Do male *Kinosternon scorpioides* (Linnaeus, 1766) select and monopolize females?

The mating systems in vertebrates can be monogamous or polygamous (polygynous, polyandrous and polygynandrous) (Emlen & Oring 1977; Sriprateep et al. 2013). According to these authors, polygynous systems, in which one or a few males mate with several females, may have dominant males that form harems and prevent other males to mate with females belonging to the harem. Thus, few males, usually the larger ones, are able to reproduce, while many others (mostly the smaller ones) have less chance of leaving descendants.

The formation of these harems is usually associated with the presence of sexual dimorphism. According to Shine (1978), intrasexual competition for reproductive females produce males larger than females in some species of snakes. This pattern is also known and studied in lizards (Cox et al. 2003). According to Berry & Shine (1980), males are larger than females in semiaquatic and bottom walking aquatic turtles where there is fighting or males subdue the females during copulation (forced insemination). Formation of harems and territoriality are common in vertebrates (Anibaldi et al. 1998; Ortega & Arita 1999; Maher & Lott 2000; Cuadrado 2001; Klose et al. 2009). In turtles, fighting for females and establishment of dominant males mostly occur in terrestrial species (Harless 1979; Berry & Shine 1980; Niblick et al. 1994; Keswick et al. 2006; Mann et al. 2006).

Polyandry is common in sea turtles (Pearse & Avise 2001; Crimm et al. 2002; Moore & Ball 2002; Lee & Hays 2004; Bowen & Karl 2007) and freshwater turtles (Valenzuela 2000; Pearse et al. 2002; Fantin et al. 2008); it increases hatching success and genetic diversity among the offspring (Pearse & Avise 2001; Pearse et al. 2002). However, polygyny is less common in aquatic turtles (Crimm et al. 2002). According to these authors, recording of this mating system was related to a female-biased sex ratio present in the study area.

The present knowledge of Kinosternidae reproduction is focused in egg size and clutch size and the relation of these characteristics to female body size and environmental variables; reproductive period; nesting behavior and ecology (Pritchard & Trebbau 1984; Mendonça et al. 1987; Clark et al. 2001; Rueda-Almonacidi et al. 2007; Dodd 2008; Lindeman 2008; Vogt 2008; Macip-Ríos et al. 2009; Berry & Iverson 2011; Iverson & Vogt 2011; Chaves et al. 2012; Iverson et al. 2012). Information regarding mating systems in this group was not found.

The Scorpion Mud Turtle *Kinosternon scorpioides* Linnaeus, 1766 (Kinosternidae), is found in the freshwaters of north, northeast and center-west of Brazil (Rueda-Almonacidi et al. 2007; Vogt 2008; Costa et al. 2010). Regarding sexual dimorphism, there is evidence of larger males (Berry & Shine 1980) and larger females (Castro 2006). There are no records of fighting between males for females and harems formation in this species. This study aims to report and discuss the presence of a polygynic mating system in the aquatic species *K. scorpioides* and the lack of preference of males of this species in relation to the size of females.

Seven adults of *Kinosternon scorpioides* (three males and four females) were maintained for one year (February 2012 to January 2013) in a cement tank size (2.7 m x 2.1 m x 0.3 m) on the outside of the Núcleo Regional de Ofiologia da Universidade Federal do Ceará (NUROF-UFC). The animals were recognized by their size, coloration as well as anomalies present. They were fed two or three times a week with neonatal mice, beef and poultry and dog's food. From Monday to Friday, behavioral observations of the 'scan' sampling type (Martin & Bateson 2009) were made every two hours, from 08:00 h to 18:00 h. Despite the nocturnal activity of *K. scorpioides*, nocturnal samplings were not performed, hence it was not possible to preclude copulations at night. In addition occasional observations were made since the tank was located in a well visible and accessible place. A total of 418 scans were performed. Chi-square analysis was used to assess whether the dominant male showed preference for a particular female. The analysis was developed in the free statistical software R ver. 2.13.0 (http://www.r-project.org/) at a significance level of $p = 0.05$.

The authors recorded 21 events of copulation, all performed by the largest male with multiple females present in the tank. The two smaller males were never seen copulating and no agonistic interactions were observed between males. The dominant individual showed no preference for certain females ($\chi^2 = 0.67$, $P = 0.881$).

Fighting for females and the formation of "harems" is chiefly reported from terrestrial turtle species (references given above). Thus, the record of the occurrence of this mating system in an aquatic species is noteworthy. However, care is needed interpreting results from studies in captivity because the conditions under which the animals are held may be different from those found in nature.

EMLEN & ORING (1977) state that the monopoly of resources, such as reproductive females, directly depends on the balance between the advantages of the monopoly (increased fitness) and the disadvantages existing (damage by fighting and energy invested in disputes). These authors emphasize that harems usually occur when females have an aggregated distribution for secondary reasons, not breeding, and males utilize this aggregation to exercise the monopoly. In the case discussed in this study, the small area of the tank in which the animals were accommodated may have increased the aggregation of females and thus facilitated the monopoly of the larger male. In the wild, this species can move considerable distances on land in search of vacant water bodies (PRITCHARD & TREBBAU 1984). In doing so, potential competitors/rivals would avoid male-male encounters; this might relativize the importance of strategies towards female monopolization. In many turtle species, females have the potential of sperm storage, which allows them to increase its fitness by chosing the male's sperm used and by saving energy avoiding additional copulations (PEARSE & AVISE 2001). The monopoly of a larger male would also reduce costs with additional matings and guarantee a good fitness to females' offspring, despite the genetic variability is reduced.

According BERRY & SHINE (1980), an example of selective pressure which may lead to the existence of larger males than females in chelonian species is the occurrence of forced insemination, in which the male subdues the female in order to copulate. This type of reproduction occurs in *K. scorpioides* (BERRY & SHINE 1980; CASTRO 2006), a fact also observed in this study. Based on this hypothesis, we predict that smaller females should copulate more frequently than larger ones, since they would be less resistant to subjugation. However, the lack of prevalence of copulations with smaller females observed in this study refutes this hypothesis. This result also reinforces the need and importance of more studies, preferably in natural habitats, of mating systems in order to better understand sexual dimorphism in turtles. The existence of a polygynic mating system forming "harems" is a novelty in kinosternids, which should be subject to studies in the natural environment.

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