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

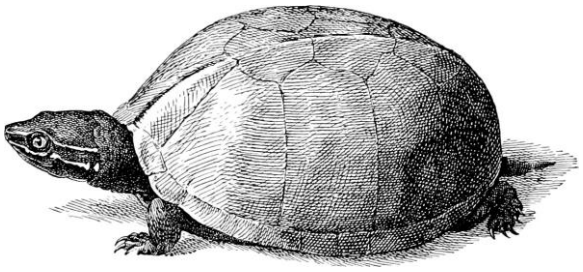
CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

A. Proposal

Inclusion of all species of Musk turtles in the Genus *Sternotherus spp.* in Appendix II in accordance with Article II, paragraph 2(a) of the Convention, and Resolution Conf. 9.24 (Rev. CoP17), Annex 2a, as per:

b) Criterion B. It is known, or can be inferred or projected, that regulation of trade in the species is required to ensure that the harvest of specimens from the wild is not reducing the wild population to a level at which its survival might be threatened by continued harvesting or other influences.

For a complete list of species, see Table 1.



B. Proponent

United States of America [*]

C. Supporting statement

1. Taxonomy

1.1 Class: Reptilia

1.2 Order: Testudines

1.3 Family: Kinosternidae (Agassiz, 1857)

1.4 Genus: *Sternotherus* (Bell in Gray, 1825)

Species: *Sternotherus carinatus* (Gray, 1856)

Sternotherus depressus (Tinkle and Webb, 1955)

Sternotherus minor (Agassiz, 1857)

Sternotherus odoratus (Latreille in Sonnini and Latreille, 1801)

as defined in the standard nomenclature reference for turtles, Fritz and Havaš (2007). Subsequently a taxonomic analysis of *Sternotherus minor* has led to the elevation of

[*] *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.*

S. peltifer (Smith and Glass, 1947) and the recognition of an additional species *S. intermedius* (Scott, Glenn, and Rissler, 2018). However, for this proposal we are using Fritz and Havaš (2007).

1.5 Scientific synonyms: See Fritz and Havaš (2007) and Turtle Taxonomy Working Group (TTWG; 2021) for synonyms of genus and species names.

1.6 Common names:

English:	Musk turtles*
French:	Tortue musquée
Spanish:	Tortuga almizclera

*See Table 1 for suggested English names for specific species

1.7 Code numbers: N/A

2. Overview

Turtles 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 (Stanford *et al*., 2020). This is reflected in the fact that almost half are categorized on the IUCN Red List of Threatened Species as being critically endangered, endangered, or vulnerable.

The family Kinosternidae is comprised of four genera—*Claudius* (narrow-bridged musk turtles), *Kinosternon* (American mud turtles), *Staurotypus* (giant musk turtles), and *Sternotherus* (musk turtles)—of small- to medium-sized freshwater mud or musk turtles that range from Canada to South America (Ernst and Lovich, 2009; Harless and Morlock, 1979). The genera *Kinosternon* and *Sternotherus* comprise the sub-family Kinosterninae (Ernst and Lovich, 2009). Musk turtles (*Sternotherus*) are endemic to the freshwaters of North America, from the extreme southeastern portion of Canada south along the eastern portion of the United States to Florida. They get their name from the musky, foul smelling secretion that is produced from two glandular openings on each side of their body near their carapace, when they are handled (Conant, 1958; Ernst and Lovich, 2009).

Sternothernus are threatened mainly by habitat loss and degradation, but are also highly susceptible to collection for the pet trade. Their life history (late maturity, long lifespan, low recruitment, and reliance on low adult mortality), like other turtle species, makes them highly susceptible to anthropogenic threats (Ceballos and Fitzgerald, 2004; C. Caceres – Canadian Wildlife Service, *pers. comm*.). Turtles from the genus *Sternotherus* are small-bodied and lay few eggs per clutch (Ernst and Lovich, 2009), making them inherently vulnerable to population declines because they are slow to reproduce, especially when adults are removed from a population (Ceballos and Fitzgerald, 2004). Given their relatively small clutch sizes/reproductive output and reliance on adult survivorship, they are more vulnerable to commercial harvest and international trade, and are unlikely to withstand harvest of adults and subadults without intense management (Ceballos and Fitzgerald, 2004), than many of the larger freshwater turtles (family Emydidae and Trionychidae) that are now widely bred in captivity (J.D. Strong – Director, Oklahoma Department of Wildlife Conservation, *pers. comm*.).

Live musk turtles are exported primarily to East Asia for commercial purposes. For the years between 2013 and 2019, almost 1.5 million live *Sternotherus* turtles were exported from the United States, with the majority of specimens (60.1%) wild-sourced. Without a complete picture of the population size of these species, it is difficult to determine whether or not this level of harvest and export is sustainable. Although U.S. states have legislation that regulates the collection of *Sternothernus* and other freshwater turtles, these species are still harvested from the wild in parts of their range within the United States and exported internationally in large commercial quantities. Inclusion in CITES Appendix II would complement State and other domestic measures and ensure that the acquisition of specimens entering international trade were acquired sustainably as well as legally and will not be detrimental to the survival of the species.

Musk turtles in the Genus *Sternotherus* spp. qualify for inclusion in Appendix II in accordance with Article II paragraph 2(a) of the Convention, satisfying Criterion B of Annex 2a of Resolution Conf. 9.24 (Rev. CoP17). Available information indicates that the regulation of trade in these species is required to ensure that the harvest of specimens from the wild is not reducing the wild populations to a level at which its survival might be threatened by continued harvesting or other influences.

3. Species characteristics

3.1 Distribution

Endemic to North America, the genus *Sternotherus* occurs in the eastern portion of the United States and extreme southern Québec and southeastern Ontario, Canada (Ernst and Lovich, 2009; TTWG, 2021). The most wide-ranging species of the genus is the Common musk turtle (*Sternotherus odoratus*). It is found from southern Maine, Québec and Ontario (Canada), south to Florida, west into central Texas, and eastern Oklahoma and Kansas, and north to southern Wisconsin and Michigan (Ernst and Lovich, 2009; TTWG, 2021). The record of a single specimen of *S. odoratus* collected in 1903 in Chihuahua, Mexico, is unconfirmed (Conant and Berry, 1978; Pritchard, 1979; TTWG, 2021).

The remaining species in the genus are more localized within the southern region of the United States. The Razor-backed musk turtle (*Sternotherus carinatus*) is found largely in Louisiana, as well as portions of Arkansas, Oklahoma, Texas, Alabama and Mississippi (Ernst and Lovich, 2009; TTWG, 2021). The Loggerhead musk turtle (*Sternotherus minor*) occurs mostly in east central Georgia, and neighboring northern Florida and extreme southeastern Alabama (Ernst and Lovich, 2009; TTWG, 2021). The Flattened musk turtle (*Sternotherus depressus*) has the most limited distribution of all species in the genus. It is restricted to the Black Warrior River watershed in north-central Alabama, above the Bankhead Dam (Ernst *et al*., 1989; Kiehl, 2000).

For more detailed information on the specific range of each species, see Table 1.

3.2 Habitat

Overall, *Sternotherus* are a highly aquatic species, rarely leaving the water except during rains or the nesting season (Conant, 1958; Mahmoud, 1969). However, some species will emerge from the water to bask more regularly than others. Fallen trees, overhanging banks, and submerged logs and rocks provide important sites for both shelter and basking. Slow-moving, permanent, freshwater bodies with soft substrates tend to dominate their preferred habitat.

The Razor-backed musk turtle (*S. carinatus*) prefers the deeper waters of rivers, streams, oxbows, and swamps, where soft substrates, abundant aquatic vegetation, and a slower current are found (Ernst and Lovich, 2009; Mahmoud, 1969). According to Ernst and Lovich (2009), this species of musk turtle basks more often than any other *Sternotherus* species. The Flattened musk turtle (*S. depressus*) inhabits shallow (1.5 m or less in depth), clear streams that have a rocky to sandy substrate and are permanent in nature (Ernst and Lovich, 2009). During the day, *S. depressus* buries itself in the sand, or hides in the crevices of the rocks or under the submerged logs found in its habitat (Ernst and Lovich, 2009). The Loggerhead musk turtle (*S. minor*) prefers the shallow (0.5 – 1.5 m in depth) waters of rivers, creeks, oxbows, spring runs, ponds, swamps, and lake margins that have a soft substrate (Ernst and Lovich, 2009); although, they have been found as deep as 13 m (Hensley 1995). Often, the species is seen around snags and fallen trees (Ernst and Lovich, 2009). The Common musk turtle (*S. odoratus*) can be found in a wide variety of water bodies, such as rivers, streams, lakes, ponds, sloughs, canals, swaps, bayous and oxbows, as long as the current is slow and the substrate is soft (Ernst and Lovich, 2009). Rocks and submerged logs are necessary shelters for this species (Ernst and Lovich, 2009). Although the species is typically found in shallow waters less than 1 m deep, they have been seen in waters as deep as 9 m (Ernst and Lovich, 2009).

3.3 Biological characteristics

Sternotherus are omnivorous, with mollusks making up the majority of their diet, especially for adults (Ernst and Lovich, 2009; Mahmoud 1968). However, their diet is varied, consisting also of insects, crustaceans, amphibians, carrion, earthworms, and aquatic vegetation (Ernst and Lovich, 2009; Mahmoud 1968). Young musk turtles (under 50 mm in size) feed primarily on small aquatic insects and algae (Ernst and Lovich, 2009). For the Flattened musk turtle, snails (Gastropoda) make up a significant portion of their diet, while also consuming a large quantity of the introduced Asiatic clam (*Corbicula maniliensis*) (Ernst and Lovich, 2009). It is presumed that due to their preference for mollusks, some musk turtle species (i.e., *S. depressus* and *S. minor*) have developed larger crushing surfaces on both their upper and lower jaws, and hypertrophied head musculature in response to their diet (Ernst and Lovich, 2009). *S. carinatus* and *S. odoratus* are bottom feeders. They search for prey as they walk along the river bottom with their neck extended, using it to probe the soft substrate and aquatic

vegetation for food (Ernst and Lovich, 2009). At dusk, Common musk turtles are also known to sometimes leave the water for land to prey on terrestrial slugs (Ernst and Lovich, 2009).

Turtles have evolved a remarkable life history strategy characterized by slow growth and late maturity (usually on the order of 10-15 years), longevity (typically living for six or more decades, and generation times often at 25-30 years) and successful reproduction throughout life without senility, relatively modest annual reproductive output (one to over 100 eggs per mature female per year, depending on species), very low survivorship of eggs and juveniles, but increasingly high average annual survivorship of subadults and adults (AC25 Doc. 19). Female Razor-backed musk turtles mature at a straight carapace length (SCL) of approximately 8.5 - 9.5 cm, which is typically reached between four to eight years of age (Iverson, 2002), and may lay of clutch of between one and seven (mean, 3.0) eggs per nesting season (Ernst and Lovich, 2009). There is little data on the reproduction of Flattened musk turtles including their size and age at maturation, however, females may lay one to two clutches per year, each with between one and four eggs (Ernst and Lovich, 2009). Female Loggerhead musk turtles mature at approximately 6 – 8 years of age, at about a SCL of 8 cm (Etchberger and Ehrhart, 1987). Although a female can lay as many as 1-5 (mean, 3) clutches per year, with each clutch containing between one and five (mean, 3.3) eggs, her reproductive potential each year is only 6 to 12 eggs (Etchberger and Ehrhart, 1987). For the Common musk turtle, the species matures faster in the southern portion of its range than in the north (Ernst and Lovich, 2009). In Florida, Iverson and Meshaka (2006) found that females mature at around three years of age, while in Oklahoma, Mahmoud (1967) found that females mature in five to eight years, with a SCL of 6.5-8.5 cm. Clutches for *S. odoratus* often contain 2 to 4 (mean, 4.1) eggs, but it has been noted that their clutch can contain just one egg or up to 13 eggs (Tucker and Lamer, 2005). Smaller clutches are found in the Common musk turtle populations in the south (Iverson and Meshaka, 2006), presumably due to the earlier maturation and shorter SCLs of southern female musk turtles (Ernst and Lovich, 2009). For all *Sternotherus* species, there is a positive correlation between the number of eggs per clutch and the female musk turtle's SCL; as the female's SCL increases, the clutch size increases as well (Ernst, 1986; Ernst and Lovich, 2009; Iverson, 1977; Mitchell, 1985). Documented specimens of musk turtles show that their natural longevity is at least 20 years with one Common musk turtle specimen living more than 54 years in the Philadelphia Zoo (Snider and Bowler, 1992, as cited in Ernst and Lovich, 2009). In the wild, *Sternotherus* species are estimated to live a maximum of 20 – 30 years (Ernst and Lovich, 2009).

In short, the key to turtle life history is to reach maturity, live for a long time, and produce a relatively modest number of eggs each year, so that over a lifetime enough eggs are produced to ensure that a few will successfully hatch and some of these will survive to adulthood (AC25 Doc. 19). If we compare this with commonly managed larger mammals (see Figure 4) then we see just how sensitive turtle life history traits are and how they limit significant off-take (e.g. taken from a specific North American species but applicable to all turtles).

3.4 Morphological characteristics

Sternotherus are moderately small in size, with the largest species in the genus, the Razor-backed musk turtle (*S. carinatus*), reaching a maximum SCL of 17.6 cm, and the smallest species, the Flattened musk turtle (*S. depressus*), reaching a maximum SCL of 12.5 cm (Ernst and Lovich, 2009). Except for *S. depressus*, which has a quite flat, broad carapace, *Sternotherus* species typically have a carapace that is oval and highly arched or domed (Ernst and Lovich, 2009). Their plastron is relatively small, significantly exposing the underside of their legs, has a single not well-developed hinge (which may or may not be readily apparent) (Conant, 1958), and has only 10 or 11 scutes (Ernst and Lovich, 2009). Their heads are wide with a projecting tubular snout (Ernst and Lovich, 2009), and barbels (downward fleshy projections) on their chin and/or neck (Conant, 1958). Musk glands positioned near the bridge of the shell can produce malodorus secretions when the turtles are disturbed (Ernst and Lovich, 2009). Juveniles of the species are difficult to tell apart, in particular *S. depressus* from *S. minor* (K. Buhlmann – University of Georgia, Savannah River Ecology Laboratory, *pers. comm.*), but they do become more easily distinguished from one another as subadults, especially *S. odoratus* (C. Hagen – Turtle Survival Alliance, *pers. comm.*).

3.5 Role of the species in its ecosystem

Turtles are major components of freshwater ecosystem food webs, playing important roles in energy flow, nutrient cycling, dispersal of aquatic vegetation, indication of pollution, and maintenance of water quality (Ernst and Lovich, 2009; Moll and Moll, 2004).

4. Status and trends

4.1 Habitat trends

It is presumed that in general, musk turtles are facing the same habitat trends that other freshwater turtles of the southeastern United States are facing: sedimentation, snagging operations to remove deadwood from waterways for navigation purposes, mining for sand and gravel, and toxic pollutants (Dodd, 1990; Lindeman, 2008; Stewart, 1990). Habitat destruction or modification, causing sedimentation and pollution, not only has a direct effect on musk turtles themselves, but also negatively affects their molluscan and insect prey (Ernst and Lovich, 2009; van Dijik, 2011c). Ultimately, this results in the elimination of the species from formerly suitable habitats (Ernst and Lovich, 2009).

Specifically, the Pascagoula River population of *S. carinatus* has shown a sharp decline as a result of toxic pollution, deadwood snag removal (which reduces or eliminates basking sites), sand and gravel mining, sedimentation, and impoundment (Lindeman, 2008; Stewart, 1990). Habitat modifications to the stream and river channels in the Warrior River Basin, Alabama, have had a significant impact on *S. depressus*, due to its restricted range (Dodd, 1990). Pollution and sedimentation from adjacent sites of open coalmining, and the impoundment of stream sections have severely impacted the species' habitat (van Dijik, 2011b). Siltation, caused by strip mining activities in the Warrior Basin Coal Field, and runoff and stream bank management associated with forestry, agriculture and construction, have caused the degradation of many waterways in the area (Ernst and Lovich, 2009; van Dijik, 2011b). The sedimentation from these activities not only contain harmful toxins, but it also physically blocks the species' essential rock crevice hiding spaces, and significantly reduces or may even eliminate their primary food source (mollusks) (van Dijik, 2011b). According to van Dijik (2011b), the species has lost about 90% of its total habitat and associated populations in the past two generations [generation time is unknown, but estimated at 20-30 years].

4.2 Population size

Although data on the population size of *S. carinatus* is not extensive, van Dijik (2011a) notes that "anecdotal information indicates that the species is abundant and stable in a variety of locations across its range; the main exception is the population of the Pascagoula river, where a combination of pollution and habitat modification have reduced populations of this and other turtle species (Lindeman, 2008)."

At one time, *S. depressus* most likely occupied almost all streams and rivers throughout the Warrior Basin (Alabama) above the Fall Line (the steep northeastern edge of the coastal plain) (Dodd, 2008; Pulliam, 1987). Today, it is now confined to areas where pollution, sedimentation, and impoundments have not entirely altered its habitat (Dodd, 2008). According to Dodd (1990), 56.3% of historically suitable habitat was degraded to the point that it had lost its *S. depressus* populations, 36.9% was severely degraded and contained remnant populations, and only 6.9% of original habitat remained reasonably unaffected by pollution, sedimentation and impoundments. Thus, surviving populations of *S. depressus* only occupy about 7% of its historically suitable habitat (van Dijik, 2011b).

According to van Dijik (2011c), *S. minor* are "generally abundant in suitable habitat." Loggerhead musk turtles reach among the highest densities known for any turtle species (Zappalorti and Iverson, 2006). The species has been found consistently at densities over 100 animals per hectare (review of data by Zappalorti and Iverson, 2006), with the highest density calculated at 2,857 animals per hectare under ideal conditions in a northwest Florida springhead (Cox and Marion, 1979).

S. odoratus is common to extremely abundant in suitable habitat anywhere within its range (Iverson and Meshaka, 2006; van Dijik, 2015). Given that the species is able to be collected easily, large amounts of population data are available (Ernst and Lovich, 2009). Density reports range from 8 - 700 individuals per hectare, and 8.4 to 41.7 kg / ha biomass (review of data by Iverson and Meshaka, 2006).

4.3 Population structure

Studies have shown that most musk turtle populations consist predominantly of adults (Ernst and Lovich, 2009). However, study results may be skewed since juveniles, as with most turtles, are more cryptic and secretive in nature, and require collection by hand, thus making them more difficult to find (Ernst and Lovich, 2009). Therefore, it is likely that these populations consist of more juveniles than the surveys express (Ernst and Lovich, 2009). Although most species have a sex ratio around 1:1, some populations of musk turtles have adult sex ratios favoring one sex over another (Ernst and Lovich,

2009; Iverson and Meshaka, 2006). Interpreting this variation is complicated by temperature-dependent sex determination in the species, possible differential migration patterns between the sexes, possible differential mortality between the sexes, and the different ages and sizes at maturity (Iverson and Meshaka, 2006).

4.4 Population trends

Overall, the population trend for *S. carinatus* and *S. odoratus* is stable (Ernst and Lovich, 2009; van Dijik, 2011a, 2015), except for the Pascagoula River population of *S. carinatus* which may have suffered a sharp decline as a result of habitat modification, mining activities, and pollution (Lindeman 2008). These trends are outlined in the species' IUCN Red List assessments; however, these assessments are over 10 years old and more current ones are warranted. In Canada, *S. odoratus* has experienced declines and local extirpations in southwestern Ontario (C. Caceres – Canadian Wildlife Service, *pers. comm.*).

Remaining populations of *S. depressus* only occupy 6.9% of its historic range and most populations are fragmented by extensive areas of unsuitable habitat (Dodd, 1990). Between the end of June and late July 1985, a severe disease outbreak swept through the Sipsey Fork population reducing the population by 50% (Dodd, 1988). This outbreak also occurred at other streams but its impact on the population was not quantified (van Dijik, 2011b). By 1995, research showed that the Sipsey Fork population had still not yet recovered to pre-disease levels (Bailey and Guyer, 1998). According to Bailey and Guyer (1998), populations of *S. depressus* were still declining throughout the Warrior Basin throughout the 1990s, possibly due to a continued lack of recruitment and illegal take. Results of the most recent surveys indicate that there are still some viable populations present in stable condition, but at an abundance lower than they were in the mid-1980s (Dodd, 2008).

While some *S. minor* populations seem to be stable in certain river systems, Zappalorti and Iverson (2006) note that there is not enough known about the overall abundance or rarity of this species. Therefore, the current population trend of the species is unknown (van Dijik, 2011c).

4.5 Geographic trends

Except for the wider ranging *S. odoratus*, all of the other *Sternotherus* species are located entirely within the southeastern United States, which ranks as one of the three "most prominent global areas of high turtle and tortoise species richness" in the world (TTWG, 2021). According to the Turtle Taxonomy Working Group (TTWG; 2021), currently, there are 59 species of freshwater and terrestrial turtles in the U.S. which constitutes approximately 17% of the global turtle species. The U.S. has the greatest freshwater and terrestrial turtle species diversity of any country in the world (TTWG, 2021). While the highest concentration of turtle species is found in southeastern Asia, the diversity of turtle species in the southeastern U.S. ranks as the second highest concentration of species in the world (Buhlmann *et al*., 2009). Freshwater ecosystems of the southeastern United States are a "global hotspot of freshwater turtle diversity," with declines in water quality contributing significantly to the decline and imperilment of many of these species. (Grosse *et al*., 2010). In their review of imperiled aquatic reptiles of the southeastern United States, including musk turtles, Buhlmann and Gibbons (1997) found that 35.5% of the species were threatened because of the continual, cumulative damage to river systems.

5. Threats

Sternotherus are primarily threatened by habitat modification, degradation and loss. Sedimentation, snagging operations to remove deadwood from waterways for navigation purposes, mining for sand and gravel, impoundment, hydrologic changes, and toxic pollutants (Dodd, 1990; Lindeman, 2008; Stewart, 1990; van Dijik, 2011a, 2011b, 2011c) have a direct negative effect on musk turtles and their molluscan and insect prey base (Ernst and Lovich, 2009; van Dijik, 2011c). Increased boat traffic on rivers and springs disturbs the habitat of these turtles (Zappalorti and Iverson, 2006). The wakes from boats cause increased turbidity of the water and erosion of the shoreline, thus adversely impacting aquatic vegetation and prey sources, and reducing the long-term suitability of their habitat (Zappalorti and Iverson, 2006).

Musk turtles are also susceptible to collection for the pet trade, with some species more readily in trade than others (Ernst and Lovich, 2009; van Dijik, 2011a; Zappalorti and Iverson, 2006). Reed and Gibbons (2004) ranked *S. carinatus* as the fifth most vulnerable non-marine turtle species in the United States with regards to its vulnerability to the commercial pet trade. The ranking was based not on its "value" to dealers, but on

the species' demography and limited range (Lindeman, 2008). Given their small size and presence of a musk gland that can taint food, *Sternotherus* are not typically used for food or medicincal use in Asia (C. Hagen – Turtle Survival Alliance, *pers. comm*.).

In addition, musk turtles, like other Kinosternidae in the United States, suffer extensive mortality at the hands of vandalistic fishermen (Pritchard, 1979). Frequently, musk turtles are accidently caught on the baited hooks of fishermen (Carr, 1952, as cited in Zappalorti and Iverson, 2006; van Dijik, 2011a, 2011c, 2015). This often leads to serious injury or even death of the individual when the fisherman removes the hook (Ernst and Lovich, 2009; Zappalorti and Iverson, 2006). Zappalorti himself personally observed fishermen on the Apalachicola River cutting the heads off of adult *S. minor* to retrieve their hooks. Furthermore, Mahmoud (1969) describes an incident in 1959 where two Oklahoma fishermen caught and killed 51 adult *S. carinatus* in the Blue River within two hours (Pritchard, 1979).

Individual turtles of *S. minor* and *S. odoratus* are also injured or killed as a result of boat propeller strike (Ernst and Lovich, 2009; van Dijik, 2011c). Bancroft *et al*. (1983) suspected that boat propellers were a significant source of mortality for *S. odoratus*, after three individuals were found dead as a result of boat propeller strikes, and 77 (2.35%) of 3,273 live individuals showed damage (propeller scars) from boats. Due to their small size, it is likely that few individuals actually survive a propeller strike, and when they die, they sink to the bottom, making them hard to find (Bancroft *et al*., 1983). Thus, the actual percentage of *S. odoratus* adversely impacted by boat propeller strikes could be significantly greater.

For the highly restricted *S. depressus*, which has disappeared from more than half of its former range due to habitat modifications to the stream and river channels in the Warrior River Basin (Alabama), individuals in the remaining viable habitats continue to be vulnerable to disease and human-related disturbance, collection for the pet trade and habitat modification (Dodd, 1990). Disease has already played a role in the significant decline of at least one population of *S. depressus* (Dodd, 1988), with impacts to other populations known but not quantified (van Dijik, 2011b). Fragmenting habitats of small populations increases their susceptibility to human-caused catastrophes and demographic accidents, and could possibly lead to eventual extinction of the species (Dodd, 1990). According to Dodd (1990), the threats facing fragmented populations of *S. depressus* probably parallel those affecting many other stream-dwelling species throughout the southeastern United States.

6. Utilization and trade

6.1 National utilization

In the United States, musk turtles are collected from the wild for the pet trade, with some species more readily collected than others (Ernst and Lovich, 2009; van Dijik, 2011a; Zappalorti and Iverson, 2006). Although *S. depressus* is currently legally protected from collection and prohibited from trade (van Dijik, 2011b), illegal collection for the pet trade remains a concern for the species (Dodd, 2008).

Prehistoric humans used *Sternotherus odoratus* for food (Rhodin, 1995) and possibly for medicinal and/or ceremonial purposes (Hoffmann, 1990, as cited in Iverson and Meshaka, 2006).

6.2 Legal trade

U.S trade data was obtained from the U.S. Fish and Wildlife Service Law Enforcement Management Information System (LEMIS) for the period 2013 through 2019 (see Table 2 and Figure 1: LEMIS 2022). This data is compiled from U.S. wildlife declaration forms required for import or export of any fish and wildlife from the United States.

Between 2013 and 2019, a total of 1,498,463 live *Sternotherus* were exported from the United States for commercial purposes: 598,058 individuals of *S. carinatus*; 640 individuals of *S. depressus*; 58,182 individuals of *S. minor*; 839,261 individuals of *S. odoratus*; and 2,322 individuals of *Sternotherus* spp.

The exports in Table 2, and Figures 1 and 2 are reported as commercial trade in live specimens (LEMIS 2022). Of the 1,498,463 live *Sternotherus* individuals exported during this time period, 900,640 individuals (60.1%) were sourced as wild; and 597,823 individuals (39.9%) were reported as captive-bred or ranched ["ranched" is defined by USFWS as "directly removed from the wild and reared in a controlled environment or are progeny from gravid females captured from the wild" (Mali *et al*., 2014)). However, due to the species' small clutch size and thus, low viability for large-scale commercial breeding, K. Buhlmann (University of Georgia, Savannah River Ecology Laboratory, *pers. comm*.)

believes that most of the individuals exported as captive-bred specimens are instead wild-caught. Specimens were primarily exported to East Asia (i.e., China, Hong Kong SAR and Macao SAR).

The majority of this demand is thought to originate from the pet trade, with an increased interest in the small species of musk (and mud) turtles in the Asian and European pet trade, although overseas demand for food may play a role as well (T. Wasley – President, AFWA, and Director, Nevada Department of Wildlife, *pers. comm*.). Given their popularity as pets and State regulations that allow harvest of these species in portions of its range, collection of wild-source specimens for domestic use in the United States is likely, although definitive information on this is lacking. However, while newborn musk turtle hatchlings can be exported internationally, domestic sales of *Sternotherus* species could be more limited since musk turtles are small in size (typically less than 4 inches even at maturity) and the U.S. restricts selling turtles smaller than 4 inches (101.6 mm carapace length (CL)) as pets due to turtle associated human *Salmonella* infections (21 CFR 1240.62). If occurring, this would have an additive effect on the *Sternotherus* populations, with actual harvest levels greater than the quantities exported show.

6.3 Parts and derivatives in trade

According to the U.S trade data obtained from the U.S. Fish and Wildlife Service Law Enforcement Management Information System (LEMIS), the vast majority of *Sternotherus* specimens in trade between 2013 and 2019 were live animals.

6.4 Illegal trade

The extent to which *Sternotherus* species are subject to illegal trade is unknown. However, incidents of illegal collection and trade in the species have been documented.

On December 10, 2020, Nathan Horton, was indicted by the federal court in Georgia (United States). Robin des Bois (2021) reported that Mr. Horton is suspected of having netted thousands of freshwater turtles between July 2015 and July 2017, and selling them in California on the pet market, even though Georgia prohibits the capture of turtles for commercial purposes. Among the species targeted by Horton, the prosecutor cited the Common musk turtle (*Sternotherus odoratus*), Eastern mud turtles (*Kinosternon subrubrum*), Loggerhead musk turtles (*Sternotherus minor*) and Stripe-necked musk turtles (*Sternotherus minor peltifer*).

Historically, according to Dodd (2008), collecting specimens of *S. depressus* for the turtle trade has adversely impacted specific populations of this species, although the exact number of turtles that have been collected has been difficult to determine. Dodd *et al*. (1988, as cited in Dodd, 2008) reported that in July 1985 as many as 200 turtles may have been illegally collected from Sipsey Fork, Alabama. While collection of *S. depressus* occurred in numerous areas prior to federal protection of the species in 1987, reports of collecting in the Warrior Basin continued through the 1990s despite protection at both the federal and state levels (Dodd, 2008). Dodd (2008) documented the sale of *S. depressus* by a herpetological dealer in Gainesville, Florida, in 1991, and noted that dealers offering *S. depressus* for sale were easy to locate on the internet ($250 Canadian, 9 Feb 2008). In addition, local residents may also be collecting *S. depressus* to keep as pets. (Dodd, 2008). While the species is legally protected from collection, illegal collection for the pet trade still remains a concern for the species (Dodd, 2008).

In Canada, the 2016 proposed recovery strategy for *S. odoratus* notes that the rate of illegal trade is expected to be high in Canada given the trade demand (C. Caceres – Canadian Wildlife Service, *pers. comm*.). The illegal sale of *S. odoratus* has been increasing through online websites such as Kijiji (C. Caceres – Canadian Wildlife Service, *pers. comm*.) Between 2008 and 2012, the Ontario Ministry of Natural Resources and Forestry led more than 25 investigations regarding the online illegal sale of this species, indicating a high demand for the species in the pet trade (C. Caceres – Canadian Wildlife Service, *pers. comm*.). The extent of illegal organized turtle harvest is poorly documented in Canada and requires further study (C. Caceres – Canadian Wildlife Service, *pers. comm*.)

6.5 Actual or potential trade impacts

As seen in Figure 3, the year 2002 began a significant downward trend in the number of wild turtle exports from Asia, with a remarkable increase in the numbers of turtles exported from North America (AFWA, n.d.). According to AFWA (n.d.), “Asian imports of U.S. mud and musk turtles increased significantly creating a sudden demand for wild-caught turtles for export as well as to stock captive

turtle farms in Asia to produce turtles to meet the growing market demand." Trade in Asian turtle species continues to follow a boom and bust pattern in which exploitation and trade shift from one species to another when: 1) a species becomes so depleted or rare that it is no longer commercially exploitable; or 2) a species becomes the subject of stricter regulation, and as such is less exploitable (Fig. 3).

According to Dodd (1988) and Ernst and Lovich (2009), mortality from a disease of unknown etiology, in conjunction with collection of *S. depressus* by turtle dealers (including up to 200 adult specimens by a Georgia pet trade collector), led to a precipitous decline in the Sipsey Fork population of *S. depressus* in 1985. As a result of increased access to Bankhead National Forest, recreational activities (such as canoeing, swimming, and fishing) in this area have increased over time (Bailey and Guyer, 1998). This increased access could lead to an increase in local non-commercial pet collection and the illegal pet trade (Bailey and Guyer, 1998). Dodd *et al*. (1988, as cited in Bailey and Guyer, 1998) note that this would likely impact male specimens more than females since males are more readily trapped, and move over longer distances and thus are encountered more frequently.

The effect of unregulated harvesting on wild populations of *S. minor* is not known (Zappalorti and Iverson, 2006). This species is easily seen and readily accessible to snorklers in clear spring runs; as a result, it has been a constant target of commercial collectors for the pet trade (Zappalorti and Iverson, 2006). In the late 1980s, large numbers were harvested from Ichetucknee spring run between US Hwy 27 and the Santa Fe River for the pet trade, but it is not known if commercial collecting of *S. minor* on this scale continues today (Zappalorti and Iverson, 2006), and if so, what impact it is having on the species.

7. Legal instruments

7.1 National

United States of America: *Sternotherus depressus* was listed as Threatened under the U.S. Endangered Species Act, on June 11, 1987, with no critical habitat designated (Pulliam, 1987). Therefore, import, export, or take of this species is prohibited. There are currently no federal regulations for the remaining *Sternotherus* species at a national level.

Some *Sternotherus* species are protected at the U.S. State level. U.S. States implement their laws, rules, and regulations, including enforcement of any license requirements and/or limits or prohibitions on wild collection and trade. CITES can complement these State regulations and management efforts to ensure at a national level that trade is legal and use is sustainable.

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).

Canada: *Sternotherus odoratus* has a very limited distribution area in Canada. It is listed as a species of "Special Concern" under Canada's Species at Risk Act (SARA) (C. Caceres – Canadian Wildlife Service, *pers. comm*.; Canadian Herpetological Society, 2022). However, this federal listing does not include prohibitions that would provide protection to *S. odoratus* (C. Caceres – Canadian Wildlife Service, *pers. comm*.). Collection, trade, and possession is however, prohibited in the two provinces where the species occurs (C. Caceres – Canadian Wildlife Service, *pers. comm*.). Legal export of *S. odoratus* is thus expected to be very low and related to conservation or scientific purposes (C. Caceres – Canadian Wildlife Service, *pers. comm*.).

7.2 International

There are currently no international legal instruments in place for members of this genus.

8. Species management

8.1 Management measures

Although habitat preserves have not been designated specifically for *S. carinatus*, populations of this species are found in eight National Forests, one State Wilderness Area, 17 National Wildlife Refuges, one National Preserve, a Ramsar Convention Wetland of International Importance, and two private

nature preserves (Lindeman, 2008). Given its numerous protected habitats and that *S. carinatus* is considered secure throughout much of its geographic range, no specific conservation management actions appear warranted at this time (Lindeman, 2008).

Populations of *S. depressus* occur in the Bankhead National Forest, including the Sipsey Wilderness Area, however, no designated protected reserves within the national forest include this species (Dodd, 2008). A Recovery Plan for the species was approved by the U.S. Fish and Wildlife Service in 1990 which advocated for establishing a work group to address water quality problems, to monitor turtle populations and threats to them, and to implement protective measures that might be warranted (Dodd, 2008). However, the recovery plan was not funded, and no further conservation actions have resulted from it (Dodd, 2008). In 2019, the U.S. Fish and Wildlife Service initiated a 5-year status review of the species (84 FR 28850; June 20, 2019); however, to date, the status review has not yet been completed. Future needed research includes further status surveys, continued population monitoring, further investigation of disease, refined demography and population dynamics studies including genetic studies to document population fragmentation effects, telemetry studies of habitat usage and movements, mollusk prey studies, contaminant studies, and further biological/natural history research (Dodd, 2008; van Dijk, 2011b)

According to van Dijik (2011c), *S. minor* occurs in a substantial number of protected springheads and spring runs in Florida, and presumably in other protected areas. However, given their increased susceptibility to commercial collection at these sites, Zappalorti and Iverson (2006) note that State wildlife agencies should monitor the overall number of wild-caught *S. minor* individuals entering the international pet trade. Management measures recommended by van Dijik (2011c) include public awareness and education to reduce wanton destruction of this and other turtle species, appropriate management of protected areas and other suitable habitats, and monitoring of key populations.

8.2 Population monitoring

According to van Dijik (2011a), studies documenting the population status (Lindeman, 2008), structure and dynamics, habitat usage, and other ecological information of *S. carinatus* is needed.

Since 1981, the U.S. Fish and Wildlife Service, Alabama Coal Association, Office of Surface Mining of the U.S. Department of the Interior, Birmingham Water Authority, and USDA Forest Service/The Nature Conservancy/Alabama Power Company have all sponsored surveys of the distribution and status of *S. depressus* (Dodd, 2008). Surveys have found a lack of juveniles or subadults, and no new populations except for those using coves around Lewis Smith Reservoir (Bailey and Guyer, 1998; review of data by Dodd, 2008). Dodd (2008) notes that *S. depressus* "populations previously affected by disease (i.e., West Sipsey Fork, Lost Creek) should be monitored periodically to determine the population status. If diseased turtles are found, research should focus on etiology, including the lethal and sublethal effects of toxic substances (insecticides, herbicides, heavy metals, organochlorines, PCBs) on turtles and their molluscan prey." Dodd (2008) states that tissues from diseased turtles should be cultured for viruses, and the role of parasites, if any, in disease transmission needs to be better understood. Although numerous studies provide baseline data on population size, structure, and status of *S. depressus,* Dodd (2008) believes that "continuing to monitor populations initially sampled from the mid-1980s to early 2000s could provide long-term comparisons and yield data on growth, survivorship, and effects of habitat disturbance." According to Dodd (2008), study sites in Sipsey Fork, Brushy Creek, Lost Creek, Blackburn Fork, and Blackwater Creek should be periodically re-censused.

8.3 Control measures

8.3.1 International

There are currently no international control measures in place for turtles of this genus.

8.3.2 Domestic

Sternotherus depressus is protected at the federal level, while other *Sternotherus* species are protected at the U.S. State level throughout portions of their range (see Section 7.1 Legal Instruments, National).

8.4 Captive breeding and artificial propagation

Due to their small size and easy care, musk turtles are a popular choice for a pet (David, 2021; Johnstone, 2022), with the Common musk turtle (*S. odoratus*) currently the top choice among aquatic turtle species (McDonald, 2022). The popularity of these small turtles has made them widely available at pet and reptile stores (Buhlmann, 2013; David, 2021). In captivity, it is common for these turtles to live between 30-50 years (David, 2021; Johnstone, 2022).

The extent to which musk turtles are captive-bred for commercial purposes is unknown. However, for many slow-reproducing species of turtles, such as *Sternotherus*, the high cost of maintenance in captivity is understood to make large-scale commercial breeding unprofitable (K. Buhlmann – University of Georgia, Savannah River Ecology Laboratory, *pers. comm*.; Stärk *et al*., 2019). To meet the demand for freshwater turtle meat, turtle farming became a lucrative business in the southeastern United States in early 1990s (Hughes, 1999), as well a common practice across Southeast Asia (Mali *et. al*., 2015). While commercial turtle trappers focus on harvesting the largest individuals from wild populations for export to Asian food markets (Close and Seigel, 1997), U.S. turtle farmers do not produce adult turtles for profit, but instead commercially raise hatchlings for either the pet trade or to supply Asian turtle farms (Hughes, 1990; Mali *et al.*, 2015).

Musk turtle species are known to be produced domestically by turtle farms in the southeastern portion of the United States (Alabama Turtle Farmer, 2019; B. Baker – Louisiana Department of Wildlife and Fisheries, *pers. comm*.; Boudreaux's Turtle Farm, 2022; Dark Hammock Turtles, n.d.), but the amount produced remains unknown. Whether turtle farms in Asia are also producing *Sternotherus* species is not clear, but other Kinosternids (ex. many of the Mexican species) are being bred on farms in China (C. Hagen – Turtle Survival Alliance, *pers. comm.*). However, captive-breeding operations [and turtle farms] must often rely on the harvest of wild-source, adult specimens for breeding stock, imposing added pressure on wild populations of these species.

8.5 Habitat conservation

Overall, the conservation of musk turtles will depend on the conservation of its habitat. Musk turtles are facing the same habitat threats that other freshwater turtles of the southeastern United States are facing: sedimentation, snagging operations to remove deadwood from waterways for navigation purposes, mining for sand and gravel, and toxic pollutants (Dodd, 1990; Lindeman, 2008; Stewart, 1990). Conserving their habitat not only has a direct effect on musk turtles themselves, but also protects their molluscan and insect prey (Ernst and Lovich, 2009; van Dijik, 2011c). Ultimately, this results in benefits to the entire food chain and aquatic ecosystems.

The Black Warrior River Basin in Alabama is inhabited by many unique species, including *S. depressus*, and special conservation efforts are necessary to provide adequate habitat for their continued existence (Bailey and Guyer, 1998). Marion and Bailey (2004b, as cited in Dodd, 2008) recommended specific conservation actions for *S. depressus* including: 1) local efforts to restore stream quality in the Warrior Basin should be undertaken; 2) laws and regulations relating to water quality and mining should be strengthened and enforced; 3) populations should be monitored; 4) contaminant studies should be carried out on turtles and sediments; 5) genetic studies should ascertain the effects of habitat fragmentation of flattened musk turtle populations; and 6) studies need to be conducted on habitat use in reservoirs.

Given that the destruction of even the smallest wetlands have been shown to destroy significant populations of *S. odoratus*, Iverson and Meshaka (2006) note that the conservation of wetlands and adjoining uplands will insure the continued presence of this species in Florida.

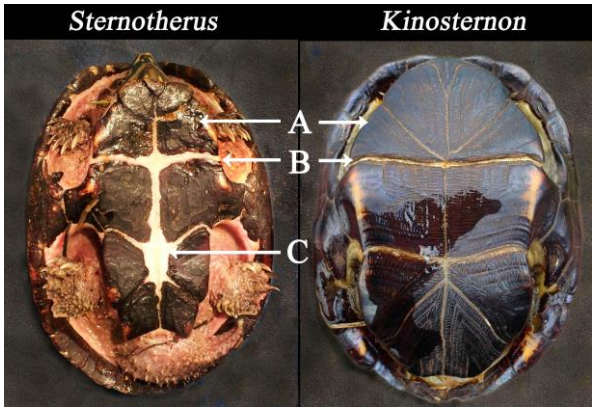
8.6 Safeguards

N/A

9. Information on similar species

Musk turtles in the genus *Sternotherus* are very similar to the American mud turtles in the genus *Kinosternon*, but tend to have a more domed carapace, with a distinctive keel down the center of it (Ernst and Lovich, 2009).

The distinguishing characteristics between musk turtles (*Sternotherus*) and the closely related mud turtles (*Kinosternon*) include:



- overall smaller plastron with legs exposed vs. a larger plastron with legs concealed;
- pectoral scute squarish vs. triangular in shape (A);
- hinges less developed vs. well developed (one likely unapparent transverse hinge vs. two readily discernable transverse hinges (Conant, 1958)) (B); and
- plastral seams often invaded by soft tissue/skin (in *Sternotherus*) (Harless and Morlock, 1979) (C).

Credit: William L. Farr, CC BY-SA 4.0 via Wikimedia Commons (https://en.wikipedia.org/wiki/Sternotherus)

10. Consultations

The United States Fish and Wildlife Service sent a consultation letter to Canada. Canada (cited as C. Caceres – Canadian Wildlife Service, *pers. comm.*) provided data on occurrence, regulations, trade, and illegal harvest of *S. ordoratus* in Canada, which was incorporated into this proposal.

In the United States, we have 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. 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 https://www.regulations.gov/docket/FWS-HQ-IA-2021-0008/document.

11. Additional remarks

The IUCN SSC Tortoise and Freshwater Turtle Specialist Group (TFTSG) supports the inclusion of the genus *Sternotherus* in CITES Appendix II (P.P. van Dijik - Deputy Chair, IUCN/SSC Tortoise and Freshwater Turtle Specialist Group, *pers. comm.*). 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 genus *Sternotherus* in CITES.

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Table 1. Information regarding all *Sternotherus* species identified worldwide.

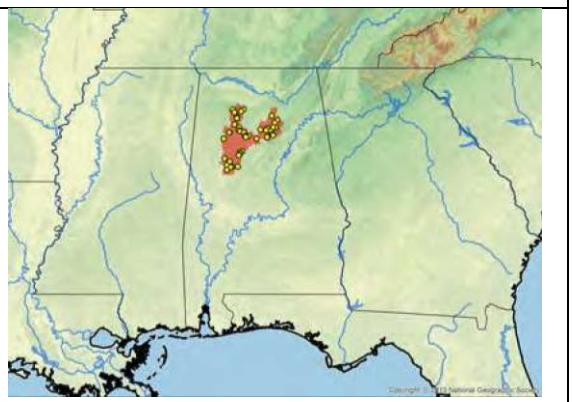
Photo (TTWG, 2021)	**Common Name** (Ernst and Lovich, 2009; TTWG, 2021)	**Scientific Name**	**IUCN Status** (van Dijik, 2011a, 2011b, 2011c, 2015)	**Distribution** (Ernst and Lovich, 2009; TTWG, 2021)	**Map** (TTWG, 2021)
 Robert C. Thomson / CBFTT / Pascagoula R., Mississippi	Razor-backed Musk Turtle	*Sternotherus carinatus*	Least Concern	U.S. (Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, Texas)	
 C. Kenneth Dodd, Jr. / CBFTT / TCC / Gurley Creek, Alabama	Flattened Musk Turtle	*Sternotherus depressus*	Critically Endangered	U.S. (Alabama)	

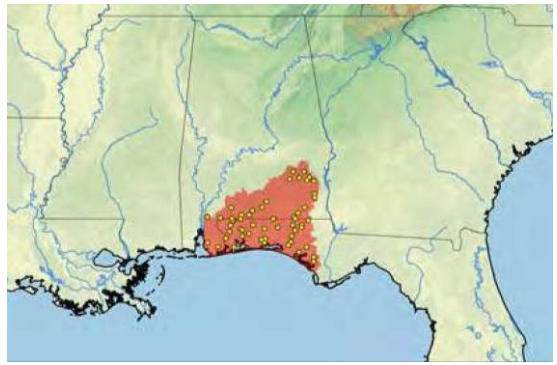
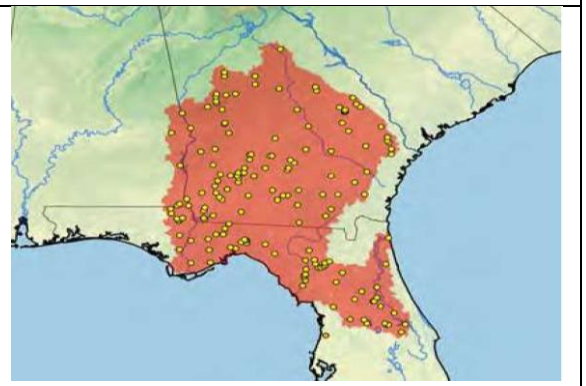
Photo (TTWG, 2021)	**Common Name** (Ernst and Lovich, 2009; TTWG, 2021)	**Scientific Name**	**IUCN Status** (van Dijik, 2011a, 2011b, 2011c, 2015)	**Distribution** (Ernst and Lovich, 2009; TTWG, 2021)	**Map** (TTWG, 2021)
 Peter A. Scott / Econfina River, Florida	Intermediate Musk Turtle	*Sternotherus intermedius** *recently identified species (Scott, Glenn, and Rissler, 2018), therefore, not included in Fritz and Havaš, 2007	Not Evaluated	U.S. (Alabama, Florida)	
 John B. Iverson / Levy Co., Florida	Loggerhead Musk Turtle	*Sternotherus minor*	Least Concern	U.S. (Alabama, Florida, Georgia)	

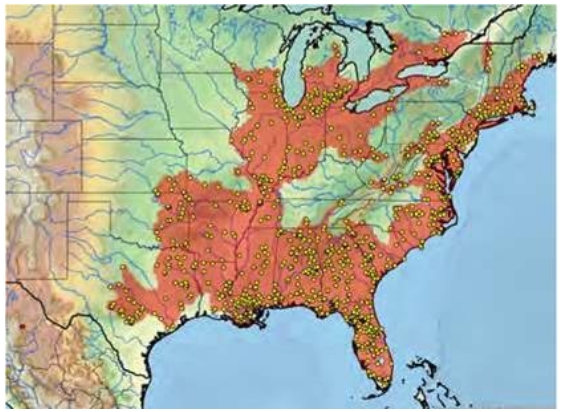
Photo (TTWG, 2021)	Common Name (Ernst and Lovich, 2009; TTWG, 2021)	Scientific Name	IUCN Status (van Dijik, 2011a, 2011b, 2011c, 2015)	Distribution (Ernst and Lovich, 2009; TTWG, 2021)	Map (TTWG, 2021)
 Peter May / CRM 3 / Volusia Co., Florida	Common Musk Turtle, Musk Turtle, Stinkpot	*Sternotherus odoratus*	Least Concern	Canada (Ontario, Québec); Mexico? (Chihuahua? [extirpated?]); U.S. (Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin)	
 C. Kenneth Dodd, Jr. / Buttahatchie R., Marion Co., Alabama	Stripe-necked Musk Turtle	*Sternotherus peltifer** *identified as *Sternotherus minor peltifer* in Fritz and Havaš 2007	Least Concern* [*as a sub-species of *Sternotherus minor*]	U.S. (Alabama, Georgia, Louisiana, Mississippi, North Carolina, Tennessee, Virginia)	

Table 2. U.S. Export Data for *Sternotherus* species 2013-2019 (LEMIS 2022)

		Number of Live Individuals Exported per Year						
Species	**Source Code**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
S. carinatus	W	36,260	67,578	41,444	77,420	40,973	35,890	39,401
	C/F	5,604	12,235	6,691	8,842	1,178	595	2,288
	R	35,601	39,120	32,765	33,756	40,452	29,250	10,715
	Total #:	*77,465*	*118,933*	*80,900*	*120,018*	*82,603*	*65,735*	*52,404*
S. depressus	W							
	C/F							
	R						640	
	Total #:	*0*	*0*	*0*	*0*	*0*	*640*	*0*
S. minor	W	2,598	5,928	11,252	12,439	5,734	361	665
	C/F	181	715	742	564	1,448	2	1,470
	R	1,013	942		715	4,096	4,064	3,253
	Total #:	*3,792*	*7,585*	*11,994*	*13,718*	*11,278*	*4,427*	*5,388*
S. odoratus	W	48,342	57,807	55,530	116,561	82,751	77,205	84,173
	C/F	23,611	21,303	13,189	6,613	28,649	2,853	9,034
	R	27,930	21,027	45,071	38,369	34,226	31,527	13,490
	Total #:	*99,883*	*100,137*	*113,790*	*161,543*	*145,626*	*111,585*	*106,697*
Sternotherus spp.	W	46				282		
	C/F	18		77			1	4
	R					800	1,094	
	Total #:	*64*	*0*	*77*	*0*	*1082*	*1095*	*4*

Figure 1. U.S. Exports for *Sternotherus* species 2013-2019 (LEMIS 2022)

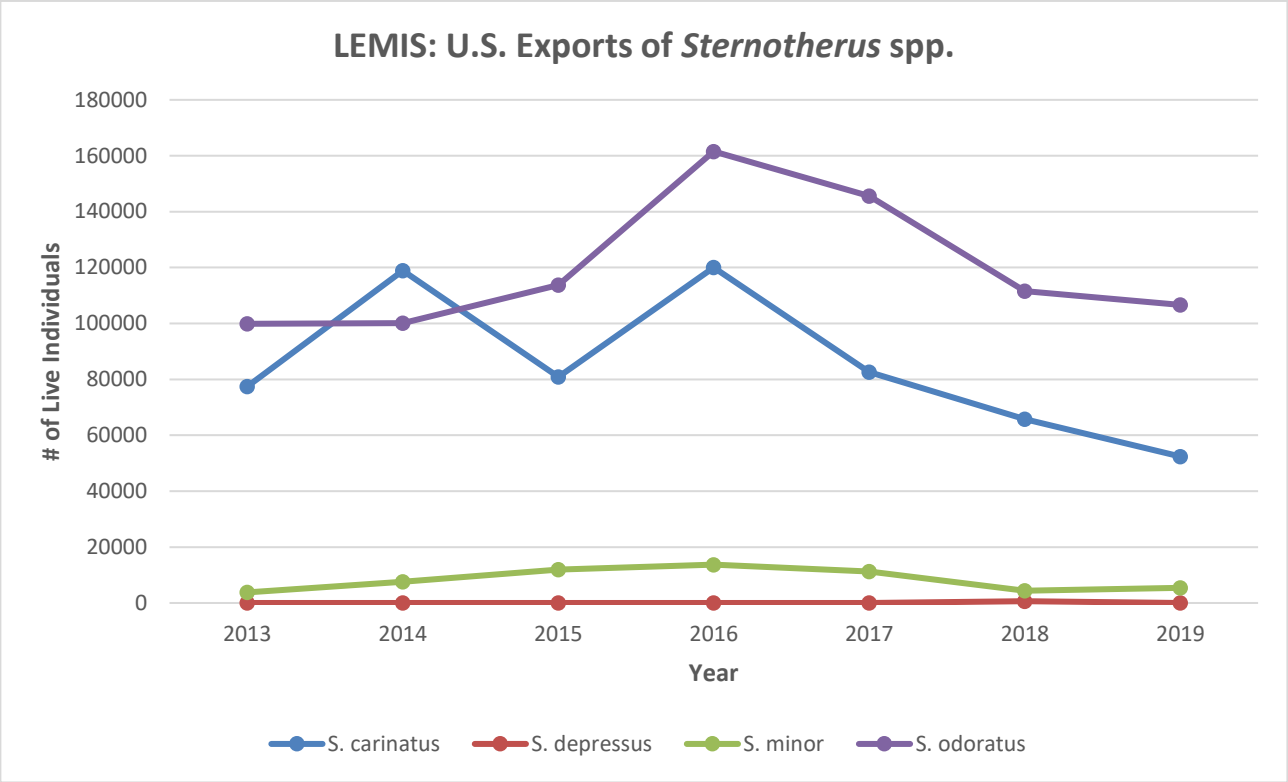


Figure 2. Source of U.S. Exports for *Sternotherus* species 2013-2019 (LEMIS 2022)

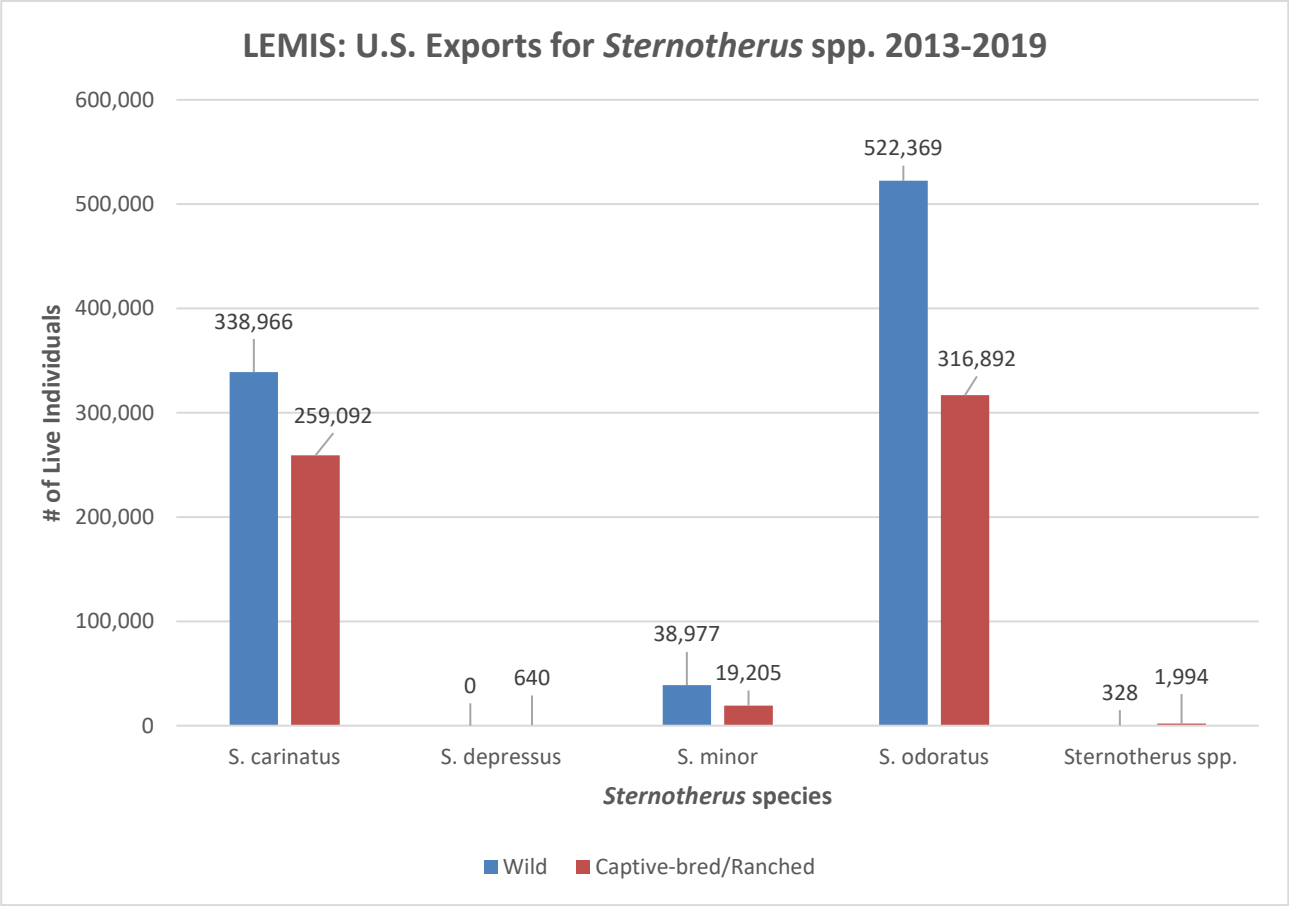


Figure 3. Effects of CITES Actions: Exports by Specimen numbers (Credit: IUCN Tortoise and Freshwater Turtle Specialist Group; CITES CoP15)

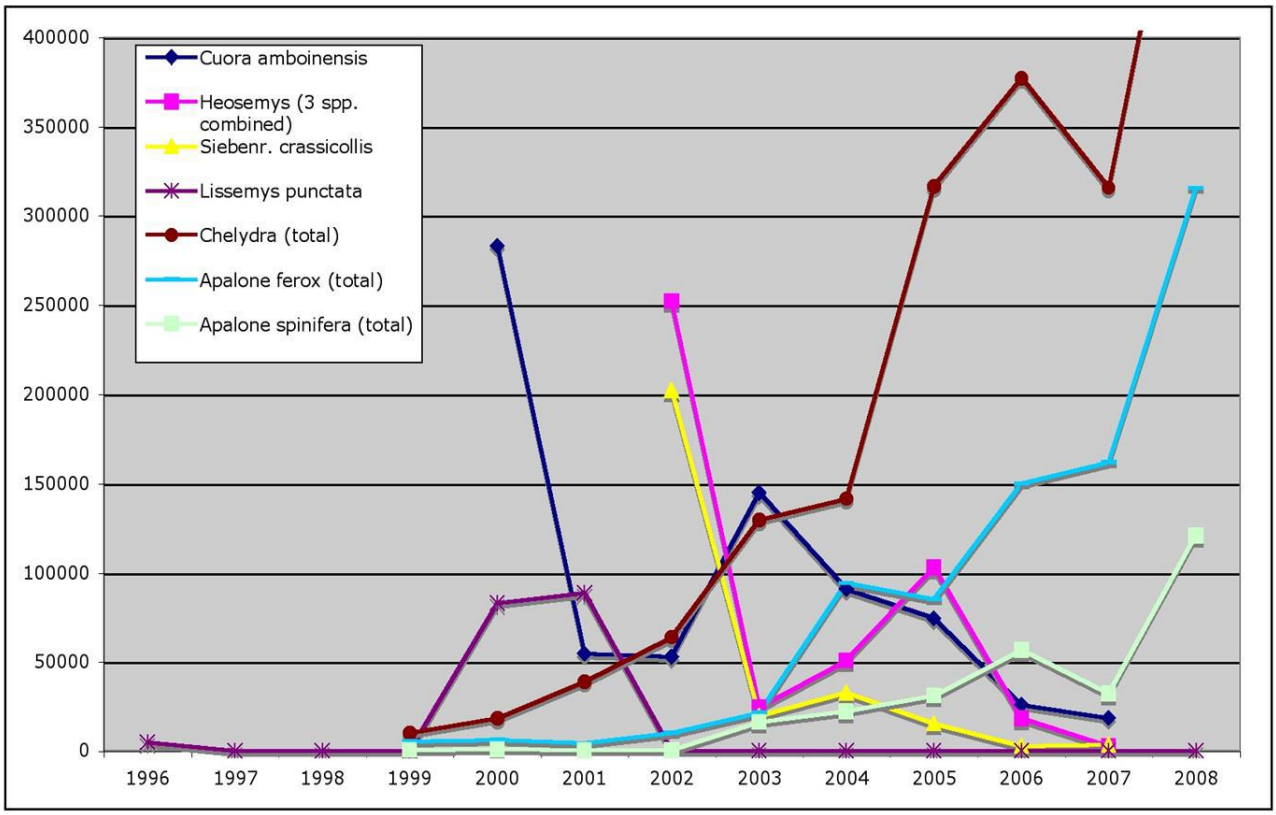
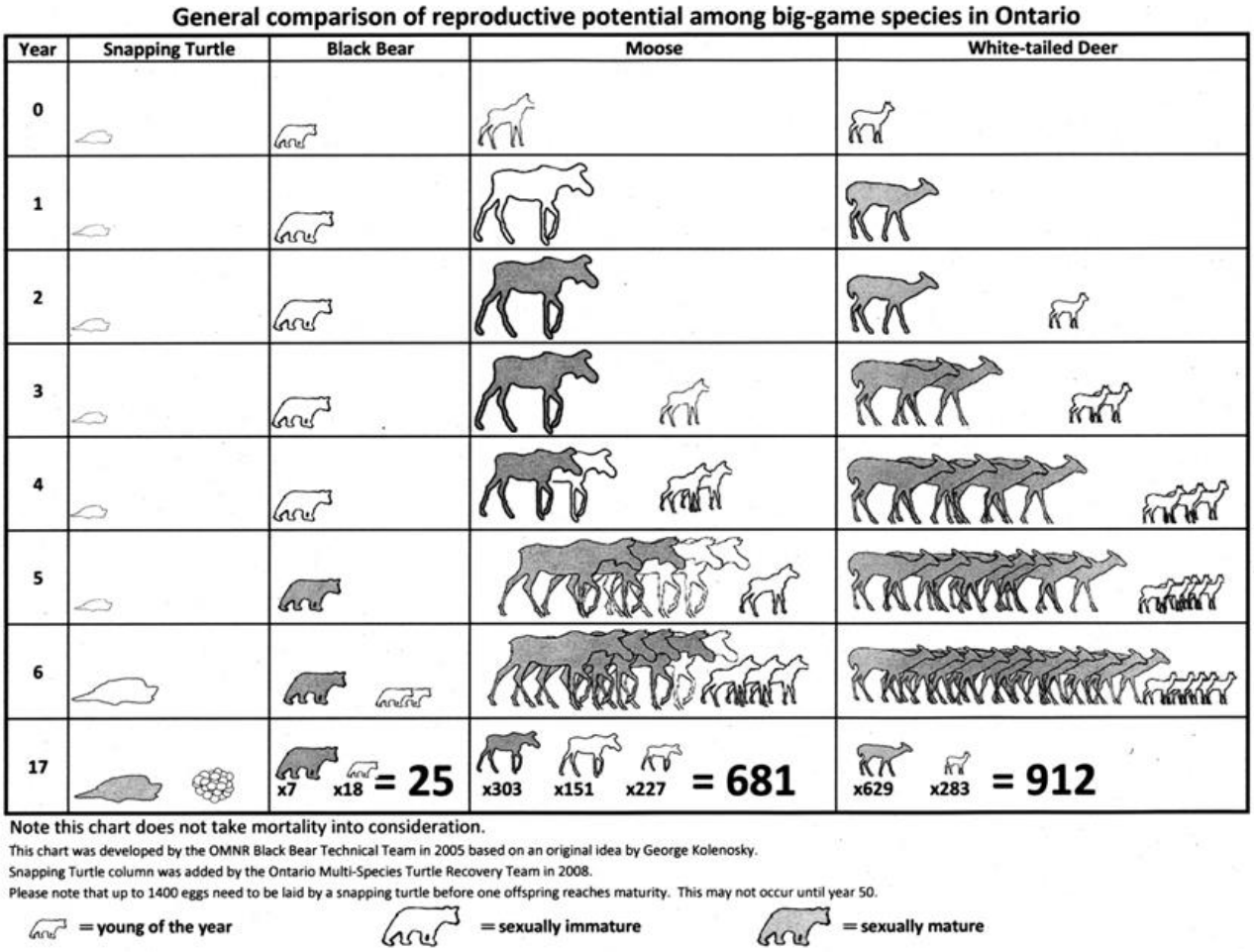


Figure 4. Comparison of reproductive output of a North American Snapping turtle to Managed North American Game Species: Bear, Moose, and Deer. (Credit Ron Brooks Co-Chair of OMSTARRT (Ontario Multi-Species of Turtles at Risk Recovery Team))



Credit: Ron Brooks Co-Chair of OMSTARRT (Ontario Multi-Species of Turtles At Risk Recovery Team)