

***Mesoclemmys vanderhaegei* (Bour 1973) –
Vanderhaege's Toad-headed Turtle, Karumbé-hy**

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SUMMARY.—Vanderhaege's Toad-headed Turtle, *Mesoclemmys vanderhaegei* (Family Chelidae), is a poorly known freshwater turtle that is widely distributed in central South America. It occurs in the Amazonas, Tocantins, Paraguay, Parana, and Uruguay River basins, where it inhabits shallow streams, ponds, and marshes. Its taxonomic status has long been uncertain and confusion with similar looking species of toad-headed turtles still occurs frequently, leading to erroneous distribution records. Adults can reach up to 285 mm straight carapace length. No subspecies are currently recognized, although there are obvious differences in shell, iris coloration, and body size among populations. The species seems to rely mainly on a carnivorous or opportunistic omnivorous diet. Females are capable of depositing more than one clutch per year with a mean clutch size of 6.4 ± 3.9 eggs. Due to its great ecological adaptability, the species occurs in pristine habitats as well as agricultural and urban areas, but with a cryptic lifestyle. There is little known about its basic ecology except for local studies in Brazil, but detailed ecological surveys in Paraguay and Argentina are lacking. The current population status cannot be fully determined.

DISTRIBUTION.—Argentina, Bolivia, Brazil, Paraguay. Occurs in portions of the Amazonas, Tocantins, Paraguay, Parana, and Uruguay drainage basins, and in montane streams of Santa Cruz in Bolivia.

SYNONYMY.—*Phrynops schöpfi* Fitzinger in Diesing 1839 (nomen nudum), *Phrynops schoepffii* Fitzinger in Siebenrock 1904 (nomen nudum, partim), *Phrynops paraguayensis* Vanzolini in Donoso-Barros 1965 (nomen nudum), *Phrynops tuberculatus vanderhaegei* Bour 1973; *Phrynops (Batrachemys) vanderhaegei*, *Phrynops vanderhaegei*, *Batrachemys vanderhaegei*, *Bufocephala vanderhaegei*, *Mesoclemmys vanderhaegei*.

SUBSPECIES.—None recognized.

STATUS.—IUCN 2014 Red List: Lower Risk/Near Threatened (NT, assessed 1996, needs updating); TFTSG Draft 2012: Near Threatened or Data Deficient; CITES: not listed; Brazil: not listed; São Paulo state: Insufficient data; Argentina: Data deficient.

Taxonomy.— Since the species' description as *Phrynops tuberculatus vanderhaegei* (Bour 1973), there has been debate (e.g., McDiarmid and Foster 1987) about the specific rank of the taxon and its strong similarity to the Amazonian Gibba Turtle *Mesoclemmys gibba* (Schweigger 1812) and the Tuberculated Toad-headed Turtle, *Mesoclemmys tuberculata* (Luederwaldt 1926). When first describing the species, Bour (1973) designated a living male (without number) as the holotype from the vague type locality of "probably the surroundings of Asuncion in Paraguay." Bour and Pauler (1987) provided clear morphological diagnostic characters between *M. tuberculata*, *M. gibba*, and *M. vanderhaegei* by including

more specimens and confirmed Pritchard's (1979) elevation of the taxon by assigning it full specific rank as *Phrynops vanderhaegei* (Bour 1973). Furthermore, they restricted the type locality to Tobati, La Cordillera, Paraguay.

Due to the lack of clear morphological affinity to any of their newly elevated genera of *Phrynops*, *Mesoclemmys*, or *Batrachemys*, McCord et al. (2001) placed the species in the new monotypic genus *Bufocephala*. By describing the morphologically intermediate *Mesoclemmys perplexa* from central-eastern Brazil, Bour and Zaher (2005) proposed a more cautious approach by including *B. vanderhaegei* (*sensu* McCord et al. 2001) into the genus *Mesoclemmys* Gray 1873. This solution is currently accepted, but further studies



Figure 1. *Mesoclemmys vanderhaegei* from Cáceres, Mato Grosso, Brazil. Photo by Elizângela S. Brito.

on the phylogeny of the toad-headed turtles based on both phenotypic and genetic characters should be prioritized.

Description. — *Mesoclemmys vanderhaegei* is a medium-sized chelid turtle with an overall flat shell shape, webbed feet, and wide head. Males can reach up to 285 mm straight carapace length (CL), while the largest known female is 280 mm CL (Métrailler 2005a). However, average sizes in populations are often significantly smaller, with a population in central Brazil (females 168 ± 16 mm CL, males 139 ± 18 mm, $n = 80$; Brito et al. 2009a) and one in southeastern Brazil (females 203 ± 27 mm, males 171 ± 20 mm, $n = 31$; Marques et al. 2013) showing variation in body size.

Complete osteological descriptions of the skull and shell of the species are given by Bour and Pauler (1987) and Cabrera (1998), who analyzed the morphological distinctiveness in toad-headed turtles. The carapace is uniformly dark brown to black, mildly domed and ellipsoid; sometimes a median groove is present in adults. The carapace is broadest across the 8th marginals and deepest at the 3rd vertebral. Vertebrae are broader than long.

The plastron of adults shows great variation in black pigmentation and can be uniformly yellow to nearly entirely

dark brown to black with a yellow halo at the margins. The intergular scute clearly separates the gulars, but not the humerals. In juveniles, the plastron is entirely black.

Dorsal head coloration is gray, while the ventral body and head parts, including the jaws, are of cream-like color. Sometimes an extent of dark mottling can occur along the upper and lower jaws as well as on the gular area, which is more often the case in juveniles. Contrary to the statement of McCord et al. (2001), there is not always a horizontal bar present in the iris. For comparison see Vetter (2005); this trait cannot be assigned to single separate populations. Two small barbels are present on the chin.

Sexual dimorphism is present in all populations, where males are distinguished from females by their longer tails and smaller anal notch, in addition to their usually smaller body size. Brito et al. (2009a) and Marques et al. (2013)



Figure 2. *Mesoclemmys vanderhaegei* from Angatuba, São Paulo, Brazil. Photos by Thiago S. Marques.



Figure 3. *Mesoclemmys vanderhaegei* from Cáceres, Mato Grosso, Brazil (top) and Angatuba, São Paulo, Brazil (bottom). Photos by Elizângela S. Brito (top) and Thiago S. Marques (bottom).

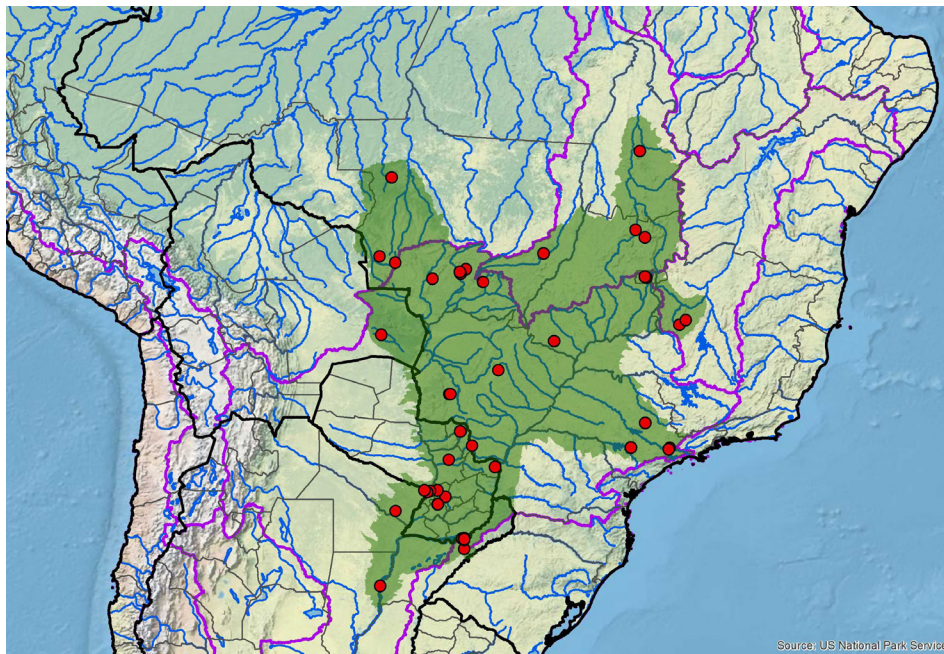


Figure 4. Distribution of *Mesoclemmys vanderhaegei* in Brazil, Bolivia, Paraguay, and Argentina in central South America. Purple lines = boundaries delimiting major watersheds (level 3 hydrologic unit compartments – HUCs); red dots = museum and literature occurrence records of native populations based on Iverson (1992) plus more recent and authors' data; green shading = projected native distribution based on GIS-defined HUCs 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 2014), and adjusted based on authors' subsequent data.

reported striking differences in body size between sexes and populations.

No morphological description of hatchlings are available in the literature, but some hatchlings have been collected in different regions. Souza et al. (2000) captured two hatchlings (39.2 mm CL, 16.4 g mass; and 41.9 mm CL, 16.0 g mass) in Itirapina Ecological Station in São Paulo state, Brazil.

No subspecies are currently recognized, and *M. vanderhaegei* is sometimes difficult to differentiate from *M. gibba* and *M. tuberculata* due to their morphological similarity. However, *M. vanderhaegei* is usually distinguished from *M. gibba* by its greater CL in adults (285 mm maximum

in *M. vanderhaegei*, 232.5 mm maximum in *M. gibba*) and slightly broader head. *Mesoclemmys tuberculata* has an even broader head, which sometimes shows a mottled dorsal pattern. Additionally, flavism seems to be more frequent in *M. tuberculata*. *Mesoclemmys gibba* and *M. tuberculata* never have horizontal black bars in their iris, and *M. vanderhaegei* can also be distinguished from other toad-headed turtles by its pugnacious behavior when handled.

Distribution. – *Mesoclemmys vanderhaegei* has a wide geographic distribution in South America, including the Amazonas, Tocantins, Paraguay, Parana, and Uruguay river basins, usually associated with open formations (Souza 2005). It inhabits water bodies in northern Argentina (Formosa, Corrientes, Misiones, and Santa Fé provinces; Waller and Chebez, 1987; Iverson 1992; Cabrera 1998; Baldo and Krauczuk 2000; Yanosky et al. 2000; Baldo et al. 2007), Paraguay (Departments of Amambay, Caaguazú, Canindeyú, Central, Cordillera, Paraguari, and San Pedro; Müller and Hellmich 1936; Bour 1973; Bour and Pauler 1987; McDiarmid and Foster 1987; Iverson 1992; Metrailler 2005a; Vinke et al. 2013a,b), and Brazil (Distrito Federal, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, São Paulo, and Tocantins states; Iverson 1992; Villaça 1999; Souza et al. 2000; Strüssmann et al. 2000; Brandão et al. 2002; Souza 2005; Vaz-Silva et al. 2007; Brito et al. 2009a; Silveira 2009; Brito et al. 2012; Marques et al. 2013).

González and Reichle (2002) first reported the species for extreme southeastern Bolivia, publishing photographs of a living adult. Rueda-Almonacid et al. (2007) and Embert



Figure 5. Hatchling *Mesoclemmys vanderhaegei* from Angatuba, São Paulo, Brazil. Photos by Paula C. Lopes.

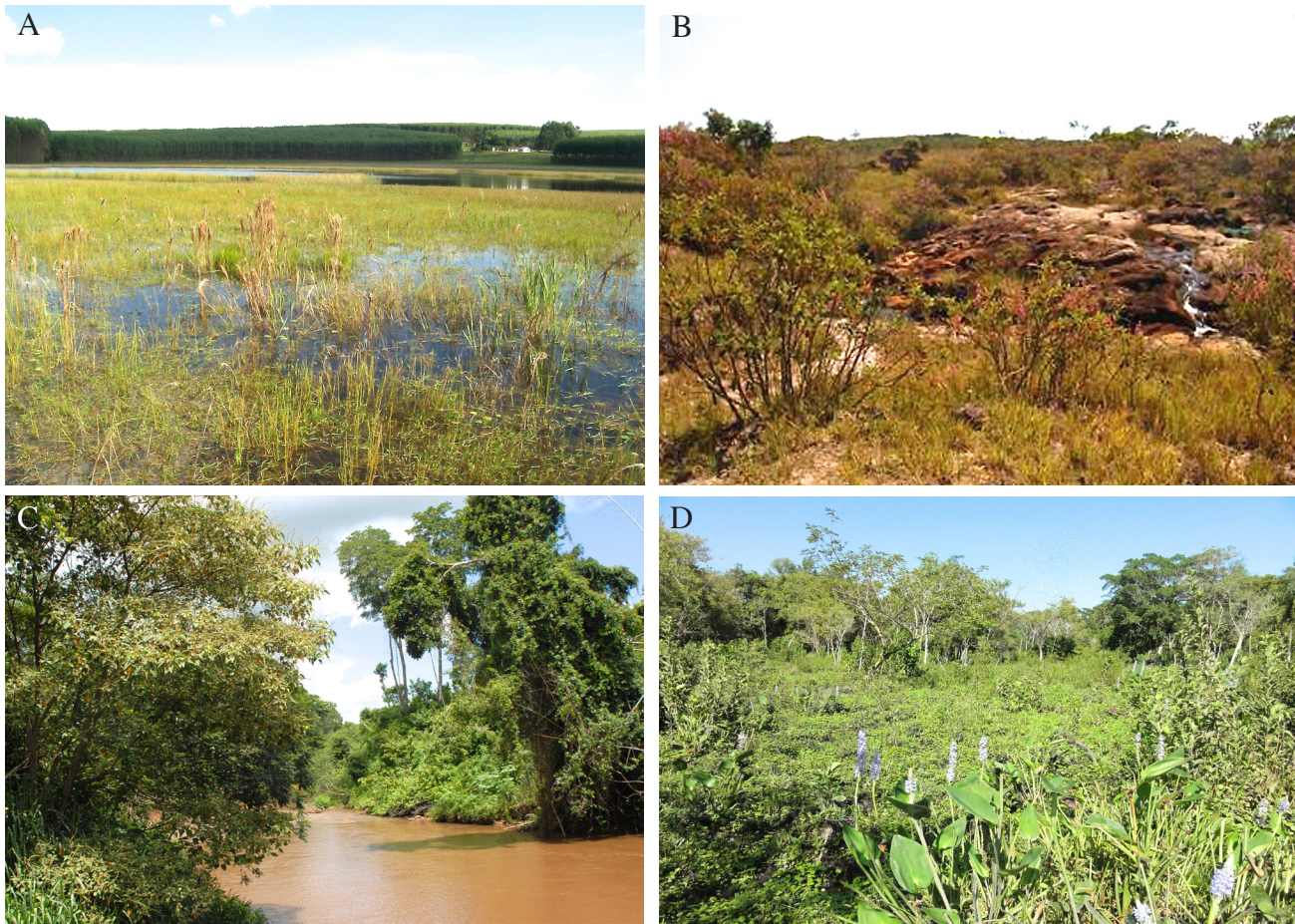


Figure 6. Habitats used by *Mesoclemmys vanderhaegei*. A: lake with dense aquatic vegetation, Angatuba, São Paulo, Brazil (photo by Thiago S. Marques); B: small stream, Pindeivar, Serra das Araras, Cáceres, Mato Grosso, Brazil (photo by Elizângela S. Brito); C: larger water body, Cerro Corá National Park, Amambay, Paraguay (photo by Sabine and Thomas Vinke); D: marsh, Areguá, Central, Paraguay (photo by Gunther Köhler).

(2007) included the taxon in the Bolivian fauna, but did not cite any records. Discussions about the presence of the species in Santa Fé province, Argentina (based on a hatchling) can be found in the literature (Cabrera 1998, Vinke et al. 2013a,b).

Habitat and Ecology. — *Mesoclemmys vanderhaegei* utilizes a wide variety of habitat types, such as rivers, lagoons, small streams with forest cover, oligotrophic streams and ponds with dense aquatic vegetation (Brandão et al. 2002; Baldo et al. 2007; Rueda-Almonacid et al. 2007; Brito et al. 2009a). The species also occurs in urban and anthropogenic environments (Rueda-Almonacid et al. 2007; Brito et al. 2012; Marques et al. 2013). Most records of the species are associated with Cerrado formation, but it can also be found in Atlantic Forest and Chaco formations (Cabrera 1998, Souza et al. 2000; Brandão et al. 2002; Brito et al. 2012; Marques et al. 2013). In Vinke et al. (2013a), a thorough pictorial overview of utilized habitats is provided.

The ecology of *M. vanderhaegei* is poorly known. Souza (2004) points to the lack of basic information about the biology of this species in his review on activity patterns, reproduction, and feeding of Brazilian chelid freshwater turtles. Few studies have been conducted on *M. vanderhaegei* since that review

(Corazza and Molina 2004; Métrailler 2005a; Baldo et al. 2007; Brito et al. 2009a,b; Silveira 2009; Ávila et al. 2010; Pinheiro et al. 2010; Brito et al. 2012; Marques et al. 2013, Vinke et al. 2013a,b), with most of them reporting geographic distribution extensions.

The species is primarily aquatic and rarely seen out of water during the daytime. Individuals are easier to observe during the night. Its ability to migrate terrestrially may have facilitated its wide geographical distribution in different watersheds (Brito et al. 2012). The need for terrestrial movements often appears to be related to barriers in water bodies; spool trailing of adults suggested frequent movements in and out of water in order to avoid riverine obstacles such as the waterfalls with height level differences of up to 3 m (Brito, unpubl. data).

It is commonly stated that diet of *M. vanderhaegei* is omnivorous with an affinity to carnivory, based mainly on aquatic invertebrates and fish (Ernst and Barbour 1989; Cabrera 1998; Rueda-Almonacid et al. 2007; Brito 2008). In a study on the diet of the species in Cerrado habitat, aquatic insects were the main food items consumed, but fruits and plant materials have also been observed in stomach contents

(Brito 2008). That study identified 64 food items from various foraging environments, with food items of animal origin present in 97% of the 80 individuals examined, with significant differences in occurrence of these items among females, males, and juveniles. Plant materials were recorded in 63% of individuals, with no differences among age classes. The frequency of occurrence of the main items were: fish (39%), Odonata (25%), Diptera (25%), Hemiptera (16%), aquatic plants (9%), fruits (9%), and leaves (6%). This diet did not significantly differ from what has been recorded for most other species of toad-headed turtles (Fachín-Terán et al. 1995; Souza and Abe 1998, 2000; Caputo and Vogt 2008; Martins et al. 2010; Brasil et al. 2011). Macroscopic aspects of the gastrointestinal tract of *M. vanderhaegei* were treated in detail by Pinheiro et al. (2010).

Mating in *M. vanderhaegei* occurs during spring and summer (September to January) and egg laying occurs from mid-summer through autumn (January to June) (Rueda-Almonacid et al. 2007). In a study area of Cerrado (Mato Grosso state, Brazil), 100% of females captured in May were gravid and ready for oviposition (Brito, unpubl. data). Courtship behavior has been described under natural conditions in the Brazilian Cerrado and behavioral sequences during courtship follow four phases: search for the female, pursuit of the female, pre-copulation, and copulation (Brito et al. 2009b). Such reproductive behavior is similar to that reported in other Chelidae (Molina 1992, 1996; Novelli and Souza 2007). Under captive conditions, females can produce up to 14 eggs per clutch and more than one oviposition per year is possible (Corazza and Molina 2004).

Body size (carapace length and body mass) varied considerably between two studied populations of *M. vanderhaegei* (Brito et al. 2009a; Marques et al. 2013). The mean values in a population from central Brazil (female CL = 168 ± 16 mm, mass = 453 ± 123 g; male CL = 139 ± 18 mm, mass = 260 ± 107 g; n = 80; Brito et al. 2009a) were relatively smaller than in a population from southeastern Brazil (female CL = 203 ± 27 mm, mass = 1052 ± 325 g; male CL = 171 ± 20 mm, mass = 539 ± 174 g; n = 31; Marques et al. 2013). Hypothetically, this pattern can be due to differences in the availability of food resources that may limit growth (Marques et al. 2013). The sex ratio in these two populations did not differ significantly from 1:1.

High numbers of injuries were found in one *M. vanderhaegei* population, including leg amputations and cracks on the carapace and plastron (48% of 31 individuals; Marques et al. 2013). These injuries were possibly related to predation attempts by Broad-snouted Caiman (*Caiman latirostris*) and wolf fish (*Hoplias* sp.), both abundant in the study area. However, injuries are also common in shells of *M. vanderhaegei* in oligotrophic upland areas of the Cerrado, possibly related to waterfalls (Brito, unpubl. data). In addition, there are records of boid snakes (*Eunectes*) feeding on

small aquatic turtles, such as *M. vanderhaegei* (Strüssmann and Sazima 1991). Health aspects of *M. vanderhaegei* are poorly known, but there are records of parasitism by leeches (Rueda-Almonacid et al. 2007) and endoparasitic infection in the gastrointestinal tract by nematode and monogenetic trematode species (Ávila et al. 2010).

Population Status. — Only two population studies have been conducted on this species. Estimates for the number of individuals in water bodies of the Chapada dos Guimarães, Mato Grosso, Brazil, were 27 in the Monjolinho artificially dammed stream, 25 in the Aldeia Velha stream and lagoon, 36 in the Quineira artificially dammed stream, 12 in Independência stream, and 19 in the Congonhas stream (Brito et al. 2009a). Estimated population size in Lagoa Suja, São Paulo, Brazil, in a silvicultural system, was 26 individuals, representing 0.65 ind/ha and a biomass of 492 g/ha (Marques et al. 2013). These two studies were only conducted over a few months, and historical trends are unknown.

Studies on the exact distribution and abundance of *M. vanderhaegei* throughout its geographic range are needed to evaluate population status. In addition, long-term studies should be conducted in both undisturbed and anthropogenic habitats, in order to compare and guide future conservation and management programs.

Threats to Survival. — The main threats to *M. vanderhaegei* are habitat degradation and destruction, notably cattle ranching, agriculture, and wetland drainage activities.

The occurrence of the species in Brazil seems to be associated with the Cerrado domain (Souza et al. 2000; Brandão et al. 2002; Brito et al. 2009a; Marques et al. 2013), a seriously threatened biodiversity hotspot (Ratter et al. 1997; Klink and Machado 2005). In recent studies in two areas of the Cerrado, the species seems to have a preference for oligotrophic small water bodies at high altitudes, and the threats to these environments can endanger the permanence of the species in certain localities (Brito, unpubl. data). Vinke et al. (2013a) discussed the species' distribution in areas that are or were previously covered by Atlantic Forest, which is also a highly threatened biome.

The species is not regularly used for human consumption. In addition, due to its dull appearance and aggressive behavior it does not play a significant role in the pet trade. The total population size of the species is unknown but there is no direct evidence of threat to its survival in the wild.

Conservation Measures Taken. — This species occurs in several protected areas in Brazil, including Chapada dos Guimarães National Park and Serra das Araras Ecological Station in Mato Grosso, Itirapina Ecological Station in São Paulo, Brasília Botanical Garden Ecological Station in Distrito Federal, Chapada dos Veadeiros National Park in Goiás, and Serra do Lajeado Environmental Protection Area in Tocantins (Souza et al. 2000; Brandão et al. 2002; Brito

et al. 2009a). Souza et al. (2000) found hatchlings in small fragments of Cerrado indicating that these environments may be relevant for reproduction. However, these areas are relatively small compared to its wide distribution.

In Paraguay, the species occurs in Cerro Corá National Park (McDiarmid and Foster 1987) and is likely to occur in Reserva Natural Mbaracayú and Ypacarai National Park (Vinke et al. 2013b). In Argentina, the species is likely to occur in Rio Pilcomayo National Park, but it has not yet been reliably confirmed for any protected area in Argentina (Chebez et al. 2005).

The species was assessed by the IUCN Red List as Lower Risk–Near Threatened in 1996; this assessment requires updating, and the current draft assessment by the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group indicates that the species is either Data Deficient, or warrants retention at Near Threatened (TTWG 2012). This species is not listed by CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) nor on the National List of Endangered Species of Brazil. However, the list of endangered species from the State of São Paulo classifies *M. vanderhaegei* as data deficient (DD), as does the most recent assessment of the Argentinian turtle fauna (Prado et al. 2012).

Conservation Measures Proposed. — No conservation measures are currently considered urgent, but the insertion of the species in long-term ecological studies is crucial for monitoring population status and potential emerging threats and conservation needs of *M. vanderhaegei*.

Captive Husbandry. — *Mesoclemmys vanderhaegei* is a rare species in hobbyist collections. Reports on captive breeding or husbandry are rare, except for anecdotal reports. Repeated egg depositions and breeding has been reported in São Paulo Zoo (Corazza and Molina 2004), where a group of adults were kept since 1988 at natural air temperatures between 6 and 35°C with water temperatures between 20 and 28°C. Adults were mainly fed beef, fish, and bone meal. Mating occurred between September and January (early spring through mid-summer), while egg depositions were recorded between January and June (early summer through late autumn). Maximum clutch size was 14 (6.4 ± 3.9 eggs; $n = 23$ clutches). The smallest reproductive female was 148 mm in CL and had a mass of 444 g. After 300 days of incubation one hatchling emerged with its yolk sac not fully absorbed. Compared to reported incubation times in other species of *Mesoclemmys* (Medem 1973; Böhm 2009), this long incubation time suggests the possibility that breaking of a diapause is needed for successful development, as is the case in other chelids with southern distributions, such as *Acanthochelys spixii* (Metrailier 2005b) or *Phrynops hilarii* (Bujes and Verrastro 2009).

Current Research. — This species is currently the subject of two field studies. Marques and collaborators are

focused on population structure and isotopic niche variation in a silvicultural system in São Paulo, Brazil. Brito and colleagues are studying habitat use and population dynamics in two areas of Cerrado in the Upper Paraguay River Basin, Mato Grosso, Brazil. Further research is needed to investigate gaps in distribution, diet, reproduction, activity patterns, and habitat selection by this species.

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