

What is known about *Mesoclemmys vanderhaegei* (Bour, 1973): a systematic review of the available literature

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ABSTRACT:

Mesoclemmys vanderhaegei (Bour, 1973), Vanderhaege's Toad-headed Turtle

We review the taxonomic history, geographic distribution, ecology, reproduction, and conservation status of *Mesoclemmys vanderhaegei*. Also, we report on an adult female individual of this species that was found near the town of Areguá, Department Central, Paraguay, that was released at the place of capture. Furthermore we provide photos of different habitats and specimens.

KEY WORDS: Reptilia, Chelonii, Chelidae, *Mesoclemmys vanderhaegei*, geographic distribution, ecology, reproduction, conservation status.

RESUMEN:

Mesoclemmys vanderhaegei (Bour, 1973), Tortuga cabeza de sapo de Vanderhaege.

Revisamos la historia taxonómica, distribución geográfica, ecología, reproducción y el estado de conservación de *Mesoclemmys vanderhaegei*. También reportamos un individuo adulto hembra de esta especie que fue encontrada cerca de la ciudad de Areguá, Departamento de Central, Paraguay, y que fue liberada en su lugar de captura. Además presentamos fotos de diferentes hábitats y especímenes.

PALABRAS CLAVE: Reptilia, Chelonii, Chelidae, *Mesoclemmys vanderhaegei*, distribución geográfica, ecología, reproducción, estado de conservación.

INTRODUCTION

South American Chelids in general and *Mesoclemmys vanderhaegei* in particular are still poorly investigated (Souza 2005). During the "IUCN Red Listing and Action Planning Workshop for Chelonians of the Southern Cone" in Filadelfia, Paraguay in 2012, the participants unanimously agreed that threat status could only be effectively assessed and effective conservation measures proposed when more data becomes available. In response this work aims to contribute towards that by collating and reviewing all available information, and highlighting the gaps in our knowledge for the species *Mesoclemmys vanderhaegei*.

TAXONOMY

The taxonomy of the South American chelids could be described as "turbulent" (McCord et al. 2001). However, this affects mainly the definition of genera and the classification of the species within them, especially regarding the toad-headed turtles (*Phrynops* sensu lato). The four remaining genera of Chelidae (*Acanthochelys*, *Chelus*, *Hydromedusa* and *Platemys*) are well-established and contain eight species. The last major changes in these genera took place almost 30 years ago with description of *Acanthochelys macrocephala* (Rhodin, Mittermeier & McMorris 1984) and the separation of the monotypic genus *Platemys* by McBee et al. (1985).

Most toad-headed turtles include a long list of synonyms as, even during the description of many species in the 19th Century, several different genera were already being employed and repeated attempts to organise the highly confusing taxonomy thus followed (Georges et al. 1998). A well presented summary of those historic data is provided by McCord et al. (2001) and Cabrera (1998), the latter also including unpublished and failed projects.

The two oldest specimens of Vanderhaege's toad-headed turtle were described as *Phrynops schoepfii* "Fitzinger" Diesing, 1840, and as *Phrynops paraguayensis* "Vanzolini" Donoso-Barros, 1965. Since neither author provides a scientific description these names are now considered „nomina nuda“, and therefore invalid (Bour & Pauler 1987). Another specimen which was brought back on the 3rd Gran Chaco-Expedition (1931–1932) and which is now in the "Zoologische Staatssammlung München (The Bavarian State Collection of Zoology)" was described as *Batrachemys nasuta* (Müller & Hellmich 1936).

A new subspecies *Phrynops tuberculatus vanderhaegei* Bour was described in 1973 (Fig. 1) and later a revision of five different taxa of toad-headed turtles by Bour & Pauler (1987) upgraded *Phrynops vanderhaegei* to full species status. This followed a recommendation by Pritchard (1979) and was anticipated by Iverson (1986). Bour & Pauler's (1987) detailed study was based on 250 specimens of different toad-headed turtle species from various museums, 26 of which were identified as Vanderhaege's toad-headed turtles (24 complete and two skulls). Remarkably, at almost the same time McDermid & Foster (1987) came to the opposite conclusion, that Vanderhaege's toad-headed is "not specifically distinct" from *Phrynops gibbus* from Peru and Brazil. Consequently they attributed their four Paraguayan specimens to *Phrynops gibbus* and did not recognise *vanderhaegei* as a valid taxon.

Cabrera (1998) and Georges et al. (1998) came to the conclusion that the genus *Phrynops* sensu lato needed to be subdivided, though Zangerl & Mendenhall (1958), earlier considered *Mesoclemmys*, Gray 1873 and *Batrachemys Stejneger*, 1909 to be synonyms of *Phrynops*.

However, even genetic analysis failed to offer any firm conclusions, and Georges et al. (1998) proposed differentiation into three genera (*Phrynops*, *Mesoclemmys* and *Batrachemys*) as well as a model which merged *Mesoclemmys* and *Batrachemys*, with *Batrachemys* taking preference as the older name. The authors eventually favoured the three genera model as this grouping had been used previously as sub-genera.



Fig. 1a–f: Holotype of *Mesoclemmys vanderhaegei*, near Asunción, Paraguay. Photos: Roger Bour



Fig. 2a–c Chapada dos Guimarães National Park, Mato Grosso, Brazil. View of the landscape with hills and typical Cerrado vegetation on the plateaus (a). In the valleys the vegetation is much denser (b–c). Photos: Elizângela Sílvia de Brito

The monotypic genus *Bufocephala* McCord, Mehdi & Lamar, 2001 was only briefly postulated as valid for *vanderhaegei* and this work split toad-headed turtles into a total of six genera, four of which were monotypic. However the arrangement did not stand a new revision by Bour & Zaher (2005), though it did confirm the placing of *Rhinemys rufipes* into the monotypic genus *Rhinemys*, Wagler, 1830. This work agreed with the synonymisation of *Batrachemys* and *Mesoclemmys* as proposed by Georges *et al.* (1998), and produced the three genera arrangement (*Phrynops*, *Mesoclemmys* and *Rhinemys*) that has been accepted ever since (Fritz & Havaš 2007, Turtle Taxonomy Working Group 2012). The current name of Vanderhaege's toad-headed turtle is thus *Mesoclemmys vanderhaegei* (Bour 1973).

The used synonyms are in summary as follows:

Phrynops schoepfii "Fitzinger" Diesing 1840
Phrynops paraguayensis "Vanzolini" Donoso-Barros 1965
Phrynops tuberculatus vanderhaegei Bour 1973
Phrynops gibbus McDiarmid & Foster 1987
Phrynops vanderhaegei Bour & Pauler 1987
Batrachemys vanderhaegei Cabrera 1998
Batrachemys vanderhaegei Georges, Birrell, Saint, McCord & Donnellan 1998
Bufocephala vanderhaegei McCord, Mehdi & Lamar 2001

DISTRIBUTION

Mesoclemmys vanderhaegei has a wide distribution that includes the basins of Amazon, Tocantins, Paraguay, Paraná and Uruguay rivers (Souza 2005). The northernmost locality is in the Brazilian state of Tocantins, about 2000 km northwest of Asunción, where the holotype was collected. Moreover, it has been found in the Brazilian states of Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, São Paulo and the Distrito Federal (Brasília) (Fig. 2-4).

There are four specimens in the Paraguayan natural history museum "Museo Nacional de Historia Natural del Paraguay (MNHN)", three of which date from the early 1980's at Cerro Corá National Park, Dept. Amambay (Fig. 5), and another from 2002 from Tobatí, Dept. Cordillera (Motte, pers. comm.). A revision of the museums Museo de Zoología "Francisco Schade" by Métrailler (2005) confirmed the species presence in Dept. Caaguazú with a specimen dating from 1966. The author also documented additional records from Dept. Paraguari, the first published finding of an accumulation of *M. vanderhaegei* in Paraguay. Thus the species is known from the Departments of Amambay, San Pedro, Cordillera, Central, Caaguazú, and Paraguari. The species existence in the Mbaracayú Forest Reserve, Dept. Canindéyú is suspected on the basis of four specimens



Fig. 3a–e: Habitat of *Mesoclemmys vanderhaegei* at the "Serra das Araras" Ecological Station, Mato Grosso, Brazil. In the elevated areas, (here at 1.5 km distance of the spring (a–c)) the landscape is open and the habitat is Cerrado in the stricter sense. In lower-lying areas the streams are bordered by dense forest (d–e). Figure c shows a trap used for capturing *M. vanderhaegei* during research. Photos: Elizângela Sílvia de Brito.



that were housed in the now non-operational biological station (Cacciali pers. message) which seem to be lost (Smith pers. Message). Its presence in other Paraguayan departments is likely.

In Argentina presence has been confirmed only in provinces Corrientes, Misiones and Formosa (Fig. 6-8). The situation in Santa Fe however is still unclear, because the specimens listed by Iverson (1986) are not those originally referred to by Bour & Pauler (1987) and so the record has since been classified as hypothetical (Waller & Chebez 1987a, Cabrera 1998) or ignored entirely (Cei 1993). However this record still figures in the extended new edition of Iverson (1992) and in the online version Iverson *et al.* (2010). The specimen is a hatchling of 28 mm (Fig. 9) but according to Bour (pers. comm.) “there is not actually any character to disprove this identification, if we accept that the rough skin of the neck is not conspicuous and the ornamentation of the plastron is different at this age. On the other hand, the head scutellation is quite similar to that of the adult, with a roughly symmetrical figure on the top.” Consequently there is no available evidence to suggest that the specimen is definitely not a *Mesoclemmys vanderhaegei* hatchling, but neither is there any confirmation that this identification is correct. The closest known areas of occurrence to this are 370 km north (Prov. Formosa, Yanosky *et al.* 2000) and 400 km to the north-east (Prov. Misiones, Baldo *et al.* 2007).

All known localities and sources of records are shown on the map (Fig. 10).

Fig. 4a–d: *Mesoclemmys vanderhaegei* from the “Serra das Araras” Ecological Station, Mato Grosso, Brazil. Photos: Elizângela Silvia de Brito



Fig. 5: Atlantic Forest, habitat of *Mesoclemmys vanderhaegei*, Parque Nacional Cerro Corá, Dept. Amambay, Paraguay. Photo: Thomas and Sabine Vinke



Fig. 6a–b: The first Argentinian record of Vanderhaege’s toad-headed turtle from Posadas, Province Misiones. Photos: Tomás Waller

Fig. 7: *Mesoclemmys vanderhaegei* from Arroyo Zaiman, Provincia Misiones, Argentina. Photo: Mario Cabrera



Fig. 8a–b: The habitat of *Mesoclemmys vanderhaegei* in Formosa, Argentina: humid Chaco with palm savannah (a), pervaded by dense forests (b). Photos: Thomas and Sabine Vinke

Fig. 9a–d: The enigmatic juvenile specimen ZMH R1025: “Puerto Malabrigo at Paraná River, Sta. Fé Province, E margin Chaco Austral, Argentina, Dr. med. Schreiber leg., ded. 5.IV.1930”. Photos: Jakob Hallermann



Fig. 10: Map of all known localities of *Mesoclemmys vanderhaegei*: 1 Müller & Hellmich (1936), 2 Iverson (1986) and Brito *et al.* (2009a), 3–4 Iverson (1986), 5–6 McDiarmid & Foster (1987), 7 Bour & Pauler (1987), 8 Bour & Pauler (1987) and MNHNP 2002, 9 Waller & Chebez (1987b) und Cabrera (1998), 10 Cabrera (1998), 11 Souza *et al.* (2000), 12 Yanosky *et al.* (2000), 13 Brandão *et al.* (2002) and Villaça (2004), 14–16 Brandão *et al.* (2002), 17–18 Métrailler (2005), 19 Ávila *et al.* (2006), 20 Baldo *et al.* (2007), 21 Brito *et al.* (2009b, 5 localities), 22 Silveira (2009), 23–26 Brito *et al.* (2012), 27 Marques *et al.* (2013), 28 Cacciali pers. comm., 29 Brito pers. comm., 30 this article.

The location of the holotype “near Asunción” is not included. 3? refers to specimen ZMH R1025. Different sources are based on independent findings. Graph by Michael Daubner, modifying OpenStreetMap

HABITAT

Vanderhaege's toad-headed turtle lives primarily in water bodies of the Atlantic Forest and the Cerrado (Souza *et al.* 2000). The first biome is a densely grown and partly-evergreen forest, whereas the latter is savannah-type (Seibert 1996, Oliveira-Filho & Ratter 2002). Superficially there is little similarity between these biomes, but they intergrade in much of the geographical distribution of *Mesoclemmys vanderhaegei*. Cabrera (1998) confirmed the existence in the Argentinean Chaco.

With respect to its aquatic habitat, *Mesoclemmys vanderhaegei* seems to be unspecialised. It inhabits fast (Brandão *et al.* 2002) and also moderately flowing streams (Yanosky *et al.* 2000, Brandão *et al.* 2002) with soft, sandy, muddy or even rocky stream beds (Brandão *et al.* 2002, Brito *et al.* 2009b). It has been found in both natural and artificial ponds (Waller & Chebez 1987b, Baldo *et al.* 2007) as well as dammed streams (BrITO *et al.* 2009b, Brito *et al.* 2012) and other areas heavily altered by human beings (Marques *et al.* 2013) including urban areas (Waller & Chebez 1987b, Brito *et al.* 2012).

The presence of aquatic plants and grass is often mentioned (Souza *et al.* 2000, Marques *et al.* 2013). Brito *et al.* (2009b) described streams inhabited by the species in their study area as oligotrophic, but ponds mentioned by Marques *et al.* (2013) were extremely rich in nutrition.

Mesoclemmys vanderhaegei of different age and gender have been found on paved and unpaved roads (BrITO *et al.* 2012) as well as walking along the banks of a creek (Yanosky *et al.* 2000). At around 10pm 4 March 2012 GK found an adult female of *Mesoclemmys vanderhaegei* in a marsh (Fig. 11) close to the village Areguá (Department Central, Paraguay). The animal was sitting on a floating mass of plants (Fig. 12) and when approached, tried to escape through a dense mat of these plants. When handled the animal performed an open-mouthed threat. When photographed the following day during the turtle was less aggressive (Fig. 13). It was released at the same spot on 10 March.



Fig. 11a–b: Habitat of *Mesoclemmys vanderhaegei*, near Areguá, Dept. Central, Paraguay. Photos: Gunther Köhler



Fig. 12a–b: *Mesoclemmys vanderhaegei* in its natural habitat, near Areguá, Dept. Central, Paraguay. Photos: Gunther Köhler



Fig. 13a–d: Details of the specimen found at Areguá. Photos: Thomas & Sabine Vinke (a–b) Gunther Köhler (c–d)

NATURAL HISTORY

Mesoclemmys vanderhaegei is an elusive turtle with an inconspicuous lifestyle. Studies on the species usually require capture for data gathering (Souza *et al.* 2000, Brito *et al.* 2009b, Pinheiro *et al.* 2010, Marques *et al.* 2013) or cite opportunistic encounters or observations on land. It is partially nocturnal (McDiarmid & Foster 1987, Yanosky *et al.* 2000, Marques *et al.* 2013).

Cabrera (1998) contextualises the statement by Bour & Pauler (1987) and Métrailler (2005), that adult and juvenile *Mesoclemmys vanderhaegei* are particularly aggressive, by stating that the open mouth threat is just a display which the animal ceases to perform once calm.

The diet is carnivorous and successful traps are baited with beef. In captivity one group was maintained in São Paulo zoo by feeding five times per week with fish, beef, mealworms and crickets (Corazza & Molina 2004).

A gastric study of 80 *Mesoclemmys vanderhaegei* revealed parasitic nematodes in three of the specimens. One adult female contained two *Spiroxyis* sp., another one an unidentified nematode and an adult male contained two *Neopolystoma* sp. (Ávila *et al.* 2010).

Quantitative studies have been carried out on two different populations to date. Brito *et al.* (2009b) caught 80 *Mesoclemmys vanderhaegei* in five localities in the state of Mato Grosso, Brazil 27 of which were male, 42 female and 11 unsexed juveniles. The demography varied between localities, one showing a clear predominance of adults and another without any juveniles. During the six days of sampling, recapture rates were about 24% (0–53,8%). Marques *et al.* (2013) caught 31 specimens in ponds. Traps were laid at monthly intervals (2–5) for three consecutive nights and gender distribution was almost equal (15, 16). Unfortunately it is unclear whether the authors did not find juveniles or whether they were not included in the analysis.

Predators cited by Marques *et al.* (2013), include Broad-snouted caimans (*Caiman latirostris*) and tararira (*Hoplias* spp.) (Fig. 14) which they identify as the source of several carapace and plastron cracks and lost legs present in 48% of their captures.

Brilo *et al.* (2009a) observed a mating pair of *Mesoclemmys vanderhaegei* on 21 December, approximately the beginning of the southern hemisphere summer. The individuals were observed about 1,5 hours before sunset and the whole event lasted a little more than six minutes, five of which consisted of failed mating attempts and the last with the pair motionless in a copulatory position. The authors were unable to conclude whether or not the mating had been successful.



Fig. 14: Tararira, *Hoplias malabaricus*: Fish of this genus predate *Mesoclemmys vanderhaegei*. Photo: Thomas & Sabine Vinke

Additional reproductive data *Mesoclemmys vanderhaegei* is available only from captive animals and was published by Corazza & Molina (2004). The mating season of *Mesoclemmys vanderhaegei* at São Paulo zoo was between September and January. Nesting took place from January to June with a peak in April. Repeated clutches were possible within the same breeding season. Each clutch consisted of 1–14 eggs with an average of 6,4 eggs. This is consistent with other literature reports of three (Bour & Pauler 1987) and six (Cabrera 1998) eggs, each based on single observations. The smallest female laying eggs were about 14,8 cm and 444 g, the longest 25 cm and 1,470 g. There is no significant correlation between size of clutch and size of female. In São Paulo only one juvenile hatched from 148 eggs, following an incubation period of 300 days. The hatchling had a carapace length of 45,1 mm and weight of 11,9 g. Incubation conditions were not described by the authors.

THREATS AND CONSERVATION

The turbulent taxonomic history of the toad-headed turtles may be seen as suggestive of intense research activities in the group however, in reality the ecology of South American chelids remains largely unknown. Few studies deal with distribution and even less investigate aspects of their natural history. Of 19 Brazilian species, Souza (2004) considers only two *Phrynops geoffroanus* and *Hydro-medusa maximiliani* to have been properly investigated, and all others as poorly known in respect to behaviour, breeding and diet. The situation had scarcely improved in the following years. Therefore the “IUCN Red Listing and Action Planning Workshop for Chelonians of the Southern Cone” in Filadelfia, Paraguay in 2012, resulted in the unanimous recommendation to change the 1998 category of *Mesoclemmys vanderhaegei* from LR/NT (Lower Risk / Near Threatened) to an amended category of DD/NT (Data Deficient / Near Threatened) (Vinke & Van Dijk, in preparation), identical to the national level category for Argentina since 2000 (Richard & Waller 2000, Prado *et al.* 2012). Though *Mesoclemmys vanderhaegei* had previously been considered Lowest Risk at the national level in Paraguay along with the majority of this country’s species-rich herpetofauna (Motte *et al.* 2009), Vinke *et al.* (2012) assert that the present status of all turtles east of the Río Paraguay — including *Mesoclemmys vanderhaegei* — is unclear.

International pet trade is not an important factor of threat (Boehm in Vinke & van Dijk in prep.) either at the international or the local level, with aquatic turtles being rarely kept as pets in southern South America.

The two biomes that form the bulk of the species range — the Atlantic Forest and the Cerrado — are amongst the most endangered ecosystems in South America (Fig. 15-16).

Most of southern and eastern portions of the oriental region of Paraguay was formerly covered by dense Atlantic Forest (94.000 km² Fragano & Clay 2003, 2005). Until 1945 80.000 km² of the Atlantic Forest remained in an unchanged status, but rapid deforestation at an increasing rates was greater than 4,000 km² per year by 1989 (Macedo & Cartes 2003). By 1997 approximately 11.618 km² remained (Cartes 2003, 2005) of which less than 50% are situated in fragments larger than 120 km² and less than 10% is protected (Fragano & Clay 2003, 2005). The implementation of various laws, projects and programs (compare table 28.6 and 28.7 in Yanosky & Cabrera 2003, table 9.1 in Yanosky & Cabrera 2005) had little impact, up until the end of the last century. In 2004 the Zero Deforestation Law, covering the oriental region of Paraguay was, implemented and considerably slowed the loss of the Atlantic Forest, but the law does not consider properties of less than 20 ha (Yanosky 2013) and between 2006 and 2008 at least 500 km² of Atlantic Forest was legally cleared. The governmental land reform program thus fails to completely protect the habitat and is only partly compatible with conservation efforts.

The situation is not any better in Brazil, with less than 100.000 km² remaining of an original cove-



Fig. 15a–b: The Atlantic Forest of Paraguay has been largely cleared, as shown here at the Cordillera de Ybyturuzú, Dept. Guairá; where apart from a few fragments, only the hillsides are remain forested. Photo: Thomas & Sabine Vinke



Fig. 16: It is unknown whether *Mesoclemmys vanderhaegei* is threatened by habitat destruction. Photo: Thomas & Sabine Vinke

rage of 1.200.000 km² (Hance 2013a) and as in Paraguay, progress in legislation and governmental policy of conservation is slow and incomplete (Gusmão Câmara 2003).

The portion of the Atlantic Forest of Argentina is situated in the province of Misiones, once covering 86% of the territory (Giraudo *et al.* 2003), and a small area of Corrientes. 30% of the original coverage is still present (Hance 2013a), and the local population is becoming more aware of the importance of conservation (Chebez & Hilgert 2003). The extensive fragmentation and degradation of the Atlantic forest seen in Brazil and Paraguay is less evident in Argentina, where nearly 30,3% of the forest is in a good state of conservation (Giraudo *et al.* 2003). However it should be noted that this refers to a small area of 9.000 km² and that 92,5% of the former trilateral extension of the Atlantic forest has been lost (Brooks & Rylands 2003).

The Cerrado, reaches its greatest extension in Brazil but has been highly fragmented and settled for agriculture, cattle ranching, and urban expansion (Cavalcanti & Joly 2002). Oliveira & Marquis (2002) stated that nearly 50% of the the original 2.000.000 km² of Cerrado was under direct human use, and about 35% of its total natural cover had been converted into planted pastures and crops, mostly covered with non-native planted pastures as food source for a herd of 51 million heads of cattle (Klink & Moreira 2002). Just 1,5% of the area is protected (Souza *et al.* 2000) and today only 20% of the original Cerrado vegetation remains (Hance 2013b). Paraguay represents the southern limits of the Cerrado, this being located in the heavily exploited northern departments of Paraguay (Dept. Alto Paraguay, Dept. Concepcion, Dept. Amambay, Dept. San Pedro) and in smaller and isolated areas south to Dept. Cordillera (Mereles 2013).

RECOMMENDATIONS

Knowledge about the basic requirements of a species is essential before planning conservation measurements. As shown above studies are mostly quantitative and limited to Brazilian populations. Information about reproduction, e.g. what are the requirements for adequate nesting places and which habitats are used by juveniles is completely lacking and should have a high priority.

It is unclear how much habitat loss influences populations of *Mesoclemmys vanderhaegei* (Marques *et al.* 2013). Alteration of habitats for extensive farming can sometimes be advantageous for chelids as demonstrated in *Acanthochelys macrocephala* in the Gran Chaco (Rhodin *et al.* 2009). However in other cases it may be serious threat as in the case of *A. pallidipectoris* (Vinke *et al.* 2011). The heavy and frequent injuries found by Marques *et al.* (2013) on *Mesoclemmys vanderhaegei*, may indicate that that habitat alteration can also benefit predators. Further investigation is highly needed.

The effects of climate change also need to be assessed. The area of occupation of *Mesoclemmys vanderhaegei* has been affected in the past years by dryness, and extremes of hot and cold. It remains to be seen what impact this will have on the species survival.

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