CONSERVATION BIOLOGY OF FRESHWATER TURTLES AND TORTOISES

A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group

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Kinosternon baurii (Garman 1891) – Striped Mud Turtle

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Summary. – The Striped Mud Turtle, *Kinosternon baurii* (family Kinosternidae) is a small freshwater species (maximum straightline carapace length of up to 13.8 cm in females and 11.5 cm in males) that occurs along the Atlantic Coastal Plain of the United States from the lower Keys of Florida north as far as Delaware. Because individuals in the northern parts of the species' range often lack characteristic shell striping, they are often misidentified as *K. subrubrum*, their close relative. *Kinosternon baurii* can be found in a variety of aquatic habitats and is commonly found moving on land during rainy periods or when water levels are low. Individuals of the lower Florida Keys often inhabit brackish water ponds. Clutch size ranges from 1–7 eggs, and 1–3 clutches are typically laid per year in Florida. Eggs of *K. baurii* may exhibit embryonic diapause (early arrested development) and embryonic estivation (late embryonic dormancy). Eggs laid in fall and winter exhibit diapause until spring and may remain in the nest cavity for nearly one year before hatching. The species appears abundant in most parts of its range, but the lower Florida Keys populations are in danger of acute habitat loss because of intensive development and sea level rise. Climate change models suggest that suitable habitat will decline substantially during the next several decades, especially in the southern and northern parts of its current distribution.

Distribution. – United States (Delaware, Florida, Georgia, Maryland [?], North Carolina, South Carolina, Virginia); the southeastern Atlantic Coastal Plain from Delaware to the Florida Keys.

Synonymy. – *Cinosternum baurii* Garman 1891, *Kinosternon baurii, Kinosternon baurii baurii, Kinosternon bauri, Kinosternon bauri palmarum* Stejneger 1925, *Kinosternon baurii palmarum.*

Subspecies. – None currently recognized.

Status. – IUCN 2021 Red List: Least Concern (LC, assessed 2011); CITES: Not Listed.

Taxonomy. — The Striped Mud Turtle was described by Garman (1891) as *Cinosternum baurii* from individuals collected in brackish water ponds in Key West, Florida. The type series includes 11 syntypes (MCZ 282–287 [now 184720, 184721, 184723, 184724, 184725, 184726], 1558, 1563, 4380, UMMZ 53038 [Peters 1952:54; formerly MCZ 4718, but formerly MCZ 4379 according to Kluge 1984:80], FMNH 73481 [Marx 1958:450; formerly MCZ 4050]); however, Barbour and Loveridge (1929:285) listed only 9 specimens (MCZ 1563 (2), 4380 (1), 4718 (5), and 4050 (1)), presumably ignoring the UMMZ and FMNH specimens. The generic name was later appropriately emended to *Kinosternon* by Loennberg (1894).

Stejneger (1925) recognized individuals from the upper Florida Keys as *Kinosternon bauri palmarum*. The nomenclature was updated in the checklist of Stejneger and Barbour (1939). Based on pigmentation patterns, Uzzell and Schwartz (1955) found individuals from the lower Florida Keys to be distinguishable from individuals from the upper Florida Keys and the peninsular Florida mainland. They recognized *K. baurii baurii* as the nominal form restricted to the lower Florida Keys, and *K. b. palmarum* as the subspecies found from the upper Florida Keys throughout the mainland peninsula. Since the study of Uzzell and Schwartz (1955), others have found mainland populations to exhibit similar pigmentation patterns to those supposedly typical of populations from the lower Keys (Iverson 1978; Lamb and Lovich 1990). Iverson (1978) synonymized *K. b. baurii* and *K. b. palmarum*. Molecular studies also have failed to indicate uniqueness of the Florida Keys populations (Karl and Wilson 2001; Wilson and Karl 2001). Currently, no subspecies are recognized.

Kinosternon baurii is a member of a monophyletic clade within the family Kinosternidae, a group of northern kinosternids in North America and northern Mexico (Thomson et al. 2021). The species is most closely related to the sympatric Florida Mud Turtle, *Kinosternon steindachneri*, and more distantly to *K. subrubrum* and *K. flavescens* (Iverson et al. 2013). Supporting evidence for this relationship comes from studies of the karyotype (Sites et al. 1979), phylogenetic analysis of biochemical data (Frair 1972; Seidel et al. 1986; Walker et al. 1998), and combined biochemical and morphological data

Figure 1. Adult *Kinosternon baurii* from North Carolina. Note the characteristic carapacial and head stripes. Photo by Jeff Beane.

(Iverson 1991; Iverson et al. 2007) of kinosternid species. Hydridization between *K. baurii* and *K. subrubrum hippocrepis* has occurred in captivity (Farkas and Sasvari 1993). Seidel et al. (1986) concluded that *K. baurii* and *K. subrubrum* were more closely related to the genus *Sternotherus* than to Central American *Kinosternon*, but Iverson (1991) and Iverson et al. (2007, 2013) suggested that the similarities could be the result of convergence rather than synapomorphy. In a comprehensive analysis of 14 nuclear loci comprising 10,305 base pairs, Spinks et al. (2014) and Thomson et al. (2021) demonstrated that both the Central American and North American clades of *Kinosternon* were more closely allied phylogenetically to one another than to the musk turtles of the genus *Sternotherus*. Spinks et al. (2014) concluded the phylogeny generated by Iverson et al. (2013) was biased by mtDNA gene tree anomalies, and hence did not support a taxonomic division of the genus *Kinosternon*.

Hoser (2021), in a disputed work (see commentary in TTWG 2021) proposed naming the unstriped northern morphs of *K. baurii* as a new subspecies, *K. b. grantturnerii*. The subspecies was named solely on the basis of the lack of the three carapace stripes, although Hoser incorrectly stated that molecular (Wilson and Karl 2001; erroneously cited in Hoser 2021) and morphometric (Lamb and Lovich 1990) analyses could be used to support such a designation. However, the lack of carapace stripes is an insufficient character to differentiate the most northern populations

Figure 2. Striped carapace variation in *Kinosternon baurii*. *Top left*: Alachua County, Florida. Photo by C. Kenneth Dodd, Jr.; *Top right*: reddish stripes, Alachua County, Florida. Photo by Jake Scott. *Bottom left*: McIntosh County, Georgia. Photo by Dirk Stevenson; *Bottom right*: Miami-Dade County, Florida. Photo by Jake Scott.

Figure 3. Unstriped carapace variation in *Kinosternon baurii*. *Left*: Virginia Beach, Virginia. Photo by John Kleopfer. *Center*: Lake County, Florida. Photo by Jake Scott. *Right*: Summerland Key, Florida. Photo by Carl D. May.

from those farther south (some turtles in Florida, for example, also lack stripes), and the designation of a unique subspecific epithet is unsupported by other data for northern populations. We reject the name *K. b. grantturnerii* as invalid based on a lack of peer-reviewed biological evidence. No new data were provided by Hoser, and, to our knowledge, the author never examined any specimens, nor has he conducted research on this taxon (Bryan Stuart, pers. comm. concerning the type specimen designated by Hoser 2021). Furthermore, the description was brought forth in a questionable self-published privately issued outlet. We agree with Kaiser et al. (2013) and Wüster et al. (2021) in that "scientifically unfounded or ethically questionable, unreviewed, privately published taxon descriptions have no place in 21st century taxonomy, and that the resulting *nomina* should not enter scientific discourse." We therefore reject this *nomen* proposed by Hoser as invalid and it should not be included in synonymies of *K. baurii*.

The karyotype of *K. baurii* is 2n = 56, which is the same as all other known karyotypes of its congeners (Killebrew 1975, Sites et al. 1979). Killebrew (1975) reported 26 macrochromosomes and 30 microchromosomes, but Sites et al. (1979) observed 24 macrochromosomes and 32 microchromosomes. Killebrew (1975) erroneously stated 2n = 54 in his Fig. 1 caption, and this was mistakenly repeated by Wilson et al. (2006).

Etymology. — The genus name *Kinosternon* is derived from the Greek *kineo*, meaning "move," and *sternon*, meaning "chest," in reference to the hinged plastron. The species name *baurii* is a patronym honoring Georg Hermann Carl Ludwig Baur (1859–1898).

Description. — *Kinosternon baurii* is a small-bodied species, reaching a maximum straightline carapace length (SCL) of 13.8 cm in females and 11.5 cm in the smaller males (Ewert and Jackson 2005; Johnston et al. 2019). Adult Striped Mud Turtles are generally characterized by three light, longitudinal stripes on a tan to black carapace (Fig. 2). Dark individuals with carapacial stripes reduced or absent have been reported from the Florida Gulf Hammock and Lower Keys (Iverson 1978), the Florida panhandle (Jackson 2002), and the middle and northern portion of the species' range (Lamb 1983a; Mitchell 1994; Palmer and Braswell 1995; Moulis and Stevenson 2008; Beane et al. 2010; Kleopfer et al. 2014; D. Stevenson, pers. comm.; Fig. 3).

Most *K. baurii* in Delaware lack carapacial stripes, but some have reduced or complete stripes (N. Nazdrowicz and G. Brown, unpubl. data). In South Carolina, all individuals examined by Camper (2019) lacked the carapacial stripes. As noted, individuals in the northern parts of the species' range often lack the carapacial markings and, in the past, have been misidentified as *K. subrubrum* (see Lamb 1983a). Lamb and Lovich (1990) provided a key and set of discriminant functions that can aid in distinguishing *K. baurii* from its close relative *K. subrubrum* in areas of sympatry. Individuals with carapacial stripes are known to occur in Georgia (G. Brashear, unpubl. data) and an unusual golden colored variant has been recorded in the Everglades (May 2008; Fig. 4).

The carapace is smooth and keelless in adults, and the vertebrals may be depressed, forming a shallow middorsal groove (Carr 1952; Ernst and Barbour 1972; Ernst 1974). The carapace has a nuchal with 11 marginals on each side, five vertebrals, and four pairs of costal scutes; the edge

Figure 4. Unusual color morphs of *Kinosternon baurii*. *Left*: reddish carapace, male, Leon County, Florida. *Center and right*: golden color variety, Monroe County, Florida. Photos by Carl D. May.

Figure 5. Plastron variation in *Kinosternon baurii*. *Top left*: Miami-Dade County. Photo by Jake Scott. *Top right*: Florida. Photo by John Iverson. *Bottom left*: Big Pine Key, Florida. Photo by C. Kenneth Dodd, Jr. *Bottom right*: Virginia Beach, Virginia. Photo by John Kleopfer.

of the carapace is smooth. The plastron is light yellow, brown, reddish-amber to olive, or nearly black in color, with two functional, transverse hinges bordering the abdominal scutes (Fig. 5). There are 11 plastral scutes plus a gular scute. The seams of the plastron scutes may have dark borders. The hind lobe of the plastron is slightly notched posteriorly and is larger than the fore lobe. A study of morphometric characters revealed a north-south clinal trend of decreasing plastral size relative to body size (SCL) within Florida (Iverson 1978). This trend may reflect the extent to which local populations are restricted to aquatic habitats (Iverson 1978).

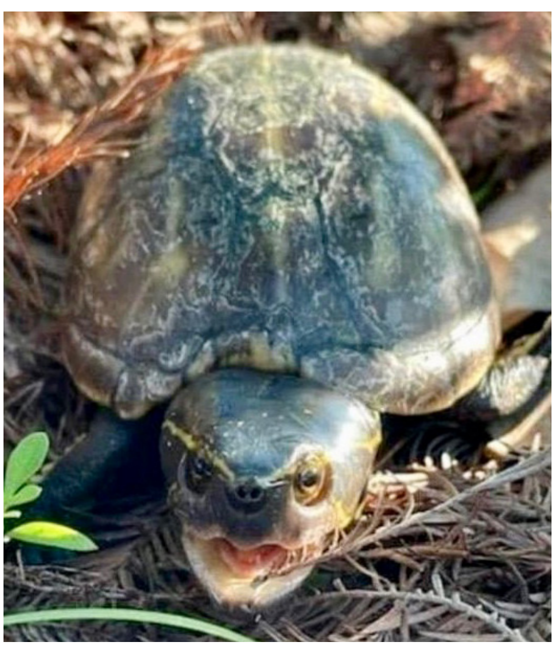

Figure 6. Megacephalic *Kinosternon baurii* from Georgia. Photo by Greg Brashear.

The skin of the head and limbs is dark gray to black, but the small, conical head displays a wide variety of pigmentation patterns throughout the species' range (Iverson 1978). Most commonly, the head is mottled, with two pronounced, cream-to-yellow stripes on the sides; the dorsal stripe extends from the nostril to the eye. Stripes may be continuous or broken. These stripes further help to distinguish *K. baurii* from *K. s. subrubrum* and *K. steindachneri*, but not from *K. s. hippocrepis*. The lower jaw varies from completely dark to dark with anteroposterior cream to yellow streaks (Uzzell and Schwartz 1955). The toes are fully webbed. A population with megacephalic individuals is known from Georgia (Fig. 6).

Hatchlings are among the smallest of any turtle species and have the following dimensions: 15–25 mm SCL, 15.45–22 mm maximum plastron length (PL), 14.0–19.0 mm carapace width, 10.9–18.2 mm shell depth/height, and mass of 2.0–3.9 g (Einem 1956; Nicol 1970; Lardie 1975b; Iverson 1979; Palmer and Braswell 1995; Johnston, unpubl. data). Hatchling shells are deeper and more circular than those of larger individuals, and the head is large in relation to the body. The carapace is black, with a light to dark yellow spot on each marginal scute (Fig. 7). Both a pronounced midline keel and weak lateral keels are present on the carapace. These keels correspond to the three longitudinal stripes typical of adults of the species (Einem 1956). Carapacial stripes are present in hatchlings from the Florida peninsula (Einem 1956; Wilson et al. 2006). The plastron is similar in coloration to that of the adult, except for a dark central blotch and dark bordered seams

Figure 7. Hatchling and juvenile *Kinosternon baurii*. *Top left and bottom left*: eggs with recent hatchlings. Photos by John Iverson. *Top right*: juvenile, Miami-Dade County, Florida. Photo by Jake Scott. *Bottom right*: juvenile, Appling County, Georgia. Photo by Kevin Stohlgren.

(Ernst and Barbour 1972). Head stripes vary in color from light yellow to yellow-orange. Hatchlings are born without plastral hinges, they but acquire them by their third month (Einem 1956).

Striped Mud Turtles are sexually dimorphic (see above; Fig. 8). Females are larger than males in all populations that have been studied (Tables 1 and 2). Females also have a longer and wider plastron relative to SCL. Maximum plastron length as a percentage of SCL is 90.3–101.5 (mean = 94.3%) for females and 81.1–91.8 (mean = 86.2%) for males from North Carolina (Palmer and Braswell 1995). These percentages vary among populations in Florida, averaging 89.4–96.1 for females and 84.8–89.9 for males (Iverson 1978). The plastron of males may also be slightly concave. Males have a longer, thicker tail than females. Adult males also have patches of rough scales proximal and distal to the popliteal space on each hindlimb. These patches (also known as clasping organs) aid in grasping the female during copulation (Carr 1952; Lardie 1975a). Both sexes have a keratinized spine

Figure 8. Sexual dimorphism of plastron in *Kinosternon baurii*. *Top*: male; *Bottom*: female. Photo by Carl D. May.

Table 1. Sexual size dimorphism in *Kinosternon baurii* populations. Carapace length (mm) presented as mean (minimum–maximum, sample size). * = straight midline carapace length (SMCL), ** = uncertain whether SMCL or maximum straightline carapace length (SCL). Maturity of females is based on size of smallest individual with shelled eggs, enlarged follicles, or corpora lutea. Maturity in males is based on smallest individual with coiled epididymides or enlarged scale patches on hindlimbs. Sexual dimorphism index (SDI) calculated following Gibbons and Lovich (1990).

Location	Females	Males	SDI	Reference
Virginia (cypress swamp)	95.7 (70.2–111.1, *n* = 31)	87.1 (71.1–101.5, *n* = 51)	1.10	Johnston et al. 2019*
Virginia (Blackwater River)	109.6 (82.6–122, *n* = 17)	90.6 (75.6–114.7, *n* = 46)	1.21	Johnston et al. 2019*
South Carolina (Savannah River Site)	98 (?–112, *n* = 13)	85 (?–96, *n* = 9)	1.15	Gibbons and Semlitsch 1991**
Northern Florida (ponds and creeks)	93.5 (74–110, *n* = 58)	88.5 (77–97, *n* = 25)	1.06	Johnston et al. 2019*
Northern Florida (ephemeral ponds)	93.3 (75–116, *n* = 33)	86.2 (74–102, *n* = 18)	1.08	Johnston et al. 2019*
Northern Florida (Santa Fe River)	103.5 (86–125, *n* = 57)	94.7 (81–110, *n* = 40)	1.09	Johnston et al. 2019*
Central Florida (swamps and ponds)	93.5 (73.4–115, *n* = 44)	83.4 (73.2–98.1, *n* = 22)	1.12	Wygoda 1979**
Central Florida (restored wetlands)	93.8 (?–?, *n* = 22)	83.0 (?–?, *n* = 10)	1.13	Stemle et al. 2020**
Southern Florida (canals and ditches)	97.6 (87–112, *n* = 14)	89.7 (82–104, *n* = 15)	1.11	Johnston et al. 2008*
Southern Florida (Everglades)	89.0 (77–107, *n* = 25)	77.2 (59–90, *n* = 10)	1.15	Meshaka and Blind 2001**
Southern Florida (canals)	104 (85–125, *n* = 14)	90.8 (80–98, *n* = 12)	1.14	Meshaka and Blind 2001**

Table 2. Body masses (g) of adult *Kinosternon baurii* presented as mean (minimum–maximum, sample size). The heaviest recorded *K. baurii* is a 401 g female (Ewert and Jackson 2005).

Location	Females	Males	Reference
Virginia (cypress swamp)	160.5 (68–220, *n* = 31)	110.6 (58–195, *n* = 50)	J.C. Mitchell, unpubl. data
Virginia (Blackwater River)	245.1 (105–365, *n* = 17)	132.5 (74–221, *n* = 44)	J.C. Mitchell, unpubl. data
Northern Florida (ponds and creeks)	146.2 (69–245, *n* = 79)	108.9 (69–164, *n* = 33)	Johnston, unpubl. data
Northern Florida (ephemeral ponds)	148.7 (69–260, *n* = 30)	106.1 (67–160, *n* = 17)	Johnston, unpubl. data
Northern Florida (Santa Fe River)	200.1 (116–323, *n* = 68)	140.8 (83–205, *n* = 51)	Johnston, unpubl. data
Central Florida (restored wetlands)	153.5 (?–?, *n* = 22)	101.0 (?–?, *n* = 10)	Stemle et al. 2020
Southern Florida (canals & ditches)	192 (131–245, *n* = 14)	129 (105–190, *n* = 15)	Johnston et al. 2008; Johnston, unpubl. data

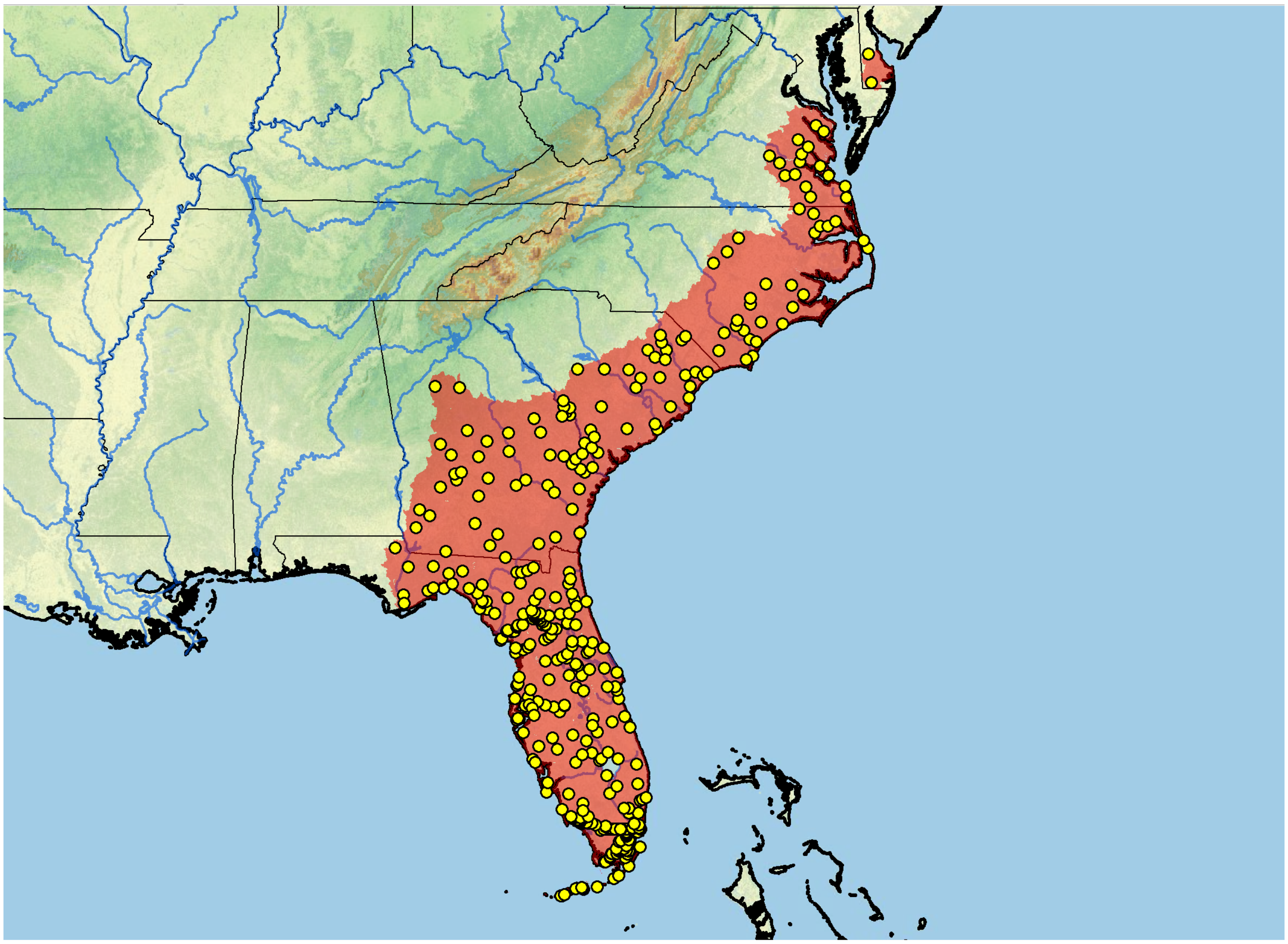

Figure 9. Distribution of *Kinosternon baurii* in southeastern USA. Yellow dots = museum and literature occurrence records of native populations based on Iverson (1992), TTWG (2017, 2021), other published literature, and authors' more recent data; red shading = presumed native historic indigenous range. Distribution based on GIS-defined level 12 HUCs (hydrologic unit compartments) constructed around verified localities and then adding HUCs that connect known point localities in the same watershed or physiographic region, and similar habitats and elevations as verified HUCs (Buhlmann et al. 2009; TTWG 2017, 2021) and adjusted based on authors' data.

at the tip of the tail, but the spine is enlarged and claw-like in males.

Carapace length has not been consistently measured and reported in the literature. Most authors reported maximum straightline carapace length (SCL) (e.g., Iverson 1978; Palmer and Braswell 1995; Wilson et al. 1999; Ewert and Jackson 2005), but others reported straight midline carapace length (SMCL) (e.g., Johnston et al. 2008, 2019). In some cases, it is not clear which measurement (SCL or SMCL) was taken (e.g., Wygoda 1979; Meshaka and Blind 2001; Stemle et al. 2020). Johnston (unpubl. data) measured both SCL and SMCL of 178 *K. baurii* captured in northern Florida and found these measurements differed by ≤1 mm in 97.7% of the turtles. The largest known male reported by Johnston et al. (2019) had the same SCL and SMCL (J. Mitchell, unpubl. data).

Carapace length varies geographically, especially among populations in different habitats (Table 1). There is no evidence of a latitudinal cline in carapace length (Johnston et al. 2019). The largest individuals of each sex were found in rivers; the female in Apalachicola River, Florida, and the male in Blackwater River, Virginia.

Distribution. — The Striped Mud Turtle was once thought to occur in the United States only from the lower Florida Keys northward along the Atlantic Coastal Plain to Georgia. Duever (1972) first reported a new locality for *K. baurii* in southern South Carolina, which extended the species' known range northward 200 km (also see Wharton and Howard 1971). Because Duever's individuals lacked the characteristic shell and head stripes of *K. baurii*, some investigators questioned his identification and considered the individuals to be *K. s. subrubrum*, a common species in the area (Gibbons et al. 1979). Subsequent morphological analyses of individuals from the Atlantic Coastal Plain confirmed that *K. baurii* occurs continuously from Florida north to Virginia (Lamb 1983a,b; Lamb and Lovich 1990; Mitchell 1994; Williamson and Moulis 1994; Moulis and Stevenson 2008; Beane et al. 2010; Camper 2019). Although the discriminant function used by Lamb and Lovich (1990) was successful in distinguishing *K. s. subrubrum* from *K.*

baurii, it misidentified most *K. s. hippocrepis* as *K. baurii* (Lovich and Lamb 1995). White and White (2007) noted the occurrence of a few *K. subrubrum* from Delaware that had two prominent yellow stripes on the head and appeared similar to *K. baurii*. Subsequent observations and genetic analysis have confirmed the occurrence of possibly disjunct populations of *K. baurii* in Delaware (Sussex and Kent Counties), expanding the known range approximately 150 km northward (G. Brown, N. Nazdrowicz, and J. Thompson, unpubl. data) (Fig. 9).

Striped Mud Turtles are found almost exclusively in the lowlands of the Atlantic Coastal Plain from Delaware (northernmost record from Kent County) south throughout the Florida peninsula, extending through the islands of the Florida Keys (Big Pine, Big Torch, Cudjoe, Johnston, Key Biscayne, Key West, Little Torch, Middle Torch, No Name, Ramrod, Saddlebunch, Stock Island, Summerland). In North Carolina, they also occur on the Piedmont (e.g., in Franklin and Wake Counties; Palmer and Braswell 1995) and on Bodie Island (Dare County; Gaul and Mitchell 2007). This species is also found on the Georgia Piedmont and only on Cumberland Island among Georgia's barrier islands (Laerm et al. 2000; Shoop and Ruckdeschel 2006; Moulis and Stevenson 2008; Brashear and Brown 2016). In Florida, the range extends west through the Florida panhandle to the Apalachicola River and then to the upper Chipola River in Jackson County (Iverson and Etchberger 1989; Ewert et al. 2004b; Krysko et al. 2011; Suarez and Mays 2019).

A single record of *K. baurii* from Cuba (Garman 1891) must have been based on an individual brought from the Keys, as the species does not occur naturally on Cuba. The record is based on a specimen sent to Garman at the Museum of Comparative Zoology by Felipe Poey of Havana, but without collection locality or other information. Garman (1887) described the individual morphologically but did not name it until later when he included it within *K. baurii*. Because of the widespread trade between Key West and Havana, it is likely the turtle was presented to Professor Poey from someone who had traveled to the Keys.

Fossils of *K. baurii* have been reported from Late Pleistocene deposits (Beds 2 and 3) at Vero Beach, Indian River County, Florida (Weigel 1962). A number of undescribed *Kinosternon* fossils are known from Florida, particularly one from the Withlacoochee River 4A site that has been attributed to the *K. subrubrum–baurii* clade (Bourque 2013). It represents the oldest occurrence of the *K. subrubrum–baurii* group in Florida (late Miocene: late early Hemphillian, ca. 5.5–6.5 mya).

Habitat and Ecology. — *Kinosternon baurii* typically inhabits shallow, lentic bodies of freshwater, but can be found in a wide variety of habitats, including swamps, ponds, streams, rivers, and brackish water (Neill 1958; Ashton and Ashton 1985; Gibbons and Semlitsch 1991; Mitchell 1994; Palmer and Braswell 1995; Wilson et al. 2006; Moulis and Stevenson 2008; Beane et al. 2010; Camper 2019; Suarez and Mays 2019; Fig. 10). In southeastern Virginia, this species is widely distributed among mainstem river, tributary, and millpond habitats in the Blackwater River drainage, where it was the second most abundant of seven turtle species (96 of 565 individuals) trapped by Norman and Mitchell (2014). At the Savannah River Site (SRS) in South Carolina, *K. baurii* is the least abundant of three kinosternid species and is found primarily in streams and along margins of the Savannah River floodplain swamp (Gibbons and Semlitsch 1991). In an assemblage of eight turtle species in a Carolina Bay at the SRS, only 7 of 982 individuals captured at a drift fence were *K. baurii* (Buhlmann and Gibbons 2001). *Kinosternon subrubrum* (n = 61 individuals) and *Sternotherus odoratus* (n = 197) were more abundant in this habitat. Striped Mud Turtles rarely visit isolated Carolina Bays, and it is usually only occasional males (K. Buhlmann, pers. comm.). Leiden et al. (1999) reported 11 *K. baurii* and 14 *K. subrubrum* among eight turtle species in a complex of managed forest and wetlands in Marion County, South Carolina.

In northern Florida, *K. baurii* is also occasionally found in spring-fed rivers and spring runs (Carr 1940; Huestis and Meylan 2004; Mitchell and Johnston 2012a). It was the least abundant of the 10 freshwater turtle species captured by Johnston et al. (2011, 2016) in spring-fed and blackwater reaches of the Santa Fe River. The majority (89.8%) of the individuals from the Santa Fe River population were captured in spring runs that flow into the river (Johnston, unpubl. data). In a network of ponds and small creeks on a golf course <10 km from the Santa Fe River in Columbia County, *K. baurii* was the second most abundant of six turtle species captured during 2018–2020 (Johnston, unpubl. data). Only 4 of 2552 turtles captured by Huestis and Meylan (2004) in the spring-fed Rainbow River (Marion County) were *K. baurii*.

In central Florida, Striped Mud Turtles primarily inhabit swamps and ponds (Carr 1952; Wygoda 1979; Stemle et al. 2020). They can also be found in the shallow littoral zones of large lakes such as Lake Conway (Orange County), where they were the least abundant of three kinosternids (97.2% *S. odoratus*, 2.5% *K. steindachneri*, 0.3% *K. baurii*) captured by Bancroft et al. (1983). *Kinosternon baurii* was the most abundant of three kinosternid species captured by Enge and Wood (1999–2000) in drift fence arrays in mesic flatwoods, hydric hammock, and basin swamp habitats in Hernando County. Munscher et al. (2017) found one *K. baurii* among 182 turtles captured in the spring-fed Weeki Wachee River (Hernando County).

In southern Florida, *K. baurii* is the most common kinosternid, inhabiting marshes, sloughs, ponds, lakes, canals, and ditches (DeSola 1935; Duellman and Schwartz

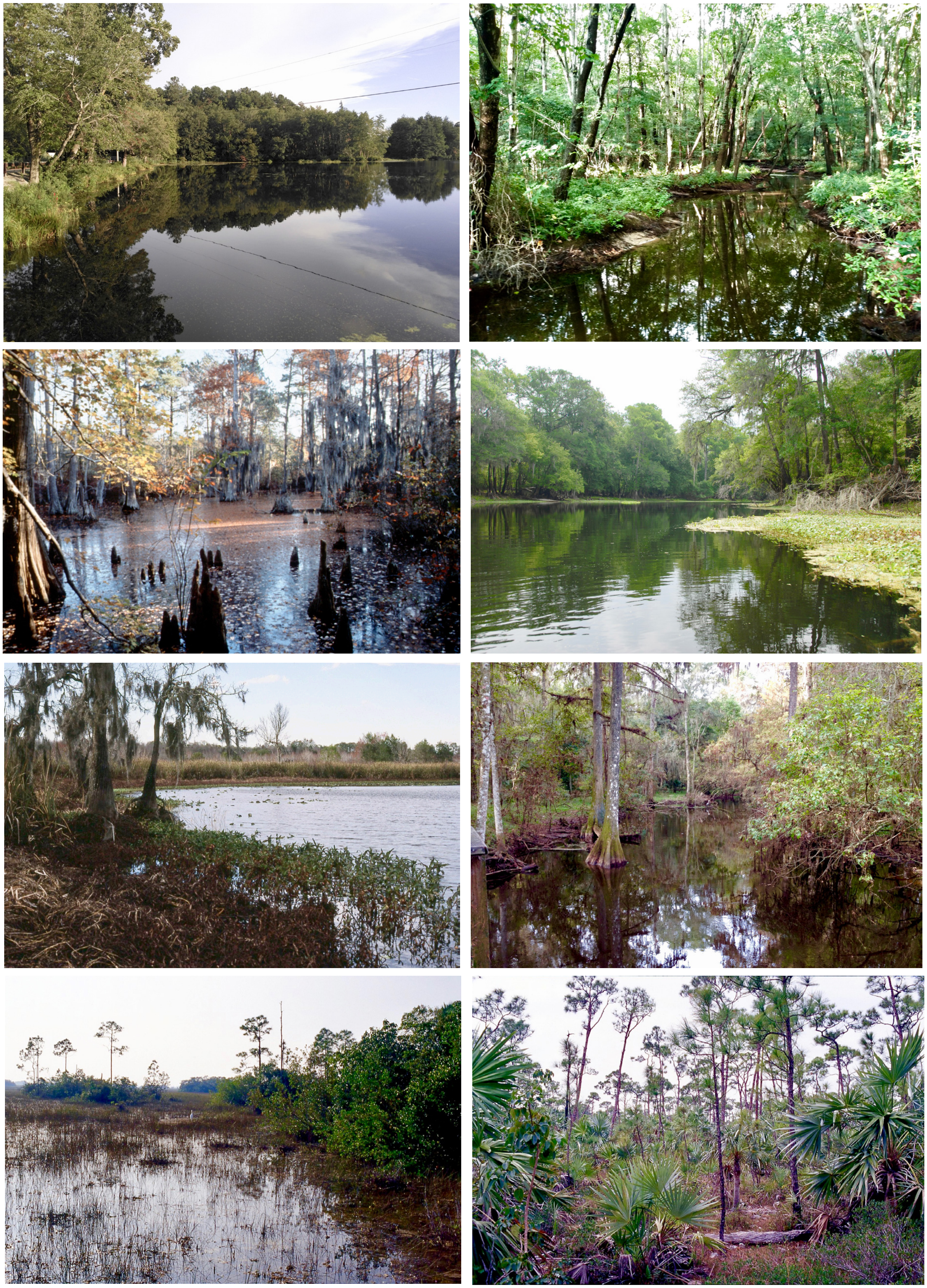

Figure 10. Habitats occupied by *Kinosternon baurii*. **First row**: pond and small stream, Sussex County, Delaware. Photos by Jack Thompson. **Second row**: *left*: cypress swamp, Virginia Beach, Virginia. Photo by Kurt Buhlmann; *right*: riverine, Santa Fe River, Florida. Photo by C. Kenneth Dodd, Jr. **Third row**: *left*: wet prairie lake, Putnam County, Florida; *right*: cypress creek, Alachua County, Florida. Photos by C. Kenneth Dodd, Jr. **Fourth row**: *left*: Everglades National Park, Florida; *right*: terrestrial habitat, Big Pine Key, Florida. Photos by C. Kenneth Dodd, Jr.

1958; Wilson and Porras 1983; Meshaka et al. 2000; Johnston et al. 2008; Meshaka and Layne 2015). Ernst et al. (1972) suggested that in southwestern Florida (Collier County) *K. baurii* usually inhabits permanent, flowing water that is at least 24 inches (0.61 m) deep, in contrast to *K. steindachneri* which is typically found in standing water up to 30 inches (0.76 m) deep. Johnston et al. (2008) found no difference in capture rates of *K. baurii* between shallow (<0.5 m) ditches and deep (3.15 m) canals in Broward County. Dunson and Mazzotti (1989) reported that Striped Mud Turtles were common in freshwater habitats in the upper Florida Keys along US Highway 1. In the lower Florida Keys, Striped Mud Turtles are found in freshwater or brackish ponds that have salinities below 15 ppt (Dunson 1981). Mays and Enge (2016) captured turtles in the Keys in water ranging in salinity from 1 to 10 ppt (mean = 3.4). Dense populations in the lower Keys were found in artificially constructed "mosquito control ditches," which tend to retain water longer than natural temporary ponds (Dunson 1992).

Little is known about aquatic habitat preference of juvenile *K. baurii*. Barbour (1920) observed young individuals among floating Water Lettuce (*Pistia stratiotes*) in the Colohatchee River (Broward County, Florida). In the Santa Fe River population, juveniles have been found in heavily vegetated spring runs that feed into the river, but never in the mainstem of the river (Johnston, unpubl. data).

Kinosternon baurii is the most terrestrial kinosternid throughout most of its range (Carr 1940). Movements on land tend to be associated with rainfall (Wygoda 1979; Wilson et al. 1999; Meshaka and Blind 2001). Meshaka and Blind (2001) observed terrestrial movements of males and juveniles in Everglades National Park only during the fall rainy season; females moved primarily in October with a secondary peak of movement in May. However, adults in the lower Florida Keys move onto land and use terrestrial retreats when ponds dry or become too saline (Dunson 1992). Nesting females in central Florida may travel several hundred meters (mean = 134.9 m; range = 62–274) from water to oviposit in upland habitats (Mushinsky and Wilson 1992; Wilson 1998; Wilson et al. 1999), which is the farthest of any known kinosternid nesting movements (Steen et al. 2012). After oviposition, central Florida females may move a few meters from the nest and bury themselves under soil or leaf litter for up to 35 days (Wilson et al. 1999). Mushinsky (1985) captured gravid female and hatchling *K. baurii* from this central Florida population more frequently in fire-maintained sandhills than in sandhills that were protected from burning. Hatchlings in Florida have been found on land during January–March, mid-late summer, and fall (Mushinsky and Wilson 1992; Meshaka and Blind 2001).

Some populations exhibit a bimodal annual terrestrial activity pattern (Iverson 1979; Wygoda 1979). Adult Striped Mud Turtles in central Florida dispersed from ponds as water levels dropped during spring (March–May) and then estivated on land until ponds and shallow swamps filled during the summer (June–August) rainy season (Wygoda 1979). As the swamps dried during September–December, the turtles migrated to the ponds. Iverson (1979) reported a similar bimodal pattern in northern Florida, with turtles most frequently observed on land during March and October.

The extent of terrestrial activity varies among populations. Bancroft et al. (1983) radiotracked one male and one female from central Florida's Lake Conway population for 6 and 9 months, respectively, and never observed them on land, suggesting terrestrial activity may be less frequent in populations inhabiting permanent lakes than in those inhabiting ephemeral wetlands. Ernst et al. (1972) suggested that *K. baurii* is less terrestrial than *K. steindachneri* in southwest Florida's Corkscrew Swamp. In Delaware, Striped Mud Turtles appear to be restricted to stream channels with permanent water and rarely move terrestrially except to nest (N. Nazdrowicz, pers. comm.). Females in the Santa Fe River population have proportionately shorter plastron lengths than females inhabiting shallow creeks and ponds on a nearby golf course (Johnston, unpubl. data, ANCOVA using SCL as covariate, $F = 29.362$, $p < 0.001$). If relative plastron length is associated with the degree of terrestrial activity, as hypothesized by Iverson (1978), individuals in the river habitat may spend less time on land than those in the creeks and ponds, but this remains untested.

Striped Mud Turtles are active from at least March to October in North Carolina (Palmer and Braswell 1995) but likely year-round farther south. Wygoda (1979) suggested that extreme temperatures prohibit terrestrial movements in central Florida during late summer. The critical thermal maximum for the Striped Mud Turtle averages 40.6°C (39.9–41.2°C), and the loss of righting response occurs on average at 39.1°C (38.2–40.4°C) (Hutchison et al. 1966).

Little is known about the spatial ecology of *K. baurii*. Tuberville et al. (1996) suggested that males may travel 3.4 km between wetlands. Stemle et al. (2019) conducted a radiotelemetry study of a population inhabiting restored wetlands on a former cattle ranch in central Florida (Polk County). Seven females were tracked for 66–369 days; mean home range was 0.51 ha (0.21–0.92 ha). Two males tracked for 152 and 230 days had home ranges of 1.44 and 0.11 ha, respectively. Dodd (unpubl. data) followed the movements of a single telemetered female (94.1 mm SCL, 86.1 mm PL, 147 g) at the Ordway-Swisher Biological Station, Putnam County, Florida, from 5 November 1987 to 12 April 1988 (Fig. 11). No movements occurred on 94 days. Movements ($n = 9$) averaged 80.4 m (range 2–335

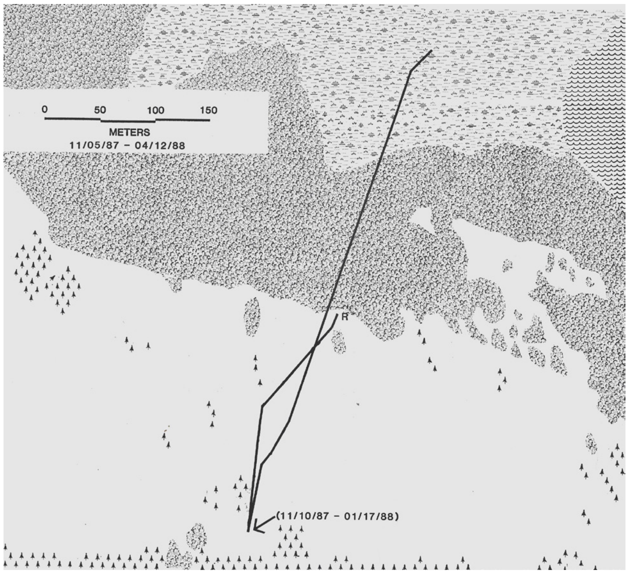

Figure 11. *Left*: Movements of radio-tracked female *Kinosternon baurii* at the Ordway-Swisher Biological Station, Putnam Co., Florida, from 5 November 1987 to 12 April 1988. No movements occurred on 94 days. R indicates the release point where she was captured crossing a dirt road moving towards the open field. *Right*: Overwintering location of the female from 10 November 1987 to 17 January 1988. Photo by C. Kenneth Dodd, Jr.

m). The longest movement occurred on 21 February 1988 during heavy rain; other straight-line movements of 102 and 120 m occurred during precipitation. The turtle spent most of her time buried in the sand (Fig. 11), including in Southeastern Pocket Gopher (*Geomys pinetis*) burrows. She was last tracked to a wet peat mound in a wet prairie. Striped Mud Turtles have also been found in Round-tailed Muskrat (*Neofiber alleni*) lodges (Lee 1968).

Basking behavior is not well-developed in this species and has only been reported to occur in the Santa Fe River population (Mitchell and Johnston 2012a). A juvenile was observed basking on a leaf overhanging a spring run, and adults were observed on tree limbs, exposed tree roots, and limestone. Basking may have a thermoregulatory function. This behavior was observed when air temperatures were 1.7–3.1°C greater than water temperatures. Basking was also associated with leech (*Placobdella* sp.) load. Adult males captured while basking had significantly more leeches than adult males captured in the water, suggesting that ectoparasite removal may, in part, explain this behavior. McKnight et al. (2021) incorrectly reported data presented in Mitchell and Johnston (2012a) by stating that "individuals captured while basking had fewer leeches than individuals captured in the water."

Diet. — *Kinosternon baurii* is an omnivore; its diet includes palmetto seeds, leaves, algae, worms, aquatic insect larvae and adults, mollusks, crayfish, fish, and small vertebrates (Wilson et al. 2006; Moulis and Stevenson 2008; Ernst and Lovich 2009). Gut analysis of 15 adults revealed seeds of cabbage palm (*Sabal palmetto*), juniper leaves, algae, snails, small bone fragments, and insects (Einem 1956). Individuals also have been observed foraging in cow dung and garbage piles (Carr 1940, 1952). *Kinosternon baurii* of the lower Florida Keys are reportedly more of a carnivorous scavenger or insectivore (Lazell 1989). Duellman and Schwartz (1958) observed Striped Mud Turtles on Big Pine Key foraging on small mammal carcasses. Scavenging on a dead Cuban Treefrog (*Osteopilus septentrionalis*) was reported by Donini (2018). Foraging may occur during the day (Duellman and Schwartz 1958; Donini 2018) or at night (Johnston, unpubl. data). This is the only turtle species known to eat leeches (*Placobdella* sp.) that are attached to its body, a behavior termed autohirudinophagy (Johnston et al. 2015).

Growth. — Few data are available on growth of *K. baurii*. Aging this species using annulus counts is difficult because some populations have a bimodal annual terrestrial activity pattern that may cause two annuli to be produced in a given year. Using this method, Iverson (1979) calculated mean PL of turtles from hatching to seven years of age as follows: 17.9, 32.7, 45.7, 57.8, 68.9, 74.3, and 75.1 mm. Females mature in 5–6 years at 75–80 mm SCL in northern Florida (Iverson 1979). In south Florida, females mature at approximately 77–85 mm SCL, depending on habitat (Meshaka and Blind 2001). Males mature at smaller sizes and presumably earlier (Carr 1952; Table 1). Einem (1956) reported a 75.8 mm SCL male that had testes filled with spermatozoa. Meshaka and Blind (2001) reported males in the Everglades and Miami canals with coiled epididymides at approximately 59 and 80 mm SCL.

Longevity. — Maximum lifespan is not well known; the oldest known wild female was originally captured and marked as an adult in Gilchrist Blue Springs, Florida in 2009 and recaptured 11 years later in 2020 (at least 16 years old;

Johnston, unpubl. data). The oldest known wild male was originally captured and marked as an adult in Gilchrist Blue Springs and recaptured 10 years later (Johnston, unpubl. data). Pope (1939) discussed a female that was a full-grown adult when captured and subsequently lived approximately 25 years in captivity. This same individual, also noted by DeSola (1935) and Mathewson (1955), ultimately lived a total 49 years, 7 months in captivity (at least 54 years old) and would have lived longer had it not perished in a fire (Johnson 1984). Jarvis (1966), Bowler (1977), and Slavens and Slavens (2000) also reported on longevity in captivity.

Reproduction. — Male *K. baurii* initiate courtship and mating. Fighting between males has been observed in the field during May and September (usually in the presence of a female) by Carr (1940, 1952) and Lardie (1975a) and in captivity by Sachsse (1977). Lardie (1975a) observed courtship in March that included tactile, mounting, and copulatory phases identical to those exhibited by *K. flavescens*. In the tactile phase, the male approaches the female with his neck outstretched, nudges her tail, and bites at her head. In the mounting phase, the male positions his plastron directly above her carapace and grasps the edges of her carapace with the claws of all four feet. In the copulatory phase, the male establishes a more posterior position on the female's carapace, bends one rear leg at the knee to grasp the female's posterior marginals with the rough patches of scales on the inner surfaces of his upper and lower leg, holds the female's tail in place with the foot of his grasping leg, and inserts his penis into her cloaca. The terminal scale on the male's tail may be placed on her plastron to maintain balance. According to Sachsse (1977), the male courts a female by sticking out his neck and swinging his head up and down at a rate of about one swing per second, occasionally bumping her snout with his snout; copulation lasts 10–40 minutes. Female *K. baurii* may store sperm and achieve fertilization after more than one year (Nijs and Navez 1990).

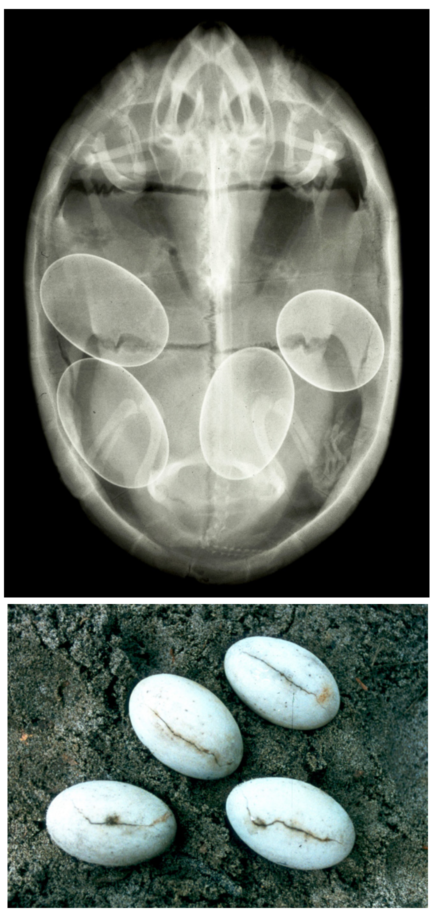

Figure 12. *Top*: radiograph of gravid *Kinosternon baurii* showing a clutch of 4 eggs. *Bottom*: the same clutch prior to pipping. Photos by Dawn Wilson.

Females ovulate nearly year-round, at least in Florida. Iverson (1979) dissected specimens collected in northern Florida and found females with corpora lutea, enlarged follicles, and/or oviductal eggs throughout most of the year, with a quiescent period during late May through June. Meshaka and Blind (2001) observed a similar cycle in the Everglades, with a mid-summer (July–August) hiatus in egg development. Mitchell (1994) observed females with oviductal eggs from July to October in Virginia.

Nesting occurs in all months in Florida but is least frequent during the hottest summer months (Iverson 1979; Mushinsky and Wilson 1992; Wilson et al. 1999; Meshaka and Blind 2001). The peaks of nesting activity occur during June (secondary) and September–November (primary) in central Florida (Wilson et al. 1999) and during May (secondary) and October (primary) in the Everglades (Meshaka and Blind (2001). Ewert and Jackson (2005) observed nesting during May and August in the Florida panhandle near the lower Apalachicola River. Carr (1940) reported egg deposition from April to June in Florida, but egg laying is now known to occur over a much longer time period. Little is known about nesting phenology north of Florida, but the nesting season is likely more restricted. Camper (2019) noted finding a road-killed female with shelled eggs on 5 September in South Carolina. In North Carolina, gravid females have been found during April, July, August, and October (Palmer and Braswell 1995).

Gravid females in central Florida exhibit strong nest site selection (Mushinsky and Wilson 1992; Wilson 1998; Wilson et al. 1999). Wilson (1998) observed that females tend to place nests in sandy soils close to vegetation and avoid open sunny sites. Furthermore, survivorship of embryos is significantly higher at nest sites selected by females than at random sites in the habitat. Wilson et al. (1999) observed nest site fidelity from year to year. Carr (1940) reported that eggs may also be laid in piles of dead water hyacinths. Ashton and Ashton (1985) stated that nests are built in sandpiles or decaying vegetation near the shoreline.

Female *K. baurii* typically lay 1–3 clutches of eggs per year in Florida (Lardie 1975b; Iverson 1978, 1979; Meshaka 1988; Wilson et al. 1999; Meshaka and Blind 2001; Wilson et al. 2006), but Iverson (1979) suggested that females in northern Florida could possibly produce up to 6 clutches. Little is known about annual clutch frequency farther north. Clutch size ranges from 1–7 eggs, with some suggestion that clutch size is greater in the north than in the south (Nicol 1970; Mitchell 1994; Ewert and Jackson 2005; Ernst and Lovich 2009). Ewert and Jackson (2005) suggested that *K. baurii* from along the Apalachicola River lay larger clutches of larger eggs than do populations in peninsular Florida.

Clutch size is positively correlated with maximum PL in northern Florida (Iverson 1979). Within populations in northern and southern Florida, egg length was found to be positively correlated with female SCL (Iverson 1979; Meshaka 1988; Meshaka and Blind 2001). In southern Florida, females in the Everglades attain smaller body sizes and produce smaller clutches of larger eggs than females inhabiting Miami canals (Meshaka and Blind 2001).

Eggs are elliptical and brittle-shelled (Fig. 12), ranging from 22.8–34.5 mm in length and 13.6–20.4 mm in width (Einem 1956; Iverson 1979; Meshaka 1988; Mitchell 1994; Palmer and Braswell 1995; Meshaka and Blind 2001; Ewert and Jackson 2005). Egg mass ranges from 3.2–8.1 g (Iverson 1979; Mitchell 1994; Ewert and Jackson 2005; Wilson et al. 2006). Packard et al. (1984) described the structure of the eggshell, and Nagle et al. (1998) evaluated lipid content of eggs and hatchlings.

Laboratory incubation times normally range from 97–143 days (Einem 1956; Lardie 1975b; Iverson 1979), but Nijs (1999) recorded an incubation of 251 days. Eggs sometimes crack along the longitudinal axis of the egg at mid-incubation (Fig. 12; Einem 1956; Iverson 1979), but this unexplained phenomenon does not appear to impede subsequent development. Because the egg stage of this species is known to exhibit embryonic diapause (early arrested development; Ewert 1991; Ewert and Wilson 1996) and embryonic estivation (late embryonic dormancy; Ewert 1985), incubation times in the field may be considerably longer than those in the laboratory. Most embryos of this species diapause (in a gastrula stage) at cool temperatures of 22.5 and 24°C and commence active development within 5–9 days at 30°C (Ewert 1991; Ewert and Wilson 1996). In central Florida, eggs laid in fall and winter exhibit diapause and then resume embryonic development in spring (Wilson et al. 1999). These eggs overlap the development of eggs laid in spring which do not diapause. Incubation time from the end of diapause to hatching ranged from 120–150 days. Thus, eggs oviposited in fall may remain in the nest cavity for nearly one year before hatching.

Kinosternon baurii exhibits temperature-dependent sex determination (TSD), but patterns are different among panhandle and peninsula populations in Florida (Ewert et al. 2004a). On the peninsula, all female offspring are produced at hot temperatures (≥29°C), nearly all male offspring at medium temperatures (25–27°C), and mixed sex offspring at cool temperatures (≤24°C). However, in the panhandle, males predominate at lower temperatures (≤24°C), females at higher temperatures (ca. 30°C), and nearly equally at temperatures from 26–27°C (Ewert et al. 2004a).

Predation. — There is intense predation on *K. baurii* eggs (Wilson et al. 1999); predators include small mammals and snakes, including Eastern Kingsnakes (*Lampropeltis getula*) (Knight and Lorraine 1986). Analysis of gut contents of Alligators (*Alligator mississippiensis*) revealed that they commonly prey on juvenile and adult *K. baurii* (D. Jackson, unpubl. data; Delaney and Abercrombie 1986). Raccoons (*Procyon lotor*) are predators of many turtle species (Ernst and Lovich 2009), including *K. baurii* (Johnston, pers. obs.). Snail kites (*Rostrhamus sociabilis*) also have been reported to prey on adults (Beissinger 1990). Walsh and Heinrich (2015) reported predation by a Red-tailed Hawk (*Buteo lineatus*) on a 55.7 mm SCL *K. baurii*. Bald Eagles (*Haliaeetus leucocephalus*) and Crested Caracaras (*Caracara cheriway*) prey on other kinosternids and may potentially prey on *K. baurii* as well (Ross 1991; Means and Harvey 1999; Morrison and Pias 2006).

Many adults in a central Florida population had missing legs and eyes, and damage to the shell that may have been attributable to a predation attempt (Wilson et al. 2006). In the Santa Fe River population, 3.3% of the adults were missing limbs (Johnston, unpubl. data). River Otters (*Lontra canadensis*) are known predators of Loggerhead Musk Turtles (*Sternotherus minor*) in the Santa Fe River (Mitchell and Johnston 2012b), and they probably also prey on *K. baurii*. Individuals of *S. minor* and *K. baurii* exhibit similar damage to the carapace most likely attributed to attempted otter predation.

When threatened, a Striped Mud Turtle typically withdraws into its shell and emits a musk. It rarely bites, in contrast with the Florida Mud Turtle (*K. steindachneri*). *Kinosternon baurii* and *K. steindachneri* may appear very similar at first glance, but their distinctly different defensive behaviors are unmistakable (Johnston, pers. obs.). Carr (1952) described *K. baurii* as easy-going, gentle, and inoffensive, unlike the irascible, belligerent, bad-tempered *K. steindachneri* (Carr 1940, 1952).

Parasites and Ectobionts. — Striped Mud Turtles host a variety of parasitic and commensal organisms. Leeches (*Placobdella* sp.) are commonly observed on the limbs, carapace, and/or plastral seams (Wilson et al. 2006; Mitchell and Johnston 2012a; Johnston et al. 2015).

This species has also been reported to carry epizoophytic algae on the carapace (Loennberg 1894; Neill and Allen 1954) and trematodes in the gut (Hughes et al. 1941). Mitchell and McAvoy (1990) found three species of bacteria (*Citrobacter freundii*, *Escherichia coli*, and *Hafnia alvei*) in cloacal swabs of individuals from First Landing State Park (formerly Seashore State Park) in Virginia, but did not detect *Salmonella*. A new species of polystome worm (Platyhelminthes: Monogenea) has been found in individuals from northern Florida (L. DuPreez and O. Verneau, unpubl. data).

Population Status. — Nothing is known about population sizes or trends of *K. baurii* north of Florida. The species is considered widespread and common in Florida despite few published studies of population ecology (Suarez and Mays 2019). The population in the Santa Fe River has remained stable (no significant changes in capture per unit effort, size structure, or sex ratio) throughout 2006–2020 (Johnston, unpubl. data). Stemle et al. (2020) estimated 81 adults per hectare and a male to female sex ratio of 1:2.2 in restored wetlands in central Florida. Dunson (1981) estimated the size of populations on Summerland Key (219–274 individuals) and Johnston Key (42–52 individuals) in the Lower Florida Keys based on fieldwork in 1979–1980. Mays and Enge (2016) captured 62 *K. baurii* on Big Pine Key during 2015–2016 and estimated that 34 individuals (95% confidence interval 20–61) inhabited a 9-ha section of the central marsh. Estimated annual population growth (lambda) in the central marsh was 0.91 (95% confidence interval 0.84–0.98), suggesting a declining population. Mays and Enge (2016) also reported that five trap nights were required to detect turtles in occupied wetlands.

Although described from Key West (Garman 1891), Carr (1940) reported he was unable to find any individuals ("I have spent many days searching for them without success, and none of the host of 'Key Westers' whom I have questioned have ever seen them"). Garman (1891), however, noted that "several collectors have secured specimens in Key West," which suggests that *K. baurii* may have been common there at one time.

Figure 13. Part of a shipment of *Kinosternon baurii* destined for Asian markets seized by the Florida Fish and Wildlife Conservation Commission (FWC) in 2018-2019. Photo by Florida Fish and Wildlife Commission, courtesy of Brooke Talley.

Threats to Survival. — In Virginia, Striped Mud Turtles are vulnerable to habitat loss, particularly of small ephemeral wetlands (Mitchell 1994). The lower Florida Keys populations are vulnerable because of intensive development, especially of the hammock pond habitat that is essential for the survival of the species, as well as road mortality and nest predation by subsidized predators, such as raccoons (Lazell 1989; Suarez and Mays 2019). Although populations exist on some protected islands of the lower Florida Keys, many large populations are on private lands. Another problem facing the Striped Mud Turtle in the lower Florida Keys is the filling of mosquito-control ditches to accommodate management recommendations for the endangered Key Deer. Dunson (1992) found these artificial ditches to support relatively dense populations of *K. baurii*. Saltwater intrusion and sea level rise also may affect the lower Keys population.

In the past, trade has been a problem for this species in Florida, with 1,417 individuals reported collected for the pet trade from 1990–1994 (Enge 2005). Trade continues to be a problem in Florida, with as many as 200 turtles sometimes collected in a single day (Suarez and Mays 2019). According to the Florida Fish and Wildlife Conservation Commission, Striped Mud Turtles were among >4,000 turtles illegally collected to be sold to Asian markets over a 6-month period in 2018–2019 (Fig. 13). The turtles were primarily collected in Lee County, but poachers expanded their activity to other parts of Florida as populations became depleted.

Road mortality is another substantial threat to this highly terrestrial species. Striped Mud Turtles made up the largest percentage of turtle species found as road kills on a 3.2 km stretch of road in Alachua County, Florida (Smith and Dodd 2003).

There has been considerable concern for the potential effects of global climate change on turtles, especially considering those with TSD. Using a maximum entropy approach to model the effects on *K. baurii*, Butler et al. (2016) concluded that areas with suitable climatic conditions for *K. baurii* are expected to decline substantially over the next few decades. The best model projected a mean annual temperature of 22–24°C, a mean temperature during the wettest quarter of 27–28°C, precipitation during the wettest quarter of 51–64 cm, and precipitation during the warmest quarter of 49–62 cm. Given these conditions, populations in the southern portions of the species' range will most likely be adversely affected, with the distribution expected to shift northeastward. The problem is that the availability of suitable habitat decreases northward, putting this species in jeopardy. Butler et al. (2016) projected that 81–95% of suitable habitat would decline by 2050. These results agree with Ihlow et al. (2012) who predicted that the range of *K. baurii* would virtually disappear in the 21st century.

Conservation Measures Taken. — *Kinosternon baurii* has been globally assessed as Least Concern by the IUCN Red List (van Dijk 2011). The species is not federally protected under the Endangered Species Act, nor is it included in the CITES Appendices regulating international trade. The lower Florida Keys population was listed as threatened by the State of Florida but was delisted in 2017. In Florida, no one may sell *K. baurii* taken from the wild. Take is limited to one turtle per person per 24-hr day from the wild for noncommercial use. The transport of more than one turtle per day is prohibited, unless the transporter has a license for sale or exhibition of wildlife, aquaculture certification from the Department of Agriculture and Consumer Services, or documentation that their turtles were legally obtained (proof of purchase). Striped Mud Turtles can only be taken by hand, dip net, minnow seine, or baited hook. Collecting of eggs is prohibited.

In Georgia, no more than 10 freshwater turtles (any combination of species) may be possessed without a commercial turtle permit. In South Carolina, *K. baurii* was listed as a species of concern prior to new laws implemented in 2020 (Camper 2019). All native turtles in South Carolina are now protected from take or possession for commercial purposes; the personal possession limit for *K. baurii* is five. In North Carolina, mud turtles may be collected (trapped) and eaten if fewer than four turtles are collected in a season. If five or more turtles are to be trapped, a license must be obtained from the Wildlife Resources Commission. With a permit, individuals may collect no more than 10 turtles from the family Kinosternidae per day and no more than 100 per calendar year. In Virginia, it is illegal to sell or purchase any turtle species that is native or naturalized, but they may be given away and kept as pets, as long as the person has no more than five individuals of that species in captivity. In Delaware, commercial collection of native turtles requires a permit; one individual of each turtle species may be possessed without a permit.

This species is known to occur in previously mentioned protected areas (e.g., Everglades National Park, Biscayne National Park, Big Cypress National Preserve, Key Deer National Wildlife Refuge, Gilchrist Blue Springs State Park, Savannah River Site), but it probably occurs in many other national, state, and local protected areas with appropriate habitat within its range.

Conservation Measures Proposed. — A thorough status survey is needed throughout the range of this species, particularly north of peninsular Florida. In the lower Florida Keys, efforts should be made to determine the proportions of Striped Mud Turtles residing on public and private lands (Dunson 1992). Commercial collection of this species for the pet trade should be abolished. Habitat protection should include aquatic habitats and surrounding uplands, ensuring a terrestrial buffer zone at least 200 m wide. To more effectively inform local habitat management decisions, future studies should examine geographic variation in terrestrial habitat use. Conservation measures taken in Florida should also be applied throughout the species' range. Conservation laws must also be enforced.

Captive Husbandry. — Sachsse (1977) and Praschag (1983) kept captive mating pairs and reported on captive breeding and clutch frequency. Coote (1978), Kirkpatrick (1999), Gurley (2003), and Lunsford (2007) described captive husbandry requirements.

Current Research. — Nathan Nazdrowicz (Delaware Department of Natural Resources and Environmental Control) is studying the status and distribution of *K. baurii* in Delaware, and Jack Thompson (Cape Henlopen High School) is conducting a mark-recapture study of a Delaware population. Long-term population studies by Johnston and colleagues are on-going in northern Florida. Jordan Donini (Florida Southwestern State College) is conducting a mark-recapture study in southwestern Florida. Chris Lechowicz (Sanibel-Captiva Conservation Foundation) is studying morphometrics and preferred habitat in sympatry with *K. steindachneri* on Sanibel Island, Florida. Jonathan Mays (Florida Fish and Wildlife Conservation Commission) is studying how Florida Keys populations respond to increasing salinity of the remaining freshwater lenses. John Iverson (Earlham College) is studying reproductive strategies in the family Kinosternidae, including *K. baurii*. Grover Brown (Jacksonville State University) has been accumulating tissues for range-wide population genomics of *K. baurii* and phylogenomic analysis of southeastern USA *Kinosternon* (*subrubrum, hippocrepis, steindachneri,* and *baurii*).

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