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Population structure of *Mesoclemmys vanderhaegei* (Testudines, Chelidae) in a silvicultural system in southeastern Brazil

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Abstract. Vanderhaege's toad-headed turtle (*Mesoclemmys vanderhaegei*) natural history is poorly known. The goal of this study was to describe the population structure of a *M. vanderhaegei* population in a silvicultural system in Alto Paranapanema River Basin, in Southeastern Brazil. We captured 31 individuals in funnel traps from October 2010 to April 2011 in three ponds: Lagoa Suja (n=20); Lagoão (n=6) and Açude do Cerrado (n=5). The population size of Lagoa Suja has been estimated in 26 individuals (0.65 individual/ha; 492 g/ha). Sex ratio was approximately 1:1 (♀:♂). Approximately half of the total population (48%) had injuries. Females were larger than males, and the overall size of both sexes in the present study were greater when compared to other populations

Keywords. Chelid, freshwater turtle, non-pristine, vanderhaege's toad-headed turtle.

Introduction

Mesoclemmys vanderhaegei (Bour, 1973) is a Neotropical freshwater turtle that inhabits rivers, oligotrophic streams and ponds with dense aquatic vegetation (Rueda-Almonacid et al., 2007; Brito, Strussmann and Penha, 2009). It occurs in Paraguay, Paraná, Uruguay, Tocantins and Amazonas river basins (Ernst and Barbour, 1989; Brandão et al., 2002; Souza, 2005), including disturbed and polluted rivers (Rueda-Almonacid et al., 2007). The species is listed as near threatened (NT) on the International Union for Conservation of Nature (IUCN, 2012); however, its natural history remains poorly known (Souza, Martins and Sawaya, 2000; Pinheiro, 2010).

Population data on freshwater turtles is required for management and conservation purposes (Gibbons et al., 2000); nonetheless, such information is scarce for Neotropical turtles. The goal of this study was to describe the population structure of *M. vanderhaegei* (Fig. 1) in a silvicultural landscape in southeastern Brazil.

Materials and methods

This study was carried out in Angatuba municipality, Alto Paranapanema River basin, São Paulo State, Brazil. Historically this region had cycles of deforestation and regeneration of the native vegetation, originally composed by Cerrado, a savanna-like formation (Lisboa, 2008). Turtles were captured in three ponds with large amounts of aquatic vegetation: Lagoa Suja (23°20'39.27"S, 48°27'52.86"W), Lagoão

Figure 1. Funnel traps placed on the water margins in pond. *Mesoclemmys vanderhaegei* captured in the study area.

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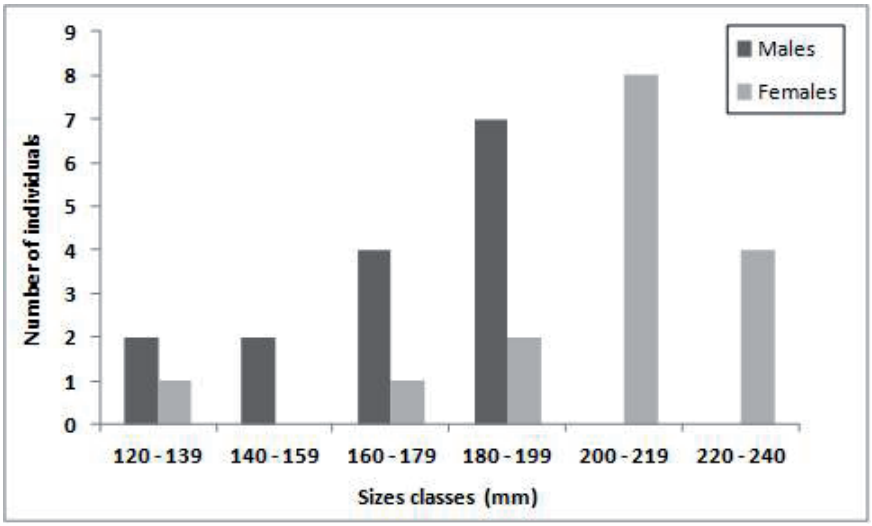

Figure 2. Size classes distribution of *Mesoclemmys vanderhaegei* in a silvicultural system in Alto Paranapanema River basin, São Paulo State, Brazil.

(23°20'33.26"S, 48°27'24.30"W) and Açúde do Cerrado (23°19'52.85"S, 48°27'44.01"W). Those water bodies are located at Fazenda Arca, a silvicultural system which has a total area of 1122.77 ha composed by 721.9 ha of eucalyptus plantation and 400.1 ha of native vegetation in different levels of anthropogenic alteration.

We captured turtles from October 2010 to April 2011, by monthly surveys of three consecutive nights (18:00 - 08:00 h). We used four funnel traps placed on the water margins in each pond, baited with bovine meat (Fig.1). The sampling effort was as follow: four surveys in Lagoa Suja (October 2010-February2011), four surveys in Lagoão (December 2010 -March 2011) and two surveys in Açude do Cerrado (March-April 2011). All turtles were marked on the carapace marginal scutes using a numeric code (Cagle, 1939), in addition to inserting PIT tags (Dixon and Yanosky, 1999). For each animal we measured carapace length (CL) and plastron linear length (PL) (caliper 1 mm), and body mass (BM; dynamometer 1g). Sex was determined based on the cloaca position and plastron shape (Ernst and Barbour, 1989; Rueda-Almonacid et al., 2007; Brito, Strussmann and Penha, 2009). Turtles ≤ 100 mm (CL) were considered juveniles (Brito, Strussmann and Penha, 2009). Body injuries were also recorded (e.g. amputation of limbs, cracked carapace).

Statistical analyses were performed using Minitab 16. Data normality was analysed using Anderson-Darling Test. The t-test (Zar, 1999) was used to verify the possible differences on carapace length and body mass between sexes. The Chi-square test (Zar, 1999) was used to test whether sex ratio differed from 1:1. Population size was estimated by Schnabel method using the program Ecological Methodology (v. 5.5), but only in Lagoa Suja, where we had recaptures (n = 6). The area of Lagoa Suja pond was determined by ArcGIS 9 (ESRI, Redlands, California) as 39.6 ha.

Results

We captured 31 individuals during the study period (Lagoa Suja: 20; Lagoão: 6 and Açude do Cerrado: 5), totaling 15 males and 16 females. Females had significantly larger carapace length (♀: 203 ± 27 mm; ♂: 171 ± 20 mm; $t = 3.79$; $df = 27$; $p = 0.001$) and greater body mass than males (♀: 1052 ± 325 g; ♂: 539 ± 174 g; $t = 5.64$; $df = 23$; $p < 0.001$; Figure 2). Sex ratio (♀:♂) was approximately 1:1 ($x^2=0.0322$; $df=1$; $p=0.85$). Injuries were found in 48% of the turtles (15 of 31 individuals), including leg amputation and cracks on the carapace and plastron.

We estimated a population size of 26 individuals (range: 12 - 60) for Lagoa Suja, representing 0.65 individuals/ha (range: 0.3 – 1.5 individual/ha) and a biomass of 492 g/ha (range: 227 – 1136 g/ha).

Discussion

The biology of *M. vanderhaegei* is poorly known, with only a few records available in the literature (Souza,

Martins and Sawaya, 2000; Corazza and Molina, 2004; Baldo et al., 2007; Brito, Strussmann and Penha, 2009; Brito, Strussmann and Baicere-Silva, 2009; Ávila et al., 2010). *Mesoclemmys vanderhaegei* could be considered a medium sized turtle, and females can reach up to 285 mm in carapace length (CL) and 1470 g in body mass (BM) (Rueda-Almonacid et al., 2007). The mean values of CL and BM found in the present study are relatively larger when compared to another *M. vanderhaegei* population in Central Brazil (Brito, Strussmann and Penha, 2009: CL♀ = 168 ± 16 mm; CL♂ = 139 ± 18 mm; BM♀ = 453 ± 123 g; BM♂ = 260 ± 107 g). Such variation could be due to environmental differences between the study sites and consequently differences in resource availability. The population studied by Brito, Strussmann and Penha (2009) inhabits oligotrophic water bodies. Oligotrophic environments have low levels of nutrients and organic production (Tundisi and Tundisi, 2008) and consequently may limit animals' growth. Our study area is inserted in a silvicultural landscape and receives external input of nutrients. Patterns of elevated biomass and density levels associated with high primary productivity were investigated for the North American freshwater turtle *Chelydra serpentina* (Galbraith et al., 1988).

Sex ratio can influence chelonians population dynamics (Gibbons, 1990; Lovich, 1996). On the other hand, sex ratio of an adult population can be determined by the juvenile sex ratio, differences in mortality, migration and age at sexual maturity for both sexes (Gibbons, 1990). Brito, Strussmann and Penha (2009) found similar sex ratio (1:1) for *M. vanderhaegei* in Central Brazil. Other species of Chelidae presented a similar pattern (*Phrynops geoffroanus* (Schweigger, 1812): Souza and Abe, 2000; *M. hogei* (Mertens, 1967): Moreira, 2002; *Acanthochelys spixii* (Duméril and Bibron, 1835): Neto et al., 2011).

Higher population densities and biomass had been described for other Neotropical freshwater turtles: *Hydromedusa maximiliani* (Mikan, 1820) (193 ind./ha and 41.6 kg/ha) in the Atlantic Forest (Souza and Abe, 1997), *P. geoffroanus* (170 ind./ha and 255 kg/ha) in urban water courses (Souza and Abe, 2000), and *Hydromedusa tectifera* (Cope, 1869) (218 ind./ha) in mountain creeks in Argentina (Lescano, Bonino and Leynaud, 2008). Our study showed low levels of density and biomass (0.65 ind./ha and 492 g/ha) when compared to other species of Chelidae.

Predation can affect the population dynamics of freshwater turtles (Spencer and Thompson, 2005), and probably determines the low population density found in the present study. The high amount of injuries found in the animals (48% of individuals) are possibly related to predation attempts by broad-snouted caiman (*Caiman latirostris*; Daudin, 1802), and carnivorous fish (*Hoplias sp.)*, both locally abundant. Based on their body size and behavior we hypothesize that *Hoplias sp.* tend to prey smaller turtles than the caiman. Therefore, the former would result in lesions on limbs and forelimbs of hatchlings and juveniles, whereas the later would cause injuries on adults' carapace. Contrary to what has been described for other turtles injured by boat propellers (Ferronato et al., 2009), there is no record of motor boats in this study area. Future investigation should focus on the effects of predators in these turtle populations.

In the State of São Paulo, *M. vanderhaegei* was originally found in the Cerrado. This biome used to cover 14% of the total area of the state. However, it is currently reduced to approximately 1% (Cavalcanti and Joly, 2002). The present results suggest that this species can use altered habitats, such as ponds used by livestock. Long-term studies should be prioritized in order to understand how this species is dealing with anthropogenic pressures and land use change on its geographic range.

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