COMMUNITY-BASED FRESHWATER TURTLE CONSERVATION IN MIDDLE SOLIMÕES RIVER, AM, BRAZIL.

CONSERVAÇÃO COMUNITÁRIA DE QUELÔNIOS NA REGIÃO DO MÉDIO SOLIMÕES, AM, BRASIL

Cássia Santos Camillo [1]; Oscarina Martins dos Santos [1];
Isabel Soares de Sousa [1]; Helder Lima de Queiroz [1].

[1] Instituto de Desenvolvimento Sustentável Mamirauá - IDSM, Tefé, Amazonas. e.mail: cassia@mamiraua.org.br

KEY WORDS:

Podocnemis;

Six-tubercled Amazon River turtle;

Giant South America river turtle;

Participant conservation;

Nesting areas.

ABSTRACT

In the middle Solimões River the longest-running initiative of community-based turtle protection (*Podocnemis sextuberculata, P. unifilis* and *P. expansa*) occurs in the Mamirauá Reserve. This study aimed to compile and analyze existing information on the community-based conservation of turtles in this region and discuss the effectiveness of this strategy for generation of scientific data and conservation purposes. We analyzed available information and compared it with data obtained through participant observation. In the last years turtle conservation expanded from beaches to lakes. Despite this improvement, data collected from 2009 to 2011 indicate a reduction in the number of *P. sextuberculata* nests, which could be related to overestimation of the number of nests in previous years; decrease in the nesting population; or natural phenomena. On the other hand, data show a gradual increase in the number of *P. expansa* nests. Our analysis suggests that data generated by a participatory monitoring system are limited to general reproductive data and more specific data collection must be accompanied by a technical team. Community-based conservation, despite its limitations, is a valid strategy for turtle conservation, as all nests would likely be preyed upon by humans, if nesting areas were not protected and guarded by local inhabitants.

PALAVRAS-CHAVE:

Podocnemis;

Iaçá;

Tartaruga;

Conservação participante;

Áreas de nidificação.

RESUMO

No médio Solimões as iniciativas mais antigas de proteção comunitária de quelônios (*Podocnemis sextuberculata, P. unifilis* e *P. expansa*) ocorrem na Reserva Mamirauá. O objetivo deste estudo é reunir e analisar as informações sobre a conservação comunitária de quelônios nesta região e discutir a eficiência dessa estratégia para conservação e coleta de dados científicos. As informações existentes foram analisadas e comparadas com as obtidas por observação participante. Nos últimos anos verifica-se a expansão da conservação de quelônios para lagos, além de praias. Apesar disso, os dados coletados de 2009 a 2011 indicam uma redução no número de ninhos de *P. sextuberculata*, que poder dever-se a superestimação de ninhos em anos anteriores; redução na população reprodutiva; ou a fenômenos naturais. Por outro lado, verifica-se o aumento gradativo no número de ninhos de *P. expansa*. Os resultados sugerem que um sistema de monitoramento participativo se limita a coleta de dados reprodutivos gerais e a coleta de dados mais específicos deve ser acompanhada por uma equipe técnica. A conservação comunitária, apesar de suas limitações, é uma estratégia válida de conservação de quelônios, visto que, provavelmente a totalidade dos ninhos seria predada por humanos, caso as áreas de nidificação não fossem protegidas e vigiadas.

INTRODUCTION

Nesting activities of *Podocnemis sextuberculata* (six-tubercled Amazon River turtle) and *P. unifilis* (yellow spotted Amazon River turtle) are frequent on Mid-Solimões River beaches, while those of P. expansa (giant South American river turtle) are rare, due to high anthropic pressure on this specie during past centuries (FACHÍN-TERAN, 2005). Hunting pressure is currently directed toward the exploitation of P. sextuberculata, through egg poaching and capturing of adult turtles, mainly for commercial purposes. This seems to be affecting the distribution of size classes and leading to a major decrease in, and even the disappearance of, adults P. sextuberculata in different areas of Mamirauá Sustainable Development Reserve (MSDR) (FACHÍN-TERAN et al., 2003). Therefore, river turtle protection in this region and other locations in the Amazon aims to reduce such anthropic pressure and recover their populations (FACHÍN-TERAN, 2001; ANDRADE et al., 2008).

In MSDR, one of the oldest protected areas in the Mid-Solimões River (IDSM, 2010), protection of river turtles was an initiative proposed by the communities located in the area bounded by the Solimões and Japurá Rivers and Paraná do Aranapu, a river side channel, (defined then as the focus of Mamirauá Sustainable Development Institute), during the General Assembly of the Reserve's Residents and Users when they agreed that each political unit (known locally as sector) would protect at least one beach. The communities aimed to protect the turtles, due to their importance in their diet, thus guaranteeing not only exclusive access to this resource, but also its long-term conservation. Meanwhile, Mamirauá Sustainable Development Institute (MSDI), a co-manager of MSDR at the time, presented a research demand on the biology and ecology of river turtles. The partnership between the community and the institution assured protection for the first beach in the region: Pirapucu Beach, in Jarauá Sector, in 1996 (PEZZUTI, 1998; VOGT, R.C., pers. com.). In 1998, conservation of river turtles and aquatic birds acquired a real community-based character, when Horizonte Sector communities started to protect Horizonte beach. At the time, MSDI offered collaboration with the organization, supporting material, and technical assistance to the Voluntary Environmental Agents (*Agentes Ambientais Voluntários*), who legitimized the community vigilance and surveillance. Since 2001, in addition to the assistance for the organization, MSDI has offered technical support for turtle protection activities (FACHÍN-TERAN, 2001).

Community conservation is performed by MSDR residents from communities inside the reserve, as well as by the residents of communities surrounding the reserve. The work is voluntary and involves surveillance of protected areas, collection of basic reproductive data, and nests care during the incubation period in order to avoid losses due to flooding and predation.

In 2011, turtle protection activities were developed in thirteen of the nineteen sectors (political organizations that gather several communities making common use of a specific area) of MSDR, in addition to two other activities in Amanã SDR, another protected area, adjacent to MSDR. Forty-four communities participate in these turtle nesting areas protection activities.

The goal of this study is to compile and analyze existing information on community-based turtle conservation in MSDR and discuss the effectiveness of this strategy for conservation purposes and as a method of scientific data collection.

MATERIALS AND METHODS

Area of study

MSDR is located in a floodplain (Várzea) at the confluence of the Solimões, Japurá and Auti-Paraná Rivers (03°09'35''S, 64°47'37''W; 01°50'05''S, 65°42'19''W; 02°32'50''S, 67°22'08''W) and has an area of 1.124.000 hectares (IDSM, 2010; Figure 1). The reserve area is politically divided into nineteen sectors (Mamirauá, Ingá, Liberdade, Horizonte, Barroso, Aranapu, Boa União, Tijuaca, Jarauá, Panauã, Guedes, Solimões de Baixo, Solimões do Meio, Maiana, Solimões de Cima, Jutaí, Auati-Paraná de Cima, Auati-Paraná de Baixo and Caruara).

Data collection and analysis

Information on the types of turtle conservation activities developed in MSDR since 1996 and their results was obtained from MSDI technical reports and master dissertations (PEZZUTI, 1998; FACHÍN-TERAN, 2001; RAEDER, 2003; OLIVEIRA, 2007; SANTOS, 2008). This information was compared to data obtained in the field through participant observation in 2009 and 2010 as well as during capacity building workshops for beach agents and technical visits to the communities throughout the development of the protection activities.

The participant observation is part of ethnographic research methods which require the permanence of researchers and technicians in the communities for a reasonable period, to enable them to gather relevant information to complement structured data obtained through questionnaires. This research technique allows for the gathering of information which would be very difficult to obtain during formal meetings or through interviews, but that is fundamental to data analysis.

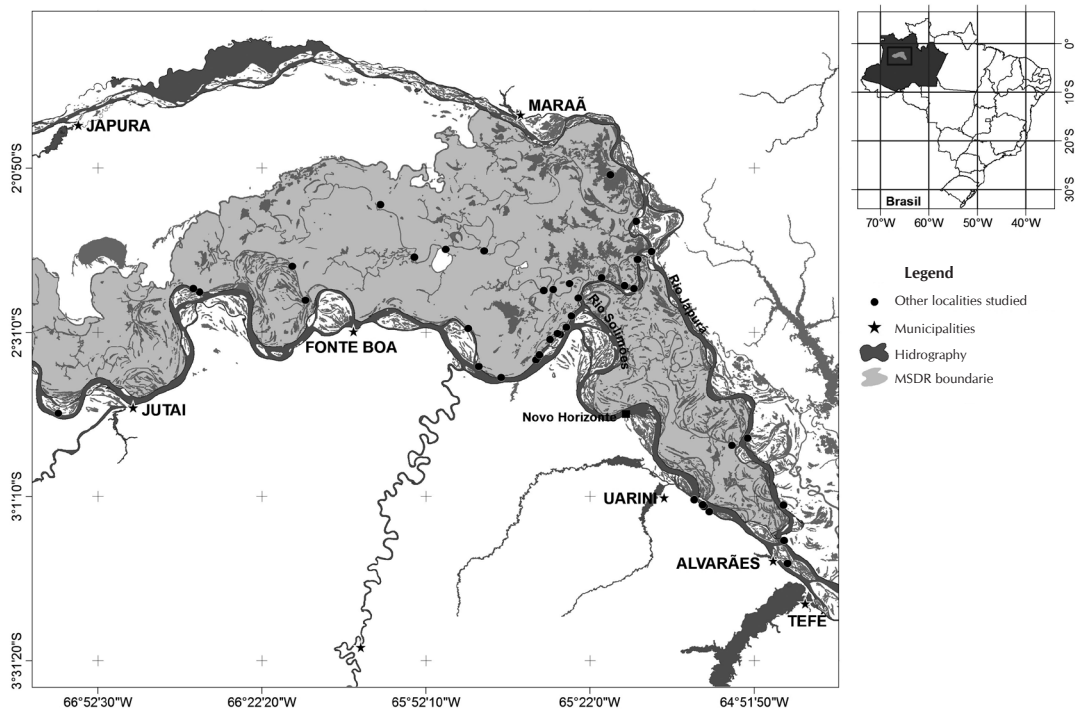

Figure 1 - Location of Mamirauá Sustainable Development Reserve, Community of Novo Horizonte, and other communities involved in turtle protection activities in 2011.

RESULTS

The protected areas assisted by MSDI have increased over time, including the expansion of turtle conservation not only on beaches, but also in lakes. In 2011, 17 lake areas were protected by communities who live far from any nearby river beach (Figure 2). On beaches, the protected species are *P. sextuberculata* and *P. unifilis* and, in some locations *P. expansa*. While in lakes, only *P. unifilis* is protected, because it is the only one which nests on lake ravines and margins.

Turtle conservation activities that can be performed are: (1) protection of natural beach, where nests are kept in situ, being transferred only when they are at risk due to flooding or natural predation; (2) hatchery on natural beach, where all nests are transferred to a fenced area on the beach; (3) artificial beach, where all nests are transferred to an artificial beach built in the community, with wood frames and filled with sand.

At first, the transference of nests to hatcheries on natural beaches or to artificial beaches was a common practice at MDSR (Figure 3). However, MSDI has encouraged the community residents to protect nests *in situ* and this has now become the most common practice (Figure 3). The decision concerning the type of activity to be developed is left to the communities involved whereby they take into consideration the community organization, the number of people interested in collaborating, and their availability to surveil the beach.

In 2009, reproductive data recorded in field forms completed by beach agents were: (1) for in situ nests: number of nests by species and date when eggs were laid, number of live and dead hatchlings, and number of unhatched eggs; and (2) for transferred nests: the same data collected for in situ nests plus date of transference and clutch size (total number of eggs inside the nest). Differences were observed between the number of nests and hatchlings reported by the beach agents via oral communication, those recorded in the field sheets they completed and those counted in the nurseries (large tanks where hatchlings are kept until they are two months old). The other data in the field sheets were not collected by community agents. In the few cases where those data were collected, differences were observed between the total number of eggs when the nests were being transferred and the sum of live hatchlings, dead hatchlings and unhatched eggs.

During the past three years, a decrease in the number of *P. sextuberculata* nests has been observed, especially if the considerable increase in the number of protected beaches is taken into account (Figure 2). It is believed that this reduction was due to a decrease in the number of protected nests on Horizonte Beach (Figure 4). In 2000, 2005, 2006 and 2008, this beach was responsible for 54%, 54%, 52% and 74% respectively of the total number of protected nests of this specie. In 2009, the Horizonte Beach was responsible for only 27% of *P. sextuberculata* nests, even though the number of protected beaches was equivalent to 2005 and 2006. In 2010 and 2011, this beach contributed only 16% and 12% respectively of protected nests, which reflects not only a decrease in nests in this location, but also an increase in protected areas.

On the other hand, there was an increase in P. expansa nests in the MSDR area bounded by the Solimões and Japurá Rivers, and Paraná do Aranapu, when compared to data results from the beginning of the protection activities. In 1999, 42 *P. expansa* nests were recorded in this MSDR area with only 18 on the protected beaches (FACHÍN-TERAN, 2001). In 2010, 45 nests of the species were protected in this area, and about 30 other nests were observed by the community agents on non-protected beaches. In 2011, 96 *P. expansa* nests were counted on the two protected beaches from Horizonte Sector, estimating a total of approximately 125 nests for the region.

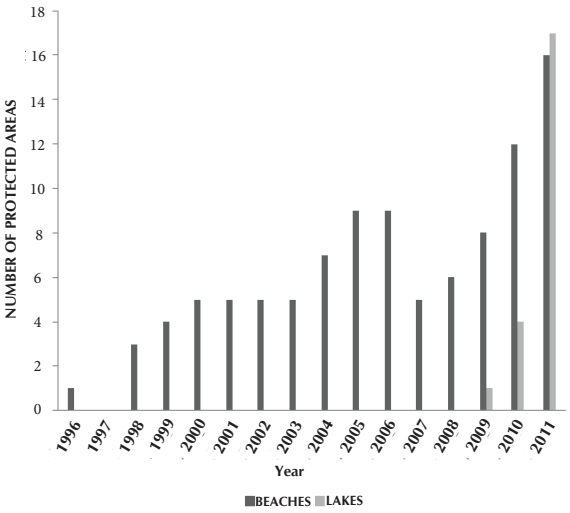

Figure 2 - Number of turtle conservation areas in Maminaruá and Amanã SDR from 1996 to 2011. Data from: PEZZUTI, 1998; FACHÍN-TERAN, 2001; FACHÍN-TERAN, 2005; OLIVEIRA, 2007; SANTOS, 2008; current study.

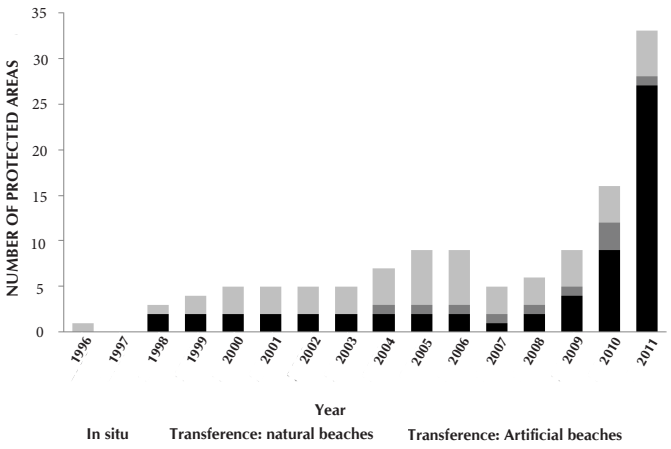

Figure 3 - Types of turtle conservtation activities developed in MSDR and ASDR from 1996 to 2011. Data from: PEZZUTI, 1998; FACHÍN-TERAN, 2001; FACHÍN-TERAN, 2005; OLIVEIRA, 2007; SANTOS, 2008 and current study.

DISCUSSION

The importance and need of carrying out turtle conservation activities as well as the difficulties of its implementation were widely discussed with the community during the capacity building workshops and visits by the MSDI team. It was noticed that although community residents are aware of the importance of this activity, there are limitations for its implementation. The most frequently mentioned problem was the fact that it is voluntary work, and most community residents avoid involvement with this type of activity. Those who show interest in participating cannot be fully committed, because they also have their own economic activities (e.g., fishing, agriculture, logging and other activities) to support their families.

Since 2009, MSDI has encouraged communities to protect nests *in situ* due to influence that microclimatic characteristics may exert over several hatchling characteristics (PACKARD et al., 1982; ALHO et al., 1985; SOUZA; VOGT, 1994; PEZZUTI, 1998; FERREIRA-JUNIOR et al., 2007). However, this decision is left to the communities. Due to difficulties in protecting the nests on a natural beach, which demands continuous surveillance throughout the reproduction period, some communities still opt for the transference of nests.

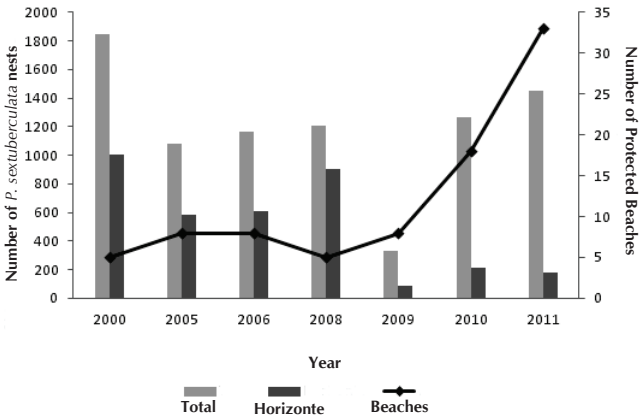

Figure 4 - Number of *P. sextuberculata* nests in MSDR protected areas and on Horizonte Beach.

A comparison of the number of nests protected during the last few years has been limited by the variation in methods used to collect data, a lack of continuity in protection of some beaches, and turnover in the people responsible for protection. However, the most important problem in reproductive data collection by the communities has been the difficulty in confirming the accuracy of the data collected by the volunteers, both on the field sheets and through personal communication. This became evident when comparing the beach agents' oral reports and the information registered on their field sheets. Raeder (2003) also reported that the number of nests recorded on Horizonte Beach when he was absent varied according to the community resident responsible for the information. It is believed that there could be overestimation of the number of nests by beach agents due to competition among them and between them and the beach agents at other nearby protected beaches (RAEDER, 2003). This could be one of the reasons for the apparent decrease in the number of *P. sextuberculata* nests on Horizonte Beach considering that from 2000 to 2008 protection and data collection were made exclusively by community residents, but from 2009 to 2011 a research team from MSDI was present on Horizonte Beach collecting data during the entire turtle reproduction season.

Turtles are considered a delicacy, but hunting of them is forbidden by Brazilian law and by the MSDR management plan. Information on consumption of female turtles in their nesting periods on protected beaches is not available most of the time. On most MSDR protected beaches, local residents usually report that voluntary beach agents poach eggs and capture female turtles on the protected beaches. It is known that, for community residents, beach protection is one way to assure certain exclusivity of the beach resources, through surveillance and banning of use to residents from other communities, sectors, or nearby towns. Assurance of use exclusivity is also often observed and claimed in community management and protection strategies of fishing resources. (LIMA; POZZOBON, 2000; CASTRO; MACGRATH, 2001). In fact, in 2009 on Horizonte Beach, many nests were marked by beach agents during the nesting period, but these nests were not found during the period of emergence of hatchlings. This led to a great difference between the number of nests reported by the beach agents and those reported by the researchers. It is believed that occasional consumption by community residents does not affect the species conservation because many nests and females continue to be protected in those localities. However, this situation raises doubts over the accuracy of the information recorded by beach agents.

On the other hand, a decrease in *P. sextuberculata* nests may be reflecting a reduction in the nesting population, which in turn, may be related to a large capture of animals when the river waters begin to recede and rise again, a period of migration between feeding and reproduction areas. These captures are also for commercial purposes and are usually done by illegal fishermen not involved in beach protection and who often live outside the communities engaged in turtle conservation activities.

Nonetheless, the reduction in the number of *P. sextuberculata* nests could also be related to two natural factors: annual variation in beach morphology and topography and annual variation in hydrological cycle. *Podocnemis sextuberculata* and *P. expansa* show preference for certain types of beach sand (FERREIRA-JUNIOR, 2003). In 2008, in the Horizonte Sector, a new beach emerged near the one being protected (known as *Tabuleiro do Horizonte*), which has more adequate characteristics for turtle nesting. This new beach became protected by the community in 2010 under the name of Santa Luzia Beach. In 2009, 13 P. expansa nests were recorded on each of the two

beaches, in 2010 only 2 on Tabuleiro and 38 on Santa Luzia Beach and, in 2011 20 nests on Tabuleiro and 76 on Santa Luzia Beach. For *P. sextuberculata*, 216 and 229 nests were recorded on Santa Luzia Beach in 2010 and 2011 respectively, while on Tabuleiro, the number of nests recorded was 214 and 180 respectively for the same period.

Moreover, the great flood of 2009 – considered the greatest one during the last 10 years in the region (RAMALHO et al., 2009) – and the drought of 2010 – the greatest drought ever recorded (IDSM, s.d.) – could also be reasons for the decrease in the number of *P. sextuberculata* nests, since migration of these animals between feeding and nesting grounds is controlled by water levels (FACHÍN-TERAN et al., 2006).

The hypothesis that the decrease in nesting was caused by natural phenomena can only be confirmed in the next few years, after observation of the inter annual variation in the number of nests using information provided by the research team and not just that provided by local beach agents.

CONCLUSIONS

During the past 16 years of turtle protection in the MSDR area, a considerable increase in the number of protected areas has been noticed as well as an expansion of conservation activities toward the lakes, where *P. unifilis* nests are also protected. The main objective of most community residents involved in turtle conservation activities is to guarantee the exclusive use of the resources by those communities engaged in protection activities, thus excluding residents from other communities or urban areas. However, they also expect to recover turtle populations aiming for future legal management for commercial purposes.

Nevertheless, community conservation still has some limitations. First is the lack of precision of information recorded by the beach agents. It has been noticed that, although they are committed to conserve turtles' reproduction areas, the communities involved in these activities do not declare that they have consumed turtles or eggs from the protected areas, even though, in some cases this occurs, as does the illegal use for commercial purposes. Therefore, it is believed that the enlargement of environmental education and awareness efforts is essential to guarantee that local people understand the importance of providing accurate information. By doing so, data from monitoring of reproduction areas will be more precise.

The second limitation concerns the difficulties faced by beach agents in completing the field sheets, primarily due to lack of writing skills but also because many local people do not value written records as researchers do. This leads to inconsistencies in registered data even in those localities where protection has been going on for quite a while. Thus, it is believed that local beach agents can collect general data, such as number of nests per species and date of nesting; however, to collect other relevant data such as clutch size, hatching success and incubation duration, it is necessary to have a technical team collecting the data and completing the field sheets.

Despite the difficulties reported here, it is believed that community-based conservation can be a strategy for conservation and recuperation of turtle populations in the MSDR, because it allows protection of several turtle nesting areas, increasing the odds of population recruitment of these animals. Even though undeclared illegal consumption of nesting females by members of the communities involved in the protection does occur

in some areas, the beach surveillances assure protection of part of the resource. If there were no vigilance, most nests would be poached by both local residents and people from neighboring towns, as is the case in most unprotected beaches in the Mid-Solimões Region (FACHÍN-TERAN; VON MULHEN, 2003; personal observation by the authors).

Nesting area surveillance alone does not guarantee the recovery of turtle populations. To achieve this it is necessary to implement additional measures in order to protect the youngs and the adults also in their feeding grounds and during their migration between these areas. (FACHÍN-TERAN et al., 2000).

ACKNOWLEDGEMENT

The authors are grateful to Mamirauá Sustainable Development Institute – MSDI OS, and the Brazilian Ministry of Science, Technology and Innovation - MCTI, for their financial support, infra-structure and logistics; to Petrobras Petroleo S.A., through the Petrobras Environmental Program (*Programa Petrobras Ambiental*) for its financial support in 2011; to the National Council for Scientific and Technological Development – (Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq) for the research grant (Camillo, C.S.); and the communities of Mamirauá and Amanã Reserves for their conservation initiatives and research support and acceptance. This research was authorized by Instituto Chico Mendes de Conservação da Biodiversidade under number 19898-1 and 28805-1.

LITERATURE CITED

ALHO, C. J. R.; DANNI, T. M. S.; PADUA, L. F. M. Temperature-dependent sex determination in *Podocnemis expansa* (Testudinata, Pelomedusidae). **Biotropica**, v. 17, n. 1, p. 75 - 78, 1985.

ANDRADE, P. C. M.; DUARTE, J. A. M.; OLIVEIRA, P. H. G.; COSTA, P. M.; VICENTE, A.; BRELAZ, A.; ALMEIDA-JUNIOR, C. D.; RODRIGUES, W.; NASCIMENTO, J.; MEDEIROS, H. C.; MENDONÇA NETO, L.; AZEVEDO, S. H.; PINTO, J. R. S. Áreas de reprodução de quelônios protegidas pelo RAN – Ibama/Amazonas e UFAM. In: ANDRADE, P. C. M. (Org.). **Criação e manejo de quelônios no Amazonas**. Manaus: Próvárzea/FAPEAM/SDS, 2008.

CASTRO, F.; MACGRATH. D. O manejo comunitário de lagos na Amazônia. **Parcerias estratégias**, n. 12, p. 112 - 126, 2001.

IDSM – Instituto de Desenvolvimento Sustentável Mamirauá. **Plano de Gestão da RDS Mamirauá**. Tefé: IDSM, 2010. v.1, 115 p.

IDSM - Instituto de Desenvolvimento Sustentável Mamirauá. **Banco de dados fluviométrico da Reserva de Desenvolvimento Sustentável**. Disponível em: <www.mamiraua.org/fluviometrico>. Acessado em: 7 mai. 2010.

FACHÍN-TERAN, A. **Preservação de quelônios com participação comunitária na Reserva de Desenvolvimento Sustentável Mamirauá**. Tefé: IDSM, 2001. 61 p. Relatório Técnico.

FACHÍN-TERAN, A. Participação comunitária na preservação das praias para reprodução de quelônios na Reserva de Desenvolvimento Sustentável Mamirauá, Amazonas, Brasil. **Uakari**, v. 1, p. 19 - 30, 2005.

FACHÍN-TERÁN, A.; VON MÜLHEN, E. M. Reproducción de la taricaya *Podocnemis unifilis* Troschel 1848 (Testudines: Podocnemididae) en la várzea del medio Solimões, Amazonas, Brasil. **Ecología Aplicada**, v. 2, n. 1, p. 125 - 132, 2003.

FACHÍN-TERAN, A.; VOGT, R. C.; THORBJARNARSON, J. B. Padrões de caça e uso de quelônios na Reserva de Desenvolvimento Sustentável Mamirauá, Amazonas, Brasil. In: CABRERA, E.; MERCOLLI, C.; RESQUIN, R. (Ed.). **Manejo de fauna silvestre en Amazonia y Latinoamérica**. Assunción, 2000. p. 323 - 337.

FACHÍN-TERAN, A.; VOGT, R.C.; THORBJARNARSON, J. B. Estrutura populacional, razão sexual e abundância de *Podocnemis sextuberculata* (Testudines: Podocnemididae) na Reserva de Desenvolvimento Sustentável Mamirauá, Amazonas, Brasil. **Phyllomedusa**, v. 2, n.1, p. 43 - 63, 2003.

FACHÍN-TERAN, A; VOGT, R.C.; THORBJARNARSON, J.B. Seasonal movements of *Podocnemis sextuberculata* (Testudines: Podocnemididae) in the Mamirauá Sustainable Development Reserve, Amazonas, Brazil. **Chelonian Conservation and Biology**, v. 5, n. 1, p. 18 - 24, 2006.

FERREIRA-JUNIOR, P.D. **Influência dos processos sedimentológicos e geomorfológicos na escolha das áreas de nidificação de Podocnemis expansa (tartaruga-da-Amazônia) e Podocnemis unifilis (tracajá), na bacia do rio Araguaia**. Tese (Doutorado em Evolução Crustal e Recursos Naturais). Ouro Preto: Universidade Federal de Ouro Preto, 2003.

FERREIRA-JUNIOR, P. D.; CASTRO, A. Z.; CASTRO, P. T. A. The importance of nidification environment in the *Podocnemis expansa* and *Podocnemis unifilis* phenotypes (Testudines: Podocnemididae). **South American Journal of Herpetology**, v. 2, n. 1, p. 39 - 46, 2007.

LIMA, D. M.; POZZOBON, J. Amazônia socioambiental: sustentabilidade ecológica e diversidade social. In: REUNIÃO DA ASSOCIAÇÃO BRASILEIRA DE ANTROPOLOGIA, 22., 2000, Brasília, Brasil. **Anais...** Brasília: Associação Brasileira de Antropologia (ABA), 2000.

OLIVEIRA, P. H. G. **Conservação de quelônios aquáticos e proteção de praias de nidificação com envolvimento comunitário na RDSM**. Tefé: IDSM, 2007. 60 p. Relatório Técnico.

PACKARD, M. J.; PACKARD, G .C.; BOARDMAN, T. J. Structure of eggshells and water relations of reptilian eggs. **Herpetologica**, v. 38, n. 1, p. 136 - 155, 1982.

PEZZUTI, J. C. B. **Reprodução de iaçá, Podocnemis sextuberculata (Testudines, Pelomedusidae), na Reserva de Desenvolvimento Sustentável Mamirauá, Amazonas, Brasil**. Dissertação (Mestrado em Ciências Biológicas). Manaus: Universidade Federal do Amazonas, Instituto Nacional de Pesquisas na Amazônia, 1998.

RAEDER, F. L. **Elaboração de Plano para Conservação e Manejo de Aves e Quelônios na Praia do Horizonte, Reserva de Desenvolvimento Sustentável Mamirauá, AM.** Dissertação (Mestrado em Ciências Biológicas). Manaus: Universidade Federal do Amazonas, Instituto Nacional de Pesquisas na Amazônia, 2003.

RAMALHO, E. E., MACEDO, J.,VIEIRA, T. M.,VALSECCHI, J.,CALVIMONTES, J.,MARMONTEL, M.,QUEIROZ, H. L. Ciclo Hidróligo nos ambientes de várzea da Reserva de Desenvolvimento Sustentável Mamirauá- Médio Solimões, período de 1990 a 2008. **Uakari**, v.5, n.1, p. 61-87, 2009.

SANTOS, O. M. **Relatório das atividades de conservação de quelônios com participação comunitária em 2008**. Tefé: IDSM, 2008. 22p. Relatório técnico.

SOUZA, R. R.; VOGT, R. C. Incubation temperature influences sex and hatchling size in the neotropical turtle *Podocnemis unifilis*. **Journal of Herpetology**, v. 28, n.4, p. 453-464, 1994.

Received: Mar./2012
Accepted: June/2012