



Species Action Plan: Southeastern Mud Turtle (*Kinosternon subrubrum subrubrum*)

Purpose: This plan provides an initial five-year blueprint for the actions needed to attain near-term and, ultimately, long-term goals for the conservation and recovery of the Southeastern Mud Turtle in Pennsylvania. Given the complexity of managing and recovering this species, this plan will be continually updated to reflect progress toward the identified goals, and to incorporate new information. This Species Action Plan (SAP) also includes a description of the species natural history, distribution, and threats that have led to its rarity or imperilment.

Goals: The goal of this plan is to provide guidance for the maintenance, augmentation, and protection of extant populations of Southeastern Mud Turtle in the Commonwealth.

Natural History

Taxonomy: Class Reptilia, Order Testudines (turtles), Family Kinosternidae (musk and mud turtles), Southeastern Mud Turtle (*Kinosternon subrubrum subrubrum*, Lacépède 1788).

Description: *Kinosternon subrubrum* is a fist-sized, non-descript olive to brown colored turtle. Adults typically range from

70-120mm in carapace length (CL), with a maximum CL of 124mm (Conant and Collins 1998). Skin color tends to be olive green or brownish. Yellow markings may be present on the head and occasionally form yellow blotches and lines, particularly around and behind the jaws. The carapace lacks patterning and ranges from yellowish brown, to golden brown, to black. Plastron coloration varies from yellow to brown. The shell is smooth, and annuli wear quickly, particularly on the carapace. The plastron nearly covers the entirety of the ventral surface and contains two transverse hinges, allowing the turtle to cover the limbs and head within the shell when retracted. (from Ruhe and LaDuke 2011).



Figure 1. Southeastern Mud Turtle (*Kinosternon subrubrum subrubrum*), Photo credit: Brandon Ruhe.

Habitat: *Kinosternon subrubrum* is a semi-aquatic species of turtle that inhabits a variety of freshwater and brackish water habitats. In the Northeastern and Mid-Atlantic United States, these aquatic habitats include shallow, still or slow-water habitats, such as: marshes, swamps, seasonal forest



pools, shallow ponds, creeks, and ditches, all with soft substrates, though little work has been done to characterize habitat type or determine the ecology of this species in the northeast (Gibbons 1983, Gibbs et al. 2007, Harden et al. 2009, Hulse et al. 2001, Schwartz and Golden 2002, White and White 2002). Gibbons (1983) mentions the absence and low occurrence of this species in larger water bodies such as rivers, streams, and reservoirs at his study site in the southeastern United States. Specific aquatic habitats at historical Pennsylvania sites are unknown, but habitat types within the general vicinity of historical Pennsylvania sites and within extant sites include tidally influenced freshwater marshes, swamps, wooded ponds, soft-bottomed (sandy or mucky) streams, and open emergent wetlands in the Atlantic Coastal Plain.

Upland habitat use is prevalent in Pennsylvania *K. s. subrubrum* (Ruhe and LaDuke 2011) as in other portions of the range (Ernst et al. 1994, Gibbs et al. 2007). Ruhe and LaDuke (2011) found adult *K. s. subrubrum* are active for 7-8 months of each year in terrestrial habitats and appear to use aquatic habitats for early-season foraging, thermoregulation, and breeding congregation. Radio-tracked *K. s. subrubrum* were followed to upland overwintering sites a maximum distance of 115m from aquatic habitats where they remained for 102 days. Upland habitats should not be viewed as “buffers” for *K. s. subrubrum*, but rather as critical habitats that this species

requires as much as aquatic habitats (Ruhe and LaDuke 2011).

Life History: Southeastern Mud Turtles are active during the warm months of the year, roughly April to November. They are secretive turtles and rarely bask in the open. They forage on a variety of small invertebrates, algae, and aquatic vegetation on the bottom of the water column. Many populations, including the one studied in Pennsylvania by Ruhe and LaDuke (2011), spend as much as half of the year on land adjacent to their aquatic habitat, buried beneath the surface to aestivate during dry periods or hibernate during winter. Both sexes mature from 4-10 years of age and between 70-80mm CL (Gibbons 1983). Mating occurs in early spring in water or on land. Females lay from one to three clutches of 1-6 eggs in sandy or loamy soil near aquatic habitats, with multiple clutches more common in the southern portion of their range. Gravid females have been observed nesting anywhere from 1m to 500 m from aquatic habitats (Ruhe, unpublished). Hatchlings in northern populations typically overwinter in the nest and emerge in early spring (Hulse et al. 2001). Adults can live up to 30 years in the wild.

Distribution and Status

National Distribution: *K. s. subrubrum* occurs in coastal states and Piedmont from Long Island, NY south to northern Florida and westward in parts of the Piedmont from Mississippi to southern Illinois and Indiana

(Figure 1). It is considered secure (G5) throughout most of its range, but critically imperiled (S1) in Pennsylvania and New York. (Figure 2).

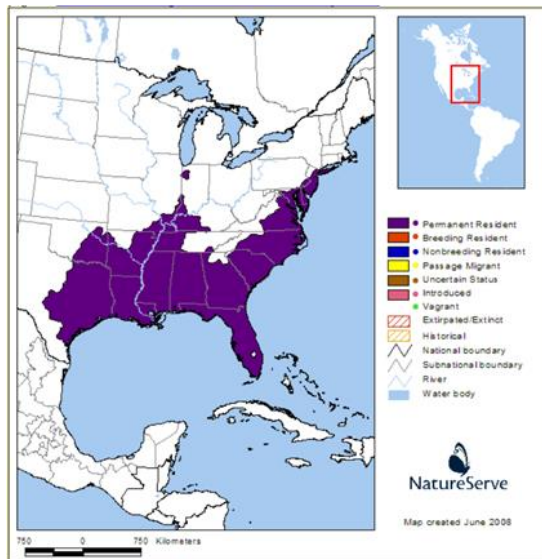


Figure 2. Distribution of *K. subrubrum* in North America, based on data from 2008 (NatureServe 2018). The southeastern subspecies' portion of the range is limited to states east of the Mississippi River and north of peninsular Florida.

Pennsylvania Distribution: In Pennsylvania, *K. s. subrubrum* was historically documented in the Atlantic Coastal Plain in Philadelphia, Delaware, and Bucks counties. As a result of intensive urbanization throughout the greater Philadelphia landscape, the current distribution in Pennsylvania is restricted to 350 ha (865 acres) at two sites in Bucks County (Ruhe and LaDuke 2011) (Figure 3).

Pennsylvania Legal Status: Endangered (listed in 2012 after being rediscovered in the state)

Federal Status: None

State Rank: S1 – Critically Imperiled (last reviewed 2015)

Global Status: G5 –Secure (last reviewed 2005)

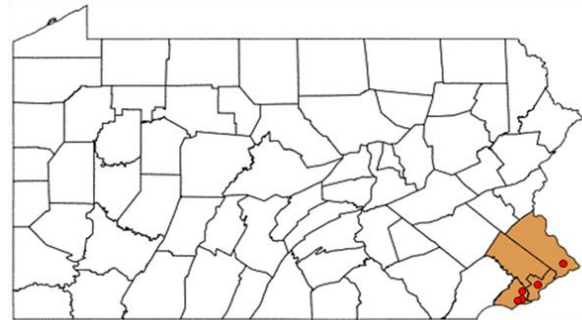


Figure 3. Historical distribution of *K. s. subrubrum* in Pennsylvania as reported by McCoy (1982) and Hulse et al. (2001). Red dots denote vouchered specimen locations.

Management Status

The Southeastern Mud Turtle was listed as an extirpated species in Pennsylvania until 2008. A single *K. s. subrubrum* was found dead-on-road in 2008 in Bucks County (B. Ruhe, unpublished). The specimen was a gravid female and found adjacent to apparent potentially suitable habitats, suggesting a native *K. s. subrubrum* population was present within Pennsylvania. As a result of this discovery, a two-year State Wildlife Grant funded study was engaged by the PFBC, through a partnership with East Stroudsburg University (ESU), to determine the status and current range of *K. s. subrubrum* in Pennsylvania (Ruhe and LaDuke 2011). Two populations with only



15 total *K. s. subrubrum* were encountered during the study, of which 27% (4) died as a result of mesopredator depredations and apparent drought stress. No additional sites were discovered in Pennsylvania, making *K. s. subrubrum* one of the rarest animals in Pennsylvania, and, when considering the massive level of urbanization in the Atlantic Coastal Plain Province, one of the most endangered.

Population trends:

One of the two populations was documented on public land but remains surrounded by residential development, roads, and utility lines. The site appears to be subject to severe drought, and the population there has been in decline despite evidence of reproduction during the 2009-2011 study (Ruhe and LaDuke 2011). The other site is on private land and a full population assessment was not able to be conducted there during the study. However, the dead-on-road specimen found here in 2008 is indicative of challenges to the success of this population.

Threats

- 1) Habitat loss by anthropogenic alteration or destruction
 - a. Historical and ongoing residential, commercial, and industrial development, road construction, agricultural practices, and dredge spoil deposition.
 - b. Road mortality threat to nesting females from developed areas adjacent to occupied habitats

- c. Reduction in available nesting habitat from dense cover of invasive plant species
 - d. Potential loss of prey items from invasive crayfish species
- 2) Predation (of nests and adults):
Predominant predators are meso-mammals (i.e., raccoon, skunk, opossum, mink, fox), populations of which are inflated in the urban and disturbed settings of the two populations.
- 3) Isolation
 - a. Total genetic isolation
 - b. Lack of migration capacity due to urban surroundings
 - c. Small population size at both sites is unlikely to remain viable
- 4) Illegal collection

Conservation and Recovery

Conservation and Recovery Goal: The goal of this plan is to provide guidance for the maintenance, augmentation, and protection of extant populations of Southeastern Mud Turtle in the Commonwealth to ensure sufficient distribution and threat management to stabilize the species status in Pennsylvania.

Conservation Actions:

- 1) Develop and implement management plans for occupied *K. s. subrubrum* sites.
 - a. Control predators
 - b. Mitigate dangerous road crossing sites with fencing or culverts
 - c. Evaluate opportunities to expand available habitat at occupied sites



- d. Protect breeding, foraging, and overwintering habitat at occupied sites through conservation easements and fee-simple acquisition (on private land).
- 2) Develop long-term monitoring plans for occupied *K. s. subrubrum* sites.
 - a. Monitor populations for population metrics including evidence of reproduction
 - b. Time monitoring in order to measure response to habitat management
 - c. Identify specific habitat components (brumation, nesting sites, etc.); determine seasonal habitat-use and response to weather extremes (flood, drought, etc.)
 - 3) Continue and expand ongoing protection measures for the *K. s. subrubrum* populations.
 - a. Review and comment on permit applications that involve proposed temporary and/or permanent disturbances to known *K. s. subrubrum* habitat.
 - b. Increase existing protections by collaborating with landowners on implementation of management plans and land conservation.
 - c. Encourage increased law enforcement presence to address poaching concerns
 - 4) Determine feasibility of population augmentation at currently occupied sites and reintroduction of *K. s. subrubrum* at unoccupied sites within historic range in Pennsylvania.
 - a. Develop a reintroduction and augmentation protocol
 - b. Identify and prepare sites that are drought resilient
 - c. Identify source of animals and/or eggs from nearby states (NJ, DE, MD)
 - d. Establish long-term monitoring and radiotelemetry of turtles
 - 5) Evaluate opportunities for connectivity between occupied sites, as well as unoccupied potential habitat.
 - a. Identify contiguous habitat and potential travel corridors
 - b. Work with landowners and partners to protect corridor sites from development

References

- Conant, R., and J. T. Collins. 1998. A Field Guide to Reptiles & Amphibians. Eastern and Central North America. Third Edition, Expanded. Houghton Mifflin Company, Boston. 616 pp.
- Ernst, C.H., R.W. Barbour, E.M. Ernst, and J.R. Butler. 1973. Growth of the mud turtle, *Kinosternon subrubrum*, in Florida. *Herpetologica* 29:247-250.
- Ernst, C.H., J.E. Lovich, and R.W. Barbour. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C.
- Gibbons, J.W. 1983. Reproductive characteristics and ecology of the mud



- turtle, *Kinosternon subrubrum* (Lacepede). *Herpetologica* 39:254-271.
- Gibbs, J.P., A.R. Breisch, P.K. Ducey, G. Johnson, J.L. Behler, and R.C. Bothner. 2007. *The amphibians and reptiles of New York State: identification, natural history, and conservation*. Oxford University Press: NY.
- Harden, L.A., S.J. Price, and M.E. Dorcas. 2009. Terrestrial activity and habitat selection of Eastern Mud Turtles (*Kinosternon subrubrum*) in a fragmented landscape: implications for habitat management of golf courses and other suburban environments. *Copeia* 1:78-84.
- Hulse, A.C., C.J. McCoy, and E. Censky. 2001. *Amphibians and reptiles of Pennsylvania and the northeast*. Comstock Publishing Associates. Cornell University Press, Ithaca. 419 pp.
- Mahmound, I.Y. 1967. Courtship behavior and sexual maturity in four species of kinosternid turtles. *Copeia* 1967:314-319.
- McCoy, C.J. 1982. Amphibians and reptiles in Pennsylvania. *Carnegie Museum of Natural History Special Publication* 6:1-91.
- Natureserve. 2018. Eastern Mud Turtle. <http://www.natureserve.org/>.
- Ruhe and LaDuke. 2011. Status Assessment and Range Determination of the Eastern Mud Turtle (*Kinosternon subrubrum subrubrum*) in Pennsylvania. Final Report to the Pennsylvania Fish and Boat Commission. 54 pp.
- Schwartz, V., and D.M. Golden. 2002. *Field guide to the reptiles and amphibians of New Jersey*. New Jersey Division of Fish and Wildlife: Vineland, NJ.
- White, J.F., and A.W. White. 2002. *Amphibians and reptiles of Delmarva*. Tidewater Publishers: Centreville, MD.