

# Hunting and hunters of the Amazonian manatee in a Brazilian protected area

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## Abstract

The Amazonian manatee has been hunted since antiquity and is part of local culture and tradition. Although protected by law, manatees continue to be hunted for food and trade. In most regions where the species occurs there are no reliable data on current hunting pressure. In addition, difficulty in determining its abundance prevents the definition of the species' conservation status. Through an interdisciplinary research approach bringing together quantitative and qualitative data in the context of a trusting relationship with our local community partners, we assess current hunter profiles and associated hunting data. Hunting manatees in this region is linked to strong family traditions. The belief that 'manatees are not for everyone' as well as the considerable value given to their meat, results in hunters being recognized and admired. The manatees of Amanã are vulnerable to hunting year-round, throughout their route of in-reserve seasonal migration, and probably throughout other migration routes in the region. We conclude that if conservation is to be effective, the professionals, policies, and practices involved must consider

### Keywords:

Sirenians; local knowledge; endangered species; *Trichechus inunguis*; wildlife use.

local traditions related to manatee consumption. Likewise, the difficulty for local communities to fully grasp the threat of extinction to the species poses a significant challenge to conservation efforts. The information on manatee hunting in the Amanã Sustainable Development Reserve generated by this work is unprecedented for the species and has served as the basis for monitoring and establishing conservation measures appropriate to the local reality.

## Introduction

The Amazonian manatee (*Trichechus inunguis*) inhabits the Amazon basin in Brazil, Peru, Colombia, and Ecuador, and is the only representative of the order Sirenia restricted to freshwater (Best, 1984; Rosas, 1994). For centuries, the manatee has occupied a central place in local culture and tradition. Due to its large size and a local appreciation for the taste of the meat, it has a long history of being hunted by inhabitants of the region (Rosas, 2001). Since the mid-1500s, manatees have been the focus of large-scale commercial hunting for meat and leather, and an export trade (Domning, 1982; Best, 1984).

In the mid-1950s, with the appearance of synthetic materials, the use of manatee leather decreased considerably (Best, 1984; Rosas, 2001). Nowadays, despite laws prohibiting hunting, the species continues to be a target for local consumption and trade (Marmontel et al., 2016). It is included in Appendix I of the CITES and it is classified as "Vulnerable" based on an estimated population decline of at least 30% within the next three generations (Marmontel et al., 2016; IUCN, 2022). Other threats to its conservation include the capture of calves, accidental death in large commercial fishing nets, and habitat destruction (Calvimontes & Marmontel, 2010).

Research on manatees in the wild is particularly difficult because of their stealthy behavior, water turbidity and because they can spend much time under large stretches of aquatic macrophytes (Montgomery et al., 1981; Best 1984; Timm et al., 1986). In most regions where the species occurs there is no reliable data on actual hunting pressure; additionally, difficulty in determining its abundance prevents the definition

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of the species' actual conservation status. The research we present here evaluates the current hunting pressure on the Amazonian manatee, describes related local knowledge, analyzes characteristics of hunters, and discusses prospects for the activity in the Amanã Sustainable Development Reserve. This information is unprecedented for the species as a whole and has served as the basis for monitoring and establishing conservation status and measures to reduce Amazonian manatees' hunting appropriate to the local context.

Our research is founded on the understanding that conservation efforts should include local partners to be effective and should incorporate local knowledge and beliefs into conservation planning (Huntington, 2000; Carlsson & Berkes, 2005). For more than twenty years, the Research Group on Amazonian Aquatic Mammals of the Mamirauá Sustainable Development Institute has conducted research and conservation actions for the Amazonian manatee at the Mamirauá and Amanã Sustainable Development Reserves (MSDR and ASDR), middle Solimões River, in the Brazilian state of Amazonas (Fig. 1). Throughout this period, the project

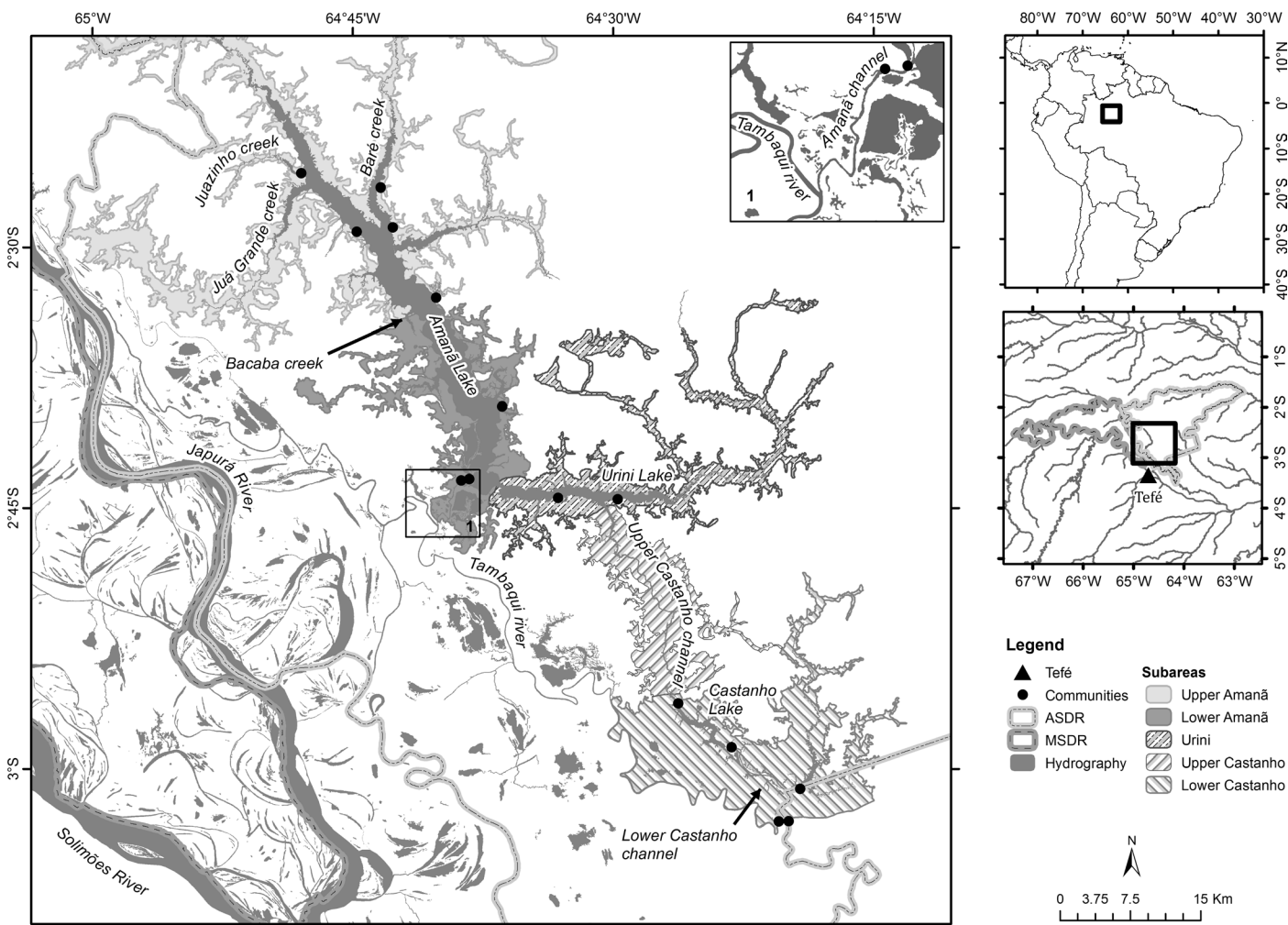
incorporated local knowledge and practices, and the participation of local residents in research and conservation initiatives.

## Materials and methods

### Study area

The ASDR, located in the middle Solimões River region, encompasses approximately 2,313,000 ha of *várzea*, *igapó* and *terra firme* forests (Queiroz, 2005). The Amanã Lake, which gives its name to the reserve, is a large terra firme lake and one of the largest in the Amazon region – approximately 45 km long and 2 – 3 km wide (Fig. 1). Its headwaters are located in black-water ecosystems, while its lower third is influenced by the white-waters of the Japurá and Solimões rivers<sup>1</sup>.

Fifteen communities were selected for the study. They are located along approximately 120 km of waterways used by manatees migrating from *várzea* regions of Castanho Lake, where they feed during the flood season, to Amanã Lake, where they



**Figure 1.** Map of the study area showing the location of the ASDR in the Brazilian Amazon, with detailed graphics of the study subareas.

<sup>1</sup> Representatives of white-water rivers are the Solimões/Amazon River and its major tributaries (Juruá, Japurá, Purus, and Madeira rivers). Parts of the catchment areas of these rivers are in the Andes and pre-Andean zone, which soils are rich in clay minerals. The waters of these rivers are muddy (“white”) because of high loads of suspended sediments and have a high nutritional status. On the other hand, the most important black-water river in Brazil is the Negro River. The catchment covers old, strongly weathered tertiary sediments composed of kaolinitic soils, large areas of white sands (podzols), and the rocky archaic Guiana Shield. The water is poor in suspended solids, transparent, has a dark, reddish-brown color (“black”), and has a very low nutritional status (Junk et al., 2015). Commonly, white-water river floodplains are called *várzeas*, while black-water river floodplains are called *igapós*.

remain in the dry season (Arraut et al., 2010). This migratory axis was chosen as the research area because of seasonal movements previously confirmed by telemetry, and because of the presence of families knowledgeable in all matters related to the manatee (Calvimontes & Marmontel, 2010).

### Data collection

Before the start of our data collection, in 2002, we held meetings in each community where the research would be carried out to communicate our objectives, methods, and the importance of the project. During these meetings, the community voiced questions, comments, and suggestions, and we provided the community with written materials containing pertinent information. We visited and consulted with all community leaders about the development of the research. After that, we received their consent to carry out our study, and to use the information collected. In addition, we participated in the monthly meetings of the ASDR residents' association for the same purpose of maintaining transparency and consent with our community partners.

We conducted structured, semi-structured, and open interviews to gather data on: (1) hunting methods and timing; (2) local ecological knowledge and perceptions about manatees; (3) hunter profiles; (4) quantitative data on hunting events; and (5) the cultural context and prospects to hunting. Our questions about hunting activity referred to methods and weapons, location, date, seasonal variation, size and sex of the animal, female reproductive status, byproducts, and meat destination. Hunter profiles included data on age, background, economic activities, and perceptions about the activity.

We interviewed our community partners, who are primarily hunters and their relatives (not necessarily hunters), known as the *conhecedores do peixe-boi da Reserva Amanã* (manatee experts of the Amanã Reserve). We contacted our partners by the snowball technique (Ortega-Argueta et al., 2012). In this paper, we refer to respondents as "community partners" to highlight the reciprocal and collaborative relationship that we strived to construct with local communities. We use the terms "active hunters" (those who hunted at least one animal during the study period) and "inactive hunters" (those who are no longer hunting but have the knowledge to resume hunting at any time, should they so choose). This distinction is relevant to the analysis of the past, present, and future of hunting.

Because manatee hunting is prohibited by law (Law n° 5.197/67, Wildlife Protection Law) the relationship between the researchers and, especially, active hunters was based on trust built up over the years of our fieldwork. During the first three years, we visited our partners' homes until we were able to ascertain all the themes and considerations for our study. Informal conversations with our partners and the communities' leaders contributed not only to building trust, but also to obtaining additional information for guiding interviews, gaining a more complete understanding of the local reality, and consolidating the network of partners that could provide data on current hunting events. This additional information shed light on local terms, kinship networks, settlement and environmental history, and residents' positions on conservation of natural resources.

We took several measures to increase the reliability of our data. When hunters refused or felt uncomfortable providing information

on some hunting events, other partners provided this information. We triangulated (Hussein, 2009) our partners' accounts both (a) temporally, when the same person was asked about the same subject and/or hunting event on several occasions; and (b) methodologically, conducting semi-structured and open interviews, informal conversations, mapping, closed questionnaires, and field trips to detail and confirm information. Three meetings (2002, 2004, 2011) were held with our partners to share new information, research results, opinions, and alternatives for manatee conservation in the region. We maintained continuous presence in the field and contact with partners to record all hunted animals and associated data.

### Data analysis

For the interview data, we analyzed demographics and socio-economic history of Amanã region; number and characteristics of hunted manatees; methods and hunting gear; relationship between seasonal water levels and hunting; byproducts and associated practices; meat destination, and finally, characteristics of hunters and their motivations and prospects about the activity. Manatee size was generally stated in *palmas*, the common local measurement based on hand-width (20 cm per *palmo*). Partners' socio-demographic data were derived directly from them. Since data on hunting events provided by third parties may be incomplete and not all partners responded to all questions, our sample sizes may not reflect the actual total number of hunting events or interviews (this specific "n" is included for each analysis).

For analytical purposes, the study area was divided into five subáreas, that generally share ecological characteristics. These are (1) Upper Amanã: from the headwaters of Amanã Lake to Bacaba Creek in the mid-area of the lake, mainly *terra firme*; (2) Lower Amanã: from Bacaba Creek, the entire lower section of Amanã Lake, as well as the upper portion of Amanã Channel, partially *várzea*; (3) Urini: all Urini Lake, a *várzea* region; (4) Upper Castanho: the Upper Castanho Channel connects Urini Lake with Castanho Lake; and (5) Lower Castanho: all Castanho Lake, and the lower portion of Castanho Channel to its mouth in Tambaqui River, also a *várzea* region (Fig. 1).

Our research was conducted prior to the Brazilian legal requirement of formal documentation that gives special protection to participants in scientific research involving human beings (*Resolução* N° 466, 12 December 2012). However, our consultative, community-based approach meets these ethical requirements in that it has secured community approval at all stages of the research. To respect the privacy of the hunters interviewed, the data presented here have been anonymized. Our research follows the mandates of the International Society of Ethnobiology Code of Ethics.

## Results

### Demographics and socio-economic history

Forty-one partners shared their knowledge about the manatee. They are not evenly distributed among the study subareas because the population of the ASDR is settled in specific communities (eight partners in Upper Amanã; 16 in Lower Amanã; 10 in

Urini; none in Upper Castanho; and seven in Lower Castanho). The average age was 50.6 years (SD = 15.4; range = 27 – 86). Partners belonged to 15 families with strong kinship ties. Most of these families (53.9%) originated in northeastern Brazil, as their ancestors migrated to the Amazon during the rubber boom period (Santos, 1980). Later, in the early twentieth century, they moved to the Amanã Lake region, known for its abundant resources. For instance, one 78-year-old resident of Urini Lake noted that

‘My paternal grandfather came to Amanã when he was around 25 years old. He had already heard about Amanã Lake, famous for the abundance of manatee, *pirarucu* [*Arapaima gigas*], *tracajá* [*Podocnemis unifilis*], *tartaruga* [*Podocnemis expansa*] and other products’.

This period is locally known as ‘time of the abundance’ and older residents remember *barracões*, large extended family houses used as warehouses and places for social and commercial activities. Our partners often referred to the ancestors that migrated to Amanã from northeastern Brazil as *arigó* (‘one who does not know how to do anything; one who does not know how to fish, build canoes, hunt, or walk in the forest’). They said that there were already many *arigós* at the beginning of the twentieth century who had learned to hunt, fish, and build canoes over time, usually through contact with residents who had more time in the region. According to our partners, these newcomers learned to hunt manatee from the already existing local populations or ‘alone, because there were a lot of manatees at that time, and it was easy to learn’.

Older residents (those who were over 60 years old) have carried out various economic activities throughout their lives, such as commercial hunting and fishing, and the extraction of rubber and other forest products. At present, most partners (90%, n = 41) consider themselves agriculturalists (mainly working on *roças*, areas where slash-and-burn techniques have been used), in addition to their activities with fishing and/or livestock. This change is related to the economic security the Amanã residents indicated feeling after becoming agriculturalists: ‘I prefer agriculture, it is safer. Hunting and fishing are just to eat. When I was young, we were fishing 1,500 kg of *pirarucu* per month, but we could not do anything, buy anything, or improve our lives. Now we live steadier’.

Most of our partners (40 of 41) were male. Women participated in our three meetings held in the area, in numerous informal conversations, and on many occasions contributed their knowledge while their husbands were being interviewed. Only one female hunter, who was the daughter, mother and wife of famous hunters was identified in the region but is now deceased.

#### Number of hunted manatees

A total of 129 manatees were hunted in the study area between January 2002 and June 2008 (Tables 1 and 2). There is variation in hunting intensity and hunter demographics within each project subarea. We consider this number to be close to the real value because the hunting of a manatee is a special and uncommon event, news of which traveled quickly through our network.

**Table 1.** Hunting events of Amazonian manatees in each study subarea and total of ASDR between January 2002 and June 2008. Each variable has its own sample size (n).

n = 129	Date n = 129	Subarea n = 129	Sex <sup>a</sup> n = 94	Length (cm) n = 95	Hunting gear <sup>b</sup> n = 112	Byproducts <sup>c</sup> n = 57	Meat destination <sup>d</sup> n = 96	Observations
1	Jan 2002	Lower Amanã	M	160	H		Fo	
2	Mar 2002	Urini	F	250	H	To, S	Fo, Sh	
3	Apr 2002	Lower Castanho	F	290	H		Fo, Sh, T	
4	May 2002	Lower Castanho	F	280	H	Mx, To	Fo, T	
5	Jul 2002	Lower Amanã	F	220	H	Mx, To, S		
6	Jul 2002	Lower Amanã	M	260	H	Mx, To, S		
7	May 2002	Lower Castanho			H			
8	May 2002	Lower Castanho			H			
9	May 2002	Lower Castanho			H			
10	May 2002	Lower Castanho			H			
11	Jun 2002	Lower Castanho			H			
12	Jun 2002	Lower Castanho			H			
13	Jun 2002	Lower Castanho			H			
14	Jun 2002	Lower Castanho			H			
15	Jul 2002	Lower Castanho			H			
16	Jul 2002	Lower Castanho			H			
17	Aug 2002	Urini	F	240	H	Mx	Fo, Sh, T	
18	Oct 2002	Urini	F	160	H		Fo, Sh	
19	Jan 2003	Urini	F(p)	180	H	Mx, To	Fo, Sh, T	
20	Jan 2003	Lower Castanho	M	180	H	Mx		
21	Feb 2003	Urini	M	200	H	Mx	Fo, T	
22	Feb 2003	Lower Amanã	M	240	H	Mx, To, S	Fo, Sh, T	
23	Mar 2003	Lower Castanho	M	140	H	FM	Fo, Sh	
24	May 2003	Lower Amanã	F(p)	260	H	Mx, To, S	Fo, Sh, T	
25	May 2003	Lower Castanho	M	180	H		Fo, Sh, T	
26	May 2003	Lower Castanho						
27	Jun 2003	Lower Castanho				Mx		
28	Jun 2003	Lower Castanho	F(p)		H		Fo, Sh, T	
29	Jun 2003	Lower Castanho	F(p)		H		Fo, Sh, T	
30	Jun 2003	Lower Castanho			H		Fo, Sh, T	

**Table 1 continued.** Hunting events of Amazonian manatees in each study subarea and total of ASDR between January 2002 and June 2008. Each variable has its own sample size (n).

n = 129	Date n = 129	Subarea n = 129	Sex <sup>a</sup> n = 94	Length (cm) n = 95	Hunting gear <sup>b</sup> n = 112	Byproducts <sup>c</sup> n = 57	Meat destination <sup>d</sup> n = 96	Observations
31	Jun 2003	Lower Castanho			H		Fo, Sh, T	
32	Jun 2003	Lower Castanho			H		Fo, Sh, T	
33	Jun 2003	Lower Castanho			H		Fo, Sh, T	
34	Jun 2003	Lower Castanho			H		Fo, Sh, T	
35	Jul 2003	Lower Castanho			H		Fo, Sh, T	
36	Jul 2003	Lower Castanho			H		Fo, Sh, T	
37	Jul 2003	Lower Castanho			H		Fo, Sh, T	
38	Jul 2003	Lower Castanho			H		Fo, Sh, T	
39	Aug 2003	Lower Castanho	M	180	H	Mx		
40	Aug 2003	Lower Castanho						
41	Sep 2003	Lower Castanho		160	H			
42	Sep 2003	Lower Castanho	M	80			Ta	Calf captured in the Tambaqui River and sold alive
43	Sep 2003	Lower Amanã	M	200	H	Mx, To	Fo, Sh	
44	Nov 2003	Upper Amanã	F	275	H	Mx, To, S, FM	Fo, Sh, T	260 kg weight
45	Jan 2004	Lower Castanho						
46	Jan 2004	Lower Castanho						
47	Jan 2004	Upper Castanho	M	220			Fo, Sh, T	
48	Jan 2004	Urini	M	220				
49	Jan 2004	Lower Amanã	F	160	H		Fo, Sh, T	
50	Jan 2004	Upper Amanã	F	60	H	FM	Fo	Calf carcass recovered as it floated down one of the creeks at Amanã Lake headwaters
51	Jan 2004	Lower Amanã	M	180	H	To, FM	Fo, Sh, T	
52	Feb 2004	Upper Amanã	F	240	H	Mx, To	Fo, Sh	251 kg weight
53	Feb 2004	Upper Castanho	F	240				
54	Mar 2004	Lower Castanho	M	180	H			
55	Mar 2004	Lower Castanho	F	160	H			
56	Mar 2004	Upper Amanã	F	80		To, FM	Fo	Calf found dying next to her dead mother in creek of Amanã Lake headwaters. 25 kg weight
57	Mar 2004	Urini	F	260	H	To, FM, SM	Fo, Sh, T	
58	Apr 2004	Lower Amanã	F	240	H	S, FM	Fo, Sh	
59	Apr 2004	Urini	F	160	H	Mx	Fo, Sh	
60	May 2004	Lower Castanho			H			
61	May 2004	Upper Castanho						
62	Jun 2004	Urini	M	220	H	FM	Fo, Sh, T	
63	Jun 2004	Lower Castanho	F	260	H			
64	Jun 2004	Lower Castanho						
65	Jul 2004	Lower Castanho						
66	Sep 2004	Urini	F	160				
67	Sep 2004	Lower Amanã	F	160	H	To, FM	Fo, Sh	Yielded 5 l of lard
68	Sep 2004	Urini	M					
69	Dec 2004	Urini	F	125	H		Fo, T	
70	Jan 2005	Urini	F	200			Fo, Sh	
71	Feb 2005	Urini	F	160	H	To	Fo, T	
72	Apr 2005	Urini	F	220	H		Fo, Sh, T	
73	Apr 2005	Lower Castanho		160			Fo, Sh	
74	Jun 2005	Urini	M	200	H	To	Fo, Sh, T	Yielded 5 l of lard
75	Jul 2005	Upper Castanho		180	H		Fo, T	
76	Jul 2005	Urini	F	300	H			Swam away with the harpoon and was found ten days later
77	Jul 2005	Lower Castanho	F	290	H	Mx, To, FM	Fo, Sh, T	Yielded one <i>mixira</i> can
78	Aug 2005	Lower Amanã	F(p)	210	H	Mx, To	Fo, Sh	Yielded one can of lard
79	Sep 2005	Lower Castanho	F	240	H	FM	Fo, Sh	
80	Dec 2005	Upper Amanã	M	160	H	Mx, To	Fo	
81	Dec 2005	Lower Castanho	M	160	H	To, FM		
82	Jan 2006	Lower Castanho	F(p)	240	T, H			This and the following four manatees were hunted in the same event
83	Jan 2006	Lower Castanho	M	160	T, H			See above

**Table 1 continued.** Hunting events of Amazonian manatees in each study subarea and total of ASDR between January 2002 and June 2008. Each variable has its own sample size (n).

n = 129	Date n = 129	Subarea n = 129	Sex <sup>a</sup> n = 94	Length (cm) n = 95	Hunting gear <sup>b</sup> n = 112	Byproducts <sup>c</sup> n = 57	Meat destination <sup>d</sup> n = 96	Observations
84	Jan 2006	Lower Castanho	M	180	T, H			See above
85	Jan 2006	Lower Castanho	F	260	T, H			See above
86	Jan 2006	Lower Castanho		180	T, H			See above
87	Jan 2006	Urini	M	200	H			
88	Jan 2006	Upper Castanho	M	220	H	Mx		Yielded 15 l of lard
89	Feb 2006	Upper Amanã	M	220	H		Fo, Sh	
90	Feb 2006	Upper Castanho	F	180	H		Fo, Sh	
91	Feb 2006	Upper Castanho	M	180	H	Mx, To	Fo, Sh	
92	Feb 2006	Upper Castanho	M	220	H		Fo, Sh	
93	Mar 2006	Lower Amanã	F	225	H	Mx, To, S, FM	Fo, Sh	
94	Mar 2006	Lower Castanho	M					
95	May 2006	Upper Castanho		180	H	SM	Fo, T	
96	May 2006	Upper Castanho	F	220	H	SM	Fo, T	
97	Jun 2006	Lower Castanho	F	200	H		Fo, Sh	
98	Jul 2006	Urini	F	240	H	Mx	Fo, Sh, T	
99	Jul 2006	Urini	M	160	H		Fo, Sh, T	
100	Aug 2006	Lower Amanã	F(p)	220	H	Mx, To	Fo, T	There was one calf with this female
101	Aug 2006	Lower Amanã	M	240	H	Mx, To	Fo, Sh	
102	Sep 2006	Lower Amanã	M	300	H	Mx, To	Fo, Sh	
103	Dec 2006	Upper Amanã	F	130	G	Mx, To	Fo, Sh	
104	Dec 2006	Upper Amanã	F	220	H	FM	Fo, Sh	
105	Jan 2007	Lower Amanã	F	200	H	Mx, To, S	Fo, Sh, T	
106	Jan 2007	Urini	F	280	H	Mx, To, S	Fo, Sh	
107	Apr 2007	Lower Castanho	M	240	H	Mx, To	Fo, Sh, T	
108	Apr 2007	Lower Castanho	M	280	H	Mx, To	Fo, Sh, T	Yielded 63 kg of meat and 11 l of lard
109	Apr 2007	Lower Castanho	F		H		Fo, T	
110	May 2007	Lower Castanho	M	240	H		Fo, T	
111	May 2007	Lower Castanho	M	200	H	Mx, To, S	Fo, Sh, T	
112	May 2007	Lower Amanã	M	160	H	To	Fo, Sh	
113	Jul 2007	Urini	F	160	H		Fo, Sh	
114	Jul 2007	Urini	M	230	H	To, S	Fo, Sh	Yielded 10 l of lard
115	Aug 2007	Upper Amanã	F	120	G, H		Fo	
116	Aug 2007	Lower Amanã	F	260	H	Mx, SM	Fo, Sh, T	
117	Sep 2007	Urini	F	180	H		Fo	
118	Sep 2007	Urini	M	240	G		Fo	
119	Sep 2007	Urini		120	G		Fo	
120	Dec 2007	Upper Amanã	M	220	H	SM	Fo	
121	Dec 2007	Lower Castanho	M	250	H		Fo, T	This and the following two were hunted in the same event
122	Dec 2007	Lower Castanho	M	200	H		Fo, T	See above
123	Dec 2007	Lower Castanho	M	260	H	Mx	Fo, Sh, T	See above
124	Dec 2007	Lower Amanã	M	260	H	Mx, FM	Fo, T	
125	Jan 2008	Lower Castanho			H		Fo, T	
126	Jan 2008	Urini	M	240	H	FM	Fo, T	
127	Jan 2008	Lower Amanã	F	220	H	SM	Fo, Sh	
128	Feb 2008	Lower Amanã	F(p)	240	H	Mx, To	Fo, Sh	Yielded one can of lard
129	Jun 2008	Lower Amanã	M	210	H	Mx, To, S	Fo, Sh	Yielded a half of can of lard

<sup>a</sup>M = male; F = female; F(p) = female pregnant<sup>b</sup>H = harpoon; G = gillnet; T = trawl<sup>c</sup>Mx = *mixira*; To = *torresmo*; S = sausage; FM = fresh meat; SM = salted meat<sup>d</sup>Fo = food for the hunter and his family; Sh = sharing among neighbors; T = trade; Ta = trade alive

### Sex of hunted manatees

Slightly more female than male manatees were hunted, with 16% of the females being pregnant (Table 2). Hunters believe that it is easier to hunt males because females are more careful and alert. Some hunters said, 'males are more stupid', so to hunt a female 'you have to be even smarter' or 'lucky'. The only time

females are supposedly easier to hunt is when they are with a calf. Young manatees must emerge more often to breathe, rendering the mother more visible and vulnerable. Additionally, if a hunter manages to catch a calf, he often ties it to a nearby spot, using it as bait to lure the mother.

**Table 2.** Manatee hunting in each study subarea and total of ASDR between January 2002 and June 2008. Each variable has its own sample size (n).

Study subarea	Hunted manatees n = 129	Sex <sup>a</sup> n = 94	Length (cm) <sup>b</sup> n = 95	Hunting gear <sup>c</sup> n = 111	Byproducts <sup>d</sup> n = 57	Meat destination <sup>e</sup> n = 96
Upper Amanã	10 (7.8%)	M = 3 (30%) F = 7 (70%)	AM = 172.5 SD = 72.8	H = 8 G, H = 1 G = 1	Mx, To = 3 Mx, To, S, FM = 1 To, FM = 1 FM = 2 SM = 1	Fo = 5 Fo, Sh = 4 Fo, Sh, T = 1
Lower Amanã	22 (17.1%)	M = 10 (45.5%) F = 12 (54.5%) [F(p) = 4]	AM = 219.3 SD = 38.7	H = 22	Mx, To = 6 Mx, To, S = 6 Mx, To, S, FM = 1 Mx, SM = 1 Mx, FM = 1 To = 1 To, FM = 2 S, FM = 1 SM = 1	Fo = 1 Fo, Sh = 11 Fo, Sh, T = 6 Fo, T = 2
Urini	27 (20.9%)	M = 10 (38.5%) F = 16 (61.5%) [F(p) = 1]	AM = 204.0 cm SD = 46.0	H = 21 G = 2	Mx = 4 Mx, To = 1 Mx, To, S = 1 To = 2 To, S = 2 To, FM, SM = 1 FM = 2	Fo = 3 Fo, Sh = 8 Fo, Sh, T = 8 Fo, T = 4
Upper Castanho	10 (7.8%)	M = 4 (57.1%) F = 3 (42.9%)	AM = 204.4 SD = 24.0	H = 7	Mx = 1 Mx, To = 1 SM = 2	Fo, Sh = 3 Fo, Sh, T = 1 Fo, T = 4
Lower Castanho	60 (46.5%)	M = 17 (58.6%) F = 12 (41.4%) [F(p) = 3]	AM = 208.2 SD = 52.8	H = 45 T, H = 5	Mx = 4 Mx, To = 3 Mx, To, S = 1 Mx, To, FM = 1 To, FM = 1 FM = 2	Fo = 1 Fo, Sh = 4 Fo, Sh, T = 18 Fo, T = 6 T = 5 Ta = 1
<b>Total</b>	<b>129</b>	<b>M = 44 (46.8%) F = 50 (53.2%) [F(p) = 8 (16%)]</b>	<b>AM = 205.5 SD = 49.2</b>	<b>H = 102 (91.9%) G, H = 1 (0.9%) T, H = 5 (4.5%) G = 3 (2.7%)</b>	<b>Mx = 9 Mx, To = 14 Mx, To, S = 8 Mx, To, S, FM = 2 Mx, To, FM = 1 Mx, FM = 1 Mx, SM = 1 To = 3 To, S = 2 To, FM = 4 To, FM, SM = 1 S, FM = 1 FM = 6 SM = 4 [ΣMx = 36 (63.2%); ΣTo = 35 (61.4%); ΣS = 13 (22.8%); ΣFM = 16 (28.1%); ΣSM = 6 (10.5%)]</b>	<b>Fo = 10 Fo, Sh = 30 Fo, Sh, T = 34 Fo, T = 16 T = 5 Ta = 1 [ΣFo = 90 (93.8%); ΣSh = 64 (66.7%); ΣT = 56 (58.3%)]</b>

<sup>a</sup>M = male; F = female; F(p) = female (pregnant)

<sup>b</sup>AM = average (arithmetical mean); SD = standard deviation

<sup>c</sup>H = harpoon; G = gillnet; T = trawl

<sup>d</sup>Mx = *mixira*; To = *torresmo*; S = sausage; FM = fresh meat; SM = salted meat

<sup>e</sup>Fo = food for the hunter and his family; Sh = sharing among neighbors; T = trade; Ta = trade alive

Σ = Total number of events with given characteristic (e.g. ΣMx = total number of events in which *mixira* [Mx] was prepared).

Partners also indicated that because 'females are fatter', they prefer to hunt them over males. Pregnant females are even fatter, and hunters may take the fetus as well. The issue of fatness is paramount when a hunter measures his success, often more important than length. Manatee lard is one of the most prized byproducts, and its yield (measured in 20-liter cans) is highly valued.

### Size and weight of hunted manatees

The average length of the hunted manatees was 205.5 cm (SD = 49.2, 10.25 *palmos*, n = 95), but there is a large range in variation (60 – 300 cm) that includes three newborn calves (60 cm, 80 cm, and 80 cm) (Table 1). According to Rosas (1994), and local knowledge, the size of a manatee at birth is typically between four and five *palmos* (80 – 100 cm). The data indicate that 58 of

these animals (61.0%, n = 95) were adults (> 200 cm, 10 *palmas*), if we take both scientific (Vergara-Parente et al., 2010) and local knowledge into account (Fig. 2). There is no difference (p = 0.723) between the average size reported for the males (206.4 cm, SD = 41.8, 10.3 *palmas*, n = 42), and females (210.1 cm, SD = 55.4, 10.5 *palmas*, n = 47). Weight information is scarce (n = 3), but ranges from 25 – 260 kg (without viscera) (Table 1).

**Methods and hunting gear**

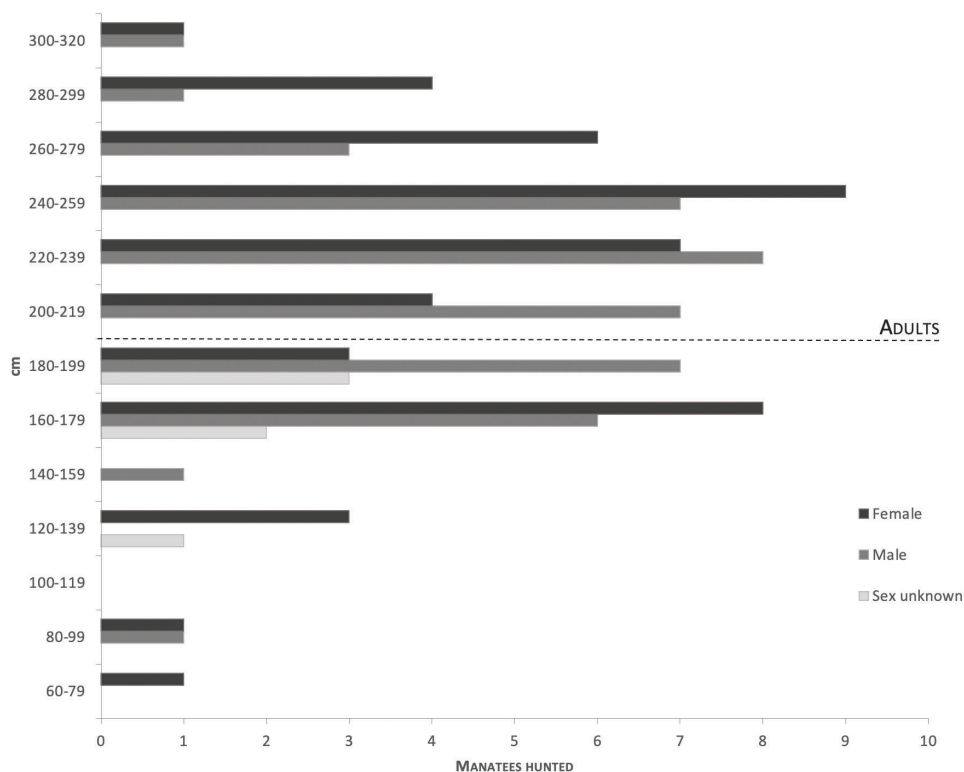
Harpoons were used in the majority of hunting events (97.3%, 108, n = 111). In most of these events (102, 91.9%), a harpoon was the sole gear used. Because specific *malhadeira* (gillnet) or *arrastão* (trawl) for hunting manatees do not exist, the events in which the harpoon is used in combination with these gears (6, 5.4%) are related to incidental and opportunistic catch. The use of only gillnets was reported in three events (2.7%). Two of them corresponded to young animals (120 cm and 130 cm) that, because of their size, the hunters do not need a harpoon to kill.

The harpoon to hunt manatees is smaller than the one used to catch *pirarucu*, because, as an old hunter at the headwaters of Amanã Lake indicated, ‘the bigger the harpoon the more difficult it is to enter the [manatee’s] skin. And as the manatee skin is tough, it does not rip open [and release the harpoon]’ (Fig. 3). The harpoon, which may be about 12 cm long, is set at the end of a *haste* (pole) and attached to a cable with a *boia* (float) at its end. The pole is usually made of *paracuúba* (*Mora paraensis*), a tree which wood is hard, but easy to work. The cable, formerly made of plant material, and currently from nylon, may only be 7 – 10 meters long (measured in *braças*, a measurement unit, roughly equivalent to 10 *palmas*), because ‘if it is too long, it entangles

and then it is hard to draw’ (Fig. 4). The float is traditionally made from a vine called *cortiça* (cork) and ‘the bigger the better, so the manatee does not take it to the bottom’. After spotting a manatee and before harpooning it, the hunters must stand up slowly in the canoe, making hardly any noise, because ‘no other animal hears better than the manatee’ and ‘because the manatee is good at sensing things’. The hunter must calculate the distance and location of the next time a manatee emerges on the surface (*boiada*), because ‘a good hunter knows where it [the manatee] will come up next’ (Fig. 5). An older hunter, member of a family with a strong hunting history, described the process:

‘A good fisherman can harpoon from a distance of 10 or 12 *braças*. But it is necessary to know how to do it right, because if you do not throw the harpoon steep, it bounces back. Usually, we throw the harpoon aiming at the [manatee’s] back, neck, or tail. The manatee bolts away and remains underwater. It can stay down and drown in 20 min or it can come out afloat. If it does not become entangled, we must wait for it to tire. In the second run, it is already tired. After harpooning it, you must hold the cable if the boat is good. But if the boat is small, it is best to drop the cable and throw the float out. By the third run, the manatee is exhausted. Then, we surround it, pulling the cable, and when it comes up near the canoe, we insert the wooden pegs [into the nostrils to asphyxiate it]. So, when it [the manatee] emerges we force the pegs more and more with a stick or something. Five minutes later it dies. It is best to use pegs because if we kill it with a club, it may take longer. After it is dead, we flood the canoe and place it inside’.

Gillnets, a relatively recent development in the region, have been widespread among fishermen in recent decades. They are



**Figure 2.** Frequency distribution (20-cm interval) of size of hunted manatees, discriminated by sex. This data shows that 61.0% (58, n = 95) were adults (> 200 cm, 10 *palmas*) (Vergara-Parente et al., 2010).





**Figure 3.** The harpoon to hunt manatees is shorter and thicker (top) than the one used to catch *pirarucu* (*Arapaima gigas*; bottom). Urini Lake, October 2022. Photo: Daniel Gonzalez-Socoloske.



**Figure 4.** The most common hunting gear for hunting Amazonian manatee. The harpoon is set at the end of a *haste* (pole) and attached to a cable. Upper Castanho channel, September 2022. Photo: Daniel Gonzalez-Socoloske.



**Figure 5.** Manatee hunters must stand up slowly in the canoe and calculate the distance and location of the next time a manatee emerges to the surface to kill it. Amanã channel, June 2004. Photo: Jorge Calvimontes.

especially used by younger fishermen because they require less experience, knowledge, and effort. When gillnets are left in flooded forests, *ressacas* (backwaters, frequently with macrophytes and grass patches), and streams, small manatees can get caught, drown, or be captured. The use of gillnets also causes conflicts between fishermen and other species such as otters (*Pteronura brasiliensis*), alligators (*Melanosuchus niger* and *Caiman crocodilus*), and dolphins (*Inia geoffrensis* and *Sotalia fluviatilis*) (Rosas-Ribeiro et al., 2012; Iriarte & Marmontel, 2013; Marmontel et al., 2015; Cook et al., 2022).

Manatee deaths are also caused by hooks-and-lines (*espinhel*) which are left for some period in the water and later inspected. When the manatees enter the flooded forest, they can become trapped in the hooks, attracted by the bait (mainly from rubber trees, *Hevea* sp., to catch *tambaquis*, *Colossoma macropomum*) or out of curiosity. Animals usually caught by this method are calves or individuals that still do not have sufficient strength to escape. The incidental capture of manatees with gillnets and hooks-and-lines poses a significant challenge to the conservation of the species, because this indiscriminate catch does not require specialized knowledge to cause manatee deaths.

The partners described the *pari* method as a way to facilitate hunting. In this method, hunters arrange a set of wooden sticks in a fence formation, and, when a manatee swims through, the sticks separate, leaving evidence of the manatee's presence. This method is mainly deployed when the water is rising, in places with abundant macrophytes, or in *comedias* – sites with diverse aquatic plants (e.g. *Echinochloa polystachya*, *Paspalum repens*, *Oryza grandiglumis*, *Hymenachne amplexicaulis*, *Pontedeira crassipes*) where manatees feed and leave easily identifiable evidence of their presence. However, as the *pari* is conspicuous, it is not used as much as in the past when hunting was not prohibited, and law enforcement was less intense. Finally, we recorded another method to detect manatees reported only in the lower portion of Amanã Lake and used by members of two communities. It is known as *bola de capim* (grass patch) and consists of placing a floating grass patch somewhere in the lake where the manatees remain in the dry season with limited access to food. Attracted by the availability of food, manatees become easily detectable and captured.

From the first quarter of the twentieth century until the early 1980s, the annual hunting of manatees intensified during the *arribação*, the seasonal migration of manatees from *várzea* regions to the *terra firme* lakes (such as Amanã) or the deep pools in the rivers. Popular hunting places included the Castanho Channel (Upper Castanho subarea), through which manatees migrate from Castanho Lake (90-km long route) and the Mamirauá Lake region (140-km long route) (Marmontel et al., 2002). An older hunter said

‘Forty years ago, there were the so-called *feitorias*, which were campsites for each family to hunt manatee. Overall, the *feitorias* captured more than 200 manatees per year. They remained set up between late July and August each year<sup>2</sup>.

In the past, some ‘professional’ hunters (old experienced hunters are called professionals) would travel seasonally to follow manatees at a given site or their movements along the passageways. Today, most hunters hunt in areas close to where they live.

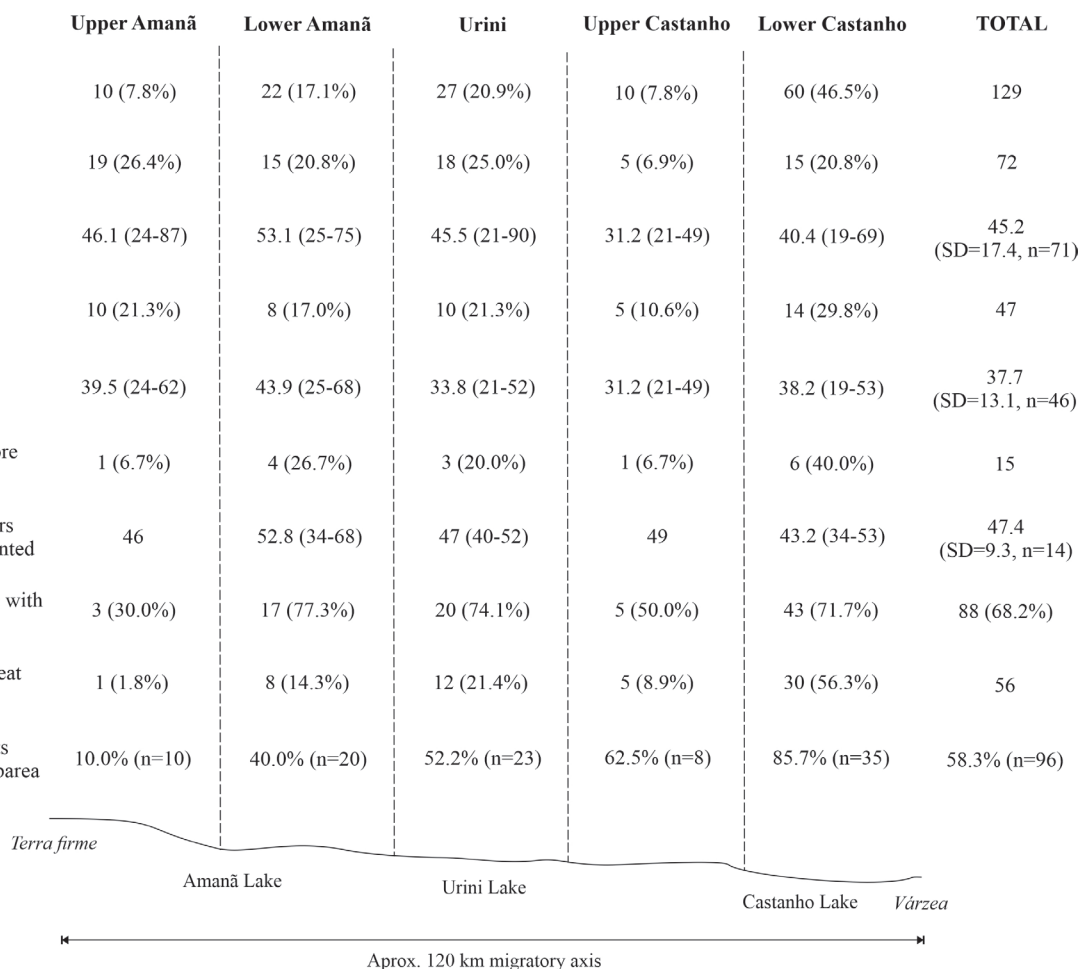
**Seasonal water levels and hunting**

The large seasonal variation in the water levels of rivers and lakes in the Amazon (up to 12 m in some cases; Ramalho et al., 2009) requires manatees to have a dynamic pattern of

migration movements and habitat use. Through the generations, hunters have learned to recognize the environmental triggers of these movements and adjust the hunting sites, methods, and expectations during the year, because ‘in the flood season, the manatees are in the *comedias*, and in the dry season, they are in the *boiadores*’. According to an older hunter, it is common knowledge in this region that

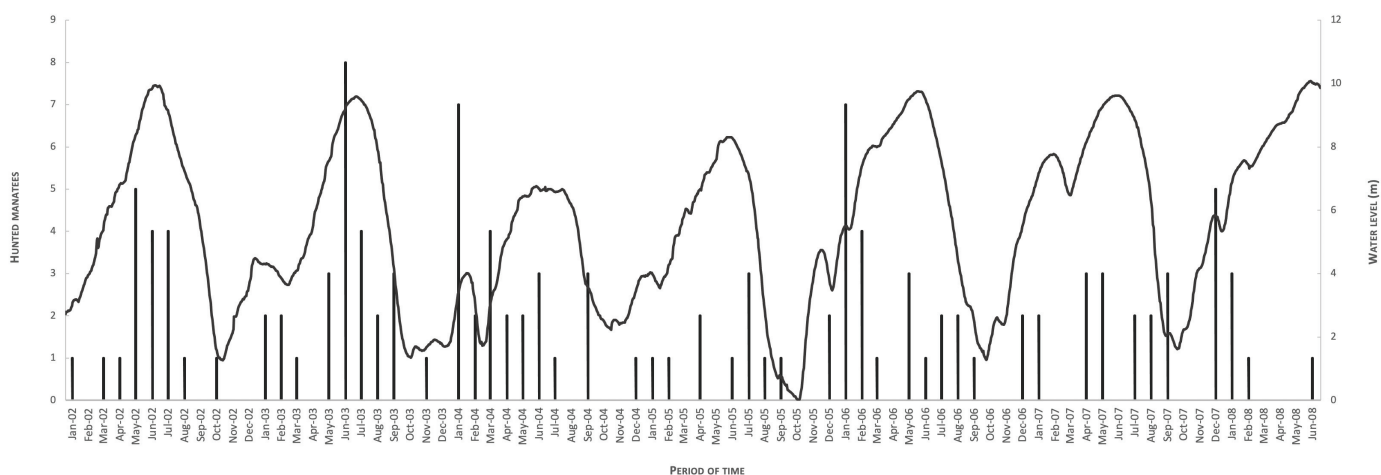
‘when the water is high, the manatees go to the *várzea* areas where there are many plants for them to eat. They stay there all this time, but do not eat at one site only, they move about. But, when the water begins to recede, they go to the deep pools, the *boiadores*, there they must spend the summer. The *boiadores* may be at Amanã Lake or the river. There are none at the *várzea*’.

A *boiador* is a place in a river or lake, generally associated with deep pools or backwaters, where manatees are said to gather. When the river level begins to rise, manatees seek places with floating macrophytes or grasses, which have grown on the dry season beaches and become accessible at this time. ‘The manatees are hungry in the dry season, and they will eat all the grass they can’, said a resident of Amanã Lake. According to our partners, the harsher the dry season, the easier it is to hunt manatees. They are starved and start feeding as soon as the water levels begin to rise.



**Figure 6.** Graph demonstrating the relationship between number of manatees hunted and hunter profile per study subarea, with data on meat trade.

<sup>2</sup>The end of the *feitorias* allegedly coincided with the arrival of researcher Robin Best in the region in the mid-1970s. Nowadays, no more than 7.8% of all hunting events occur in the Upper Castanho subarea.



**Figure 7.** Total number of hunted manatees vs. variation of the water level showing that hunting activity is more intense overall during the flood and flooding seasons. These results are strongly influenced by the number of hunted animals in the Lower Castanho subarea, in the *várzea*.

During the flood season (*cheia*), hunters may take two or three days for the process of hunting. They must visit *ressacas*, creeks, and lakes looking for *comedias*. Hunters believe manatees feed at night because it is quieter. Thus, hunters return to the *comedias* at night in search of manatees. However, hunting is said to be easier when waters are rising (*enchente*) and during *repiquete* (sudden oscillations in river level due to changes in rain patterns in the headwaters, generating an “accordion” effect that could either cause water levels to rise or recede). During periods of highwater, manatees are ‘widely dispersed in the flooded forest’, making hunting more difficult. When the water is receding (*vazante*), hunters scout manatees’ travel channels as they undertake *arribação* toward the *terra firme* lakes or the deep pools in the rivers, where they remain during the dry season (*seca*). Hunters will then observe the water during the day to spot manatees in transit. They watch the herds, select an animal, follow it a few meters, and attempt to harpoon it.

#### Hunted manatees and current environmental influences on hunting

Almost half of all hunted manatees (46.5%,  $n = 129$ ) came from the Lower Castanho (Fig. 6), a *várzea* area where ASDR management initiatives began only recently, and where there has been less contact with researchers. The Urini subarea has the second largest hunting record (20.9%). According to the partners, formerly there were *boiadores* on Urini Lake; however, due to changes in its geomorphology, the lake is more like a passageway today. Extensive beaches have been created, which makes the available food for manatees restricted only to the flood and flooding seasons. The Lower Amanã (17.1%) is home to the greatest number of hunters from traditional hunting families. Manatees can be found throughout the year, being especially vulnerable during the *enchente*, when they approach the newly flooded beaches to feed, and during the *vazante*, when *arribação* occurs. Finally, the Upper Amanã (7.8%) is where the highest number, and the most important *boiadores* of Amanã Lake are located. At least eight of ten animals hunted were captured in the creeks of the Amanã Lake’s headwaters during the *enchente*. Due to the capture of three very small manatees during the *enchente* and an adult female in the *seca*, we infer that at least

some manatees remained in the creeks during this period, and those births may have occurred at the headwaters of the lake.

Hunting activity is more intense during the flood and flooding seasons (Fig. 7). These results are strongly influenced by the number of hunted animals in the *várzea* in the Lower Castanho. This represents a change relative to the past, when most hunting took place during the *arribação*. However, similar to decades past, the manatees are vulnerable to hunting throughout the seasonal migratory route between the *várzea* region of Castanho Lake and *terra firme* region of Amanã Lake, and in all types of habitats they use throughout the year.

Manatees seem to be at greatest risk of being hunted in *várzea* regions. This can be attributed to several factors, such as the ease of finding feeding sites (*comedias*) by an experienced hunter, as well as the animal’s vulnerability in the flooding season because of limited food resources during the dry season. Nevertheless, hunters adapt to the characteristics of the environment in which they live by employing various techniques to hunt manatees, and by always considering the water dynamics of the region.

#### Manatee hunting byproducts

Historically, meat, lard, and skin of manatees have been used and traded in the Amazon region (Domning, 1982; Best, 1984;



**Figure 8.** Two hunters begin to prepare a recently hunted manatee. Upper Castanho channel, 1997. Photo: Miriam Marmontel.



**Figure 9.** Detail of the nostrils of a hunted manatee. Lower Amanã subarea, May 1998. Photo: Miriam Marmontel.



**Figure 10.** Amazonian manatee meat mixed with *farinha* (manioc flour). Upper Castanho channel, September 2022. Photo: Daniel Gonzalez-Socoloske.

Rosas, 1994) (Figs. 8, 9, 10). A variety of byproducts are produced, with *mixira* and *torresmo* being the most common (Tables 1 and 2). The *mixira*, chunks of fried meat preserved in its own lard in a container is undoubtedly the best-known and most appreciated manatee byproduct. An Urini Lake hunter described the process:

'To make *mixira* you must fry the meat, but first you have to boil it. Prior, you separate the meat from the lard. You salt the meat. The next day, you scald the meat, clean it well and fry it. The first day is only salting, the second frying the meat and the lard, fry it all day long. Everything gets mixed together and the *mixira* is made'.

According to our partners, this complicated process should be performed by an expert, so the meat is not spoiled. 'It has always been the men who made the *mixira*', said an older hunter, with the help of their wives. It is highly valued, because 'there is nothing better than *mixira*', and because it is closely tied to tradition. The daughter of one of the most famous hunters in the area said 'When I was a child, we never ran out of *mixira* to eat in our house'. A hunter also said '*Mixira* is something special. Preparing *mixira* is a tradition'.

The residents attached significant importance to the taste of *mixira*, and its long shelf life. An older hunter said it might last

'up to one year', when the chunks of meat are completely covered by lard; or, by adding more lard, 'it can last up to two years'. Thus, the hunters and their families can take pieces of the meat and fry them again. A *lata de mixira* (*mixira* can) is the most common measure to refer to this byproduct. A hunter said 'a *mixira* can has 18 kg; it is a 20-liter can. A manatee of 14 *palmas* yields more than four cans of *mixira*'. One partner explained the ratio of lard to *mixira* as 'for each can of lard you have two cans of *mixira*'. *Mixira* is also the byproduct that yields the highest income to the hunters. Currently, a can of *mixira* costs about 800 *reais* (approximately US\$160) in the city.

The sharing of *torresmo*, crisp manatee lard, is sometimes the impetus for a gathering. *Torresmo* is shared by hunters, their families, and, in some cases, members of their community (Tables 1 and 2). As one partner noted, '*torresmo* is what first gets consumed from the manatee, bringing a lot of people together, who consume it right away'. An Urini Lake hunter added 'When we catch a manatee, we make *torresmo*, and my house fills with people. Sometimes, it becomes a party'.

#### Destination of manatee meat

Three possible destinations exist for the meat of a hunted manatee: food for the hunter and his family, sharing among neighbors, and trade. We recorded a variety of combinations of these three possibilities (Tables 1 and 2). Sharing the meat with neighbors is a tradition among manatee hunters, reinforcing the belief that a manatee hunter is a special person and the hunting event an important occasion (Table 1). All hunters interviewed on this subject (n = 32) related to sharing 'about 2 or 3 kilos per household'.

In the past, when hunters 'always had buyers for the *mixira*', trade of manatee meat was the main motivation for hunting. At that time, hunters might keep only small amounts of meat, and sell the majority to accrue the highest possible profit. Today, due to law enforcement and changes in local economic activities of residents, hunting for local consumption of meat, with a prevalence of trade, is the most common practice. The hunters of Amanã will trade if they have the opportunity to sell the meat. However, sales are not necessarily the motivation for hunting. Because of that, rarely is trading meat the sole end meat destination (Table 1). They will allocate some of the meat for sale - if they have access to the Market - only if they do not jeopardize their own consumption. In this way, trade of manatee meat continues to be an important motivation for hunting. In 58.3% of the hunting events, some amount of meat was traded in markets inside or outside of the ASDR.

It has always been difficult for a hunter to transport manatee meat to the city. In the past, due to the distance and the precarious transport; currently, because of law enforcement. So, selling through *regatões*<sup>3</sup> was and is the most common practice. Even though the *regatão* often offers less money for a *mixira* can and for fresh meat, hunters prefer to deal with them because they will not be at risk of being sued, fined, and stripped of their working materials by law enforcement officers.

Our data suggest that differences in trade between each of the study subareas can be attributed to the varying socioeconomics of each community. In Lower Castanho, we recorded sales for

<sup>3</sup>The *regatão* is a merchant who travels by boat between regional centers and communities, exchanging goods or money for regional agricultural and extractive products (McGrath, 1999).

85.7% of the hunting events (Fig. 6). In this region there is a higher commercial motivation for hunting manatee, because extractive activities such as fishing and hunting are relatively more important than agriculture.

Manatee meat is currently a scarce and coveted delicacy in the region, not readily available in local produce markets. For many years, and especially in recent times, the local businessmen in the city of Tefé are most often the buyers of fresh manatee meat or *mixira*, and, as result, hunters and *regatões* target them when they arrive in town. Since many of these merchants have been buyers for many years, the sale is generally a given. Therefore, manatee meat is traded in a shadow economy.

On a much smaller scale, the sale of live manatee calves as pets was more important in the past, and we recorded only one event in recent times. According to our partners, it is more profitable to use the calves found alive as bait to lure their mothers and then kill them both.

### Changes in the social context of manatee hunting

The history of each family in the Amanã region is replete with anecdotes about the great abundance of natural resources that their ancestors found when they arrived. One of the most important of these resources is, without doubt, the manatee. Born in 1918, the oldest member of one of the most important families in the region, and currently a non-active manatee hunter, said

‘My father, [...], came from [the region of the River] Juruá in 1906, at the time of the rubber. My mother was an Amazonian. My grandfather left [the northeastern state of] Ceará and went to Juruá. He did not hunt manatees. He worked with the rubber, died there [...]. My father started to hunt manatees when he was 50 years old. Before that, he had been working in rubber until it stopped making money. In 1933, the price of rubber fell to two cents, it was too little. After that, in 1935, the pirarucu was our job between August and November. We sold [the hunted manatees] to the *regatões*, we had *feitórias* [...]. For these times there was plenty of food [...]. My father hunted a lot of manatees. Sometimes, he hunted two in a single day. We lived in the Parana do Amanã [Lower Amanã subarea], behind it was the rubber tree plantation. We learned to hunt manatees in front of the *barracão* during the *arribação*. I do not remember how old I was when I hunted my first manatee, it must have been when I was between twelve and eighteen. I have hunted more than 300 manatees in my whole life’.

Hunting manatees in the Amanã region is linked to strong family traditions. Expert hunters hold a unique knowledge about the species which is passed down to certain family members within families with a strong hunting history. This process starts when the participants are very young, and is fueled by their admiration of the experienced hunter. These families and their history are part of the cultural heritage of the area. Thus, the history of manatee hunting is intertwined with the history of the region and the ASDR.

Although learning to hunt manatees differs today from the past, there are still residents interested in learning this activity, and some families with a strong hunting history have easy access to this knowledge. The widespread belief that ‘manatees are not for everyone’, and that ‘a hunter only kills a manatee because of God’s will’, reinforces the perception that hunters are extraordinary. This perception, added to the great value given to manatee meat,

makes hunters famous and admired. Thus, the status that hunters have in the region further increases the hunting motivation.

While the prevalence and importance of manatee hunting has decreased in Amanã over the decades, several groups of hunters nonetheless persist. We registered 72 people with manatee hunting history in the study area. Of the three oldest residents with a hunting history (over 80 years old), two died during the data collection period. They belonged to two traditional hunting families of the Amanã Lake region, and among their descendants are other recognized hunters. Two hunters who began to hunt manatees at age 10 were recorded; both were over 60 years old at the time of data collection. The oldest age for a hunter to catch his first manatee was 47, and the capture was unplanned and opportunistic. The average age at which hunters started the activity was 20.9 (SD = 8.6, n = 35).

Among the people with a hunting history, 47 (65.3%) were considered “active hunters”. The three active hunters aged over 60 live in the Lower and Upper Amanã and belong to traditional hunting families with ties to each other. Hunting events involving younger hunters (15 and 16 years old) occurred in Lower Castanho. According to local residents, one hunted his first manatee when he was 13. Both belong to a family with a hunting history; their fathers and uncles were also considered active hunters. On two occasions, people younger than 25 were taking part in a hunting event along with an experienced hunter. In one of them, two young men followed and hunted a manatee with a close relative in the Upper Amanã. In another similar event, in the Urini subarea, three young men carried out the hunt. These anecdotes indicate that knowledge of manatee hunting continues to be learned by new generations.

While only 15 active hunters (31.2%) killed three or more manatees, they account for 68.2% (88 animals) of all manatees hunted in the region during the study period. Six of them live in the Lower Castanho, and one is responsible for the death of 23 animals on his own. The perception of manatee hunters as special people is reinforced by the fact that only a core group of knowledge holders hunted the majority of manatees. Details of all of these hunters can be found in Fig. 6.

### Motivation and prospects for manatee hunting

Not only are tradition or economic benefit motivations for hunting, but also, more simply, the flavor of the meat (Fig. 10). Among the respondent hunters (n = 26), 81% consider manatee meat the best they have ever experienced. Statements like ‘there is no better meat than manatee’ or ‘everyone knows that the manatee is the best fish [They consider the manatee a fish ‘because it lives in the water, but in all the rest, he is like a bull’] in the Amazon’ are common among the residents. The remaining 19% prefer white-lipped peccary (*Tayassu pecari*) meat, but place manatee second. Thus, 100% of the respondents consider manatee meat one of the best.

As already indicated, a manatee hunter has the status of “special person” with highly valued skills enabling him to kill this “half invisible” animal. The old professional hunters are revered by the younger ones and become recognized in all communities. These hunters usually come from families with strong hunting traditions. Thus, admiration for ancestors is also a great motivation to learn everything one needs to become a good hunter. However, only 40% of the respondent hunters

(n = 30) claim to have passed the hunting knowledge to the younger generations.

The prospects for hunting manatees are influenced today by changes in economic activities among the Amanã residents. As mentioned previously, our partners often cited the importance of agriculture in their livelihood: 'The abundance of manatees is over. Today there is an abundance of crops'. This change may have a positive influence on the reduction of manatee hunting in the medium and long term. However, this relationship between economic activity and level of hunting is not straightforward and will depend on the community's location and the age of the new apprentice hunters.

Compared to the historical records, fewer manatees are hunted today than in the past (Calvimontes, 2009). Although there is no reliable estimation of the current size of the manatee population, many of the partners (36%, n = 26) thought the number of manatees has decreased. Despite this, all our partners also stated that they do not believe that the manatee could disappear. According to our data, the idea that manatees cannot become extinct is originated in the religious beliefs of the population, and how they see the world and the natural resources they use. It is common to hear answers such as, 'what God has left in the world does not end. It may even be difficult, but it does not end'. Hunters believe that manatees may have fled to other regions and therefore their number has decreased locally. One of the causes of this escape could be the increase in human population and the noise of the engines because 'the manatee is afraid of noise'. This widespread disbelief about potential extinction of manatees will have significant consequences for defining future management strategies.

## Discussion

Hunting manatee is motivated largely by the appreciation of the taste of manatee meat and its economic value in the market, rather than subsistence needs. However, the importance of tradition in manatee consumption for the local population should not be undervalued. When formulating conservation strategies, it is imperative to take into consideration this centrality of custom and tradition, as well as the local population's disbelief in extinction. Great sensitivity is necessary in discussing conservation with local residents because, in addition to topics in environmental awareness, the cultural mores and religious beliefs of this social group will inform any discussion (West & Brockington, 2006). The matter should be addressed taking local reality into account, especially considering the danger inherent in the residents' belief that natural resources never end.

On the other hand, it must be recognized that the manatee trade constitutes a serious threat to the species. The ASDR hunters are aware of this when they distinguish hunting for consumption and commercial hunting: 'for eating, there are limits, but for selling there aren't'. That is, hunters themselves recognize that local consumption affects species' populations to a much lesser extent than hunting for commercial purposes. Similarly, we observed the perception of "different levels of prohibition" among residents in relation to the use of different species. Residents tended to hide manatee hunting to greater extent than *pirarucu* fishing though both are equally prohibited

under the law. For example, it is very common to see large pieces of *pirarucu* meat drying in the sun in these communities, but only after gaining confidence with a select number of residents were we privy to observing evidence of manatee hunting. The hunting of manatee, however, is assumed and perceived as more serious, which makes it very difficult to talk about manatee hunting events openly. These "levels of prohibition" can be attributed to residents' latent understanding of the differing vulnerability of each species, and to interactions with law enforcement in the area. Thus, law enforcement and discussion about species conservation play a key role in reducing trade and ensuring the conservation of the species.

Although the number of hunted manatees is now much lower than in the past (when *feitorias* were active), hunting is still active and unlikely to end soon. New hunters are learning the process through the knowledge available from their relatives with strong hunting backgrounds, and meat consumption is still deeply rooted in the region. The motivation for the sale of meat also plays an important role. Furthermore, the persistence of manatees in the region, though diminished, renders the dialogue on the vulnerability of this species and its conservation status a complex issue. The residents of the ASDR perceive and understand the manatee from their local reality, their position in history, and their knowledge related to day-to-day use. Researchers and conservationists perceive the manatee from a different perspective, which is geographically wider (Wohling, 2009). Dialog between the two perceptions is essential if we are to conserve the species and ensure that future residents of the ASDR continue to coexist with it.

Our results show the reality of Amazonian manatee hunting in one of the most emblematic protected areas in the region, and arguably reflect the same reality in other nearby areas. Manatees are vulnerable throughout the year (with more incidence at the flooding season) and in all environments. As such, it is imperative to devote significant attention to the processes that precede the implementation of effective conservation actions through participatory management (Chuenpagdeea & Jentoft, 2007). The successful management experience of ASDR and MSDR provides a viable possibility for conservation efforts by building a pact between local populations and management. This pact is based on local populations committing to maintaining the exploitation of the environment at sustainable levels in exchange for the guarantee of land tenure rights and the access to different economic alternatives (Lima & Peralta, 2017). Thus, in the process of negotiation between ASDR management and local population to ensure this socio-environmental pact, rules linking the sustainable use of natural resources to the protection of vulnerable species, such as manatees, could be established in the medium to long term. Our research not only contributes to addressing specific environmental awareness and participatory research actions, but builds mutual trust and local support through effective communication and complimentary mechanisms to foster broad participation in effective conservation processes (Manson et al., 2010). Through the dialog of knowledge, the participation of the population in research and management, and the creation of rules that consider the local reality, it is possible to establish realistic and effective conservation actions for the Amazonian manatee.

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