

# Traditional knowledge applied to hunting and breeding of the vulnerable Yellow-footed Tortoise (*Chelonoidis denticulatus*) in the Cazumbá-Iracema Extractive Reserve, Acre, Brazil

Marcela Alvares Oliveira<sup>1,2\*</sup>, Ana Paula Vitoria Costa-Rodrigues<sup>3</sup>  
and Armando Muniz Calouro<sup>2,4</sup>

## ABSTRACT

Hunting is intensely practiced in the Amazon and is related to the survival of riverside communities as a source of income and food. This study was conducted at Resex Cazumbá-Iracema between June and November, in the dry season and the beginning of the flood period. Twenty-one families were monitored, six hunting events were followed, and 23 *C. denticulatus* individuals were recorded, all of which were categorized as opportunistic. Among the studied individuals, 11 were males and 12 females, and those with a carapace over 40 cm were considered adults. The tortoise is captured mainly for food, but there are beliefs concerning its medicinal use in treating inflammatory diseases. Reptiles, in general, are among the least hunted species for food in the Amazon. This preference may be related to the higher mammals' biomass and the birds' species richness. However, its importance for consumption may vary according to the location.

**Keywords:** Biodiversity; Chelonians; Ethnoecology; Subsistence hunting.

1 Universidade Federal do Acre/UFAC, Programa de pós-graduação em Ecologia e Manejo de Recursos Naturais/PPG-ENRM, BR 364, Km 04 – Distrito Industrial, Rio Branco, Acre, 69915-900, Brazil.

2 Rede de Pesquisa em Diversidade, Conservação e Uso da Fauna da Amazônia (RedeFauna), Manaus, Brazil.

3 Curso de Medicina Veterinária, Escola de Ensino Superior da Amazônia, Reduto, Municipalidade, n° 530; CEP 66.053-180, Belém, PA - Brasil.

4 Universidade Federal do Acre/UFAC, Centro de Ciências Biológicas e da Natureza/CCBN, BR 364, Km 04 – Distrito Industrial, Rio Branco, Acre, 69915-900, Brazil.

\* Corresponding author ✉. E-mail address: MAO ([marcela.mugrabe@gmail.com](mailto:marcela.mugrabe@gmail.com)), APVC-R ([anapv.bio2@gmail.com](mailto:anapv.bio2@gmail.com)), AMC ([armandocalouro1@gmail.com](mailto:armandocalouro1@gmail.com))

## SIGNIFICANCE STATEMENT

We present information on the breeding and popular knowledge of extractivists about *Chelonoidis denticulatus*. We highlight popular beliefs related to the consumption of the meat and related diseases, botanical species consumed in the natural environment, locations most likely to be captured, how they are fed in captivity, and the relation of consumption to commemorative dates.

## INTRODUCTION

Hunting is historically practiced throughout Brazil (Alves *et al.* 2011; Constantino, 2018; Félix-Silva *et al.* 2018). Its importance as an income and food source in the rural populations' survival throughout the Amazon (Shoobridge 2018) may vary according to the populations involved and/or the communities' purchasing power (Nunes *et al.* 2019), access to other protein sources (Cajaiba *et al.* 2015), or as a protein source complement (Damasceno *et al.* 2019). In Acre state, Brazil, hunting plays an important role in the diet of different populations, being essential to guarantee food security for people living in the forest (Chaves *et al.* 2018). However, the use of hunting resources has established a critical debate regarding its sustainability in tropical forests in the ethical and scientific field (Bragagnolo *et al.* 2019; Figueiredo and Barros 2015; van Vliet *et al.* 2019). It reinforces the need to understand different aspects of hunting to perform adequate management actions, considering local peculiarities. Hunting is part of a network of food choices and use influenced by ecological, economic, and cultural patterns that impact its social context (Figueiredo and Barros 2016). In this way, research on animals' use contributes to the fauna valorization from a social, medicinal, ecological, and economic view (Félix-Silva *et al.* 2018).

Reptiles are among the least hunted species in the Amazon (Chaves *et al.* 2018; Shaffer *et al.* 2017), which may be related to the higher mammals' biomass and birds' species richness (Cajaiba *et al.* 2015). However, its importance for consumption may vary according to the location (Félix-Silva *et al.* 2018; Oliveira *et al.* 2022; Pezzuti *et al.* 2004, 2010; Reis *et al.* 2018). These species are mainly consumed in warmer and wetter tropical and subtropical regions, which present higher reptiles diversity and larger sizes (Alves and van Vliet 2018).

The Amazon chelonian species have been highly exploited as food resource and medicine for riverside communities; wildlife trafficking; besides being impacted by human and natural activities (Alves *et al.* 2011; Cantarelli and Verdade 2014). Its products have high nutritional, ornamental, and medicinal value for many rural and urban populations in Brazil (Alves *et al.* 2011). *Chelonoides* species (tortoises) stand out among turtles due to their easy capture since they do not require any equipment or experience (Félix-Silva *et al.* 2018; Figueiredo and Barros 2015; Reis *et al.* 2018) and due to its meat flavour (Fuccio *et al.* 2003). In addition to being a food resource, the *C. denticulatus* species can be sold as a pet (Alves *et al.* 2019; Fernandes-Ferreira *et al.* 2013) or meat (Morcatty and Valsecchi 2015a; van Vliet *et al.* 2015).

Understanding the aspects related to this group's

hunting, use, and breeding is paramount to avoid overexploitation, threatening the local population's income and nutritional quality (Mocarty and Valsecchi 2015a,b) since the distribution of species susceptible to human activity can be affected even in light hunting regimes (Hallett *et al.* 2019). This study aimed to characterize the local population knowledge concerning the hunting of *Chelonoides denticulatus* in the Cazumbá-Iracema Extractive Reserve, highlighting aspects related to the local belief system and maintenance in captivity.

## MATERIAL AND METHODS

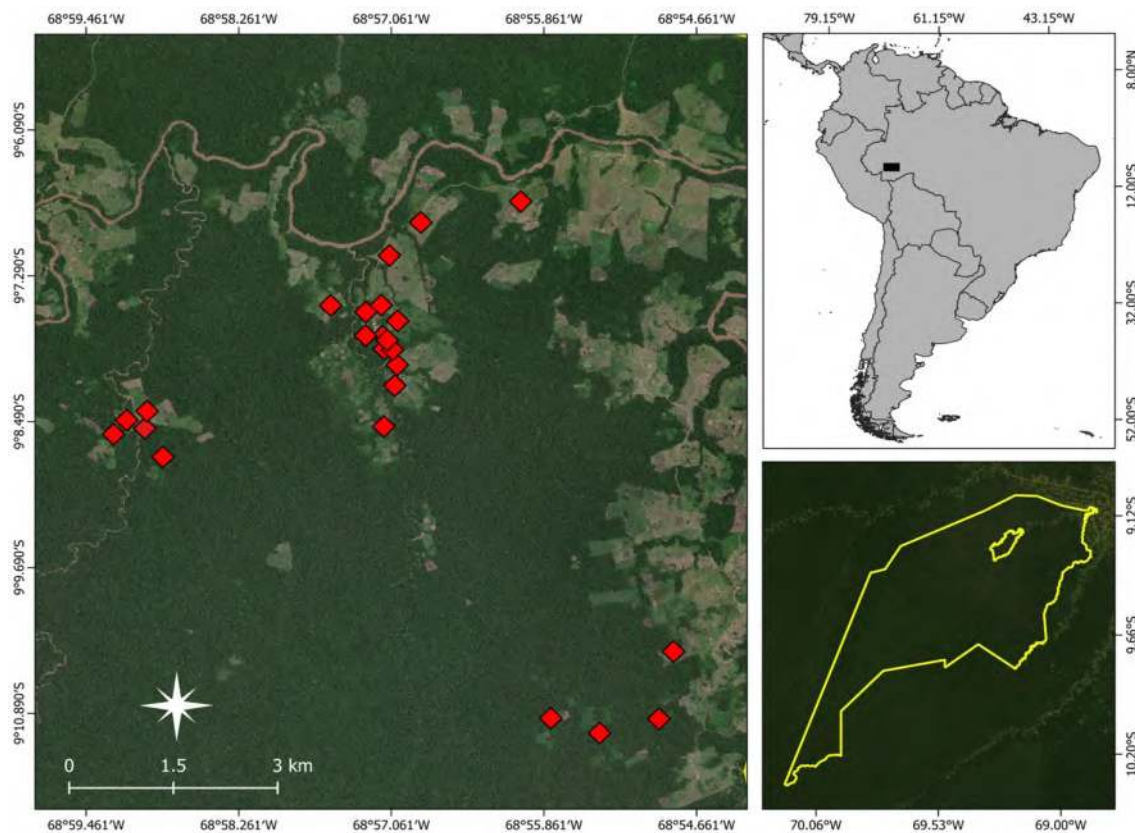
### Study area

This study was performed in the Cazumbá-Iracema Extractive Reserve (Resex) (750,794.70 ha) located in the southwestern Brazilian Amazon (9°30'50.78"S 69°28'21.58"W), in the Purus River basin, Acre state (Figure 1). The Resex is divided into five macro-regions (ICMBio 2007), including Cazumbá, where this study was conducted. This region concentrates the highest population density of the Resex, which is called Núcleo do Cazumbá. The study was conducted with residents who live in a system like a village. The residents are about 27 km from the region's centre and about 5 km from each other. Their income comes from flour production, cattle raising, corn and rice plantations, rubber extraction, Brazil nuts, and vegetable leather crafts (ICMBio 2007). Meat is obtained from hunting and fishing and local farmers' occasional beef and poultry sales.

The predominant vegetation in the study area is the Terra Firme Open Ombrophilous Forest with bamboo. Taboca (*Guadua* spp.) is the predominant vegetation genera, being clonal, with opportunistic growth, presenting a great capacity to invade disturbed areas (Smith and Nelson 2011). The population residing in the Núcleo do Cazumbá has a Hunting Agreement that restricts activity to specific species considering specific reproductive stage, sex, and age, in addition to specific locations and hunting strategies. Although it restricts foreign sales, the agreement does not have any restriction involving *C. denticulatus* (Oliveira and Calouro 2019).

### Data collection

The Hunting Calendar and Participant Observation methods were used for data collection. The Hunting Calendar method proposed by Oliveira *et al.* (2018) consists of calendars, where each sheet corresponds to a month and hunted species or capture localities informed by the residents are displayed. The following data were recorded for each hunting



**Figure 1.** Study area. The diamonds represent the sampled residences.

event: sex, age group, and hunting category. Hunting events were categorized as opportunistic (associated with other work activities) or intentional (intention to capture). The Participant Observation method was used to complement information received from hunters (Ferreira *et al.* 2012). The goal of this method was to deepen the understanding regarding the aspects related to hunting, maintenance in captivity, and local beliefs.

Data collection was conducted between June and November 2011, comprising the dry season and the beginning of the flood period. Twenty-one hunters and families were monitored, all of legal age, where they were informed about the project's purpose and the information anonymity was assured.

## RESULTS

Twenty-three individuals of *C. denticulatus* were captured, 11 males (seven adults and four juveniles) and 12 females (11 adults and one juvenile), with a 1:0.9 sex ratio. All individuals were categorized as opportunistic, where ten were captured during their displacement to a different area in the community (always on roads in areas of terra firme forest).

Other two individuals were found in plantation areas, four during the rubber tree latex collection (*Hevea brasiliensis*), and seven during hunting activities focused mainly on medium and large mammals. All records were diurnal, predominantly (97%) during the early hours of the day, between 05:00 and 09:00 am. There was no record of the use of traps or specific capture methods.

The hunters defined an adult as individuals with carapace size over 40 centimeters. Two hunters reported that *C. denticulatus* meat and fat consumption has medicinal properties for rheumatism treatment. The fat is melted and stored in a jar and later used in a plaster placed over the affected area. There was only one report of eggs consumption for eggnog. All hunters stated that the tortoise meat could be allergenic (locally known as "reimosa"), increasing the probability of a disease called "febrão", characterized as a high, constant, and disabling fever of variable duration. Meat should also be used when needed for wound healing and pregnant women.

Six hunting events were followed, where a *C. denticulatus* was found randomly on the hunting trail. It was possible to locate the so-called "Yellow-footed Tortoise's bed" during the activity in two events. This

environment consists of very low entangled branches, bamboos, or liana with a single entrance, with a 60 cm maximum height from the ground and a large leaf accumulation. The entrance is the only area free of leaves, branches, and lianas, with a very clean trail (Figure 2). The active search for tortoises is considered a secondary event during the hunt. When hunters move to their hunting areas, they actively search for any animal traces, being able to locate the bedding or foraging sites known locally as "feeders". The hunters agree that the beds can be more easily found in environments with a dense density of buriti (*Mauritia flexuosa*), tucumã (*Astrocaryum aculeatum*), babaçu (*Attalea speciosa*), uxi (*Endopleura uchi*), genipapo (*Genipa americana*), and piquiá (*Caryocar villosum*). The "feeders" are characterized by the presence of partially crushed fruits from the plants mentioned above. A hunter reported digging the bed searching for eggs carried in pockets wrapped in banana leaves (Heliconaceae).

Once found, the animals are placed belly-up to prevent escape. Subsequently, two small sticks are placed in the gular and anal portion of the plastron to reduce limb movement. Bark strips from the envireira tree (Annonaceae) are taken and braided with the sticks to resemble a backpack and facilitate transport. If the hunter chooses to continue the hunt after capturing the tortoise, it is left in the belly-up position on the hunting trail (Figure 3).

After the capture, the animals were kept in small fences, locally called "pigsties", during a variable period influenced by the demand for meat and the animal's size, with no record of breeding for pet purposes. The minimum time spent in the pigsty was a month, corresponding to the procedure called cleaning the meat. Such procedure consists of feeding the animals with leafy vegetables or cassava husks and, more rarely, food scraps, avoiding any animal protein once it can lead to flavour change. According to hunters and residents, this procedure occurs because *C. denticulatus* feed on rotten meat, which gives the meat a bitter taste and bad odour, which is the only restriction regarding the future meat preparation. Furthermore, there is a higher possibility of disease transmission in the absence of this procedure, especially worms. For young individuals, maintenance was performed to reach the ideal size for slaughter. According to all hunters, the ideal minimum size was 40 cm, but animals could be slaughtered earlier, depending on the meat supply available or some celebratory event. All hunters reported preferentially consuming captive animals during religious commemorative dates such as Easter, Christmas, or birthdays.

The animals' slaughter follows a specific preparation method to optimize the meat. The animals should be thrown to the ground at least three times

before bleeding so that the liver expands and have greater use, which is considered the best part for consumption. After that, bleeding could occur, consisting of cutting the head entirely to the blood be collected for other dishes, but this procedure was not mandatory. Afterwards, the carapace and plastron were separated through longitudinal cuts. Blood is collected for food preparation. The limbs, organs, meat, and eggs (if any) were removed and seasoned with salt and pepper. The only form of preparation recorded was cooking due to the meat texture (Figure 4).

Although it was impossible to record directly, there is a trade to supply the urban market. The transportation of these animals to the urban centre occurs through small boats during the flood season. Thus, there is greater security to inspection and favouring a higher number of animals to be transported. The residents mentioned the expulsion of a person from the community for transporting about 30 *C. denticulatus* to be sold in Sena Madureira, the closest city to the Resex, based on the rules imposed by the Hunting Agreement.

## DISCUSSION

Reptiles are an important component of different populations' diets worldwide (Alves *et al.*, 2011). However, our data reinforce the preference for other groups as observed in other portions of the Amazon (Oliveira *et al.*, 2022) and the state of Acre, due to the opportunistic characteristics of the capture (Calouro and Marinho-Filho, 2005; Lemos *et al.*, 2018; Sampaio *et al.*, 2022). The capture sex ratio is an important biological indicator (Mocarty and Valsecchi 2015), where a prominent disproportion between males and females can cause damage to the population (Reis *et al.* 2018). Hunting *C. denticulatus* is likely driven by chance rather than hunting investment since it occurs opportunistically. The balance found in the males and females collection demonstrates no capture trend related to sex, and the population growth rate may not be affected.

Active search and visitation are among the least cited by hunters in the Peruvian and Brazilian Amazon, although the active search has a good capture efficiency (Tavares *et al.* 2020). The absence of traps and dogs in the hunting activity can be explained by the hunting agreement followed by a large part of the population of the *Núcleo do Cazumbá* that prohibits both modalities (Oliveira and Calouro 2019). The use of traps is the strategy that has the greatest success in capture and the best cost-benefit compared to active search (Morcatty *et al.*, 2020). Together with the protected areas' geographical isolation, these management initiatives play an important role in managing fauna (Sampaio *et al.*, 2022), especially species under



**Figure 2.** Schematic representation of the “Yellow-footed Tortoise’s bed”. Elaboration: Thiago Bento de Alencar.



**Figure 3.** Adult individual of *Chelonoidis denticulatus* captured and belly-up position. Photo: Luiz Henrique Medeiros Borges.

some threat of extinction.

*Chelonoidis denticulatus* is captured mainly for use in food, but there is a medicinal value perception of its meat (Alves *et al.* 2013). The *C. denticulatus* medicinal use is related to rheumatism treatment documented by Pezzuti *et al.* (2010) in the Jaú National Park, Amazonas. In addition to the fat and meat consumed in meals, other body parts of the individuals can be used for treating issues such as swelling, toothache, inflammation, bruising, and haemorrhage (Pezzuti *et al.* 2010). Belfort *et al.* (2020), in Baixo Madeira, Rondônia, recorded the use of fat for the treatment of dislocations and inflammation. Barros

*et al.* (2012), in the Riozinho do Anfrísio Extractive Reserve, Pará, recorded the use of fat in hernia and pneumonia treatment. In the urban center of Cruzeiro do Sul, State of Acre, Oliveira *et al.* (2019) recorded the use of fat to treat acne and burns. These different uses demonstrate the therapeutic purposes employed in different locations and contexts and with pharmacological potential. It highlights the importance of the fauna for food and as an alternative medicinal source originated from years of experimentation. Restrictions on consumption are inexpressive, although there are myths in other regions of the state concerning the consumption of older individuals, which are



**Figure 4.** Slaughter and preparation process of *Chelonoidis denticulatus*. Photos: Luiz Henrique Medeiros Borges.

believed to cause the hunter's death (Lemos et al. 2018).

The species is solitary, being found and captured especially in forest environments (Böhm 2011; Ferronato and Morales 2012; Pezzuti et al. 2010). This aspect is related to two factors: preference of hunting environment due to food availability for the target species (Figueiredo and Barros 2015), the distribution of fruit components of the species' diet, and habitat preference (Stevenson et al. 2007; Tavares et al. 2019). The presence of bamboos as the landscape's predominant elements in the Resex can favour the formation of beds and reduce the hunters' locomotion capacity, emphasizing the importance of recognizing landscape elements for the animals' location and tracking. The preference for fallen trees and foliage, elements that produce the resting places, were

documented by Tavares et al. (2019), highlighting the local residents' knowledge about the species' environmental preferences (Barboza et al. 2013). The diet informed by the hunters (fruits and fresh and decomposing meat) is supported by studies in captivity (Castro et al. 2018) and in the wild (Stevenson et al. 2007), characterizing a generalist diet that can act positively as a seed's disperser (Sobral-Souza et al. 2017) reinforcing the importance of traditional knowledge, which is accumulated over several years of environment experimentation and the knowledge transmission, for understanding the species' ecology.

*Chelonoidis denticulatus* is economically important since it is easily sold (Morcatty and Valsecchi 2015a,b). Thus, its capture may be strongly related to trade and not consumption (Pezzuti et al. 2010), supplying mainly local markets (Alves et al. 2011).

For this reason, their trade is maintained, even with the hunter possible expulsion from the community or by inspection. The tortoise is among the most captured species by the locals and seized in surveillance activities in the Serra do Divisor National Park, at the Acre's extreme northwestern (Lemos *et al.* 2018), reinforcing the species' monetary value. As observed in the present study, local agreements strengthened by management plans are essential to combat illegal hunting (Constantino 2018) and preserve species (Oliveira and Calouro 2019). In addition, the tortoise is the main species seized by IBAMA in Acre state (Fuccio *et al.* 2003), highlighting the need for intensifying inspections in the rivers that can be used as routes for the transportation of the animals and meat from illegal hunting (Chaves *et al.* 2018).

Pigsties are widespread throughout the Amazon (Pezzuti *et al.* 2010) and can have different purposes. The use of these places for storing live animals may be related to the seasonal availability of other meat sources (Fuccio *et al.* 2003), especially in the winter period (Félix-Silva *et al.* 2018) or to gain weight (Figueiredo and Barros 2016). In the present study, this use was more related to the cleaning and maintenance process for the festivities than to a meat stock related to the low availability of other meat sources. In a quilombola community of the Ipaú-Anilzinho Extractive Reserve, Pará, Figueiredo and Barros (2016) recorded a higher frequency of *C. denticulatus* consumption in the Holy Week period due to the influence of the Judeo-Christian tradition, reinforcing the species importance as a religious element. The degree of importance within this aspect may be related to the community religious adherence, species abundance, and/or other species insertion with the same symbolic role. The consumption preference associated with commemorative events indicates the connection between fauna and local traditions, highlighting hunting with utilitarian value beyond human biological needs and as a socialization and cultural identity element, as highlighted by Figueiredo and Barros (2015).

Another important aspect is the *C. denticulatus* meat characterization as allergenic. This characteristic refers to a binary food restriction dividing hunting meat that is safe for everyone to consume (non-allergenic) and another that is dangerous (allergenic). The state of allergenic is not static, being applied to people who are more physically or socially susceptible to worsen their situations or manifest new clinical conditions, such as postpartum women or sick people (Alves *et al.* 2013; Maués and Motta-Maués 1978; Oliveira *et al.* 2019; Panzutti 1999; Pezzuti *et al.* 2004). The species is among the most allergenic species in the Caxiuana National Forest, in Pará state, but they are also the most consumed hunting species (Félix-Silva *et al.* 2018) with no direct rela-

tionship between restriction and consumption. As the allergenic reactions show fluctuating manifestations and the animals can be kept alive for a prolonged period, this restriction may not influence the capture rate and/or consumption. However, it can influence food preferences and other hunting species' abundance and/or availability. Other restrictions, such as disgust, pity, and palatability, are related to consumption and can act positively on the absence or low consumption (Oliveira *et al.* 2019).

Urban centres' populations highly appreciate freshwater turtles (Chaves *et al.* 2020; El Biziri *et al.* 2020; Morcatty and Valsechi 2015a). *Chelonoidis denticulatus* stands out among other chelonians as it is highly appreciated in urban centres in the State of Acre (Fuccio *et al.*, 2003; Oliveira *et al.*, 2019). This demand may be related to the migration of the rural population to the urban area (Chaves *et al.*, 2020; Parry *et al.*, 2010), where food preferences are kept and encourage species trafficking (Chaves *et al.* 2018; Fuccio *et al.* 2003). The possible unsustainable capture rate of the species associated with high demand outside the protected areas may positively favour the *C. denticulatus* population's decline. Despite the species being categorized as Vulnerable (VU) on a global scale by Tortoise & Freshwater Turtle Specialist Group (1996), in Brazil, its conservation status is considered as Least Concern (LC) (Vogt *et al.* 2016), which indicates the need for studies to assess local population variations resulting from its use.

## CONCLUSION

These data contribute to understanding the traditional beliefs associated with *C. denticulatus* and its importance on the people or community cultural identity beyond consumption. These factors highlight the need to deepen these aspects in decision making regarding the capture and consumption of hunting species. Understanding how it occurs and the intensity of the species' use, both in terms of its populations' sustainability and the sociocultural aspects involved in its capture, allow management strategies, if necessary, to present a greater chance of success. Participatory management, with the inclusion of residents in decision-making, considers the cultural aspects of hunting activity and the appreciation of empirical knowledge about the hunted species' ecology.

## ACKNOWLEDGEMENT

We thank the Cazumbá-Iracema Extractivist Reserve residents and ICMBio team at Sena Madureira for their support. Additionally, we thank the FUNTAC (Fundação de Tecnologia do Estado do Acre),

ARPA (Programa Áreas Protegidas da Amazônia), and FUNBIO (Fundo Brasileiro para a Biodiversidade) for financial support. This study was partially financed the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES; financing code 001). We are grateful to anonymous referees for their valuable contributions to our manuscript.

## DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

## CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

## CONTRIBUTION STATEMENT

Conceived of the presented idea: MAO.

Carried out the experiment: MAO.

Carried out the data analysis: MAO, APVC-R.

Wrote the first draft of the manuscript: MAO, APVC-R.

Review and final write of the manuscript: MAO, APVC-R, AMC.

Supervision: AMC.

## REFERENCES

Alves RRN, Vieira KS, Santana GG, Vieira WL, Almeida WO, Souto WM, Montenegro PF, Pezzuti JCB (2012) **A review on human attitudes towards reptiles in Brazil.** *Environmental Monitoring and Assessments* 184(11):6877–6901. doi: [10.1007/s10661-011-2465-0](https://doi.org/10.1007/s10661-011-2465-0).

Alves RRN, Oliveira TPR, Rosa IL (2013) **Wild animals used as food medicine in Brazil.** *Evidence-Based Complementary and Alternative Medicine* 2013:670352. doi: [10.1155/2013/670352](https://doi.org/10.1155/2013/670352).

Alves RRN, Araújo BMC, Policarpo IS, Pereira HM, Borges AKM, Vieira WLS, Vasconcellos A (2019) **Keeping reptiles as pets in Brazil: ethnozoological and conservation aspects.** *Journal for Nature Conservation* 49:9–21. doi: [10.1016/j.jnc.2019.02.002](https://doi.org/10.1016/j.jnc.2019.02.002).

Barboza RSL, Barboza MSL, Pezzuti JCB (2013) **"Estava pescando de malhadeira, vi na praia uns cascos brilhando, era luar, abeirei a terra e fui pegar": práticas de pesca de quelônios na**

**várzea Amazônica (Santarém-PA).** *Amazônica-Revista de Antropologia* 5(3):622–653. doi: [10.18542/amazonica.v5i3.1583](https://doi.org/10.18542/amazonica.v5i3.1583).

Barros FB, Varela SAM, Pereira HM, Vicente L (2012) **Medicinal use of fauna by a traditional community in the Brazilian Amazonia.** *Journal of Ethnobiology and Ethnomedicine* 8:37. doi: [10.1186/1746-4269-8-37](https://doi.org/10.1186/1746-4269-8-37).

Belfort MJS, Barbosa GS, Silva CP, Oliveira MA (2020) **Perception of subsistence hunters in Lower Madeira on the impact of the Santo Antônio Hydroelectric Power Plant.** *Revista Brasileira de Ciências da Amazônia* 9(3):16–25. doi: [10.47209/2317-5729.v.9.n.3.p.16-25](https://doi.org/10.47209/2317-5729.v.9.n.3.p.16-25).

Böhm S. 2011 **Observations on the South American yellow-footed tortoise (*Chelonoidis denticulata*) in French Guiana.** *Radiata* 20(2):18–32.

Bragagnolo C, Gama GM, Vieira FA, Campos-Silva JV, Bernard E, Malhado AC, Correia RA, Jepson P, Carvalho SHC, Efe MA, Ladle RJ (2019) **Hunting in Brazil: What are the options?.** *Perspectives in ecology and conservation* 17(2):71–79. doi: [10.1016/j.pecon.2019.03.001](https://doi.org/10.1016/j.pecon.2019.03.001).

Calouro AM, Marinho-Filho JS (2005) **A caça e a pesca de subsistência entre seringueiros ribeirinhos e não-ribeirinhos da Floresta Estadual do Antimary (AC).** In: Patricia Drummond (eds) *Fauna do Acre*. EDUFAC, Rio Branco, pp. 109–135.

Cantarelli VH, Malvasio A, Verdade LM (2014) **Brazil's *Podocnemis expansa* conservation program: retrospective and future directions.** *Chelonian Conservation and Biology* 13(1):124–128. doi: [10.2744/CCB-0926.1](https://doi.org/10.2744/CCB-0926.1).

Castro IRW, Pinke Testa CAE, Silva DCS, Santos GJ, Hippólito ALG, Melchert A (2018) **Condição nutricional e sugestão de padrão alimentar para *Chelonoidis* sp.** *Archives of Veterinary Science* 23(3):17–20. doi: [10.5380/avs.v23i3Esp.61316](https://doi.org/10.5380/avs.v23i3Esp.61316).

Chaves WA, Silva FPC, Constantino PAL, Brazil MVS, Drummond PM (2018) **A caça e a conservação da fauna silvestre no estado do Acre.** *Biodiversidade Brasileira* 8(2):130–148. doi: [10.37002/bio-brasil.v%25vi%25i.792](https://doi.org/10.37002/bio-brasil.v%25vi%25i.792).

Chaves WA, Valle D, Tavares AS, Morcatty TQ, Wilcove DS (2021) **Impacts of rural to urban migration, urbanization, and generational change on consumption of wild animals in the Amazon.** *Conservation Biology* 35(4):1186–1197. doi: [10.1111/cobi.13663](https://doi.org/10.1111/cobi.13663).

- Constantino PAL (2016) **Deforestation and hunting effects on wildlife across amazonian indigenous lands.** *Ecology and Society* 21(2):3. doi: [10.5751/ES-08323-210203](https://doi.org/10.5751/ES-08323-210203).
- Constantino PAL (2018) **O Perfil da Caça nos Biomas Brasileiros: um Panorama das Unidades de Conservação Federais a partir dos Autos de Infração Lavrados pelo ICM-Bio.** *Biodiversidade Brasileira* 8(2):106–129. doi: [10.37002/biobrasil.v%25vi%25i.786](https://doi.org/10.37002/biobrasil.v%25vi%25i.786).
- Damaceno AB, Ortega GP, Turci LCB (2019) **Uso da caça de subsistência no assentamento Santa Luzia, Cruzeiro do Sul, Acre.** *PUBVET* 13(2):1–8. doi: [10.31533/pubvet.v13n2a262.1-8](https://doi.org/10.31533/pubvet.v13n2a262.1-8).
- El Bizri HR, Morcatty TQ, Valsecchi J, Mayor P, Ribeiro JES, Vasconcelos Neto CFA, Oliveira JS, Furtado KM, Ferreira UC, Miranda CFS, Silva CH, Lopes VL, Lopes GP, Florindo CCF, Chagas RC, Nijman V, Fa JE (2019) **Urban wild meat consumption and trade in central Amazonia.** *Conservation Biology* 34(2):438–448. doi: [10.1111/cobi.13420](https://doi.org/10.1111/cobi.13420).
- Félix-Silva D, Vidal MD, Alvarez JB, Pezzuti JCB (2018) **Caracterização das atividades de caça e pesca na Floresta Nacional de Caxiuanã, Pará, Brasil, com ênfase no uso de quelônios.** *Biodiversidade Brasileira* 8(2):232–250. doi: [10.37002/biobrasil.v%25vi%25i.794](https://doi.org/10.37002/biobrasil.v%25vi%25i.794).
- Fernandes-Ferreira H, Mendonça SV, Cruz RL, Borges-Nojosa DM, Alves RRN (2013) **Hunting of Herpetofauna in Montane, Coastal, and dry-land areas of northeastern Brazil.** *Herpetological Conservation and Biology* 8(3):652–666.
- Fernandes-Ferreira H, Alves, RRN (2017) **The researchers on the hunting in Brazil: a brief overview.** *Ethnobiology and Conservation* 6:6. doi: [10.15451/ec2017-07-6.6-1-7](https://doi.org/10.15451/ec2017-07-6.6-1-7).
- Ferreira DSS, Campos CEC, Araújo AS (2012) **Aspectos da atividade de caça no Assentamento Rural Nova Canaã, município de Porto Grande, estado do Amapá.** *Biota Amazônia* 2(1):22–31. doi: [10.18561/2179-5746/biotaamazonia.v2n1p22-31](https://doi.org/10.18561/2179-5746/biotaamazonia.v2n1p22-31).
- Ferronato BO, Morales VM (2012) **Biology and conservation of the freshwater turtles and tortoises of Peru.** *IRCF Reptiles & Amphibians* 19(2):103–116.
- Fuccio H, Carvalho ER, Vargas G (2003) **Perfil da caça e dos caçadores no estado do Acre, Brasil.** *Aportes Andinos* 6:1–18.
- Hallett MT, Kinahan AA, McGregor R, Baggallay T, Babb T, Barnabus H, Wilson A, Li FM, Boone WW, Bankovich BA (2019) **Impact of low-intensity hunting on game species in and around the Kanuku Mountains Protected Area, Guyana.** *Frontiers in Ecology and Evolution* 7:1–12. doi: [10.3389/fevo.2019.00412](https://doi.org/10.3389/fevo.2019.00412).
- Instituto Chico Mendes de Conservação da Biodiversidade - ICMBio (200) **Plano de Manejo da Reserva Extrativista do Cazumbá-Iracema.** [[https://www.icmbio.gov.br/portal/images/stories/imgs-unidades-coservacao/resex\\_cazumba-iracema.pdf](https://www.icmbio.gov.br/portal/images/stories/imgs-unidades-coservacao/resex_cazumba-iracema.pdf)] Accessed 07 November 2021.
- Lemos LP, El Bizri HR, Valsecchi J, Santos AS, Koga DM, Silva FE (2018) **Caça de vertebrados no Parque Nacional da Serra do Divisor, Acre.** *Biodiversidade Brasileira* 8(1):69–88. doi: [10.37002/biobrasil.v8i1.795](https://doi.org/10.37002/biobrasil.v8i1.795).
- Maués RH, Maués MAM (1978) **O modelo da "Reima": representações alimentares em uma comunidade amazônica.** *Anuário Antropológico* 2(1):120–147.
- Medeiros MFST, Garcia L (2006) **Consumo e as estratégias de caça utilizadas pelas populações tradicionais da Reserva Extrativista Chico Mendes.** *Interações* 7(12):121–134.
- Mesquita GP, Rodríguez-Teijeiro JD, Barreto LN (2018) **Patterns of mammal subsistence hunting in Eastern Amazon, Brazil.** *Wildlife Society Bulletin* 42(2):272–283. doi: [10.1002/wsb.873](https://doi.org/10.1002/wsb.873).
- Morcatty T, Valsecchi J (2015a) **Social, biological, and environmental drivers of the hunting and trade of the endangered yellow-footed tortoise in the Amazon.** *Ecology and Society* 20(3):3. doi: [10.5751/ES-07701-200303](https://doi.org/10.5751/ES-07701-200303).
- Morcatty T, Valsecchi J (2015b) **Confirming the occurrence of the endangered yellow-footed tortoise in flooded forests of the Amazon.** *Oryx* 49(4):577–580. doi: [10.1017/S003060531500071X](https://doi.org/10.1017/S003060531500071X).
- Morcatty TQ, Tavares AS, Nijman V, Valsecchi J (2020) **Adapting a traditional hunting technique to improve capture rates for the endangered yellow-footed tortoise (*Chelonoidis denticulatus*) during ecological surveys in Amazonia.** *Journal of Ethnobiology* 40(2): 252–267. doi: [10.2993/0278-0771-40.2.252](https://doi.org/10.2993/0278-0771-40.2.252).
- Nunes AV, Guariento RG, Santos BA, Fischer E (2019) **Wild meat sharing among non-indigenous people in the southwestern Amazon.** *Behavioral Ecology and Sociobiology* 73(26):1–10. doi: [10.1007/s00265-018-2628-x](https://doi.org/10.1007/s00265-018-2628-x).
- Oliveira RD, Calouro AM, Botelho ALM, Oliveira

- MA (2018) **Calendário de caça na gestão da fauna cinegética amazônica: implicações e recomendações.** *Biodiversidade Brasileira* 8(2):304–316. doi: [10.37002/bio-brasil.v%25vi%25i.788](https://doi.org/10.37002/bio-brasil.v%25vi%25i.788).
- Oliveira MA, Calouro AM (2019) **Hunting agreements as a strategy for the conservation of species: the case of the Cazumbá-Iracema Extractive Reserve, state of Acre, Brazil.** *Oecologia Australis* 23(2):357–366. doi: [10.4257/oeco.2019.2302.13](https://doi.org/10.4257/oeco.2019.2302.13).
- Oliveira MN, Costa EN, Vasconcelos VS, Matos RP, Moraes LGL, Correia MJ, Lopes-Filho II, Silva MIA, Silva TL (2019) **Consumo de quelônios no perímetro urbano de Cruzeiro do Sul, Acre, Brasil.** *Gaia Scientia* 13(4):99–108. doi: [10.22478/ufpb.1981-1268.2019v13n4.47149](https://doi.org/10.22478/ufpb.1981-1268.2019v13n4.47149).
- Oliveira MA, El Bizri HR, Morcatty TQ, Messias MR, Doria CRC (2022) **Freelisting as a suitable method to estimate the composition and harvest rates of hunted species in tropical forests.** *Ethnobiology and Conservation* 11:8. doi: [10.15451/ec2022-03-11.08-1-](https://doi.org/10.15451/ec2022-03-11.08-1-).
- Panzutti NM (1999) **Impureza e perigo para povos de floresta.** *Ambiente & Sociedade* 5:69–78. doi: [10.1590/S1414-753X1999000200006](https://doi.org/10.1590/S1414-753X1999000200006).
- Parry L, Day B, Amaral S, Peres CA (2010) **Drivers of rural exodus from Amazonian headwaters.** *Population and Environment* 32(2-3):137–176. doi: [10.1007/s11111-010-0127-8](https://doi.org/10.1007/s11111-010-0127-8).
- Pezzuti JCB, Lima JP, Félix-Silva D, Begossi A (2010) **Uses and taboos of turtles and tortoises along Rio Negro, Amazon Basin.** *Journal of Ethnobiology* 30(1):153–168. doi: [10.2993/0278-0771-30.1.153](https://doi.org/10.2993/0278-0771-30.1.153).
- Pezzuti JCB, Lima JP, Félix-Silva D, Rebêlo GH (2004) **A caça e a pesca no Parque Nacional do Jaú, Amazonas.** In: Borges SH, Iwanaga S, Durigan CC, Pinheiro MR (eds) *Janelas para a Biodiversidade no Parque Nacional do Jaú*. Fundação Vitória Amazônica, Manaus, pp. 213–230.
- Rueda-Almonacid JV, Carr JL, Mittermeier RA, Rodriguez-Mahecha JV, Mast RB, Vogt RC, Rhodin AGJ, Ossa-Velásquez J, Rueda JN, Mittermeier CJ (2007) **Las tortugas y los cocodrilianos de los países andinos del trópico.** Editora Panamericana, Bogotá, CUN, Colômbia.
- Sobral-Souza T, Lautenschlager L, Morcatty TQ, Bello C, Hansen D, Galetti M (2017) **Rewilding defaunated Atlantic Forests with tortoises to restore lost seed dispersal functions.** *Perspectives in ecology and conservation* 15(4):300–307. doi: [10.1016/j.pecon.2017.08.005](https://doi.org/10.1016/j.pecon.2017.08.005).
- Reis YS, Valsecchi J, Queiroz H (2018) **Caracterização do uso da fauna silvestre para subsistência em uma Unidade de Conservação no oeste do Pará.** *Biodiversidade Brasileira* 8(2):187–202. doi: [10.37002/bio-brasil.v%25vi%25i.796](https://doi.org/10.37002/bio-brasil.v%25vi%25i.796).
- Sampaio R, Morato RG, Abrahams MI, Peres CA, Chiarello AG (2022) **Physical geography trumps legal protection in driving the perceived sustainability of game hunting in Amazonian local communities.** *Journal for Nature Conservation* 67:126175. doi: [10.1016/j.jnc.2022.126175](https://doi.org/10.1016/j.jnc.2022.126175).
- Shaffer CA, Milstein MS, Yukuma C, Marawanaru E, Suse P (2017) **Sustainability and comanagement of subsistence hunting in an indigenous reserve in Guyana.** *Conservation Biology* 31(5):1119–1131. doi: [10.1111/cobi.12891](https://doi.org/10.1111/cobi.12891).
- Shoobridge D (2018) **El mercado de la cacería – la cacería del mercado: carne de origen silvestre en bosques tropicales.** *Scientia Agropecuaria* 10(3):433–448. doi: [10.17268/sci.agropecu.2019.03.15](https://doi.org/10.17268/sci.agropecu.2019.03.15).
- Smith M, Nelson BW (2011) **Fire favors expansion of bamboo-dominated forests in the south-west Amazon.** *Journal of Tropical Ecology* 27:59–64. doi: [10.1017/S026646741000057X](https://doi.org/10.1017/S026646741000057X).
- Stevenson P, Borda CA, Rojas A, Álvarez M (2007) **Population size, habitat choice and sexual dimorphism of the Amazonian tortoise (*Geochelone denticulata*) in Tinigua National Park, Colombia.** *Amphibia-Reptilia* 28(2):217–226. doi: [10.1163/156853807780202459](https://doi.org/10.1163/156853807780202459).
- Tavares AS, Morcatty TQ, Zuanon J, Magnusson WE (2019) **Influence of body size, topography, food availability and tree-fall gaps on space use by yellow-footed tortoises (*Chelonoidis denticulatus*) in Central Amazonia.** *PloS one* 14(2):e0211869. doi: [10.1371/journal.pone.0211869](https://doi.org/10.1371/journal.pone.0211869).
- Tavares AS, Mayor P, Loureiro LF, Gilmore MP, Perez-Peña P, Bowler M, Lemos LP, Svensson MS, Nekaris KAI, Nijman V, Valsecchi J, Morcatty TQ (2020) **Widespread use of traditional techniques by local people for hunting the yellow-footed tortoise (*Chelonoidis denticulatus*) across the Amazon.** *Journal of Ethnobiology* 40(2):268–280. doi: [10.2993/0278-0771-40.2.268](https://doi.org/10.2993/0278-0771-40.2.268).
- Tortoise & Freshwater Turtle Specialist Group (1996) *Chelonoidis denticulata* (In: IUCN Red List of Threatened Species 1996). IUCN. [<https://dx.doi.org/10.2305/IUCN.UK.1996.RLTS.T9008A12949796.en>.] Accessed 05 April 2022

Van Vliet N, Antunes AP, Constantino PDAL, Gómez J, Santos-Fita D, Sartoretto E. (2019) **Frameworks regulating hunting for meat in tropical countries leave the sector in the Limbo.** *Frontiers in Ecology and Evolution* 7:280. doi: 10.3389/fevo.2019.00280.

Vogt RC (2008) **Tartarugas da Amazônia.** Editora Biblios, Lima, LM, Peru. doi: 10.1016/j.pecon.2017.08.005.

Vogt RC, Fagundes CK, Bataus YSL, Balestra RAM, Batista FRW, Uhlig VM, Silveira AL, Bager A, Batistella AM, Souza FL, Drummond GM, Reis IJ, Bernhard R, Mendonça SHST, Luz VLF (2015) **Avaliação do Risco de Extinção de *Ch-***

***elonoidis denticulatus* (Linnaeus, 1766) no Brasil** (In: Processo de avaliação do risco de extinção da fauna brasileira). ICMBio. [<http://www.icmbio.gov.br/portal/biodiversidade/fauna-brasileira/estado-de-conservacao/7400-repteis-chelonoidis-denticulatus-jabuti-amarelo.html>] Accessed 05 April 2022.

**Received:** 20 January 2022

**Accepted:** 27 April 2022

**Published:** 2 May 2022

**Editor:** Rômulo Alves