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Community-based environmental protection in the Brazilian Amazon: Recent history, legal landmarks and expansion across protected areas

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Abstract

Globally, community-based initiatives are effective in protecting ecosystems and the species within them. In this paper, we analyze the emergence and large-scale expansion of a community-based environmental protection system (the Voluntary Environmental Agents Program – VEA Program) in the central Brazilian Amazon and identify factors that have determined its success since its inception, 25 years ago. Collective actions to protect the environment in the region have been undertaken by local people for at least 40 years, before its legal regulation in 2001 by the federal government of Brazil, and by the Amazonas state in 2007. The system is based on territorial surveillance and

monitoring, and on guidelines for the better use of the territory and its natural resources. Between 1995 and 2020, the program expanded into the two protected areas where it was first implemented reaching approximately 9 thousand km² of area protected by the system. The number of people participating also grew in this period by around 2,050%, as did the participation of women, which grew by 5,600%. The system was replicated in 37 protected areas in central Amazonia, and currently covers almost 200 thousand km² of Amazon rainforest. From our analyses we unveil four main factors that may have allowed the VEA Program to expand and flourish: (a) the communities' previous demand for an effective control system, (b) its legal formalization and regulation, (c) the support from external institutions, and (d) the consolidation of community-based management programs to fund actions. These factors shall be further investigated as to confirm their critical role in the success of the VEA Program. We demonstrate that this community-based environmental protection system has established itself as a legitimate form of social control, and as a mechanism of socio-environmental governance in the areas in which it operates. By allowing more effective protection of territories, it generates consensus amongst users for the adequate management of natural resources, especially in contexts where government's actions are absent or inefficient. We claim that this system can be replicated in various parts of the world.

Keywords: community-based management; co-management; environmental protection; governance; Amazon;

1. Introduction

The engagement of local people is critical to effective, sustainable and equitable conservation (Hayes and Ostrom, 2005). The participation of local actors can be more appropriate and essential in landscapes where official enforcement is absent or ineffective (Norris et al., 2018) and in some situations is the only means to ensure adequate management of natural resources (Cinner et al., 2012). Community-based conservation is being increasingly recognized as a major global force in the protection and sustainable management of ecosystems and species (Kothari et al., 2013). In the Amazon, community-based conservation arguably plays an even greater role since protected areas (PAs) management is often hampered by a lack of financial resources and personnel as well as by low or sometimes nonexistent political interest (Campos-Silva et al., 2015; Ruiz-Mallén et al., 2015). In these situations, community-led surveillance and actions on the ground can ensure environmental protection and prevent crimes against nature (Barreto and Mesquita, 2009; Araújo et al., 2012).

In recent decades, in Amazonian countries, a number of official legal instruments have emerged to regulate social participation for the protection of natural resources in PAs (Akchurin, 2015). Since 2001, in Brazil, various laws at the federal and state levels have been established that recognize and support actions by local communities to safeguard their territories and natural resources, e.g., the Voluntary Environmental Agent (VEA) category and the Voluntary Environmental Agents Program (Ruffino, 2005; Brazil, 2001; 2005; Amazonas, 2007; 2008). These mechanisms enable community members to voluntarily carry out surveillance, social mobilization, environmental education, leadership training, and conflict mediation (Brazil, 2005; Amazonas, 2008).

Community-based environmental protection is the basis of co-management between governments and local actors (Borrini-Feyerabend et al., 2007) allowing the sharing of power and responsibility (Berkes, 2009). Community-based management relies on the “theory of common resources”, i.e. assets that are under the jurisdiction of a community of users (Ostrom, 1990; Borrini-Feyerabend et al., 2004). This requires the

77 collective organization of the group to exclude external users and to guarantee equity in
78 resource exploitation (Feeny et al., 2001). In PAs, community-based management
79 involves the participation of local communities in decision-making as well as the
80 incorporation of local practices and knowledge in regulation and enforcement processes
81 (Armitage, 2005). By involving local communities and institutions in environmental
82 conservation and protection, decentralizing power and authority (Kellert et al., 2000), this
83 approach is an economically viable and environmentally sustainable alternative (Ruiz-
84 Mallén and Corbera, 2013).

85 Community-based protection is built upon adequate governance, a set of rules,
86 implementation mechanisms and iterative processes that coordinate people's activities
87 towards a desired outcome (Huppert et al., 2001). Governance of natural resources and
88 biodiversity by local communities can be more effective compared to traditional ways of
89 environmental conservation (Brondizio and Le Tourneau 2016; Levis et al., 2020). For
90 example, Porter-Bolland et al. (2012) showed that tropical forests managed by local
91 communities experienced lower deforestation rates. Similarly, in some African PAs,
92 better responses to specific threats to the ecosystem were possible by relying on illegal
93 activities recorded by local rangers (Gray and Kalpers, 2005). Kauano et al. (2017) also
94 demonstrated that less fishery infractions were detected in “sustainable use” PAs in the
95 Brazilian Amazon than in “strictly protected” PAs.

96 Currently, PAs occupy 15% of the planet but only a third of these are managed
97 effectively (WDPA/IUCN, 2020). As a result, a number of different ways of improving the
98 management of PAs have been proposed and debated. The recent processes of
99 decentralization in the management of natural resources (Ribot, 2002) have provided
100 important “bottom-up” collaborative arrangements for conservation and improved PAs
101 protection (Berkes, 2004, Borrini-Feyerabend et al., 2004). These attempts reconcile the
102 maintenance of natural integrity with local peoples’ needs, empowerment, and cultural
103 valorization (Hockings et al., 2006; 2019).

About 45% of the world's PAs are managed by local populations (UNEP-WCMC/IUCN, 2016; Garnett et al., 2018), but only recently has there been a movement by local communities to be more directly involved in protection activities of these areas (Kothari et al., 2013; Basurto, 2013). Even in PAs where surveillance actions were traditionally top-down (often typically militarized or associated with external or non-local interests) collaborative protection actions have emerged and legitimized local interests (see Masse et al., 2017 for examples of these actions in sub-Saharan Africa).

In the present study, we analyze the emergence and expansion of a community-based protection system in PAs in the Brazilian Amazon. This system relies on the VEA Program that permits local involvement in the protection of natural resources, as well as the implementation and expansion of such system. We analyze the trajectory of this system and its large-scale social and territorial expansion since 1995. We also identify and describe possible critical factors that have led to the success and observed growth of this system. In the first part of this study, we review the legal instruments that guaranteed the regulation of this community-based environmental protection practice and identify historical milestones that have influenced the emergence and maintenance of this system during 1980 - 2020. In the second part, we use the Mamirauá Sustainable Development Reserve (MSDR) and the Amanã Sustainable Development Reserve (ASDR) where VEA activities began, to characterize VEAs activities there and describe the first phase of social and territorial expansion of this initiative, which started in 1995. In the final part, we evaluated the replication and second expansion of this program to other PAs in the central Brazilian Amazon, beginning in 2008.

2. Methods

2.1 Study area

Our study focuses on the state of Amazonas, central Brazilian Amazon (Figure 1a), which corresponds to about one third (29%) of the Amazon basin. In this region, inhabitants of PAs (mostly IUCN category VI) are voluntarily involved as VEAs in community-based nature protection activities.

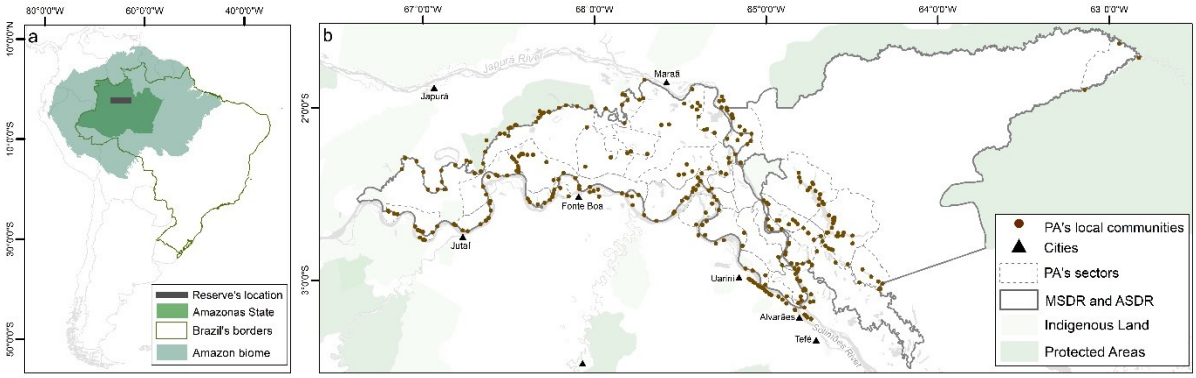


Fig. 1. Location of (a) the state of Amazonas in dark green, within Brazil and the Amazon Biome, and of (b) the Mamirauá Sustainable Development Reserve and Amanã Sustainable Development Reserve, where community-based environmental protection activities began.

The MSDR (03º08'S, 64º45'W) encompasses an area of 11,240 km² in the central Amazon and is entirely composed of flooded forest. The ASDR (02º21'S, 64º16'W) covers 23,500 km² and includes a number of different environments within flooded and non-flooded ecosystems (Fig. 1b). The human population inside and around the perimeter of the two PAs is approximately 16,750 persons in 344 settlements (communities and isolated households) (IDSM 2018; 2019). Fishing, hunting, farming, exploitation of non-timber products and logging are the main economic and subsistence activities carried out by residents across the region (Queiroz and Peralta, 2006; Alencar, 2010). In the immediate surroundings of the two PAs are four small towns: Alvarães (15,860 inhabitants), Fonte Boa (18,221 inhabitants), Maraã (18,186 inhabitants) and Uarini (13,387 inhabitants). The city of Tefé (60,164 inhabitants), approximately 50 km from the two PAs, is an important regional hub for the flow of rural products and offers several urban services for rural people such as the sale of food, receipt of social benefits and health services.

153 In the two PAs, the territorial classification was based on the history of use and
154 occupation of the landscape by local communities (Queiroz, 2005). Accordingly, the
155 MSDR and ASDR are divided into sectors that aggregate adjacent communities into
156 geopolitical organizations; these preceded the creation of the PAs. The organization in
157 sectors was also encouraged by the Catholic Church in the 1970s-80s, with the aim of
158 strengthening social and territorial cohesion of local communities and facilitating their
159 access to public policies (Reis, 2005). The PAs are organized at different levels of
160 management and governance (community, sector and PA). Communities and sectors
161 have associations and councils; and PAs have a Deliberative Council, composed of
162 different users and institutions. The local interests of the communities are always defined
163 collectively, in democratic spaces at different levels. Local institutions are essential for
164 VEAs, both for their appointment to the VEAs Program as community representatives,
165 and for the definition and decision of collective interests. MSDR has 22 sectors
166 (Amazonas, 2014) and ASDR has 11 sectors (Amazonas, 2020). Use and management
167 of natural resources are organized within these different sectors (Queiroz, 2005; Queiroz
168 and Peralta 2006) and delimits the community-based environmental protection activities
169 within the PAs.
170
171 **2.2 Data collection and analysis**

172 We reviewed the scientific literature as well legal documents and bills within the
173 federal and state regulatory frameworks relevant to the emergence and regulation of
174 community-based environmental protection actions in the Brazilian Amazon. From data
175 gathered between 1995 and 2020 we characterized the community-based protection
176 system in the two PAs. We used a participatory monitoring system that allowed VEAs to
177 describe their daily activities in forms developed for the purpose. This monitoring records
178 information as a date; PA; sector; number of agents involved; geographical coordinates
179 as well as the activity performed by the VEA. We recorded the number of active VEAs

by year and gender and estimated the expansion (in km²) of this system in the MSDR and ASDR as new sectors became integrated each year. Based on demographic surveys carried out by the Mamirauá Sustainable Development Institute (MSDI) (2018; 2019) we also determined the number of communities and human population within each of the territories under protection. In addition, while describing the main aspects in the creation and consolidation of this system in the two PAs, we selected those factors we considered to be critical for its success and expansion of the VEA system in the two PAs. We checked whether these same factors were present in the new areas added to the system as it expanded in the analysis period. We also recorded the occurrence of programs of community-based management of natural resources, support of VEAs to organizations outside the two PAs, and the support received by VEAs from other partner organizations. These findings were represented as graphs and maps of the sectors inside the PAs and surrounding areas for different periods in time (1995, 2001, 2007, 2013 and 2020).

Finally, we used data collected between 2008 and 2019 by the VEA Program (from the Department of Climate Change and Management of Protected Areas of the State Secretariat for the Environment) to analyze the replication and implementation of this program in other PAs within central Brazilian Amazonia; the second phase of geographic expansion of the system. We estimated the number of PAs and other territories where the use of natural resources had participation of VEAs, their extension and the total number of trained agents in these locations. Spatial analyzes and maps were generated with ArcGIS 10.4, and graphs using R 3.5.0 software.

3. Results

3.1 Historical context and legal framework of the community-based environmental protection in the Brazilian Amazon

We identified 13 legal documents and bills within the federal and state regulatory frameworks relevant to the regulation of community-based environmental protection in

207 the Brazilian Amazon (Box 1). These documents also allowed us to reconstruct the
208 conditions that led to the creation of the VEAs category and the VEA Program.
209
210 **Box 1.** Regulatory framework instruments relevant to the political and legal activities of
211 community-based environmental protection in the Brazilian Amazon.

Year	Legal Instrument	Provisions	Governing Body	Administrative Level
1988	Brazilian Federal Constitution	Provides about the responsibility of the government and society to defend and preserve the environment (Article 225)	Federal Government of Brazil	Federal
1988	Resolution No. 03 (03/16/1988)	Provides about social participation in the protection of natural resources through environmental efforts	National Environment Council (CONAMA)	Federal
1990	Decree No. 12.836 (03/09/1990)	Creates the Mamirauá Ecological Station, which would be recategorized in Mamirauá SDR in 1996	Amazonas State Government	State
1998	Decree No. (08/04/1998)	Creates the Amanã SDR	Amazonas State Government	State
1998	Law No. 9,608 (02/18/1998)	Provides about voluntary services in Brazil	Federal Government of Brazil	Federal
1998	Law No. 9,605 (02/12/1998)	Deals with the possibility of anyone detecting an environmental violation and reporting it to the environmental authorities	Federal Government of Brazil	Federal
2000	Law No. 9,985 (07/18/2000)	Establishes the National System of Conservation Units	Federal Government of Brazil	Federal
2001	Normative Instruction No. 19 (11/05/2001)	Creates the Voluntary Environmental Agent category at the federal level	Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA)	Federal
2005	Normative Instruction No. 66 (05/12/2005)	Creates the Voluntary Environmental Agents Program at the federal level	Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA)	Federal
2005	Ordinance No. 19 (01/21/2005)	Regulates voluntary actions within Protected Areas in Brazil	Ministry of Environment (MMA)	Federal
2007	Complementary Law No. 57 (06/05/2007)	Creates the State System of Conservation Units in Amazonas state and defines the Voluntary Environmental Agent category at the state level	Amazonas State Government	State
2008	Resolution No. 02 (09/26/2008)	Creates the Voluntary Environmental Agents Program at the state level in Amazonas state	State Council for the Environment (CEMA/AM)	State
2013	Normative Instruction No. 09 (11/22/2013)	Ceases the Voluntary Environmental Agents Program at the federal VEA level	Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA)	Federal

212

213 Other documents found in the existing literature allowed us to establish that
214 modern environmental protection in the Middle Solimões region, where the MSDR and
215 ASDR are found, originated in the 1980s. These actions were grounded on social
216 movements initiated by the local communities, guided by their perception of the

increasing scarcity of natural resources and of the social injustice in the region (Peralta, 2012). In the 1980s, the region's natural resources, especially fish, were under intense pressure as a result of technological advances in vessels and fishing techniques impacting fish resources in that region and in other parts of Amazonas state (Batista et al., 2004; Santos and Santos, 2005). Stocks of giant arapaima (*Arapaima* spp.), for more than three centuries, an important fishing resource in much of the Amazon, were severely reduced. These dwindling stocks were much disputed between local populations in various regions, including the Middle Solimões, and commercial fishermen from more distant urban centers (Queiroz and Sardinha, 1999). Similarly, caiman populations (*Melanosuchus niger* and *Caiman crocodilus*) were heavily commercially exploited (Da Silveira and Thorbjarnarson, 1999), despite the ban of these species since 1967 (Brazil, 1967). Furthermore, logging was unsustainable for most forest species (Nascimento et al., 2012).

In such a difficult social and environmental scenario, the Catholic Church spurred the emergence of the Lakes Preservation Movement in the 1980s (Pereira, 2004; Reis, 2005; Queiroz, 2005; Peralta, 2012). This movement aimed to guarantee exclusive access to fishing resources to local populations through community organization mechanisms for water courses protection used for fishing (Pereira, 2004; Reis, 2005; Peralta, 2012). The role of the Catholic Church was crucial in the start of the environmental protection movement, from which several “sustainable use protected areas” were created in the following decade, allowing local people to remain within them (Peralta, 2012). This institutional role was adopted, modified as well as amplified from the first half of the 1990s by the MSDI, a research institute focused on the management of natural resources in PAs of the Middle Solimões region. The role played by the Church and by the MSDI may be considered a critical factor, since they provided political and technical support and also legitimacy to these community-based organizations flourishing in the region.

In 1990, one of the sites, primarily made up of fish-productive whitewater-flooded forest areas and where the Lakes Preservation Movement was strong, was transformed into a protected area. First created as the Mamirauá Ecological Station, this PA was relatively populated (Peralta, 2012). Because this PA (Ecological Station - Category IA by IUCN) is listed as “strictly protected” in Brazilian legislation, human populations are not allowed to live inside (Brazil, 2000); hence, the PA designation was not appropriate given the local reality (Queiroz, 2005; Peralta, 2012). As a result, in 1996, the Mamirauá Ecological Station was transformed into the Mamirauá Sustainable Development Reserve (MSDR), a “sustainable use” PA (Category VI by IUCN), the first of its kind in Brazil (Brazil, 2000; Queiroz, 2005). The creation and transformation of this PA was catalyzed by the action of researchers since the early 1980s, who focused on the needs for conserving and involving local communities in the protection of the area (Ayres et al., 1999; Queiroz, 2005; Peralta, 2012). The MSDR has served as model for the creation of the contiguous Amanã Sustainable Development Reserve (ASDR), which took place in 1998 (Queiroz, 2019).

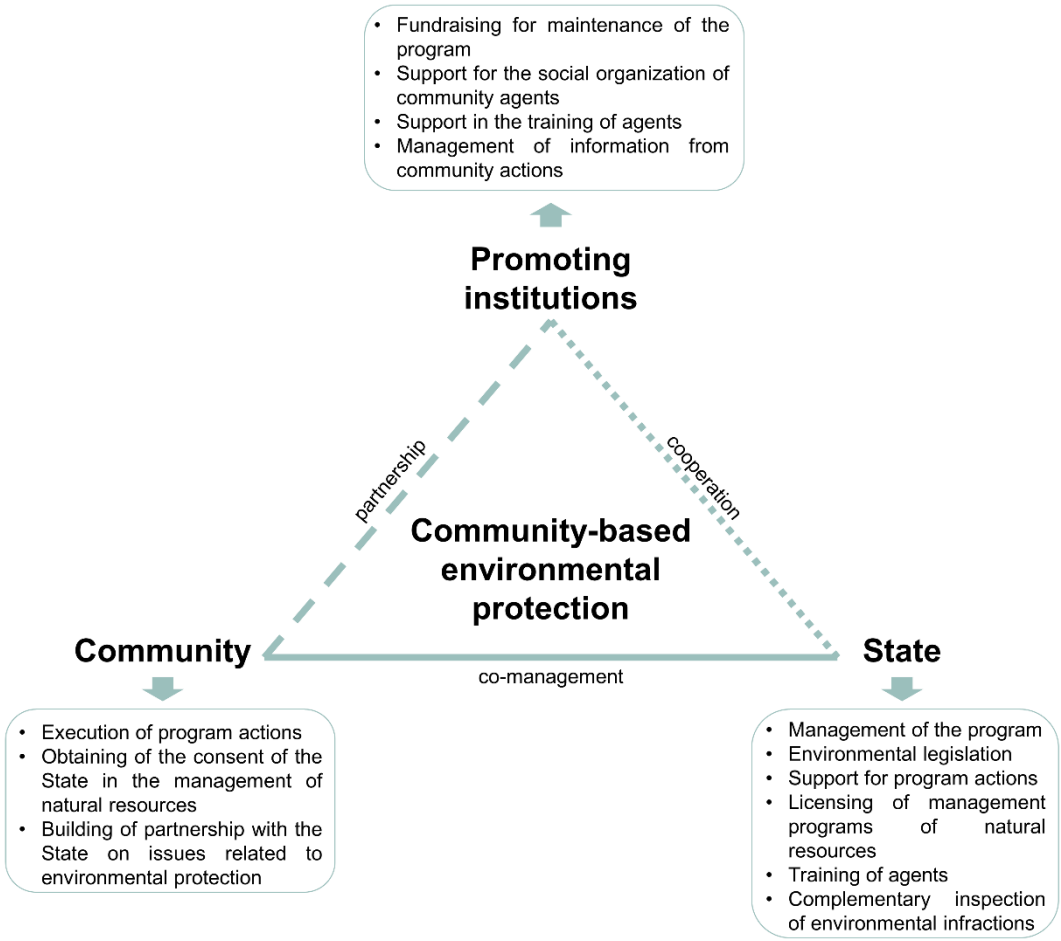
As the process of creating these PAs progressed, the demand from local communities for the establishment of an effective protection system of the area and helping them comply with management decisions affecting natural resources (Souza and Queiroz, 2008). This factor may be considered a critical factor, since this demand drove the further involvement in all management initiatives in these PAs. The first formal action involving local people in surveillance and control matters took place in 1995, with the training by IBAMA (Brazilian Institute of the Environment and Renewable Natural Resources) of the first MSDR residents as VEAs (Souza and Queiroz 2008). The formal recognition of this activity through legal instruments occurred only six years later, in 2001 (Item 8 of Box 1). In 1999, the first experience of community-based management of giant arapaima (locally known as *pirarucu*) was undertaken by residents of the MSDR in one of the two sectors that received VEA training. Based on the experiences of informal and

voluntary involvement of VEAs in surveillance actions under Fisheries Agreements for pirarucu management (Ruffino, 2005), the VEA category was finally recognized in 2001 by the federal government, through the Normative Instruction IBAMA No 19/2001 (Brazil, 2001), and the Resolution No. 03/1988 of the National Environment Council (CONAMA), which regulates social participation in surveillance actions in PAs (Brazil, 2001). Four years later, IBAMA strengthened created the national VEAs Program through the Normative Instruction No. 66/2005, which regulates the voluntary assistance of local people to IBAMA in "environmental education, protection, preservation and conservation of natural resources" inside PAs (Brazil, 2005, Article 1; see Appendix A). This Normative Instruction, however, limited the surveillance role of VEAs to preventive activities only (Feitosa, 2014), but not inspection or control. This Normative Instruction was revoked by Normative Instruction IBAMA No 09/2013, which also ceased all VEA activities within the federal government.

In 2007, the Amazonas state government recognized the VEA category through the Complementary Law No. 57/2007, which instituted the State System of Conservation Units (Amazonas, 2007), and updated by Resolution No. 02/2008 of the State Environmental Council of Amazonas, which also created the VEA Program at the state level (Amazonas, 2008; see Appendix A). The state VEA Program was created to allow agents to undertake various activities in areas with relevant protection interests (Box 2), such as PAs and areas of collective use of natural resources within the state (Amazonas, 2008). The program was created "considering the need to enable the implementation of mechanisms that favor the effective participation of organized civil society in environmental management" (Amazonas, 2008). The consolidation of the state legal framework allowed VEA activities to endure, even after the revocation of the federal legal framework. This sequence of official rules and regulations was probably another critical factor because they provided a strong legal official support to the VEAs, and were

297 essential for its persistence through time, providing means for their capacity building and
298 legality.

299 The surveillance actions of the system work as a territorial monitoring. Each
300 territorial unit has a team of agents. These agents watch over their territories and areas
301 where natural resources are used. In these surveillance actions, when VEAs find
302 violators, they use dialogue as the main approach to build environmental awareness.
303 VEAs are only responsible for the vigilance, the recognition, and the interception of
304 violators, but not the penalization. After the conversation with the violator, the agents
305 draw up a report to be sent to competent penal agencies. Among the possible measures
306 to be taken by VEAs are the retention of intercepted products and materials, removal of
307 invaders from the area and notification. The support of official environmental agencies is
308 extremely important for the work carried out by VEAs. At first, when the work of the VEAs
309 had an inspection character, IBAMA supported the forwarding and resolution of the
310 verification records. This official body has historically been responsible for receiving the
311 materials intercepted by the VEAs and for undertaking judicial proceedings against the
312 invaders. The communication between the VEAs and the competent bodies located in
313 the urban headquarters is carried out through radio broadcasting installed in some key
314 locations within the PAs. The official environmental agencies, federal and state, are
315 responsible for the training of agents and for the support to their actions. In turn, MSDI,
316 as a promoting institution, has a partnership relationship with communities and
317 cooperation with the State. Its main functions are related to raising financial resources
318 for the maintenance of activities, support for social organization and training of agents
319 and management of information from monitoring (Figure 2).



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321 **Fig.2.** Community-based environmental protection institutional framework of actors (community,
322 state and promoting institutions), their relationships (co-management, cooperation, and
323 partnership) and functions (operation, support, maintenance, and financing). The different lines
324 of the triangle represent the degree of dependence of the system on relations: the line of co-
325 management is strong and continuous; the partnership line is dashed, suggesting less
326 dependence and less persistence; and the line of cooperation is dotted, which suggests even less
327 persistence and dependence among these actors and for the system.

328 **Box 2.** Main objectives of the activities performed by Voluntary Environmental Agents
329 (Amazonas, 2018).

Objectives	Activities
Environmental education	Conduction of lectures about the use of natural resources in schools and communities, for people of different age groups among residents and users of PAs.
Social mobilization	Mobilization of residents for actions at the community level, natural resource management and PA projects (i.e.

	organization of social and political events in the PA, surveillance and territorial monitoring actions, and efforts for the management of solid waste in communities).
Multiplication of leaderships	Involvement of residents to the actions carried out by VEAs, to impart learning to other community members.
Conflict mediation	Conflict mediation usually involving intra-community problems and conflicts with external agents. In these actions, dialogue is always prioritized as a form of awareness.

330

331 **3.2 First expansion phase: protected areas of the Middle Solimões River**

332 The VEAs of the MSDR and ASDR were trained by both federal and state VEA
333 Programs; all training activities received the technical and financial support of an external
334 institution, the MSDI. Although not all trained VEAs are currently active, 719 qualified
335 during 1995 - 2019. Between 1995 and 2011, 10 courses that trained 338 agents were
336 undertaken through the federal program. During 2010 - 2019, another 8 training courses
337 were held through the state program; 381 agents were trained.

338 Activities undertaken by VEAs started in only two sectors of the MSDR in 1995,
339 covering an area of 798 km² (Figure 3a). In that year, 10 VEAs were active, and all were
340 men; this system started operating in one ASDR sector in 1997 (Figure 3b). Between
341 1995 and 2001 - the period before the regulation of the activity - there was an increase
342 of 228.7% in the area under the protection of this system, covering 2,623.3 km² and eight
343 sectors of the two PAs (Figure 3c and 3d). In 2020, the area under operation in these
344 PAs was 8,879.3 km², with 18 sectors of the two reserves including active VEAs (Figure
345 3e). This accounted for an increase of 1,012.6% in the area under protection by VEAs
346 since 1995 (Appendix A), where 9,124 people in 184 settlements resided.

347 The actions of VEAs in the two PAs have always had the support of members of
348 IBAMA's local executive management head in Tefé city. This support lasted until 2011
349 when this executive head was ended, following the central government’s policy to reduce
350 the agency's representations in cities from inner portions of the country. This reduction
351 in the government's control and surveillance capacity caused the reduction of official

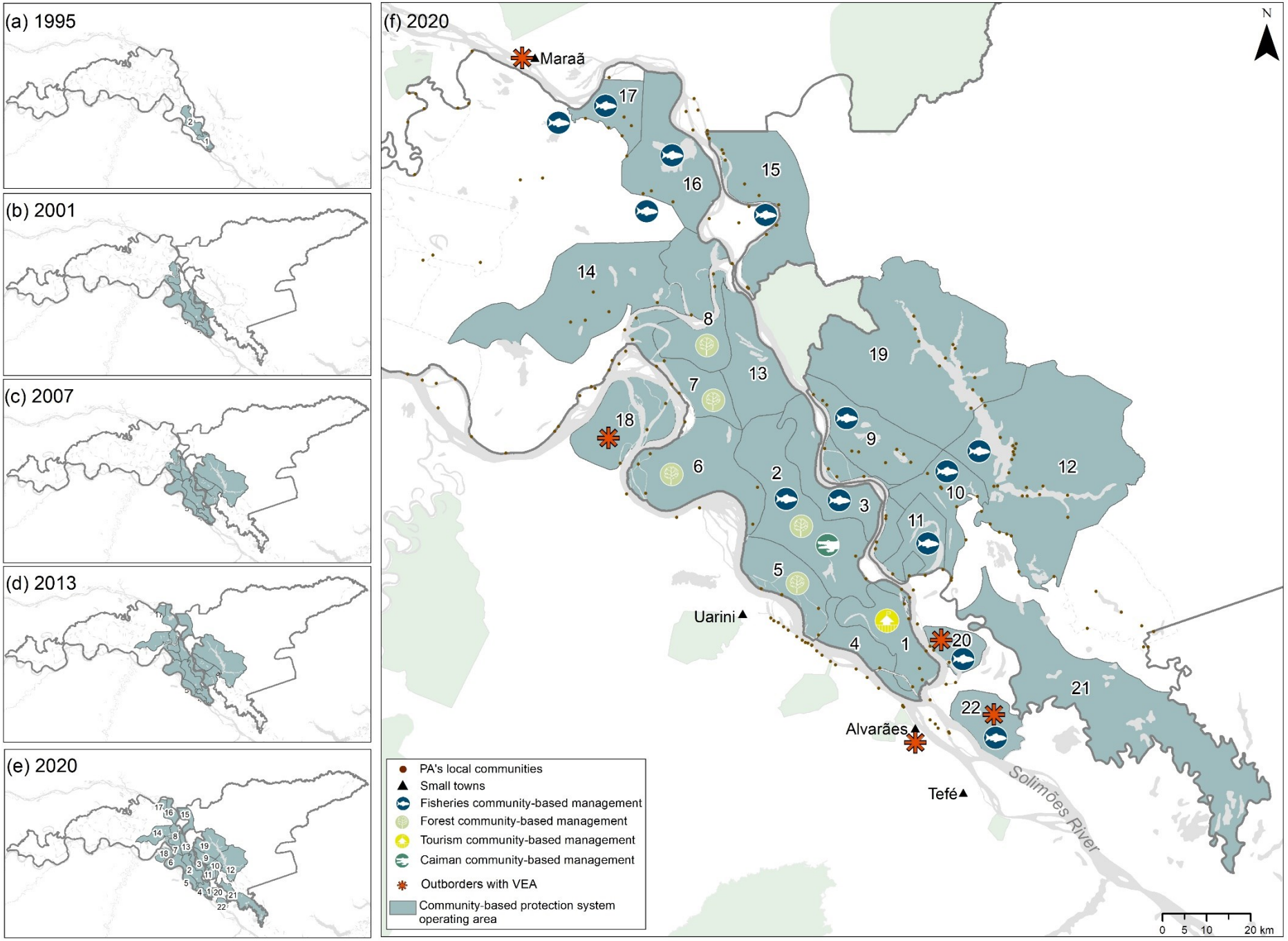
352 environmental protection actions, but it did not prevent VEAs actions from continuing and
353 being consolidated in new territories (Clark, 2011).

354 The operation of VEAs in areas around these PAs began in 2015; in 2020, eight
355 external areas counted with the participation of VEAs. Among those, there are areas with
356 different activities: a sector that has a local management system as if it belonged to the
357 boundaries of the MSDR, two areas containing fisheries resource management projects,
358 three fishing areas managed by entities representing urban fishermen, and two areas
359 managed by two public environmental management agencies in small towns surrounding
360 the PAs. Currently, 13 community-based fisheries management projects, 10 community-
361 based forest management projects, one community-based caiman management project
362 and one community-based tourism project are currently implemented in areas protected
363 by VEAs (see Appendix A) (Figure 3e). Overall, in and around these two PAs, the
364 protection system operates in 22 territories, including geopolitical sectors, outborders
365 areas and fisheries or other agreements for participatory management of natural
366 resources.

367 Community-based management programs, in particular the management of giant
368 arapaima fisheries, have emerged in 2002 as a factor of great importance for the
369 consolidation of the community-based environmental protection system. In 2018,
370 fisheries projects had the participation of 57 VEAs (Franco et al., 2018). Community-
371 based management of timber resources and ecotourism programs were also of
372 outstanding importance, as it was the first legal *in situ* community-based management
373 of caimans (*Melanosuchus niger*) carried out in the MSDR in 2020; all of these programs
374 occurred in areas protected by VEAs. By VEAs managing areas they restrict access of
375 external agents to their territories and assist in the application of protection rules that
376 guarantee resource use sustainability. The efforts of VEAs, for example, contributed to
377 a 25.7% reduction in illegal logging in the MSDR between 1992 and 1999 (Nascimento
378 et al., 2012).

Most of the abovementioned community-based management systems fully or partially finance the activities of VEAs to protect their territories. This aspect is particularly important, and is probably an additional critical factor to the success of this system, since the long-term surveillance and control of large areas can be very expensive. Without a continuous input of financial support, VEAs would probably not be able to keep their field work for long periods. The contribution to surveillance systems can account for 30% - 40% of the total financial resources that managers earn. Such financing scheme acquired even greater importance from 2016 onwards, a period when the traditional institution that used to support and promote field actions, the MSDI, was unable to continue its financial support to VEAs of the two PAs (Escobar, 2015; Fernandes et al., 2017; Magnusson et al., 2018).

In 2001, when 22 VEAs were active, all men except one woman. Between 2001 and 2020, after legal regulation and the consolidation of the community-based environmental protection system, there was an increase of 877.2% in the number of VEAs in the field, totaling 215 agents (Appendix A). In the same period, there was an increase of 5,600% in the participation of women in activities, with 57 in operation in 2020 (26.5% of the total; Figure 4). The increased diversity and representativeness of this protection system is also evident in the increase in participation of indigenous people. Between 2003 and 2020 there was a 733.3% increase in indigenous participation, with 25 indigenous people in operation in 2020 (11.6% of the total).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PA's local communities
Small towns
Fisheries community-based management
Forest community-based management
Tourism community-based management
Caiman community-based management
Outborders with VEA
Community-based protection system operating area
0 5 10 20 km

399

Fig.3. Territorial expansion of community-based protection in and around Mamirauá and Amanã Sustainable Development Reserves, **a** = 1995 (1 = ST, FM Mamirauá; 2 = ST, FM Jarauá); **b** = 2001 (3 = ST Tijuaca; 4 = ST Ingá; 5 = ST Liberdade; 6 = ST Horizonte; 7 = ST Barroso; 8 = ST, FM Aranapú); **c** = 2007 (9 = ST, FM Coraci; 10 = ST, FM São José; 11 = FM Pantaleão; 12 = ST, FM Paranã do Amanã); **d** = 2013 (13 = ST Boa União; 14 = ST Panauã de Baixo; 15 = ST, FM Joacaca; 16 = ST, FM Caruara; 17 = FM Acapú); **e** = 2020; (18 = ST, O Macopani; 19 = ST Lago Amanã *; 20 = FM, O Jurupari; 21 = ST Cubuá-Copeá; 22 = FM, O Capivara); **f** = 2020 in detail with the location of community-based management projects for natural resources. (ST = PAs sectors; FM = Fisheries community-based management area; O = Outborders) (* = sector created from the division of ST Paranã do Amanã (12), occurred in 2014).

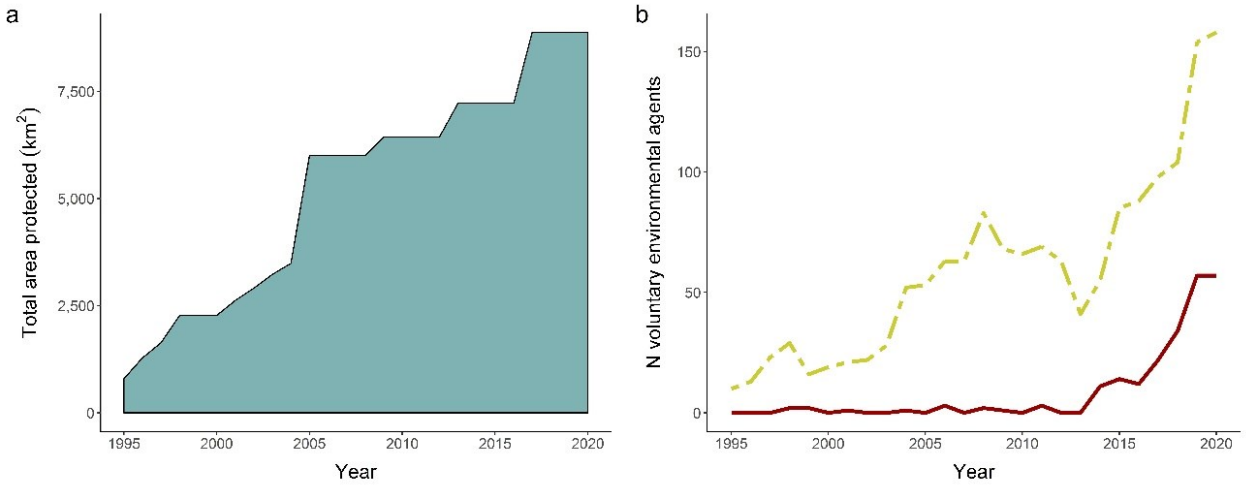

Fig.4. (a) Area under actions of the community-based environmental protection system between 1995 and 2020. (b) Number of active Voluntary Environmental Agents by sex (men: two-dashed yellow line; women: solid red line) between 1995 and 2020.

3.3 The second stage of expansion: other PAs in the Brazilian Amazon

In a second phase of expansion, we were able to identify the replication of the community-based environmental protection system in other PAs in the Brazilian Amazon. Between 2008 and 2019, the VEAs Program was implemented in 37 new PAs (see Appendix A), amounting to 39 officially protected PAs (36 state and 3 federal) in the Amazonas state by VEAs (Figure 5). The continuation of the VEA Program in federal PAs in Amazonas state was made possible through the implementation of this system in other state PAs bordering those areas, and management programs of natural resources nearby. The demand for the implementation of the VEA Program in these federal PAs was through local community's side. By 2020, this environmental protection system covered 36.1% of all existing PAs of the state of Amazonas (n=108); 80% of all state PAs (n=45) and 4.76% of federal PAs (n=63).

In addition to these PAs, we identified the participation and support of VEAs in 8 community-based fisheries management programs in Amazonas state. In 2019, 1,999 VEAs were trained by the state program; of these, 82.5% qualified in state PAs, 14.5%

in community-based management of fisheries resources projects, and 3% in federal PAs. Across the state of Amazonas, 31 community-based fisheries management areas rely on the community agents for their protection. This involves around 1,700 agents. In 2017, protection activities represented about 41% of all fisheries management costs. Despite these high costs, such activities benefited as many as 4,044 fishermen and their respective families (Rossoni et al., 2018).

In 2020, the VEAs were operating in an area of 199,266.82 km² of the Amazon biome, where they protect a variety of ecosystems and species, and support dozens of community-based management programs. This protection system covers many hundreds of rural communities and affects the lives of thousands of local people, demonstrating a rapid and very successful expansion in just 25 years.

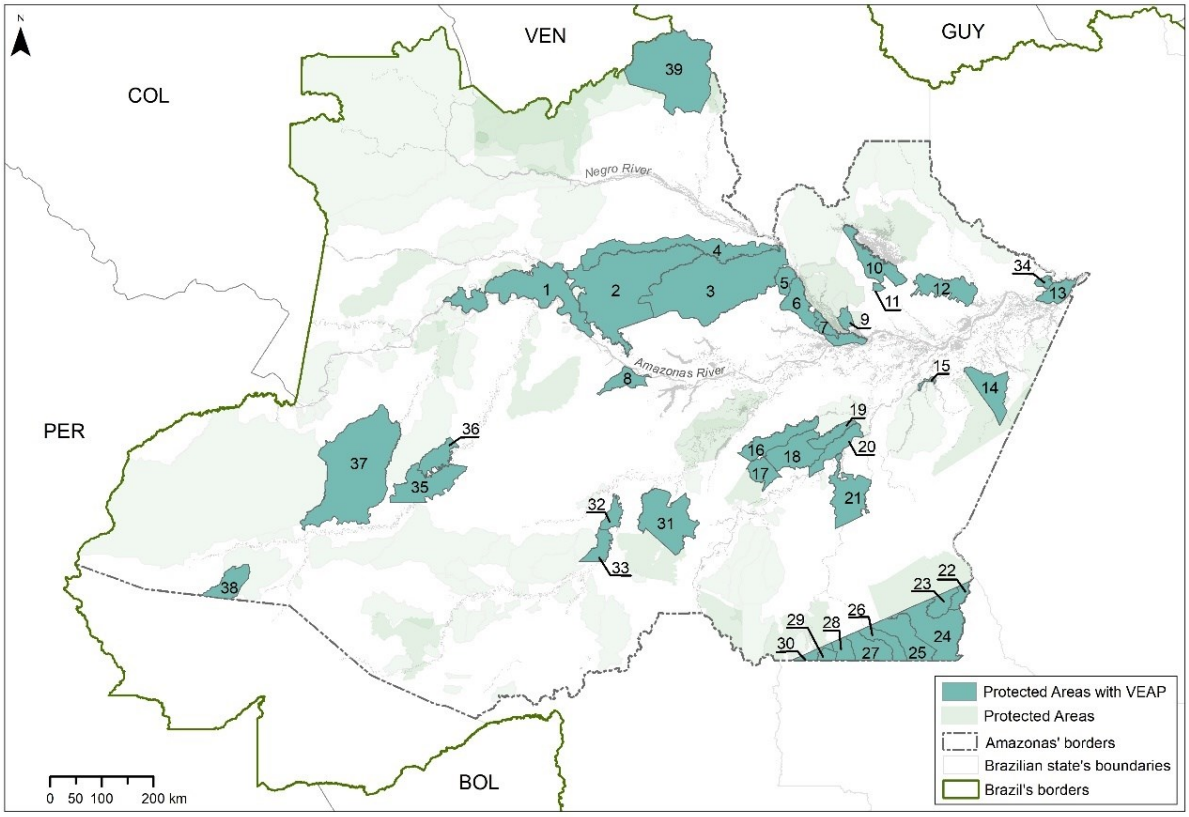

Fig.5. Protected Areas of different categories in the state of Amazonas that present the state Voluntary Environmental Agents Program in 2020; 1 = Mamirauá SDR; 2 = Amanã SDR; 3 = Jaú NP; 4 = Unini ER; 5 = Rio Negro Setor Norte SP; 6 = Margem Direito do Rio Negro-Paduari-Solimões EPA; 7 = Rio Negro SDR; 8 = Catuá-Ipixuna ER; 9 = Puranga Conquista SDR; 10 =

Caverna do Maroaga EPA; 11 = Rio Urubu SF; 12 = Uatumã SDR; 13 = Nhamundá EPA; 14 = Maués SF; 15 = Canumã SDR; 16 = Igapó-Açu SDR; 17 = Rio Amapá SDR; 18 = Matupiri SP; 19 = Matupiri SDR; 20 = Rio Madeira SDR; 21 = Juma SDR; 22 = Bararati SDR; 23 = Apuí SF; 24 = Sucunduri SP; 25 = Sucunduri SF; 26 = Aripuanã SDR; 27 = Aripuanã SF; 28 = Guariba ER; 29 = Guariba SP; 30 = Manicoré SF; 31 = Tapauá SF; 32 = Canutama SF; 33 = Canutama ER; 34 = Guajuma EPA; 35 = Uacari SDR; 36 = Médio Juruá ER; 37 = Cujubim SDR; 38 = Rio Gregório ER; 39 = Serra do Araçá SP. (SDR= Sustainable Development Reserve; ER= Extractive Reserve; NP=National Park; EPA = Environmental Protection Area; SF = State Forest; SP= State Park).

4. Discussion

Collective actions carried out by local communities aimed at protecting natural resources in central Amazonia started about 40 years ago before their legal regulation. These initiatives have been strongly associated with the creation and consolidation of PAs. This suggests that the degree of interest by local communities to protect their territories and resources is more important than any conferring of formal protection status to these territories by governments. We show how critical the motivation and petition by local populations are for the implementation of effective protection for adequate management of subsistence and extractive activities. Local institutions, when capable of bringing their interests together, are more efficient in providing effective protection than the formal enactment of PA (Hayes, 2006). Thus, during the first stage of expansion in the first two PAs dealt with in this study we understand that it is the motivation and the request made by local populations to implement effective protection that were critical to the success of the program.

From the rise in social representativeness recorded over time we show that the demand for effective protection by local populations is clear. We observed that throughout the historical process of the VEA Program, and even before its formalization (1995 – 2020), there was an important diversification in VEAs. Since the start, men have

participated more than women and indigenous people. However, women and indigenous peoples have subsequently become more involved, coinciding with the period in which activities were regulated formally by the Amazonas state. Another possible factor that explains the increase in women participation is the increase in the number of fisheries co-management areas, especially arapaima (*Arapaima* spp.). These fisheries have provided greater space for women (Freitas et al., 2020). One of the main benefits of this participation is a greater dissemination of the objectives of this protection system in everyday places where women predominate. The regulation of protection actions has proved an efficient way to legitimatize local demands but also to encourage better gender and ethnic equity in the management of natural resources and territories.

The legal regulation of the VEA Program was identified by us as another critical factor, since it made it possible to delegate the role of protecting their territories to the local communities, allowing them to fulfill their wishes for more sustainable use of natural resources. At first, the protection function was clearly to exercise control, in line with the social demands of the period. However, with the improvements in the legal framework the system, a more preventive approach developed. The changes in the character of the program's performance were mainly due to the risks associated with the activity and the understanding that an approach aimed at environmental awareness can be more effective in the long-term. Over time, new regulation was drafted including environmental education, social mobilization, multiplication of leaders and mediation of conflicts as part of the activities undertaken by VEAs. This protection system then gained a more significant role in preventing inappropriate extraction of natural resources by legitimate and non-legitimate users and empowered local people to manage their territories. VEAs were also present in practically all official surveillance events in the MSDR and ASDR (Franco et al., 2019). Therefore, these agents acquired a new status as important actors in local environmental governance and in the definition of local communities' agendas (Lemos and Agrawal, 2006; Borrini-Feyerabend et at., 2007; Sablayrolles et al., 2019).

Empowerment of communities have created conditions for the appropriation, understanding and agreement of local and legal rules by local populations. On the one hand, it strengthened their territoriality (with appropriation and access control), and also generated greater compliance with the rules of management agreements. The establishment of social ownership rules, such as those established by the VEA Program, are fundamental for ensuring effective governance (Ostrom, 2010) and are in tune with the fair environmental governance criteria of PAs proposed by the International Union for Conservation of Nature (IUCN, 2017).

As with any shared governance system, involving local communities, the participation of other governmental and non-governmental institutions is also critical (Borrini-Feyerabend et al., 2007, Pokharel & Tiwari, 2013). In the case of the MSDR and ASDR, the Catholic Church and the local social movements supported by it were considered by us as critical factors for the development of the protection system and channeling the demand for official regulation. The support from the MSDI was also fundamental in the first phase of expansion of this system in the Middle Solimões River, mainly by providing the financial resources needed for the operationalization of VEAs' activities and assisting in the training and capacity development of the VEAs, while training courses were provided by governmental organizations.

For the operationalization of protective actions, logistical costs are important aspects to be considered. Although the work performed by the VEAs is voluntary, there are unavoidable costs linked to their activity. Funding for community-based protection actions is an additional critical factor to the success of these initiatives (Franco et al., 2019). Common resource co-management activities, such as community-based tourism projects, timber management, caiman management and management of fisheries resources demand effective environmental protection actions to guarantee compliance to the rules, the resilience of resources and integrity of the territory. While the financing of protection actions was first obtained by external institutions, funding for the protection

524 of management areas were subsequently raised by the many management programs
525 implemented in several territories.

526 The community-based management systems cited here play key roles in local
527 peoples' lives and in generating clear environmental and socioeconomic benefits
528 (Campos-Silva and Peres 2016; Campos-Silva et al., 2018). All areas under the
529 management of fisheries resources in the PAs evaluated in this study have their own
530 protection systems, most of them involving VEAs. These community-based management
531 systems in Central Amazonia contribute to guaranteeing users in the effective
532 conservation and protection of managed areas, as seen in some forestry management
533 systems in Central Asia (Pokharel and Tiwari, 2013; Pokharel et al., 2015). It is important
534 to note that the greater the degree of social engagement in community-based
535 management actions, the greater their ability to distribute benefits and fund other co-
536 management procedures such as environmental protection. In other parts of the
537 Amazon, where groups of communities carry out participatory management of non-
538 timber forest resources in partnership with private enterprises, access to resources and
539 benefits is asymmetrical, and there is less capacity to apply management and
540 environmental protection rules (Sikor, 2006).

541 Strengthening governance systems at appropriate scales is one of the most
542 important challenges for biodiversity conservation worldwide (Agrawal and Ostrom,
543 2006). This challenge is especially relevant in countries that, like Brazil, suffer from the
544 absence or the weakening of the environmental regulatory framework (Abessa et al.,
545 2019). Compromises to socio-environmental governance can irreversibly affect the
546 maintenance of ecosystem services of global importance (Ferrante and Fearnside, 2019;
547 Levis et al., 2020). Although the performance of environmental agencies throughout the
548 Amazon is insufficient, it is worth mentioning that the VEA Program in the state of
549 Amazonas is a unique initiative, with effective legal support for the protection and
550 management of natural resources compared to other states in Brazil. In addition to

551 enabling the continuation of the VEA Program at the state level, since at the federal level
552 the program ended, the state of Amazonas regulated the creation of Fisheries
553 Agreements, through state legislation, subsequent to Complementary Law 140 of 2011.
554 This act did not occur in any other state in the Amazon region. Community-based
555 environmental protection described here occurred within a multilevel governance, in
556 which the different actors that compose it are originated from different social spheres
557 and act simultaneously in different levels of organization and territories, acting as bridges
558 or links among all groups involved (Sattler et al., 2016). We believe that this protection
559 system can be replicated in any co-managed PA, or areas under shared management
560 anywhere in the world, once adjusted to the particularities of each local context. The
561 existence of legal regulations and formal protection are important requirements for
562 effective protection, but they are usually not sufficient to guarantee them. This is
563 especially critical in regions with a low governmental investment in enforcement actions,
564 and low capacity to apply the regulatory framework. In these countries or regions,
565 community-based actions are effective ways to enforce the rules for the use and
566 protection of territory and natural resources, and to legitimate the interests of local
567 communities.

568

569 **5. Conclusions**

570 We showed that the community-based protection system of natural resources in
571 PAs in the Brazilian Amazon is a tool for social control, but also a preventive and
572 guidance process for the use of the territory, and for the conservation and management
573 of its natural resources. This activity is performed predominantly by voluntary local
574 community agents, working in their own areas or in the surroundings, and in regions
575 where community-based management of common use resources are established,
576 generating conformity to the rules. This form of protection arose from the demands of
577 social movements and has been officially regulated over the years. We identified that

(a) the communities' previous demand for an effective control system, (b) the formalization and regulation, (c) the existence of external supporting or promoting institutions, and (d) the existence of community-based management programs that can finance their actions, are likely critical factors that allowed the success in the first phase of territorial expansion of this system within the two firs PAs in central Brazilian Amazon. Future investigations need to be carried out to confirm their role in the development, success and expansion of the system, and to verify to what extent these same factors were equally critical for the replication and success of this community-based environmental protection system in the second phase of expansion to other PAs in the central Brazilian Amazon. In addition to allowing more effective protection, this community-based protection system also generates conformity for the management of community-based natural resources, especially in contexts where official action is absent or inefficient. This system can therefore serve as a model for the protection of PAs in various parts of the globe.

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Appendix A. Supplementary data

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