

Keeping, breeding and rearing of the striped mud turtle *Kinosternon baurii* GARMAN, 1891

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Systematics

The turtle family Kinosternidae is distributed in the American continent from southern Canada to the the centre of South America. After a recent molecular phylogenetic analysis (IVERSON et al. 2013) it consists of 5 genera with *Claudius* (1 species), *Staurotypus* (2 species), *Sternotherus* (4 species)

and *Kinosternon* (s. l.) (TURTLE TAXONOMY WORKING GROUP 2012), now separated by IVERSON et al. (2013) in *Cryptochelys* (6 species) and *Kinosternon* (14 species), by uplifting 2 subspecies to full species.

- *Cryptochelys acuta* (GRAY, 1831)
- *Cryptochelys angustipons* (LEGLER,

1965)

- *Cryptochelys creaseri* (HARTWEG, 1934)
- *Cryptochelys dunnii* (SCHMIDT, 1947)
- *Cryptochelys herrerae* (STEJNEGER, 1925)
- *Cryptochelys leucostoma* (DUMÉRIL & BIBRON 1851)



Fig. 1

Despite of its highly variable morphology no subspecies exist of the striped mud turtle, *Kinosternon baurii*.

- *Kinosternon abaxillare* BAUR, 1925
- *Kinosternon alamosae* BERRY & LEGLER, 1980
- *Kinosternon arizonense* GILMORE, 1922
- *Kinosternon baurii* GARMAN, 1891
- *Kinosternon chimalhuaca* BERRY, SEIDEL & IVERSON, 1997
- *Kinosternon durangoense* IVERSON, 1979
- *Kinosternon flavescens* AGASSIZ, 1857
- *Kinosternon hirtipes* WAGLER, 1830
- *Kinosternon integrum* LE CONTE, 1854
- *Kinosternon oaxacae* BERRY & IVERSON, 1980

- *Kinosternon scorpioides* (LINNAEUS, 1766)
- *Kinosternon sonoriense* LE CONTE, 1854
- *Kinosternon subrubrum* (BONNATERRE, 1789)
- *Kinosternon steindachneri* SIEBENROCK, 1906

Physical Description

Kinosternon baurii is a small species and does not exceed a length of 13 cm (SCHILDE 2001). The carapace is dark-black with three longitudinal yellow stripes. The young specimens have three keels that disappear when they grow up. The plastron is yellow,

orange or brown with a black spot along the plastral seeds; it's double hinged. The skin is very dark with few yellow marks. The head is black with two lateral yellow stripes from the eyes to the neck. Males have a long and thick tail and are smaller than females. Detailed descriptions are published by POPE (1939), CARR (1969), PRITCHARD (1979), ALDERTON (1988), ERNST & BARBOUR (1989), ERNST et al. (1994), SCHILDE (2001), VETTER (2004), BONIN et al. (2006), and LUISON & REDAELLI (2008). Extra-ordinary yellow or golden specimens are reported by MAY (2008) from the Everglades in Florida.



Fig. 2

Usually the striped mud turtle has a dark carapace and dark skin, here an astonishing bright coloured specimen of unknown origin showing an extraordinary marked head similar to the "Golden Mud Turtle" (MAY 2008).



Fig. 3a-b

A striped mud turtle with a more typical appearance, originating in North Florida.



Fig. 4a-b

Also nuances exist, like this lighter coloured turtle with yellow stripes on carapace and head (a) or the reddish toned juvenile which is still showing clearly its keels in contrary to the adult specimen.

**Fig. 5a–b**

This striped mud turtle originating at the Florida Keys is representing the other extreme with a completely dark carapace without the yellow name-giving stripes.

Distribution and Habitat

The distribution of the striped mud turtle reaches from Virginia, through North and South Carolina, Georgia to Florida (IVERSON 1992). This species is also native in the Florida Keys (MAY 2007) and lives in aquatic basins with muddy banks and aquatic plants, furthermore in rivers, ponds and marsh swamps. Sometimes it can be found in brackish basins, but the proportion of salt is a limiting factor (DUNSON 1979). A condensed review of the species' ecology is given by WILSON et al. (2006).

Setup

Kinosternon baurii usually is not a good swimmer and prefers to look for food in shallow waters. It is a small

and calm species so, for this reason, it's possible to prepare a naturalistic paludarium. We use plastic tanks of 100×50 cm with a 70 % water area of 20 cm depth and 30 % land section filled up with humid sand. Water cleaning is very important, for this matter we use internal filters. Sand

When keeping aquatic turtles
cleaning of the water is a very
important matter

bottom, floating plants like water hyacinths or duckweed, *Lemna minor* can be a good solution to create an adequate environment and to filter water. There are many aquatic hiding places to avoid stress to the turtles. Each tank has a heat spot lamp pointed on the land zone for thermoregulation.

Males and females are kept separated; each tank contains only one male or two females.

Seasonal Temperatures

From April to October we put the tanks outside, in a shady place to avoid overheating of the water. From November to March turtles are kept inside a reptilium, until February heated at 22 °C, afterwards temperature is dropped to 15 °C in order to create a chilling period. The room is exposed to natural light.

Feeding

We feed *Kinosternon baurii* twice a week with insects, molluscs, larvae, crustaceans, worms, snails, fish and artificially coloured gel; they occa-



Fig. 6a-c
Kinosternon baurii show a strict sexual dimorphism (female left, male right).



Fig. 7
Kinosternon baurii have a robust jaw and large claws.



Fig. 8
Our striped mud turtles are kept in tanks with shallow water and sandy soil.



Fig. 9a-b

Some animals of the mentioned breeding groups, above the females and below the males: This overview shows again quite obvious the broad spectrum of colouration of that species and the sexual dimorphism. The plastron is double hinged, but the most of the turtles cannot close both sides at the same time, as it is also in *Kinosternon scorpioides*.

**Fig. 10**

More members of the breeding groups: Males and females are kept separated, the males individual, and the females single or in groups of 2 specimens.

1 st FK group		
Specimen	Carapace length mm	Weight g
Male #1	190	111
Female #1	108	210
1 st NF group		
Specimen	Carapace length mm	Weight g
Male #2	76	86
Female #2	95	154
2 nd NF group		
Specimen	Carapace length mm	Weight g
Male #3	83	86
Female #3	88	108
Female #4	92	130
3 rd NF group		
Specimen	Carapace length mm	Weight g
Male #4	66	66
Female #5	86	120
Female #6	93	118

Table 1

Size and weight of the members of the different breeding groups of *Kinosternon baurii*.

sionally eat aquatic plants in small portion.

Breeding Group

We have 4 different breeding groups of two different forms coming from the Florida Keys and North Florida. Size, weight and composition of the group are given in table 1.

Breeding and Incubation

Females of *Kinosternon baurii* mature at five to six years of age, whereas males at their third or fourth year. For mating, at the beginning of spring, when water temperature exceeds 14 °C, each female is introduced into the male's tank. When the male notices the female, it starts to move around the female, sniffing the anal region and biting her legs repeatedly. If the female is susceptible to mating it remains motionless and enables the male to copulate. Sometimes the female bites the male and refuses to mate; only several attempts, the male succeeds to copulate. Copulation lasts about 10–15 minutes, depending of the specimen. After copulating, both turtles do not show any interest in each other.

The nesting season starts in May and lasts until October. Females lay the eggs in the sand, at a depth of 10–15 cm. The average clutch size is 3–5 eggs, with a maximum of seven eggs. The eggs are elliptical, white-pink, measuring 10–23 mm and 3–5 g of weight. Our females use to lay one or two clutches a year.

All eggs are incubated in plastic boxes in moist vermiculite (in the ratio 1:1 with water). The temperature of incubation is 28–29 °C and 90 % of relative humidity. After one week, the eggs develop a white blotch on their top. Hatchlings occur after 70–95 days. SCHILDE (2001) describes an incubation period of 101 days of a single egg of a wild caught female,

bred constantly at 28 °C. Furthermore he remarks that *Kinosternon baurii* is known to produce “frequently” bimodal hatching, caused by diapause, but without mentioning the source. At least under natural conditions it can spend up to one year until hatchlings leave their nest (WILSON et al. 1999).

Kinosternon baurii is known to have both, genetic sex determination (GSD) and temperature-dependent sex determination (TSD) with producing females with higher temperatures over 28 °C, males in the middle range, but females and males on the same portion at the cool range (EWERT et al.

1990). Therefore my breeding temperature over 28 °C should provide females.

Usually, we keep our hatchlings in the incubator for 2 days after they

Under natural conditions
it can spend up to one year
until hatchlings leave their nest

broke up their eggshells. Detailed information of breeding data is given in table 2.

Care of Hatchlings and Juveniles

All our hatchlings (Kinosternidae, Geoemydidae, Emydidae) are reared

in plastic tanks (white or transparent) of 40×30×20 cm each. Water level is about 5–10 cm according to the species. Usually we set up the tanks with stones and live plants like common duckweed (*Lemna* spp.), water hyacinth (*Eichhornia crassipes*) and other plants. The water is unheated; its temperature is identically to the room.

The hatchlings start to feed only after 2–3 days. We feed them with Tubifex, red mosquito larvae, earthworms and turtle pudding (ARTNER 1998). During their first two months of life they are fed 3–4 times a week, later two times a week. When the



Fig. 11 All tanks include a land and a water section and are covered with floating plants, here the indoor enclosures.



Fig. 12a–b

During summer the turtles are kept in outdoor enclosures. The set-up is equally to the way they are kept indoors. Due to the high summer temperatures in Italy we use shady places to avoid over-heating.

juveniles reach 5 cm, they are moved outside, in tanks of 60×40×30 cm.

Notes

This species presents many chromatic varieties, depending on the origin of the specimens. No subspecies are recognized, but in former times they had been divided into two subspecies: *K. b. palmarum* in the north and *K. b. baurii* in the south (discussion in MAY 2008). The species is not listed in CITES and available for free sale without special permits.

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Egg-laying date	Number of eggs	Incubation temperature in °C	Hatching date	Incubation time	Hatchling number
12.05.2008	2	29	29.07.2008–01.08.2008	78–81	2
02.06.2008	2	28,5	01.09.2008–03.09.2008	91–93	2
27.06.2008	1	29,5	-	-	0
10.07.2008	1	29	-	-	0
31.08.2008	3	29,5	26.11.2008	87	1
29.05.2009	2	29	29.08.2009	90	1
08.06.2009	1	29	-	-	0
22.06.2009	2	29	10.09.2009–12.09.2009	78–80	2
12.07.2009	3	29	22.09.2009–25.09.2009	70–73	2
01.06.2010	1	29	20.08.2010	80	1
29.06.2010	1	29	-	-	0
18.05.2011	3	29	10.08.2011	82	1
22.06.2011	2	29	12.09.2011–14.09.2011	80–82	2
24.06.2011	1	29	17.09.2011	83	1
01.07.2011	2	29	19.09.2011	79	1
15.06.2012	2	29	14.09.2012–17.09.2012	89–92	2
03.07.2012	2	29	01.10.2012–02.10.2012	88–89	2
11.07.2012	2	29	-	-	0
19.07.2012	2	29	09.10.2012–11.10.2012	80–82	2
25.07.2012	1	29	12.10.2012	77	1
19.05.2013	2	29	-	-	0
04.06.2013	2	29	31.08.2013–01.09.2013	86–87	2
13.06.2013	2	29	04.09.2013	81	1
19.07.2013	1	29	-	-	0

Table 2

Nesting and incubation data and hatching information of *Kinosternon baurii*. Bimodal hatching or diapauses do not occur during our incubation mode.

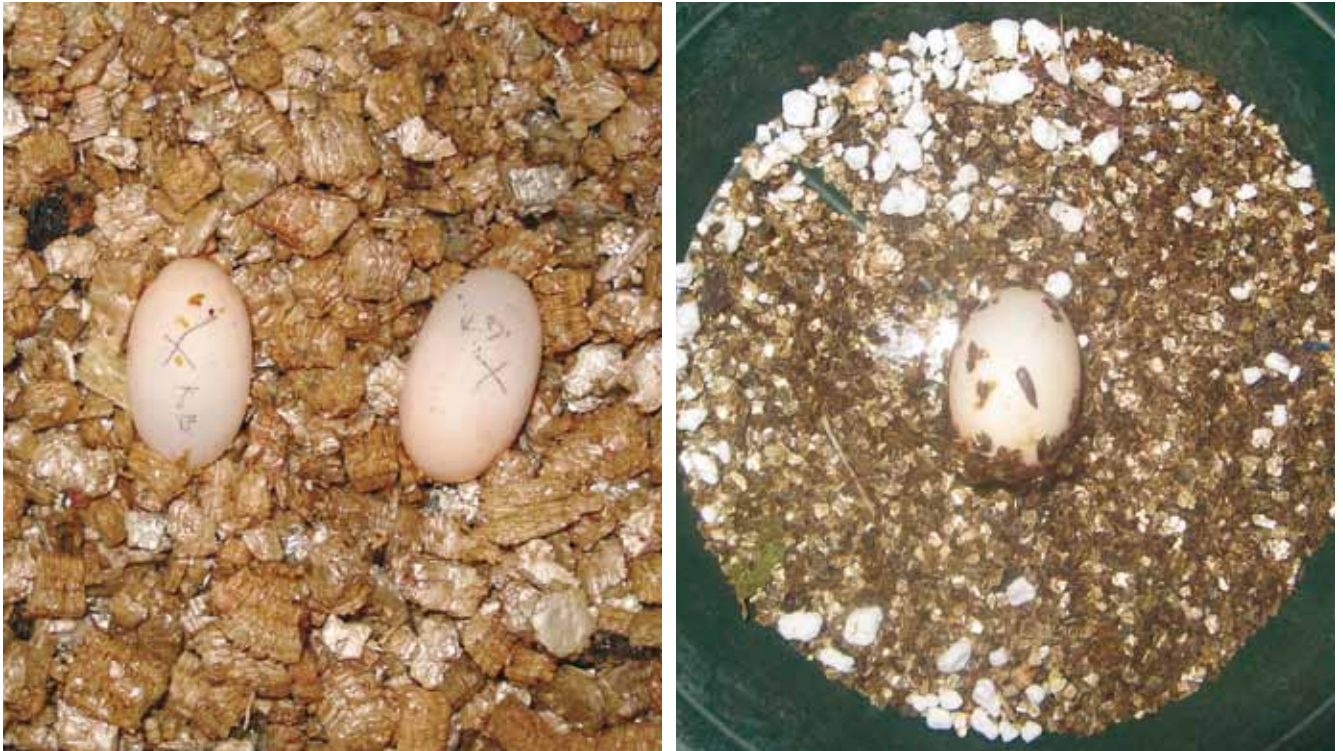


Fig. 13a-b

The eggs are incubated in Vermiculite, clearly visible the white blotch at the top, developing after a week.

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TURTLE TAXONOMY WORKING GROUP



Fig. 14

The embryos develop longitudinal in the egg. Under our incubation condition hatching takes place after 70–95 days.



Fig. 15a-c

This hatchling meets completely to the colours of the description of a "typical" *Kinosternon baurii*.

**Fig. 16**

Breeding temperatures as well as chromosomes are important factors of sex determination.

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Abstract

Keeping, breeding and rearing of the striped mud turtle *Kinosternon baurii* GARMAN, 1891

Abstract

The successful breeding of the striped mud turtle *Kinosternon baurii* in captivity is described. The authors keep 4 different breeding groups of two different forms coming from Florida Keys (FK) and North Florida (NF). The sexes are kept separately except for mating attempts. The diet of the adults and the young consists of live insects, molluscs, larvae, crustaceans, worms, snails, fish and artificially coloured gel; they occasionally eat aquatic plants in small part. Until today few clutches of small eggs were deposited. The eggs were incubated between 27 and 29 °C. The hatchlings emerged after about 70–100 days incubation time and mostly weighed 2–3 g.

Key words

Reptilia: Testudines: Cryptodira, Kinosternidae, *Kinosternon baurii*, unrecognizable subspecies, captive keeping, captive breeding, raising of hatchlings.