

Does *Kinosternon scorpioides* (Linnaeus, 1766) (Testudines: Kinosternidae) prefer to reproduce in clean water?

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Abstract. *Kinosternon scorpioides* is commonly found in many different aquatic environments and it reproduces well in captivity. We aimed to evaluate if copulation in this species is influenced by changing the quality of the water where they live. Seven scorpion mud turtles kept in captivity in a cement tank were observed between January and December of 2012. We used Chi-squared tests to assess the influence of the water exchange over copulation attempts of *K. scorpioides*. These animals copulated during the whole year, but it was most frequent in the rainy season. We observed more mating events during the water exchange than on the other days. Therefore, mating activity of *Kinosternon scorpioides* could be influenced by the quality of the water.

Keywords. Captivity, mating, scorpion mud turtle, water quality.

Introduction

Kinosternon scorpioides (Linnaeus, 1766) (Testudines: Kinosternidae), known as scorpion mud turtle, is a medium-sized chelonian widely distributed in South and Central America and Mexico (Rueda-Almonacid et al., 2007; Vogt, 2008; Berry and Iverson, 2011). The species has a wide geographical variation in size and it can have sexual dimorphism with larger females, with larger males or no dimorphism (Marquez, 1995; Castro, 2006; Rueda-Almonacid et al., 2007; Iverson, 2010; Berry and Iverson, 2011).

Castro (2006) found that the majority of matings and nesting of captive *K. scorpioides* in Belem, Brazil, occurred respectively in May-June and in June-July. Iverson (2010) noted that nesting in this species occurred for 7-10 months in populations in Mexico and Belize. There was continuous ovarian activity from August-May and multiple nests (Legler and Vogt, 2013). According to these authors, a series of 26 females collected 12-31

July 1966 had no corpora lutea, shelled eggs, or enlarged follicles, suggesting that nesting is curtailed in June and July, but commences again in August. Courtship and copulation have been observed in Venezuela in October and November (Sexton, 1960). Nesting occurs in northern Guatemala from March to May (Campbell, 1998). According to Vogt (2008), copulations occur in October and November in the Amazon region.

Kinosternon scorpioides can be found in aquatic temporary, permanent and semipermanent habitats (Berry and Iverson, 2011). This species has great ecological tolerance and it can be found in swamps, temporary ponds, rice paddies and other anthropogenic water bodies (Rueda-Almonacid et al., 2007; Vogt, 2008). The observation of the occurrence of this scorpion mud turtle in aquatic habitats with different physicochemical characteristics generated the following question: Is *K. scorpioides* copulation influenced by the water quality of the environment where it lives?

The aim of this study is to describe characteristics of the reproductive cycle of *K. scorpioides* kept in captivity and to discuss the influence of water quality in the process.

Materials and Methods

The observations were performed between January and December 2012 in Núcleo Regional de Ofiologia da Universidade Federal do Ceará (NUROF-UFC),

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located in Fortaleza (3°44'43.76" S, 38°34'29.81" W, WGS84), Brazil. The climate is warm sub-humid tropical with mean monthly rainfall of 1338 mm which was concentrated between January and May (IPECE, 2011).

Seven *K. scorpioides* (three males and four females) kept in a cement tank (2.7 m x 2.1 m x 0.3 m) located around the NUROF-UFC were observed daily. The tank had a small island in the centre, in which the animals could nest and thermoregulate. This terrarium was located in an open area with moderate people flow. The water of this tank was exchanged weekly, in order to prevent the accumulation of excreta. SCAN type observations (Martin and Bateson, 2009) were carried out from Monday to Friday from 08:00 to 18:00. The observation times were short (on average one minute) in order to not interfere in the behaviour of the individuals.

Chi-squared test for given probabilities were used to evaluate two null hypotheses: no difference between the number of matings performed soon after the water exchange and those made without any such change; no difference between the number of copulations in the dry and rainy season. The water exchange was performed once a week, so the chance of observing an event in that day is four times lower than in the other days of the week. The rainy season is shorter than the dry period, hence we need to use different probabilities in this analysis too. Statistical tests were performed in the software R ver. 2.13.0 with a significance level of 5%.

Results

Matings were recorded in almost every month of the year except in August and November. These events were observed 18 times, mainly between January and March. 12 mating events occurred in the rainy season and six in the dry period ($\chi^2 = 4.49$ df = 1, $P = 0.03$). Eight copulations occurred after water exchanges, and 10, in situations without such interference. We found a greater number of matings on days of water change than the expected by the null hypothesis ($\chi^2 = 6.72$, df = 1, $P = 0.01$).

Three nests were observed on the surface of the island. They occurred in May (two clutches) and June. In these events, the last egg of the clutch was not completely buried. Other eggs were also found on the island, but it was not possible to know when they were laid by females.

Discussion

The copulation of *K. scorpioides* followed the pattern established for Kinosternid turtles in Molina (1992). The continuous copulations throughout the year are the first reported for this species. However, Castro (2006) visualized largest concentration of matings between April and August in Pará. The stability of the captive conditions may not reflect natural stimuli that the animal would receive to control the reproductive process. Thus, cyclical processes dependent on environmental factors may be masked in captivity.

Chaves et al. (2012) found no difference in the gonadosomatic index of captive females of *K. scorpioides* between the dry and rainy seasons, however Legler and Vogt (2013) and Iverson (2010) found the ovaries to be quiescent in June and July. Three clutches were found at the end of the rainy season in the tank, but the difficulty of establishing the day of nesting of the other clutches did not allow us make good comparisons.

In captivity, the scorpion mud turtles are more concentrated than in natural environments, due to space constraint of enclosures. The water accumulates urea and other by products which are discarded only when the water is changed. Turtles have a vomeronasal system capable of detecting chemical signals in the water (Hatanaka, Shibuya and Inouchi, 1988; Fadool, Wachowiak and Brann, 2001; Poschadel, Meyer-Lucht and Plath, 2006; Lewis et al., 2007). Poschadel, Meyer-Lucht and Plath (2006) and Lewis et al. (2007) found that males of *Emys orbicularis* and *Sternotherus odoratus* are able to search for females by identifying their chemical cues in the water. In one of the first phases of the mating behaviour in *K. scorpioides*, the male approaches the female from her back and smells her cloaca (Castro, 2001; pers. obs.), probably as a recognition process (Molina, 1992). Hence, the drop in the level of the excreta during the water exchange may allow males to find females visually or due to chemical cues more easily. The highest occurrence of mating in the rainy season could also support this hypothesis, because the rain increased the water volume of the tank, decreasing the concentration of excreta.

Therefore, mating activity of *K. scorpioides* could be influenced by the quality of the water. However, other factors, like water temperature, not measured in this study, could have an important influence too.

Acknowledgments. We thank an anonymous reviewer for providing very useful comments on the manuscript.

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