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Brazil's *Podocnemis expansa* Conservation Program: Retrospective and Future Directions

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ABSTRACT. – Between 1975 and 2004 the giant South American river turtle (*Podocnemis expansa*) as well as *Podocnemis unifilis* and *Podocnemis sextuberculata* had part of their nesting beaches protected. This resulted in the release of approximately 46 million hatchlings and the apparent recovery of these species in some areas; however, this ranching program faces operational and bureaucratic difficulties. In addition, harvesting wild populations is banned by Brazilian law, thereby excluding local villagers from using this natural resource.

Brazil has 36 species of chelonians, including 29 freshwater species, 5 marine species, and 2 terrestrial species. Of these, 16 species can be found in the Brazilian Amazon, distributed among 6 families: 4 belonging to the suborder Cryptodira (Emydidae, Kinosternidae, Geoemydidae, and Testudinidae) and 2 belonging to the suborder Pleurodira (Chelidae and Podocnemididae) (Pough et al. 2004; Centro Nacional de Pesquisa e Conservação de Répteis e Anfíbios/Instituto Chico Mendes de Conservação da Biodiversidade [RAN/ICMBio] 2011).

Species belonging to the Podocnemididae family are found in Madagascar and in South America. The giant South American river turtle (*Podocnemis expansa*) is found in Orinoco, Essequibo, and Amazon river systems, reaching 13°S (Roze 1964; Pritchard and Trebbau 1984; Iverson 1992). This species is the largest neotropical freshwater turtle, exceeding 90 kg in body mass and 80 cm in carapace length (Pritchard and Trebbau 1984).

Historically, *P. expansa* has had significant importance from both socio-economic and cultural perspectives for populations living along the rivers in the Amazon Basin. This turtle provided meat and eggs for human

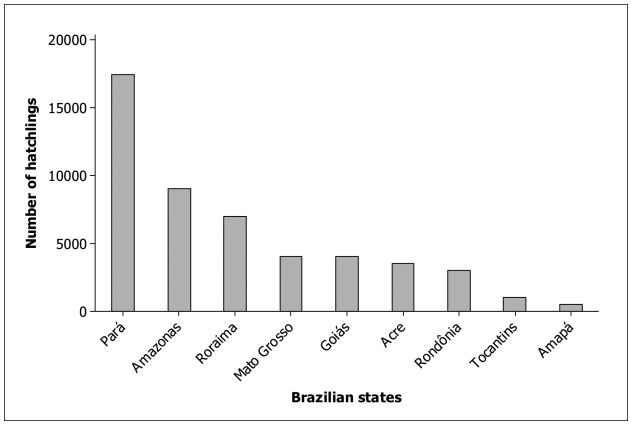

Figure 1. Total number of hatchlings (*n*) of *Podocnemis expansa* (approximately 46 million) released in the Brazilian states of Pará, Amazonas, Roraima, Mato Grosso, Goiás, Acre, Rondônia, Tocantins, and Amapá between 1975 and 2004.

consumption, its fat was rendered to oil for fuel, and its carapace was used to make tools (Bates 1863; Santos 1956; Ojasti 1967; Prado 1976; Smith 1979; Cantarelli 2006; Salera et al. 2006). It is estimated that more than 214 million *P. expansa* eggs were collected between 1700 and 1903 (Smith 1979) from an effective population of approximately 400,000 females (Bates 1863). The overexploitation that occurred during the European colonization of the Amazon caused a massive decline in the species' abundance and overall range (Ramirez 1956; Santos 1956; Pereira 1958; Ojasti and Rutkis 1965; Ojasti 1967; Andrade et al. 1998; Kemenes and Pezzuti 2007). In addition, extreme alterations of nesting habitats, such as the construction of hydroelectric plants and highways, have negatively impacted vital reproductive habitats for the species (Alfinito 1975; Smith 1975; Mittermeier 1978). As a consequence, *P. expansa* was considered an endangered species (von Hildebrand et al. 1988), requiring the establishment of conservation and sustainable use programs (Mittermeier 1978). Although legal harvesting restrictions since the 1960s have decreased overexploitation in most Amazonian countries, this legislation has not eliminated this threat. As a consequence, the species is considered of ''Lower risk/ Conservation dependent'' (International Union for Conservation of Nature [IUCN] 2013). In Brazil, where most of the species geographical range occurs, conservation initiatives focus on the protection of riverine nesting beaches and captive rearing (Ferreira 1974; Alfinito 1978; Corrêa 1978; Mittermeier 1978). However, some initiatives involving local communities and institutions have been carried out in Amazonas state with an increase in nesting habitat protection (Terán 2005; Andrade et al. 2008a).

This study describes the advances achieved in the conservation of *P. expansa* between 1975 and 2004. The programs supported by the Brazilian government are presented in the context of biological conservation and sustainable use of natural resources.

Protection of Nesting Beaches. — In 1979, the now-defunct Brazilian Institute for Forestry Development created the Amazonian Chelonian Protection and Management Project known as ''Projeto Quelonios'' (Cantarelli 1980; Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis [IBAMA] 1989), with the primary goal of promoting the protection of the main nesting areas of *P. expansa*. These efforts were ongoing in the Brazilian states of Acre, Amapá, Amazonas, Goiás, Mato Grosso, Pará, Rondônia, Roraima, and Tocantins. Until 1989, the program included 120 beaches on the main Amazonian rivers,

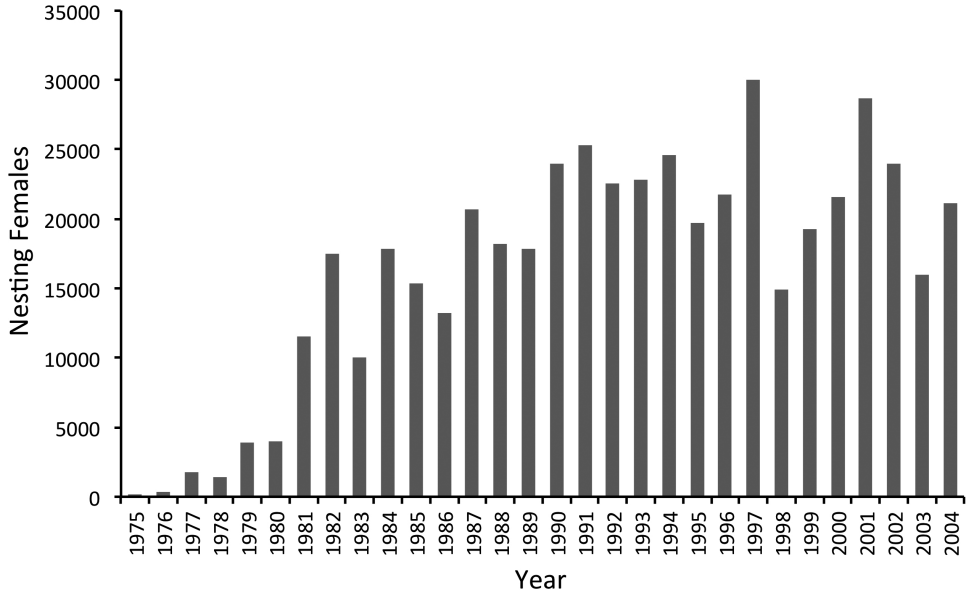

Figure 2. Variation in the number of nesting females of *Podocnemis expansa* observed in sand beaches between 1975 and 2004.

Table 1. *Podocnemis expansa* and *Podocnemis unifilis* ranches in states of the Brazilian Amazon.

State	No. of ranches	
	1990s	2012
Acre	6	6
Amapá	1	1
Amazonas	70	33
Goiás	7	7
Mato Grosso	2	2
Pará	13	13
Rondônia	16	16
Roraima	4	4
Tocantins	1	1
Total	120	83

covering nearly 54% of Brazil's territory (Vogt 2008). Between 1979 and 1989, close to 10 million hatchlings were released in the wild. As a result, the species was removed from Brazil's official list of endangered species (Brasil 1989).

The reproductive sites under protection included the aggregation areas for reproductive females in deep river stretches (locally named ''boiadouros'') as well as the nesting beaches for these species. Protection at these beaches usually lasted 120 d/yr, until all eggs were hatched. Some nests located in flood-prone areas were transferred to higher ground and hatchlings were transferred to a nursery to prevent predation by carnivorous fish and birds, which tend to aggregate near nesting areas during the hatching period (Alho and Pádua 1982; Salera et al. 2009). The hatchlings were kept in nurseries for 2 wk to allow for yolk absorption. Turtles were reared in nurseries (i.e., fenced areas of natural habitats) near the nesting beaches. The hatchlings were then returned to hatching sites that, according to local knowledge, were less susceptible to predatory birds, shorebirds, reptiles, and carnivorous fish.

Between 1975 and 2004, approximately 46 million *P. expansa* hatchlings were released in 9 Brazilian states (Fig. 1). The estimated population of nesting females in

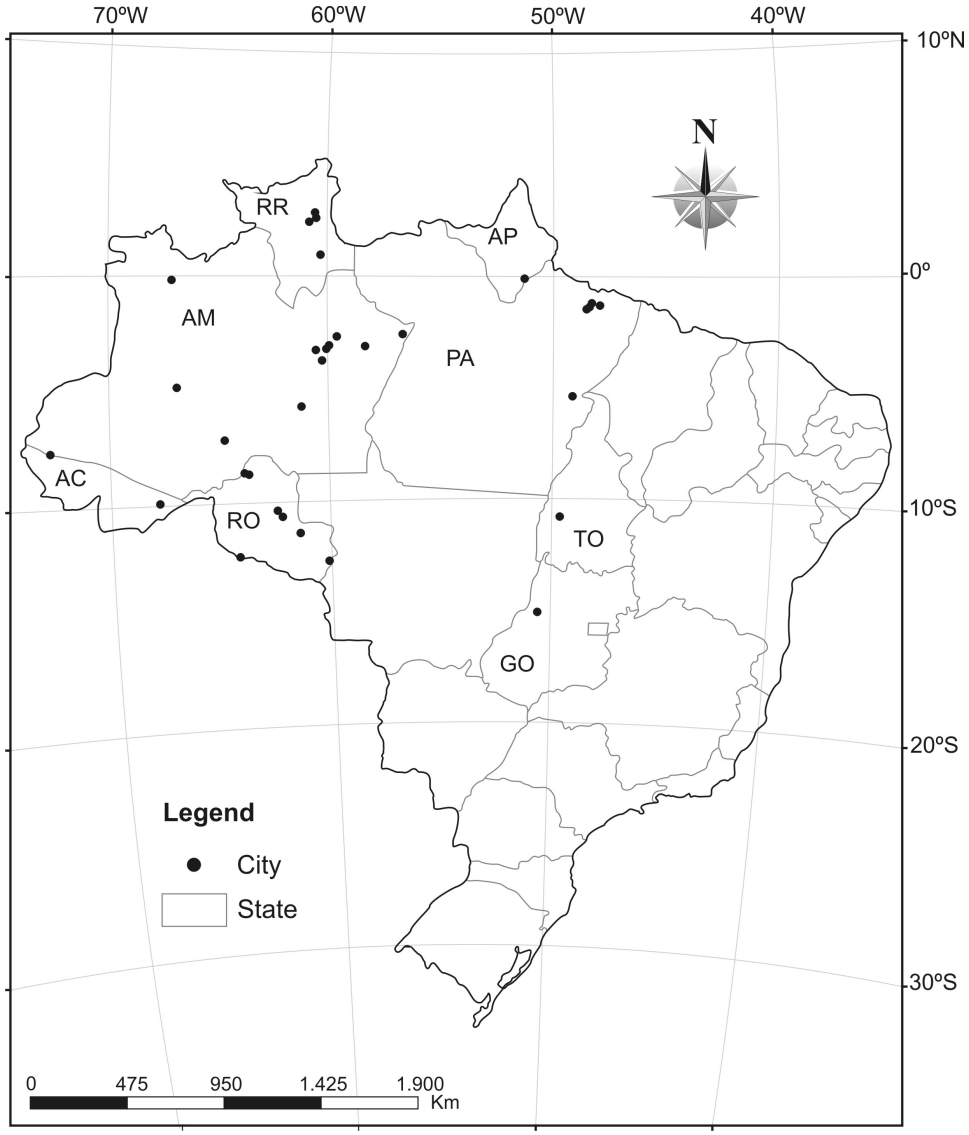

Figure 3. Location of *Podocnemis expansa* and *Podocnemis unifilis* ranches in Brazil.

the monitored beaches during that period peaked in 1997, with a total of 30,000 females (Fig. 2), although this may be underestimated due to the logistical limitations of fieldwork (i.e., lack of financial and human resources to monitor large areas).

Ranching Program. — The first *P. expansa* turtle ranch was established in 1976 in Juruti, in the state of Pará, using hatchlings from the Trombetas River. Ranching operations usually implied a low-input system with artificial unpaved ponds with a high animal density. A few ranches also included *Podocnemis unifilis* and *Podocnemis sextuberculata* hatchlings, but in a small number ($> 10\%$) in relation to *P. expansa*. The number of ranches increased to 120 in the 1990s but has slightly decreased since then, especially in the state of Amazonas, reaching 83 in 2005 to date, spread over 9 states of Brazilian Amazon (Table 1, Fig. 3; Lima et al. 2008).

An improvement in nutrition and water quality control made it possible to slaughter 18-mo-old turtles with a minimum body mass of 1.5 kg (Luz 2005). From 2002 to the present (2013) the price paid to farms varied between US$6.00 and US$9.50 per kilogram of meat, possibly underestimated because of competition with the remaining illegal trade (Lima et al. 2008). In addition, commercialization remains limited due to the lack of federal sanitary regulations on slaughter methods and meat processing. According to the Brazilian Law this prevents interstate meat trading.

Podocnemis expansa captive breeding is still negligible. For this reason, there is no record of animals being released into the wild as a conservation measure. As a result, the only direct conservation benefit from the ranching program has been the protection of nesting habitats.

Retrospective and Proposals for the Future. — Despite structural limitations, the conservation initiatives described in this article seem relevant to these species' conservation because of a significant increase in the total area of protected nesting habitats. Legal trade of turtle products from breeding farms may reduce illegal trade (Luz 2005; Andrade 2008). However, the economic viability and conservation relevance of wildlife farming has been questioned (Magnusson 2003; Verdade 2004). In Brazil, the low reproductive performance in captivity has pushed the turtle ranches to restrict their activities to rearing wild hatchlings supplied to farmers by a government agency (i.e., IBAMA). Thus, landowners benefit more than the riverine human populations because the latter have no legal access to this natural resource. However, the production of captive-reared hatchlings is still negligible, occurring at less than 10% of the farms (Andrade et al. 2008). Furthermore, the lack of slaughter and meat processing procedures and product technology has prevented the establishment of a productive supply chain.

In many countries wildlife hunting has been considered to be a feasible sustainable use of natural resources, both legally and technically (Robinson and Redford 1991). However, wildlife hunting has been banned in Brazil since 1967. For this reason, research on sustainable use of natural wildlife populations has been discouraged (Magnusson 2003; Verdade and Seixas 2013). In contrast to other countries, Brazilian laws are still incipient to provide sustainable use of wildlife on a large scale, considering not only economic but also historical and cultural values. This has prevented the development of sustainable programs that value nature based on the economic exploitation of a restricted group of species in a biologically sustainable fashion (Verdade 2004). Such programs could generate enough income to maintain natural environments and also result in the social inclusion of local communities, whose involvement is essential for species conservation (e.g., Berkes et al. 1989; Novaro et al. 2000; Bodmer and Lozano 2001).

The development of such programs requires the participation of educational and research institutions and nongovernmental organizations that can represent the various related sectors of society, rather than being centralized by government agencies. Such joint action requires a multidisciplinary approach by the scientific community including economics, history, food sciences, medicine, and ecology (Almeida et al. 2010) along with the active participation of local communities.

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