recent studies observed a mean of 5.4 (range 4-7) and 9.2 (range 4-13) eggs per clutch but did not estimate number of clutches annually (Lindeman 2020, Coleman 2020). As with other species of broad-headed map turtles, there may be an increase in annual clutch frequency with increasing female-biased size dimorphism (Ernst & Lovich 2009).

3.4 Morphological characteristics

The first application of *Graptemys* to this taxa dates to 1857 and refers to the distinctive map-like markings on the carapace (graptos-inscribed, painted; emys-turtle) (Selman & Lindeman 2020). The five broad-headed species of map turtle exhibit a domed carapace with a strong vertebral keel and laterally compressed spines on the anterior of each vertebra, the second and third most often prominent. The plastron is yellow-white, hingeless, and sometimes has seam-following patterns of pigmentation; the skin may be olive, brown or black, with light yellow or yellow-green markings (Ernst & Lovich 2009). The similarity of body form, shell markings and head markings make it difficult to differentiate between these species (USFWS 2021a) and certain national measures to protect the Pearl River map turtle are proposed for the four other broad-headed species due to similarity of appearance. The accurate identification of specimens with an unknown provenance is challenging, even to experts (USFWS 2021b).

3.4.1. *G. barbouri* is a large, broad-headed map turtle with an oval, posteriorly serrated, high-domed carapace that is highest anterior to the middle. The carapace is olive to olive-brown with yellow C-shaped markings on the pleural scutes and a yellow bar on the upper surface of each marginal scute. The dorsal head pattern consists of a large interorbital blotch connected to postorbital blotches; behind the orbits is a heart or Y-shaped dark pattern with a light concentric pattern inside of it. The chin has a transverse or curved bar that often follows the curve of the jaw, and the dorsal neck has relatively wide, equally sized stripes (Ernst & Lovich 2009).

3.4.2 *G. ernsti* is a moderate-sized, high-domed, medially keeled map turtle with a prominent yellow bar on the dorsal surface of each marginal scute. The species' olive carapace bears a pronounced broken black stripe down the center and relatively wide yellow rings and vermiculations are present on the distal portion of the pleural scutes. The head pattern consists of a large interorbital blotch that is separate from the large postorbital blotches on each side of the head. A three-pronged nasal trident is evident on the anterior portion of the interorbital blotch, and dorsal neck stripes are relatively wide and roughly equal in size (Ernst & Lovich 2009).

3.4.3 *G. gibbonsi* is a moderate-sized, high-domed, medially keeled map turtle with a single vertical yellow bar on the dorsal surface of each marginal scute. The carapace is olive-brown and divided by a black, sometimes interrupted, medial stripe and exhibits relatively wide yellow rings and vermiculations on each pleural scute. Marginal scutes have a single relatively narrow band of dark pigment on the ventral surface and the head pattern consists of a large interorbital blotch connected by thin stripes to a pair of postorbital blotches (Ernst & Lovich 2009). The description of this species was refined when the Pearl River map turtle was split from this group (Ennen et al.2010). The following characteristics are described as diagnostic of the Pascagoula map turtle: yellow pigment bar on 12th marginal scutes greater than 50% of the scute length and

trending anteromedially from the rear margin of the carapace, yellow bar on fifth marginal scutes wide with associated and conspicuous concentric rings, dark vertebral stripe usually broken (especially toward the posterior) and less likely to have a nasal trident (66% occurrence) than *G. pearlensis*, although there is overlap of these characteristics between the two species (Ennen et al. 2010).

3.4.4. *G. pearlensis* is a moderate-sized map turtle possessing a high-domed shell with a median keel, which is distinguished by a complete dark stripe. Features which may distinguish the species from *G. gibbonsi,* with which it was grouped until 2010, are marginal scutes featuring narrow, yellow vertical bars without conspicuous secondary concentric rings, and the yellow vertical bar on the 12th marginal scutes are usually less than 50% than the scute length. The species frequently exhibits a nasal trident on the dorsal head surface behind the nares (79% occurrence) and does not possess supraoccipital spots or anteriorly expanded dorsal paramedian neck stripes (Ennen et al. 2016).

3.4.5 *G. pulchra* is a moderate-sized, relatively low-domed medially keeled map turtle with a series of concentric yellow markings on the dorsal surface of each marginal scute. The dark olive carapace is divided by a black, often interrupted, medial stripe, and narrow yellow vermiculations are present on each pleural scute. The species' head pattern has been described as resembling a mask, with a large interorbital blotch broadly fused to a pair of narrower postorbital blotches. The neck stripes are relatively wide and homogeneous (Ernst & Lovich 2009).

3.5 Role of the species in its ecosystem

Broad-headed map turtles serve as both predator and prey in the riverine habitats they inhabit. Large Barbour's map turtles, and particularly females, feed primarily on mollusks while adult males feed primarily on insects, which comprised 81% of their digestive tract contents by weight in one study (Ernst & Lovich 2009). Female Barbour's map turtles have presumably shifted away from native gastropods and unionid mussels to the invasive Asian clam, which makes up 87% by volume of their diet (Sterrett et al. 2020). Eggs and hatchlings of *G. barbouri* are preyed upon by snakes, racoons, fish crows and armadillos, and larger specimens have been observed in the diet of nesting bald eagles (Ernst & Lovich 2009). *G. ernsti* is essentially insectivorous below 100 mm in straight-line carapace length (SCL), with females shifting to mollusks at an SCL of 90-100 mm. Clams were found to comprise at least 95% of all food consumed by females in one study (Aresco & Shealy 2006) and the introduced Asian clam (*Corbicula sp*.) may be an important food source (Lovich et al. 2011). Nest predation of *G. ernsti* can exceed 90% in a given year, with predators including fish crows and racoons. Predators of hatchlings and juveniles include gars, large turtles and herons (Aresco & Shealy 2006). The unpublished field notes of the late Fred Cagle indicate that *G. gibbonsi* consumes insects, snails and clams. Predators of its eggs and hatchlings include racoons and spotted bass (Ernst & Lovich 2009). Stomach flushings of Pearl River map turtles revealed a diet comprised of 24% insects, 24% mollusks and 44% fish, which was a notably more diverse diet than found in other *Graptemys* species and sites sampled (McCoy et al. 2020). Another study observed high molluscivory in female *G. gibbonsi* (81-95% by volume) and *G. pearlensis* (70% by volume) and suggested that the high percentage of fish observed by McCoy et al. (2020) in the diet of the Pear River map turtle may have been a byproduct of eating trapped fish in the fyke nets used to catch *Graptemys* (Vučenović and Lindeman 2021). The eggs and hatchlings of *G. pulchra* are preyed upon by a variety of vertebrates, but particularly raccoons (Ernst & Lovich 2009).

4. Status and trends

4.1 Habitat trends

The riverine systems upon which the five broad-headed species of *Graptemys* depend are vulnerable to numerous threats, described in detail in Section 8.1. Additionally, flooding during hurricanes may suppress reproduction of *G. ernsti* by washing out nests (Ernst & Lovich 2009).

4.2 Population size

4.2.1 The total population of *G. barbouri* was estimated between 1,000 and 10,000 individuals, found in 1 to 20 subpopulations and the species is thought to be abundant in parts of its range, including the Chipola, Apalachicola and Flint Rivers, while rare in others (van Dijk 2011e). During single-pass surveys of 502 rkm performed in 2014-2015 on the Choctawatchee, Apalachicola, Chipola, and Ochlockonee rivers and their major tributaries in Florida, 5,917 Barbour's map turtles were observed; from repeated surveys on the middle

Apalachicola and Ochlockonee Rivers, map turtle abundance was estimated at 2,079 and 292 individuals, respectively, while population abundances in Florida are estimated between 11,601 and 28,176 individuals (Mays & Hill 2020).

4.2.2 According to Aresco and Shealy (2006), 97 basking *G. ernsti* individuals were observed in a 19.3-km stretch of the Escambia River in Florida, or approximately 5 turtles per kilometer. In the Conecuh River, basking *Graptemys* were observed at an overall mean basking density of 5.9 turtles per rkm, but overall numbers were variable (Godwin 2000, 2002 unpublished reports cited in Lovich et al. 2011).

4.2.3 *G. gibbonsi* (which included populations now known as *G. pearlensis*) was described by Lindeman as the second rarest *Graptemys* species, based on extensive basking surveys (van Dijk 2011b). In surveys of basking turtles on the Pearl River and Pascagoula Rivers in 1994 and 1995, the species represented 8% and 22.3% of the emydids counted, respectively (Ernst & Lovich 2009). Lindeman et al. (2020) estimated a total population abundance of 34,081 individuals, of which 57% inhabits main stem river stretches of the Pascagoula River drainage and the remaining 43% inhabit small to large tributaries.

4.2.4 *G. pearlensis*: Basking surveys of the Pearl River drainage conducted from 2006 to 2018 produced mean basking densities of 3.0 *G. pearlensis* per rkm, with mainstem reaches having higher basking densities than tributaries (Lindeman et al. 2020). Total population abundance was estimated at 21,841 individuals within the Pearl River drainage, 36% less than population estimates for *G. gibbonsi* (Lindeman et al. 2020).

4.2.5 *G. pulchra* is thought to be locally abundant in several parts of its range and surveys by Godwin (2003) along multiple rivers yielded an overall mean of 2.7 turtles per rkm (unpublished data cited by Lovich et al. 2014). Jensen (2016) observed 252 *G. pulchra* over 39.5 rkm in the Coosa River, with some river stretches as low as 0.5 turtles per rkm.

4.3 Population structure

Adult sex ratios of *G. barbouri* have shown a strong male bias, compatible with the difference in maturation times between the sexes (summarized by Ewert et al. 2006). These male biased sex ratios were also reported in populations of *G. barbouri* in Florida (1.7:1; Mays & Hill 2020). Selman and Jones (2017) found few reproductively mature female *G. pearlensis* and no gravid females. Surveys on the Pearl and Pascagoula Rivers observed male: female sex ratios of 1.8:1 and 1.1:1 for *G. pearlensis* and *G. gibbonsi* (Lindeman et al. 2020); historical, contemporary, and biological factors may influence population structure, including deteriorating water quality, manipulated flow regimes associated with water impoundments, and disparity in age of sexual maturity between sexes (Lovich et al. 2014, Selman & Jones 2017).

4.4 Population trends

All species of broad-headed map turtle of Genus *Graptemys* are characterized as having a decreasing population trend, except for *G. pulchra*, the Alabama map turtle, whose trend is unknown (van Dijk 2011a, van Dijk 2011b, van Dijk 2011c, van Dijk 2011d, van Dijk 2011e).

4.4.1 Comparisons of studies spanning several years have yielded differing results about *G. barbouri* population trends. Surveys performed in 1952 and 1986 produced data that could indicate either a stable or a declining population along the Chipola River; at least a local decline was suggested by another comparison (van Dijk 2011e). A recent study suggests that *G. barbouri* are stable in Florida, based off distributional surveys and estimates of population abundance (Mays & Hill 2020).

4.4.2 *G. ernsti* has a restricted range in three small river systems but the Escambia map turtle is apparently the most abundant turtle on the Escambia and Yellow Rivers, based on surveys and observations (summarized in Aresco & Shealy 2006).

4.4.3 Populations of *G. gibbonsi* are estimated to have declined 80 to 90% since 1950. Since the 1990s, the species has been observed less frequently than its sympatric counterpart, *G. flavimaculata,* at a ratio of 1:2.4, which represents a decline in abundance (van Dijk 2011b, Lindeman et al. 2020). This decline has been attributed to the effect of water pollution on mollusk prey, associated with habitat degradation by channelization for navigation and by industrial pollution (Ernst & Lovich 2009).

4.4.5 The Pearl River map turtle was formerly observed/captured in double the numbers as sympatric *G. oculifera* until a decline in the 1990s. Observations of *G. pearlensis* have more recently been reduced to a

1:5.8 ratio, while the abundance of *G. oculifera* has remained stable or declined locally (Lindeman et al. 2020). Three of five long-term monitoring sites have declining populations of *G. pearlensis* over the last three decades (Selman & Jones 2017). This may be explained by the presence of water pollution that harmed mollusk populations upon which the species depends (van Dijk 2011a).

4.4.6 Populations of *G. pulchra* seem well-off in comparison to some other species of map turtle but population surveys and monitoring are called for. Significant local or range-wide declines have not been reported but the species does not appear to be particularly abundant anywhere in its range (van Dijk 2011d).

4.5 Geographic trends

The five broad-headed species of map turtle are endemic to the southeastern United States. The rivers that *G. gibbonsi* and *G. pulchra* inhabit have experienced severe flooding and saltwater storm surge during hurricanes since 2004 and these events have probably had adverse effects on reproduction and subsequent recruitment in these populations (Ernst & Lovich 2009), as seen with population declines of the sympatric yellow-blotched map turtle (*G. flavimaculata*) within the Pascagoula River drainage (Selman et al. 2009).

5. Threats

5.1 The difficulty of documenting the presence of aquatic turtle species and developing ecological knowledge about them has been identified as an impediment to conservation, while it is estimated that 35.5% of imperiled reptiles in the southeastern United States are threatened because of the sustained degradation of river systems upon which they depend (Buhlmann & Gibbons 1997). Individual species within the genus *Graptemys* are relatively poorly studied compared to species of other genera in the United States and Canada (Lovich & Ennen 2013). Map turtles are threatened by human alterations to river systems, pollution and declines in water quality, sport shooting, harvesting and take for the pet trade, disease, and heightened predation by subsidized predators (Aresco & Shealy 2006, Buhlmann & Gibbons 1997, Ewert et al. 2006, Selman & Lindeman 2020).

5.1.1 The threats to *Graptemys barbouri* include habitat degradation, overharvesting and predation. Channel modification, dredging, barge traffic and pollution are threats to its riverine habitat and overgrowth of sandy spoil mound sites may change the distribution of nests by increasing clumping. More than one Superfund site is located adjacent to Barbour's map turtle habitat and an industrial accident would be expected to affect a significant portion of the species' total population (van Dijk 2011e). Large numbers of adult females have been found dead along the Flint River in Georgia, possibly attributable to pollution or shell disease (Ernst and Lovich 2009). Where they are sympatric, the species may hybridize with *G. ernsti*, which could locally deplete *G. barbouri* as a pure form (Godwin et al. 2014).

5.1.2 The contamination of water and sediments in the Conecuh and Escambia Rivers by industrial releases or agricultural runoff has the potential to be devastating to local populations of *Graptemys ernsti* by reducing populations of freshwater mussels and negatively influencing female fecundity and male viability (summarized in Aresco & Shealy 2006). Other threats to the species' habitat include salvage logging of submerged tree trunks, snag removal for boating, and impoundments and associated water flow changes. Nest and hatchling mortality of Escambia map turtles from recreational vehicle use on riverine sandbanks has also been observed (Aresco & Shealy 2006). The Escambia map turtle is in some demand in the global pet trade and persistent collection could have significant impacts (van Dijk 2011c).

5.1.3 Documented declines of *Graptemys gibbonsi* have been attributed to significant water pollution in parts of the Pascagoula River system, which harms mollusk populations, a major food source for broad-headed map turtles. Industrial pollution of the Pascagoula River was linked to endocrine disruption in the sympatric, yellow-blotched map turtle (*G. flavimaculata*), where males had significantly lower levels of testosterone, and 10% of males had estradiol levels similar to adult females (Shelby & Mendonça 2001). Other threats include snag and log removal, channelization and impoundment, collection for the pet trade, wanton destruction by people, and predation (van Dijk 2011b).

5.1.4 Recorded declines of *Graptemys pearlensis* have been attributed to water quality issues impacting mollusk populations on which the species depends, as well as stream channelization and impoundment, snag and log removal, gravel mining, collection for the pet trade, wanton destruction, and heightened mortality from potentially subsidized predators (van Dijk 2011a). Sewage overflows and wastewater discharge from the city of Jackson has contributed to elevated nutrient levels within the Pearl River and a

Water Contact Advisory issued by Mississippi Department of Environmental Quality for the past three years (MDEQ 2019). The collection of wild specimens for the domestic and international pet trade is expected to remain a threat for the foreseeable future due to the globally increasing demand for turtles, and map turtles, in particular (U.S. Fish and Wildlife Service 2021a). Pearl River map turtles of all age classes have been seen offered at pet expositions and in online classifieds, and it has been suggested that the majority of Pearl River map turtles on the market were collected by a single individual (Selman & Jones 2017). Additionally, wild adult females have been captured and held for unknow periods of time during the nesting season for a local turtle race (L. Pearson, pers. comm.).

5.1.5 Heightened egg predation from subsidized predators like racoons, and other native predators, may be threats to *Graptemys pulchra*. Riverine development, including snag removal to facilitate shipping and boating, may reduce basking sites; development and associated pollution may impact native mussel populations, which may be offset by the availability of nonnative species which are consumed instead (van Dijk 2011d).

6. Utilization and trade

6.1 National utilization

Small numbers of *G. barbouri* have been advertised and at least one announcement was made of intentions to breed the species for commercial purposes (Ewert et al. 2006). Internet searches in May 2022 revealed the presence of multiple listings for broad-headed map turtles; one post for a ("sold out") specimen described as a Pearl River map turtle referenced the proposed U.S. Endangered Species Act listing and had the highest listing price of those observed. Listed species, at-risk species, or species generally considered rare tend to garner higher interest and subsequently higher prices (Sung & Fong 2018). Most of the observed listings identified turtles as captive bred but this information is not substantiated.

6.2 Legal trade

Trade information housed in the UNEP-WCMC CITES Trade Database for *G. barbouri, G. ernsti, G. gibbonsi, G. pearlensis* and *G. pulchra* was reviewed. During the years 2010-2020, there were a total of 24 transactions recorded for these species, the majority of which occurred between non-range Parties, and was largely comprised of specimens described as bred or born in captivity. The People's Republic of China and Hong Kong were the destination of more than half of the recorded shipments. The United States was the country of export for seven shipments, all of which were for breeding or scientific purposes. Species were traded as follows, by total number of individuals/specimens: *G. gibbonsi* (192), *G. barbouri* (104), *G. pulchra* (13), *G. pearlensis* (7) and *G. ernsti* (2). However, specimens traded as *G. gibbonsi* may actually be *G. pearlensis*, based on an anecdotal report that the majority of individuals in trade were collected by one individual on the Pearl River, and capture and trade of *G. gibbonsi (sensu lato)* was unrestricted in Louisiana (Selman & Qualls 2007, Ennen et al. 2016).

Separately, trade data collected by the U.S. Fish and Wildlife Service and housed in the Law Enforcement Management Information System was analyzed for years 2005-2022 (USFWS 2022b). This analysis revealed the export of 1.5 million turtles described as *Graptemys* spp., or their parts, exported from the United States into 36 countries during these years. In 2005 (the year before the genus was included in CITES III), 35,000 turtles (*Graptemys* spp.) were exported in a single shipment to Spain and 172,645 *Graptemys* turtles were exported to 24 countries. It is unclear whether these specimens originated from captive or wild-collected stock (USFWS 2021b). In a recent report, Louisiana residents mentioned ongoing harvesting of wild turtles at several locations occupied by *G. pearlensis* within the Pearl River drainage, Louisiana, with these turtles destined for the international pet trade (Selman 2020).

6.3 Parts and derivatives in trade

According to the UNEP-WCMC CITES Trade Database, the vast majority of specimens in international trade during the years 2010-2020 were live. Only two shipments were recorded as non-living specimens.

6.4 Illegal trade

As described in Section 7.1, many range States in the United States regulate these species either through licensing requirements or collection and trade restrictions, and the extent of State enforcement actions relating to these species is unknown. It has been reported that nine out of the top ten CITES-listed wild-

sourced reptile species seized globally in recent years, based on number of individuals, were tortoises and freshwater turtles (UNODC 2020). Due to the difficulty of accurately identifying species within the broad-headed map turtle group, there is some concern that species may be incorrectly declared to law enforcement to bypass CITES regulations.

6.5 Actual or potential trade impacts

All but one species of broad-headed map turtle are said to have declining population trends and harvesting for the pet trade is one of the myriad activities that collectively threaten this species (van Dijk 2011a, van Dijk 2011b, van Dijk 2011c, van Dijk 2011d, van Dijk 2011e). Targeted wild collection for various trade activities in other regions is described as severely impacting freshwater turtles because much of the trade involves mature individuals, which would otherwise exhibit high survivorship and sustained production of offspring (van Dijk et al. 2000).

7. Legal instruments

7.1 National

Two species of map turtles are protected by the U.S. Endangered Species Act: *Graptemys oculifera* and *Graptemys flavimaculata* were listed as Threatened in 1986 and 1991, respectively. Unless authorized by a permit issued by the U.S. Fish and Wildlife Service, it is unlawful to take, import or export, ship in interstate or foreign commerce in the course of a commercial activity, or sell or offer for sale in interstate or foreign commerce, any Threatened species. In 2021, the U.S. Fish and Wildlife Service announced that it intends to list *Graptemys pearlensis* as Threatened under the Endangered Species Act, and the other four broad-headed map species as Threatened due to similarity of appearance (USFWS 2021a). In addition, the United States Food and Drug Administration for health reasons prohibits turtles with a carapace length of less than 4 inches for sale, held for sale, or offered for any other type of commercial or public distribution, except if the live turtles are intended for export only [provided that the outside of the shipping package is conspicuously labeled "For Export Only"] (21 CFR 1240.62).

7.1.1 The State of Alabama classifies *G. barbouri* and *G. ernsti* as species of high conservation concern, and *G. pulchra* as a moderate conservation concern. All map turtles of the genus *Graptemys* (and specifically, *G. barbouri*, *G. ernsti* and *G. pulchra*) are considered nongame reptiles regulated by the State of Alabama. A scientific collection or written permit from the State's Department of Conservation and Natural Resources must authorize certain activities with listed species. Otherwise, the take, capture, kill; attempt to take, capture or kill; possession, sale or trade of any specimens, parts or reproductive products is illegal (www.outdooralabama.com).

7.1.2 The State of Florida classifies *G. barbouri* as threatened under the state's Endangered and Threatened Species Rule. In 2010, the species was subject to a status review by the Florida Fish and Wildlife Conservation Commission (FWC), and the species' status was maintained on the basis of its geographic range and restricted population. State rules prohibit possessing or taking from the wild species listed by the state as imperiled, including *G. barbouri*. Florida also prohibits the taking of certain species that look similar to imperiled species, including *G. ernsti*. The possession limit for *G. ernsti* is two specimens. No one may sell turtles taken from the wild in Florida and no one may buy, sell or possess *G. barbouri* in the State of Florida (www.myfwc.com).

7.1.3 The State of Georgia's Protected Species list includes *G. barbouri* and *G. pulchra* as threatened and rare species, respectively (georgiabiodiversity.org). The Georgia Department of Natural Resources regulates the collection of freshwater turtle species; collection is allowed year-round, except for species protected by federal or state law. The possession limit of non-protected freshwater turtles without a commercial license is ten individuals at a time (any combination of species) (georgiawildlife.com).

7.1.4 The State of Louisiana's published checklist of native or established amphibians and reptiles includes *G. pulchra*; *G. pearlensis* is known from the Pearl and Bogue Chitto Rivers in the extreme eastern parishes of the state. No known state-level listings apply to the species. The Louisiana Department of Wildlife and Fisheries regulates the collection of certain turtle species (i.e. alligator snapping turtle, diamondback terrapin, etc.) and requires that all persons engaged in the collection of those turtles possess a recreational fishing license (www.wlf.louisiana.gov). However, all other turtle species not listed as prohibited or with specific regulations can be harvested with no limits, including the Pearl River map turtle.

7.1.5 The State of Mississippi's 2015 published Listed Species List does not include any broad-headed map turtles, but the Mississippi Department of Wildlife, Fish and Park (MDWFP) regulates the harvest of nongame wildlife, which includes native turtles. The State's herpetology checklist (rev. 2012) includes the Pascagoula map turtle, Pearl River map turtle and Alabama map turtle. Either a Resident Sportsman's license, Resident All Game Hunting, or Freshwater Fishing license, or a Small Game Hunting and Freshwater Fishing License or a Non-Resident All Game Hunting is required for the possession of nongame species for personal use. Except for certain species listed by the State which cannot be taken, a person may possess and harvest from the wild no more than 10 nongame turtles per license year. No more than four can be of the same species or subspecies and none may be collected between April 1 and June 30 (www.mdwfp.com).

7.1.6 The State of Tennessee, in which *G. pulchra* has been observed (Brown 2021), limits sport fishing of turtles to common snapping turtles, which requires a sport fishing license (www.tnwildlife.org).

7.2 International

Effective June 14, 2006, *Graptemys* spp. was added to CITES Appendix III by the United States.

8. Species management

8.1 Management measures

8.1.1 The Alabama State Wildlife Action Plan identifies *G. barbouri* and *G. ernsti* as species of greatest conservation need (Alabama Department of Conservation and Natural Resources 2015). The Conecuh River basin, which has a history of various water quality impacts, includes two Strategic Habitat Units and one Strategic River Reach for aquatic species of greatest conservation need, including *G. ernsti*. According to the Alabama Department of Environmental Management (2014), several portions of the Conecuh River mainstem along with major tributaries did not fully support their designated uses due to atmospheric deposition of mercury. Siltation and enrichment from agricultural sources were also noted. Actions for the Escambia map turtle in this basin include the performance of comprehensive surveys at 5- to 10-year intervals to monitor its abundance and distribution. The Yellow River basin in Alabama is described as having overall good water quality, though 15 miles of the Yellow River's main channel were classified as impaired due to the atmospheric deposition of mercury. This basin includes one Strategic Habitat Unit for aquatic species of great conservation need, including *G. ernsti,* and similar surveys for the species are suggested. The Choctawatchee River basin, described as largely free of impoundments, includes two Strategic Habitat Units and two Strategic River Reaches and is inhabited by both *G. barbouri* and *G. ernsti***.** The aquatic fauna of this basin is described as largely intact, though 232 miles of streams that do not support or do not fully support their designated uses were identified. Comprehensive surveys for Barbour's and Escambia map turtles are suggested, as well as investigations of life history and the determination of systematic relationships among populations from different Gulf Coast drainages using morphological and genetic analyses. The Apalachicola River basin, which included 103 miles of streams that did not support or did not fully support their designated use, includes two Strategic Habitat Units and is occupied by *G. barbouri*; comprehensive surveys at 5- and 10- year intervals are suggested.

8.1.2 The Florida State Wildlife Action Plan identifies *G. barbouri* and *G. ernsti* as species of greatest conservation need (Florida Fish and Wildlife Conservation Commission 2019). The State reports the performance of habitat monitoring to assess the state, condition and trend of habitats described in its Wildlife Action Plan. Time and resources are largely directed to monitoring species addressed in Florida's Imperiled Species Management Plan (rev. 2017), which includes measures for *G. barbouri* (described in a 2013 Species Action Plan). The Species Action Plan for *G. barbouri* aims to maintain the existing extent of the species' occurrence in Florida and to maintain or increase population sizes in each river where the species naturally occurs by: maintaining prohibitions on wild collection and possession of the species; maintaining or improving historic levels of water quality, quantity and habitat characteristics of occupied rivers, including streamside habitats; identifying and conserving private lands bordering occupied rivers and streams; reducing mortality associated with recreation; educating the public and law enforcement; performing outreach to public and private land managers; and supporting research on hybridization of sympatric *Graptemys* spp.

8.1.3 The Georgia State Wildlife Action Plan identifies *G. barbouri* and *G. pulchra* as high priority species (Georgia Department of Natural Resources 2015). The ecoregions associated with these species are the Piedmont and Southeastern Plains, and the Southwestern Appalachians/Ridge and Valley, respectively;

according to monitoring by the Environmental Protection Division, over half of the streams in each of these regions did not support designated uses in 2012. The importance of water quality improvements to mollusk health and wildlife conservation are noted. High priority conservation actions described in Georgia's Wildlife Action Plan include surveys for new populations of priority species, like the Barbour's and Alabama map turtles, with the potential deployment of environmental DNA (eDNA) surveys for appropriate candidates.

8.1.4 The Louisiana State Wildlife Action Plan identifies *G. pearlensis* as a species of greatest conservation need (Holcomb et al. 2015). The 2012 Water Quality Inventory Report indicated that 26% of the 23 waterbody sub-segments within the Pearl River basin fully support their designated use for fish and wildlife propagation; identified causes of water quality issues include metals, nutrients, fecal coliform bacteria, organic enrichment and low concentration of dissolved oxygen, low pH levels, and turbidity. An Inland Fisheries Management Plan for the Pearl Basin also exists. Louisiana's Wildlife Action Plan identifies research and survey needs for riverine turtles, including determination of the magnitude of submergence of sandbars (potential nesting habitat) resulting from water releases of upstream reservoirs, and determination of peak nesting times for riverine turtles in all major rivers so to minimize negative influences on species' productivity. Research and survey needs for *G. pearlensis* include the completion of ecological studies on reproduction, nest success and recruitment, as well as the generation of population estimates via mark-recapture or mark-resight surveys. Reptile conservation actions applicable to map turtles include: working with partners to protect/restore sandbars; control of exotic plants and animals on sandbars; restriction or prohibition of the use of off-road vehicles on sandbars and in streams; partnering to reduce the impacts of dredging and channelization on sandbar-nesting turtles; partnering to minimize the impacts of gravel mining on sandbar-nesting turtles; retention of emergent and submerged wood debris (subsidizing if necessary) and providing outreach on its importance; partnering to time the regulation of water levels to minimize impacts to nesting turtles.

8.1.5 The Mississippi State Wildlife Action Plan identifies *G. gibbonsi*, *G. pearlensis*, and *G. pulchra* as species of greatest conservation need (Mississippi Museum of Natural Science 2015). The ecoregions associated with these species are the Eastern Gulf Coastal Plain, the Upper East Gulf Coastal Plain and Streams. The Alabama map turtle occupies the Tombigbee drainage, which is described as highly modified and imperiled, with 42 percent of its streams monitored by the Mississippi Department of Environmental Quality rated as poor quality. The upper and lower Pearl River drainages, inhabited by the Pearl River map turtle are each considered vulnerable to further degradation. Of the streams in these drainages monitored by the Mississippi Department of Environmental Quality, the majority were found to be in good or fair condition. The Pascagoula drainage, inhabited by the Pascagoula map turtle and considered vulnerable, is described as less modified than other waters but also impacted by sedimentation, pollution, and surrounding uses. Of the streams in this drainage monitored by the Mississippi Department of Environmental Quality, over 90 percent were found to be of good or fair quality. Categories of actions to address habitat and species concerns include land/water protection; land/water management; species management; education and awareness; law and policy; livelihood, economic and other incentives; and external capacity building.

8.1.6 *Graptemys pulchra* has recently been observed in one county in Tennessee (Brown 2021) and is not included in the existing State Wildlife Action Plan.

8.2 Population monitoring

State Wildlife Action Plans discuss the need for surveys and monitoring of broad-headed map turtles. Existing data is described in detail in Section 4.2. As noted elsewhere, declining populations of *Graptemys pearlensis* have been observed at long-term monitoring sites (Selman & Jones 2017).

8.3 Control measures

8.3.1 International

All species of genus *Graptemys* have been included in Appendix III since 2006 (U.S. Fish and Wildlife Service 2005). Since the listing took effect on June 14, 2006, international trade in these species must be authorized by issuance of a CITES export permit, a process that requires a legal acquisition finding, or by a certificate of origin or re-export certificate to ensure legal, traceable trade.

8.3.2 Domestic

Some States have implemented measures to conserve and restrict collection and/or trade in these species. Range States in the United States implement and enforce their rules and regulations, including any license requirements and limits or prohibitions on wild collection and trade. Despite these measures, domestic protection is likely inadequate to control harvest pressure. The species herein are specialized and restricted in their river ecosystems and therefore, likely benefit from a wholistic macro-scale conservation approach that can monitor trade at the federal level to compliment regulations already instituted by states where these species occur, in order to ensure that any trade is legal and use is sustainable.

8.4 Captive breeding and artificial propagation

Most species of *Graptemys* are thought to do well in captivity, as reported by Lovich et al. (2014). However, given the specialized feeding habits of these broad-headed map turtles, notably females, suitable food is required for captive specimens; it remains unclear how available and effectual an (artificial) mollusk diet would be in a commercial context. *Graptemys pearlensis* has been successfully maintained in a public institution, though captive propagation has not been attempted (Ennen et al. 2016). The extent to which the five species of broad-headed map turtles are captive bred for commercial purposes remains unknown, though successful captive propagation of specimens that entered trade as *G. gibbonsi* has been reported in Europe and the United States (Ennen et al. 2016). In general, for many slow-reproducing turtle species, the high cost of maintenance in captivity is understood to make large-scale commercial breeding unprofitable (Stärk et al. 2019). Hatchlings of other species of map turtles are known to be produced domestically by turtle farms but specimens also enter the trade through wild collection (USFWS 2005).

8.5 Habitat conservation

Habitat conservation measures by range States in the United States are described under section 8.1. The U.S. Fish and Wildlife Service may also designate critical habitat for species that are listed under the Endangered Species Act.

8.6 Safeguards

We are aware of one population *of G. gibbonsi* maintained as an assurance colony at a zoo in the United States.

9. Information on similar species

All species of genus *Graptemys* are currently included in Appendix III, and species are difficult to differentiate due to similarity of appearance (USFWS 2021b). The identification of hatchlings during all stages of trade and regulation would pose additional challenges.

10. Consultations

None needed (U.S. endemic spp.). The United States has an open, transparent process to engage and consult with the public, including: States, Tribes, industry, non-governmental organizations and other interested stakeholders when it comes to CITES issues at a CoP, as outlined in Part 23 of Title 50 of our U.S. Code of Federal Regulations (https://www.ecfr.gov/current/title-50/chapter-I/subchapter-B/part-23/subpart-G/section-23.87). We are one of the few countries in world with such a robust and lengthy process. To see the specific comments on species proposals to amend the CITES Appendices that we received, please see: htps://www.regulations.gov/docket/FWS-HQ-IA-2021-0008/document.

11. Additional remarks

The IUCN SSC Tortoise and Freshwater Turtle Specialist Group (TFTSG) has expressed support for the inclusion of all freshwater turtles in CITES Appendix II, at a minimum. (https://www.regulations.gov/comment/FWS-HQ-IA-2021-0008-0006)

This proposal was reviewed by turtle biologist, Dr. Kurt Buhlmann, of the University of Georgia, Savannah River Ecology Laboratory (Aiken, South Carolina). He agrees that the regulation of trade in these species is needed and supports the inclusion of the species of *Graptemys* in CITES Appendix II, at a minimum.

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