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Governing a layered territory: overlapping property rights and the mismatch of incentives in Afro-Brazilian Territories

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Abstract

Significant advances have taken place in the recognition of property rights in areas of occupied by local and indigenous communities, particularly in tropical forest areas known for their conservation value. In the Brazilian Amazon, for instance, these areas correspond to 44% of the region today. The figure is even higher for areas of remnants of Atlantic forest along the Southern coast of the country. As a result, complex mosaics of property rights are evolving whereas one observes both overlaps and mismatches between rights regulating land rights, ecosystems, and specific resources and species. In this paper, we use Schlager & Ostrom's (1992) bundles of property rights concept and Yandle's (2007) mismatch of property rights to analyze how overlapping property systems and related institutional arrangements affect the incentives to manage common property resources in tropical forests. In particular, we examine the case of the Afro-Brazilian (Quilombola) territories in the Atlantic Forest. We take a Social-Ecological Systems approach to examine the type and degree overlaps and mismatches across three levels: *Quilombola* territories (governance system), forest (resource system), and the Euterpe edulis palm tree (resource unit). The Euterpe edulis palm tree is an emblematic conservation species for the Atlantic Forest. It is highly appreciated as a food source, and it demands high prices in informal markets throughout the region. For decades, the conservation movement has coalesced around protecting the palm against illegal extraction. Yet, the Euterpe edulis economy has not followed a path of domestication and intensification as other palm trees in the Amazon, such as the Euterpe oleraceae (açaí) or other extractive resources (Brondizio 2008) Homma 1993). Nor it has been adequately preserved in public protected areas, or been successfully managed in commonly held land, as suggested by (Ostrom 1990). Instead, and in spite of efforts, it continues to follow a tragedy of the commons path as predicted by (Hardin 1968). To examine this puzzle, in addition to our analysis of bundles of rights, we use the Ostrom Design Principles to evaluate the underlying governance conditions at each level of analysis: the territory, the forest resource system, and the Euterpe palm resource unit. We argue that the layered structure of property rights has diffused the sense of ownership of the resource without providing effective mechanisms for assuring compliance to rules and monitoring of the resource. These arrangements are also limiting the ability of Quilombola residents to effectively develop management plans that reconcile conservation and development goals.

1. Introduction

Tropical forests are recognized for their importance in providing local and global ecosystem services such as water, biodiversity and carbon storage, but also for contributing to local livelihoods (FAO 2014, IUCN 2012). Forest commons account for 18% of global forest area (Chhatre & Agrawal 2008) and are sources of timber and non-timber forest products for regional and global markets (Brondizio 2008, FAO 2014). Common-pool resources (CPRs) such as forests are managed by a wide variety of property rights systems, with outcomes varying according to multiple contextual factors (Cole & Ostrom 2011, Ostrom *et al.* 2007).

The conventional typology of property regimes recognizes four different types: state/public, private, common property, and open access. Each involves different levels of coordination among and resulting in different sets of advantages and disadvantages to different actors (Ostrom 2003). Open access functions as a default condition, often preceding the emergence of a given property rights arrangement and management regime (Cole & Ostrom 2011, Ostrom 2003). In open access regimes, the features of the resource and its saliency among potential users will define its conditions for subtractability, and as such, the degree to which it may be overused, including a potential "tragedy of the commons" (Hardin 1968, Ostrom 1990).

Research has shown that successful governance outcomes are not a function of a specific property regime, but depend on the fit between local ecology and governance arrangements, the rules in place, market pressures, monitoring, enforcement, and the recognition of system legitimacy by local users (Moran and Ostrom 2005; Chhatre & Agrawal 2008, Cole & Ostrom 2011, Ostrom & Cox 2010)¹. The bundles of rights framework has been instrumental in providing elements to disentangle relevant components of property rights particularly, but not exclusively for common-pool resources, such as rights of access, withdraw, management, exclusion and alienation (Ostrom 2003, Schlager & Ostrom 1992). For instance, when the analysis of property regimes is disaggregated in terms of bundles of rights, one observes that hybrid regimes of resource governance are the norm (Ostrom 2003, Schlager & Ostrom 1992, Yandle 2007).

¹ Using the International Forestry Resources and Institutions Program (IFRI) database, Chhatre & Agrawal (2008: 13287) showed that "forests with a higher probability of regeneration are likely to be small to medium in size with low levels of subsistence dependence, low commercial value, high levels of local enforcement, and strong collective action for improving the quality of the forest. Larger forests in the sample with high subsistence dependence, low enforcement, and high commercial value have a higher probability of having degraded. While the influence of individual factors—group size, patch size, collective action, subsistence dependence, and commercial value is as predicted, the ensuing analysis demonstrates the significant role played by the level of enforcement in moderating the influence of these factors on changes in the condition of forest commons".

In situations of change, where property rights become incompletely defined or their redistribution creates overlaps between institutional arrangements and local conditions, conflicts may arise and can undermine the resilience and adaptive capacity of local social-ecological arrangements, even those developed over long periods of time (Meinzen-Dick & Mwangi 2009, Yandle 2007). The most usual cases of overlaps/mismatches involve spatial and temporal dimensions (Cash *et al.* 2006, Cole & Ostrom 2011, Duraiappah *et al.* 2014), but they can also involve property rights created to manage individual resources or sectors, such as land, specific species, and other natural resources (Meinzen-Dick & Mwangi 2009, Yandle 2007)².

The recognition of property rights in areas of occupied by local and indigenous communities has significantly advanced, particularly in tropical forest areas known for their conservation value. In the Brazilian Amazon, for instance, these areas correspond to over 40% of the region today (Nepstad et al 2006). The figure is even higher for areas of remnants of Atlantic Forest along the Southern coast of the country, which is also a biodiversity hotspot (Myers *et al.* 2000) and protected by laws and regulations. As a result, complex mosaics of property rights are evolving whereas one observes both overlaps and mismatches between rights regulating land rights, ecosystems, and specific resources and species (Futemma *et al.* 2015). Whether overlapping property rights supports or undermines the long-term sustainability of forest ecosystems and species remains a question.

In this paper, we use (Schlager & Ostrom 1992) bundles of property rights concept to analyze how overlapping property systems and related institutional arrangements affect incentives to manage common property resources in tropical forests. In particular, we examine the evolution of overlapping property rights affecting Afro-Brazilian (*Quilombola*)³ territories located in areas of Atlantic Forest remnants in Southeastern Brazil. We take a Social-Ecological Systems (SES) approach to examine the type and degree of overlaps and mismatches across three levels: *Quilombola* territories (governance system), forest (resource system), *Quilombola* and non-*Quilombola* resource users (actors), and the *Euterpe edulis* palm tree (resource unit).

² A mismatch can be defined as "a problem of fit involving human institutions that do not map coherently on the biogeographical scale of the resource either in time or space" (Cash *et al.* 2006:4). (Yandle 2007: 2) has expanded this concept to property rights: "when a variety of property rights arrangements are created to manage individual resources or sectors, the result may be the creation of incompletely defined property rights arrangements, causing conflicting expectations among resource users".

³ The *Quilombolas* are descendants of former Maroon colonies, and are among the poorest and most marginalized rural communities in Brazil (Penna-Firme & Brondizio 2007, Schmitt *et al.* 2002).

The *Euterpe edulis* native palm tree is an emblematic conservation species for the Atlantic Forest (Galetti & Fernandez 1998, Reis *et al.* 2000). Called locally as *palmito* or *juçara*, its ecology poses many challenges to sustainable management (Reis *et al.* 2000). This species is characterized by single-stem individuals that are dispersed over large, usually mountainous areas. It does not regenerate from cutting and its replacement rates ranges from 6 to 10 years. Different from other species of the *Euterpe* genus, the *E. edulis* palm does not produce off-shots, depending on seed dispersal and canopy gaps for the palm to grow. However, its heart of palm (often referred by locals as "white gold") is highly appreciated as a food source, and demands high prices in informal markets throughout the region (Orlande *et al.* 1987, Orlande *et al.* 1996).

For decades, the conservation movement has coalesced around protecting the palm against illegal extraction. Yet, the *Euterpe edulis* economy has not followed a path of domestication and intensification as other extractive resources in the Amazon, including another related species, the *açaí* palm (*Euterpe oleraceae*) (Brondizio 2008) Homma 1993), despite its potential for sustainable management (Reis *et al.* 2000). Nor it has been adequately preserved in public protected areas, or successfully managed in commonly held land, as suggested by (Ostrom 1990). Instead, and in spite of efforts, it continues to follow a tragedy of the commons path as predicted by Hardin (1968), leading to a decline in population density, loss of genetic diversity and local extinctions (Reis *et al.* 2000, Romeiro & Barcia 1996, Silva Matos & Bovi 2002, Fanelli *et al.* 2012, Orlande *et al.* 1987, 1996). Why efforts that have led to multiple layers of property rights and monitoring intended to protect the palm have not been effective? What mismatches exist between governance efforts, property right arrangements, market demand, and the ecological and social contexts of the *Euterpe edulis* palm?

To examine this puzzle, in addition to our analysis of bundles of rights, we use Ostrom's Design Principles to evaluate the underlying governance conditions at each level of analysis: the *Quilombola* territory, the forest resource system, and the *Euterpe* palm resource unit. We argue that the combination of overlapping systems of property rights, geographical and ecological characteristics, and the structure of the informal/illegal heart of palm economy undermines the effectiveness of legislation, local efforts to carry out cooperative monitoring and local investment in sustainable management.

In the remaining of this section, we present our theoretical framework. In section 2, we use the SES framework to contextualize the Afro-Brazilian territories located in the Ribeira Valley (state of São Paulo), and give a brief description of the historical changes in their governance institutional arrangements (Futemma *et al.* 2015). In section 3, we discuss overlaps and mismatches between types of property rights (i.e., analysis of bundles of rights) and their implications for the governance of the

Quilombola territory, the forest, and the *Euterpe edulis* palm (i.e., analysis of design principles). In section 4, we discuss the policy implications of our findings, followed by a brief conclusion.

1.2. Social-Ecological Systems, Design Principles and Property Rights

Social-ecological systems (SES) are "a subset of social systems, in which some of the interdependent relationships among humans are mediated through interactions with biophysical and non-human biological units" (Anderies *et al.* 2004: 3). As such, SES are complex, adaptive systems, embedded in larger systems and involving multiple subsystems (Anderies *et al.* 2004). The SES framework developed by E. Ostrom and collaborators is a diagnostic tool that helps to analyze the factors affecting the sustainability of social and ecological systems (McGinnis & Ostrom 2014, Ostrom & Cox 2010). The SES framework evolved and is often used in combination with the Institutional Analysis and Design (IAD) framework (McGinnis 2011; Ostrom 2011).

Comparative research, starting with Ostrom (1990), has shown that robust and sustainable SES of common-pool resources share in common a number of conditions, or 'design principles', characterized as: clearly defined social and biophysical boundaries, proportional equivalence between benefits and costs, collective-choice arrangements, monitoring, graduate sanctions, conflict-resolution mechanisms, minimal recognition of rights to organize and nested enterprises (Anderies *et al.* 2004, Ostrom & Cox 2010; Cox et al. 2010).

As reviewed by McGinnis & Ostrom (2014), the primary components of SES are: social, economic, and political settings (S); resource systems (RS); governance systems (GS); resource units (RU); actors (A); action situations: interactions (I) \rightarrow outcomes (O); related ecosystems (RO). These first-tier variables can be further divided in second-tier variables that specify characteristics or components of each system as appropriate to a given problem (Ostrom & Cox 2010). However, it has been argued that the SES framework does not systematically incorporate the contribution of laws, theories and principles from the natural sciences, which could increase its diagnostic capacity (Epstein *et al.* 2013). Therefore, here we adopted the revised SES framework as proposed by Epstein *et al.* (2013) and Vogt *et al.* (2015) (see Appendix 1). The revised framework helps analyzing case studies while explicitly identifying ecological conditions, facilitating scholarly review and future reinterpretation of ecological results in light of new research (Epstein *et al.* 2013, Vogt *et al.* 2015).

Common-pool resources such as forests can be governed by different property rights regimes or systems, which can be better understood as being constituted of bundles of rights (Schlager & Ostrom 1992). Bundles of rights might be shared or divided between different actors, and different distributions affect the incentives for individuals to manage a resource (Yandle 2007). Schlager & Ostrom (1992) defined five different types of property rights: access (the right to enter a defined physical area and enjoy non-subtractive benefits); withdraw: (he right to obtain resource units or products of a resource system); management (the right to regulate internal use patterns and transform the resource by making improvements); exclusion (the right to determine who will have access right, and how that right may be transferred); and alienation (the right to sell or lease exclusion, management or withdraw rights).

Here, we built upon the concept of property rights mismatch used for the analysis of marine fishing systems (Crowder *et al.* 2006, Wilson 2006, Yandle 2007) to analyze overlaps between rights assigned to the *Quilombola* territories (SES component = governance system), the forest (SES component = resource system) and the *E. edulis* palm (SES component = resource unit) in the Atlantic Forest, and resulting mismatches in incentives for *Quilombola* residents and other users of these resources (SES component = actors). In previous papers, we analyzed the historical changes in the institutional arrangements that govern *Quilombola* Territories (Futemma *et al.* 2015, summarized in section 2) and described how different public policies have affected *Quilombola* livelihoods (Adams *et al.* 2013). This paper is based on data collected by an interdisciplinary and interinstitutional research group on several aspects of the human ecology and institutional arrangements in 10 *Quilombola* communities situated in the municipalities of Eldorado and Iporanga, state of São Paulo, since 2003 (for a review see Adams et al. 2013).

2. Afro-Brazilian (Quilombola) Territories in the Atlantic Forest

The Brazilian Atlantic Forest originally extended approximately 3,300 km along the coastline, covering approximately 148,000,000 ha (Metzger 2009, Ribeiro *et al.* 2009). Since the European conquest, it has experienced significant deforestation for timber, agriculture, cattle ranching, firewood and urban expansion (Dean 1997), which left only 11.7 % of the original forest cover (Ribeiro *et al.* 2009). With the majority of its remaining area designated as a Biosphere Reserve by UNESCO in 1991, the Atlantic Forest is considered one of the world's top biodiversity hotspots (Myers *et al.* 2000). It is also remarkable for its social and cultural diversity, being home to so-called traditional populations (e.g., *Caiçaras, Quilombolas*) and indigenous groups (Guarani *Mbyá* and *Ñandeva*, among others), many of which still depend on shifting cultivation and forest resources for their livelihoods (Adams 2003, Castro *et al.* 2005, Penna-Firme & Brondizio 2007).

The Ribeira River Valley (2,830,666 ha), where we focus our analysis, is situated between two of the country's most important cities, São Paulo and Curitiba, and is the largest Atlantic Forest remnant in Brazil (Adams et al. 2013, Dos Santos & Tatto 2008)⁴. Due to the mountainous relief, the area restricts mechanized agriculture. Difficult road access has also limited the economic development of the region (Hogan et al. 1995, Dos Santos & Tatto 2008). Home to 59 Afro-Brazilian *Quilombola* communities (Dos Santos & Tatto 2008), municipalities in the region are characterized by low human development index (HDI), reflecting low levels of education and income and high levels of infant mortality and illiteracy (Alves 2004, Hogan et al. 1995).

The region is also infamous for the illegal extraction and trade of the *Euterpe edulis*' heart of palm (*palmito*) (Galetti & Fernandez 1998). Although official statistics do not exist, estimates indicate that 29 tones were extracted annually from ne of the municipalities in *Ribeira* River Valley (Sete Barras) in the 1990's (Galetti & Fernandez 1998), and around 200 tons were extracted monthly from the region as a whole during the same period (Ribeiro *et al.* 1993). During 1996-97, for example, the Environmental Military Police (EMP) made 49 arrests and apprehended 77 tons of canned *palmito* (Fantini 1999), which is considered a fraction of the actual industry. Monitoring and enforcement are recognized as being inefficient both by scholars and residents of the region (Fantini *et al.* 2004, Galetti & Fernandez 1998). Middlemen have reported that the chance of being caught by the EMP when transporting the *palmito* is 1 in 4, while the risk of being arrested while cutting *palmito* in the forest is much lower (Fantini *et al.* 2004).

The *Ribeira* River Valley is also symbolic for the recognition of land rights of Afro-Brazilian (*Quilombola*) communities. The *Quilombolas* are, besides Indigenous groups, the only populations in Brazil with legal claim to ancestral lands (Barros 2007, O'Dwyer 2009). This right was granted in the 1988 Brazilian Constitution, and represented an attempt to guarantee access and land use rights for the descendants of the maroon communities formed, usually in isolated parts of the Brazilian territory, between the 16th and 19th centuries (Futemma *et al.* 2015). The *Quilombola* territories are collective properties of land, and the communities are not allowed to sell, transfer, or rent the land. In other words, they have access, and exclusion, limited management rights, but not alienation rights.

The creation of the *Quilombola* territories is considered a compensation policy (Schmitt *et al.* 2002). From an initial limited number of communities acknowledged as having ancestral *Quilombola* rights, this constitutional provision extended broad and wide to encompass today, 2,697 recognized communities, most in rural areas. To date, 196 territories have already received their collective land

⁴ The Atlantic Forest Biosphere Reserve has 470,000 ha (http://www.ciliosdoribeira.org.br/vale-ribeira/patrimonio)

titles throughout the country (INCRA 2015)⁵. In the state of São Paulo, the seven territories that have been granted land titles are situated in the municipalities of *Eldorado* and *Iporanga*, in the *Ribeira* River Valley (Figure 1).

The occupation of the Ribeira River Valley by Afro-Brazilian descendants' dates back to the beginning of the 19th century and their history is marked by land conflicts and state intervention (see Futemma et al. 2015 for details). Futemma et al. (2015) explains that historical changes in the institutional structure of *Quilombola* communities can be divided in four periods (Figure 2). Until around mid 20th century, *Quilombolas* relied mainly on shifting cultivation, hunting, fishing and collection of forest resources. Use and access to new areas for cultivation were based on customary norms and rights, based on recognition of usufruct rights or "first come, first served" basis (Futemma et al. 2015). The family first claiming a site through clearing and planting could use it as long as the site remained productive with no restrictions on the duration of use, or on the size of the area. Despite not having formal and established ownership of an area, each family could claim rights to land large enough to rotate shifting cultivation fields. Kinship members or kindred group (group of kin families) could access a piece of land and use it for farming or building a house. Thus, in this first period the use and occupation of land for housing and farming was based on self-governance (Ostrom 1990). In many cases, however, these lands were claimed, often by force, by absentee "owners", based on titles acquired during the colonial period or illegally.

The 1950s-60s period was considered by Futemma et al. (2015) as a transitional phase from self-governance to a hierarchical state-controlled system (Chuenpagdee 2011), characterized by policies based on a development-oriented paradigm in which the state played a central role (Figure 2). The construction of roads and a highway connecting the *Ribeira* River Valley to other states in the Southern region of Brazil, attracted land grabbers and outsiders interested in ranching and in extracting the *Euterpe edulis* palm heart, at the time widely abundant. In this period, state-crafted rules emerged reinforcing an institutional structure that reflected the role of the public sector in crafting, enforcing and monitoring higher-level or collective choice rules (as defined by Ostrom *et al.* 1994: 46-47). Rules such as the prohibition to raise pigs, farming, and extraction of resources in several newly created protected areas were put in place. These rules had a direct impact on the production system and livelihood activities of local farmers (Futemma et al. 2015).

⁵ The *Fundação Cultural Palmares* (Ministry of Culture) certified 17 new communities in 30th of December 2016, totalizing 2,697 recognized communities in Brazil (http://www.palmares.gov.br/?p=40153). Once they are recognized, the communities can demand land titles to INCRA (National Institute for Colonization and Agrarian Reform).



Figure 1 – Studied *Quilombola* communities in the Ribeira Valley, state of São Paulo, Brazil (in red the ones with legal land titles) (Adams et al. 2013)



Figure 2 - Timeline depicting historical facts and changes in governance of the *Quilombola* communities from 19th century to 21st century (from Futemma et al. 2015).

In the 1970s, in part as a response to the presence of guerilla groups in the region, the military government delivered elementary schools, roads, and health centers to parts of the region. The availability of new public services created incentives for local families and dispersed communities to cluster in small villages. Land grabbing and the arrival of squatters also marked the period. Rural communities and families in the region were frequently subjected to violence and expulsion. In the 1980s, state and non-governmental organizations started to support rural communities to solve land conflicts situations. Lands occupied by what later became *Quilombola* communities were parceled out by a state agency (SUDELPA) dedicated to regional development, including solving land conflicts. At the time, families received a 0.25-hectare lot based on the recognition of their customary use. Land regularization led to changes in the production system and types of land ownership, including contributing to, unexpectedly, land transactions with externals buyers and speculators (land grabbers). This third phase was thus characterized by a transition from state-centered control to partnership arrangements, including in some cases co-governance, involving NGOs, unions, and organizations representing different social groups and interests (Figure 2) (Futemma et al. 2015, Adams et al. 2013).

With the support of several institutions, the process of collective land titling of *Quilombola* communities began in the 1990s. In 2000, the regulation of Article 68 of the 1988 Brazilian Constitution was passed, granting land titles to *Quilombola* communities based on ethnicity, settlement history, and Afro-Brazilian ancestry. In the Ribeira River Valley collective ownership cancelled out the previous parceling of land conducted by SUDELPA. Despite the collective title, land use was still based on informal usufruct rights established in earlier periods (Futemma *et al.* 2015).

Currently, each community governs its own territory through a legal association composed of a president, vice-president and secretariats, although some communities have been unfamiliar with this system. Decisions with respect to norms and rules regarding land occupation and use are made within the association, in which members of the community vote. The level of organization among the Afro-Brazilian communities differs significantly (Futemma et al. 2015). Livelihoods are based on the production of rice, beans, maize, cassava and vegetables for subsistence, and few cash crops such as bananas and, recently, the Amazonian *pupunha* palm tree (*Bactris gasipae*). Governmental cash-transfer programs play an important role in household income (Adams et al. 2013, Fanelli et al. 2012), but the *Quilombola* communities remain the poorest rural populations in Brazil (Penna-Firme and Brondizio 2007). A 2012 report from the National Secretary for the Promotion of Racial Equity estimates that 75% of *Quilombolas* in Brazil are in situation of extreme poverty (Brasil 2012).

Over the last 20 years, the *Quilombolas* from the Ribeira were faced with crucial changes in their production system due to environmental policies and regulations affecting farming, husbandry and extraction of forest resources (Adams et al. 2013). State and Federal rules began to be enforced by legislation limiting agricultural activities in forested areas. Thus, the design, enforcement and monitoring systems at the collective-choice and constitutional-choice levels (state and federal governments) began to replace the local customary system concerning the use of forests and specific resources such as the *Euterpe edulis* palm (Futemma et al. 2015)

As a result, a complex mosaic of property rights evolved whereas one observes both overlaps and mismatches between rights regulating Afro-Brazilian territories, forest ecosystems, and specific resources and species. In the next section, we characterize the *Quilombola* SES and examine the bundle of property rights and resource governance across three levels – *Quilombola* territories (governance system), forest (resource system), and the *Euterpe edulis* palm tree (resource unit).

3. The Quilombola Social-Ecological System

3.1. Resources and Property Rights

In the following paragraphs, we characterize some of the primary components of the *Quilombola* SES (McGinnis & Ostrom 2014) *vis-a-vis* their bundles of property rights (Schlager & Ostrom 1992) (see also Appendix 1).

3.1.1. Resource System: the Atlantic Forest

The 1988 Brazilian Constitution declared the Atlantic Forest as a national patrimony. Two years later, Federal Decree 99.547/1990 was issued prohibiting any kind of use of its resources, due to the mobilization of environmentalist groups that helped to design the constitution and their concern with the vanishing forest. The restrictions imposed by this policy directly affected the *Quilombola's* livelihoods by prohibiting the traditional shifting cultivation system and the collection of forest resources. The technical support offered by the government of the state of São Paulo to promote agricultural intensification in non-forested areas was not enough to cease the decline of subsistence production systems in the *Ribeira* River Valley (Romeiro & Barcia 1996).

The controversies that followed Federal Decree 99.547/1990 regarding the use of the forest's resources by farmers and members of 'traditional communities' lead to its substitution by Federal Decree 750, in 1993, which was considered as the most effective legal instrument to protect the Atlantic Forest (Greenpeace 2006). Federal Decree 750/1993 prohibited cutting primary and secondary

forest in intermediate and advanced succession stages, except in cases of public utility or social interest and after the approval of an impact assessment report (Varjabedian 2010). The use of forest in initial stages of successions was to be regulated by IBAMA (Brazilian National Environmental Institute) and state environmental agencies. Despite very strict rules regarding the use of the Atlantic Forest's resources, it did allow for the use and consumption of vegetation species (such as *palmito*) by members of 'traditional communities', under an authorization of the state environmental agency.

In 2006, after 14 years of debate in the Brazilian parliament due to the pressure from farmers and loggers, Federal Law 11.428 (Atlantic Forest Law) substituted Federal Decree 750⁶ (Greenpeace 2006)(Romeiro & Barcia 1996). Environmentalists considered the Atlantic Law as a throwback, because it reduced the protection and increased the risks to the Atlantic rainforest remnants. The new law, which is still in force, differentiated the intermediate stage of succession from the advanced stage/primary forest, and allowed it to be used by smallholders (50 hectares) and traditional people for subsistence agriculture and cattle ranching. Licenses were to be issued only by state environmental agencies, without the need to hear IBAMA (Varjabedian 2010). In the state of São Paulo, the licenses are issued by CETESB (São Paulo State Agency for Environment) under Resolution 27/2010 (SÃO PAULO 2010). However, the resolution prohibits the use of fire based on State Law 10.547/2000 (SÃO PAULO 2000), a crucial element of the shifting cultivation system. Furthermore, to obtain the license an extensive paperwork has to be filled by the *Quilombolas* with the help of ITESP (the state agency of São Paulo for land tenure issues). The process is highly bureaucratic, and it can take months for the license to be released by CETESB (Futemma *et al.* 2015).

Besides the legislation that specifically protects the Atlantic Forest, the use of the forest is also subjected to the Brazilian Forest Code. This piece of legislation regulates land use and management on private properties, and has been recently revised (Soares-filho *et al.* 2014). The 1965 Forest Code required landowners to conserve native vegetation on their rural properties, both by setting aside a Legal Reserve (LR) and by protecting environmentally sensitive areas (Areas of Permanent Preservation - APPs), such as along river and streams and in areas of steep topography. In the Atlantic Forest biome, the LR should be equivalent to at least 20% of the property, compared to 80% in the Amazon region. The APPs includes hilltops, high elevations, steep slopes, and riparian areas (Soares-filho *et al.* 2014). In the *Ribeira* River Valley, as elsewhere in Brazil, the 1965 Forest Code proved difficult to monitor and enforce, and most *Quilombolas* were unaware of the regulations imposed by it, including the prohibition to cultivate on riparian areas (Futemma et al. 2015).

⁶ Federal Law 11.428/2006 and Federal Decree 6.660/2008 (BRASIL 2006, BRASIL 2008).

In 2012, after a long period of lobbying by large rural landowners and a heated debate involving environmentalists, ecologists, landowners, politicians and scientists, a revised Forest Code was approved in Brazil (Federal Law 12.651/1992). Although it maintained the relative sizes of the RL, it reduced the APPs, and considered deforested areas before July 2008 as consolidated and exempted their landowners for not obeying to the previous Forest Code⁷. The new Forest Code recognizes all the forested areas in Brazil as common resources, limiting property rights to the rule of law. The commercial use of forested areas is allowed provided the property is registered in the Rural Environmental Registry (CAR) and has a management plan approved. Members of 'traditional communities' still have the right to non-commercial uses of forest resources, and are allowed to use fire for agricultural practices. Regulations detailing the code are still under negotiation (Soares Filho et al. 2014), and it is yet not clear how the new regulations will affect the Quilombola's livelihoods. It is certain that most communities will not have a problem establishing the legal reserve because 86% of their territories, on average, are covered with forest. However, the growth of secondary forests in initial and intermediate stages of succession due to the gradual abandonment of shifting cultivation is leading to the loss of areas available for agriculture (Adams et al. 2013). Regulations pertaining to different categories of protected areas, which surround the Quilombola territories in the Ribeira River Valley and impose restrictions to traditional subsistence activities and use of forest resources, including the *palmito*, have not been changed.

3.1.2. Resource Units: The Euterpe edulis Palm Trees

The native *juçara* palm tree (*Euterpe edulis* M.) is an ecological and symbolic keystone species in the Atlantic Forest. Not only it has a crucial role in the Atlantic Forest's food chain (Barroso *et al.* 2010), but it is also is an iconic symbol of the pressure imposed on forest resources. Despite the forest and the palm tree being protected by the rule of law and protected areas, illegal harvesting of *juçara's* high quality heart of palm (called *palmito*) is an ongoing profitable activity. Over-harvesting is considered to be leading the system to a 'tragedy of the commons' scenario, illustrated by the inclusion of the *E. edulis* palm tree as a vulnerable species on the Brazilian endangered species list (BRASIL 2014), and as a threatened species in the State of São Paulo's list (SÃO PAULO 2004).

The tragedy is explained largely by the fact that monitoring and sanctioning by the state are inefficient to curb illegal extraction and market demand, and because use rights are poorly defined or impractical (Orlande et al. 1987). The palm is distributed across Atlantic Forest remnants along the Brazilian coast and adjacent interior, but it presents low population densities in secondary forests,

⁷ Observatório do Código Florestal (<u>http://www.observatorioflorestal.org.br/pagina-basica/o-codigo-florestal</u>, accessed in 15th February 2016).

which are dominant in this region (Fantini *et al.* 2004, Freckleton *et al.* 2003). In protected areas, the level of control of *palmito* extraction varies significantly, but most of them are considered as *de facto* open access forests. The *juçara's* biological and ecological characteristics also pose a challenge to monitoring and management: *Euterpe edulis* is a single stemmed palm (heart of palm extraction kills the plant), its population dynamics is density-dependent, it reproduces only through seeds and has slow growth rate (6-8 years for reproduction, ideally 10 years for cutting but 7 in practice). Although in natural populations it can produce 300 kg of fruit/ha/yr (Reis *et al.* 2000), its juice is not as appreciated as the Amazonian *açaí* palm (*Euterpe oleraceae*).

Heart of palm extraction is an important source of income for *Quilombola* households in the *Ribeira* River Valley since the 1930s (Barroso *et al.* 2010). The palm also has other uses in art craft and construction. Increased demand in urban areas, including international demand, availability and lack of regulation against extraction led to the industrialization of heart of palm production after the 1940s, and several canaries opened in the region, encouraging illegal harvesting. In 1969, the Brazilian Institute for Forest Development (IBDF) established regulations to control over-exploitation⁸, mandating that the canaries should maintain palm tree plantations, and plant two saplings for each harvested adult (Matos 1995). However, these regulations proved to be ineffective and the palm trees continued to be overharvested from the forest. Estimates are that during the 1970s-1980s up to 120 adult palm trees could be cut per person/day, each piece being sold for less than a dollar. Factories produced from 2-6 tons a month of canned heart of palm, reaching a peak production of 98.5 tons/month in the 1980s (Silva Matos & Bovi 2002). In this period, overharvesting and the reduction in native populations made most factories move to the Amazon to explore the *açaí* palm (*Euterpe oleraceae*), which still today dominates national and international markets (Brondizio 2008, Fantini *et al.* 2004, Galetti & Fernandez 1998).

Yet, increased market demand has contributed to maintain a smaller and diffused, but illegal extractive industry in the Atlantic Forest (Fantini et al. 2004, Orlande et al. 1996, Reis et al. 2000). In 1990, fourteen legal processing factories remained in the *Ribeira* River Valley (Galetti & Fernandez 1998), together with an estimated 585 illegal "home factories" (Fantini et al. 2004). In an attempt to curb illegal harvesting, and following Federal Decree 750/1993, the Environmental Secretariat of the State of São Paulo (SMA/SP) issued an ordinance [Ordenance DEPRN 9/1989, Resolution 12/1994 and Resolution16/1994] to regulate the extraction of the *juçara* palm tree. Licenses for managing natural or planted populations in primary and secondary intermediate/advanced succession forests

⁸ Portaria IBDF 1238, de 2 de fevereiro de 1970, ammended in subsequent years.

were granted after the approval of a sustainable management plan. In other words, the main government regulatory strategy was to ban unmanaged palm harvesting, and grant licenses to exploit managed palm stands (Galetti & Fernandez 1998). However, between 1992 and 1996, only 20 licenses for cutting *palmito* were issued by DEPRN (Romeiro & Barcia 1996), and the costs and bureaucratic obstacles to obtain a license have only contributed to expand illegal harvesting. For Romeiro and Barcia (1996), increased surveillance and sanctioning of heart of palm extractors (instead of the consumers) helped to legitimize illegal extraction by the poor and contributed to the on-going "tragedy of the commons".

The heart of palm illegal production chain involves three different stages and actors: the harvesting (and frequently canning) of the palm from the forest by *palmiteiros*, transportation of palms to the cities by middlemen, and offering it to consumers by restaurants and supermarkets (Galetti & Fernandez 1998). Extraction is carried out both in private and protected areas. Illegal extraction in the forest is essentially a male, full or part-time activity, which usually complements other income sources such as working on banana plantations that are abundant in parts of the region (Fantini *et al.* 2004, Galetti & Fernandez 1998). As an illegal activity, little is known about how many and who are the *palmiteiros*, except for the fact that they are among the poorest residents of the *Ribeira* River Valley, both from rural and urban areas (Galetti & Fernandez 1998, Nogueira 2003). Many are landless workers that resort to illegal extraction according to fluctuating needs for income (Orlande *et al.* 1987).

Extraction is a dangerous and strenuous activity, carried out during the night to avoid encounters with the Environmental Military Police (EMP)⁹. *Palmiteiros* can travel long distances to find stocks of palm trees in mountainous terrain, camping 3-4 days in the forest. Reports of invasion by armed groups of *palmiteiros* in private¹⁰ and public protected areas are not rare, leading some to compare the palm harvesting to the drug market (Nogueira 2003). The harvest is either sold *in natura*, or canned in precarious conditions in the forest, before being collected by intermediaries who are responsible for taking the jars to [legal] factories and paying the transportation costs. They are also responsible for taking care of bribes or eventual fines ensued when the EMP detains a truck. The factories are the main suppliers to supermarkets and restaurants, and can mix legal and illegal *palmito* stocks before selling them. Although there is not a marked seasonality, *palmito* harvesting is preferred in the drier weather, when it is easier to cut and transport (Orlande *et al.* 1987).

⁹ The Environmental Military Police of the State of São Paulo is responsible for environmental law enforcement and is part of the National Environmental System (SISNAMA). It monitors environmental crimes such as hunting and fishing native species, illegal *palmito* extraction and deforestation, among others.

¹⁰ <u>http://www.revistarural.com.br/edicoes/item/5678-palmito-mestico-de-boa-origem</u> and field notes.

Efforts and initiatives to develop plantations and sustainable management of native populations have been largely ineffective (Barroso *et al.* 2010, Fanelli *et al.* 2012, Fantini *et al.* 2004, Reis *et al.* 2000). In many places, sustainable management in the forest would depend on restocking the natural population before managing the area (Oliveira Junior *et al.* 2010). Although Resolution 16/1994 is still in force in the state of São Paulo, extraction of *palmito* from primary and secondary intermediate/advanced forests is no longer allowed, due to the Atlantic Forest Law (2006). The law prohibits not only its extraction, but also forest and agroforestry management, even in areas where palm trees have been re-introduced (Fanelli *et al.* 2012, Fantini *et al.* 2004). Legal production in areas of initial secondary forests requires a management plan approved by state agencies and can cost up to US\$ 10,000-35,000, taking approximately 6 months to be approved (Fantini *et al.* 2004, Galetti & Fernandez 1998, Orlande *et al.* 1987)¹¹.

Although it is difficult to estimate incomes from *palmito* extraction it can represent in some cases 90% of the average household total income for *Quilombola* families in the region (Fantini *et al.* 2004), and monthly income can be five times the national minimum wage. Nevertheless, payment received by *palmiteiros* is probably just a small fraction of gross income from sales of the final product (Orlande *et al.* 1987). Some estimates calculate that illegal production is twice as profitable as legal production (Orlande *et al.* 1987). As a result, pressure to extract palm heart in relatively small *Quilombola* territories has led to a steady decline in natural populations (Fanelli *et al.* 2012, Romeiro & Barcia 1996). Despite the *E. edulis* potential for sustainable management and the accumulated scientific (Fantini *et al.* 2004) and ethnoecological knowledge about the species (Barroso *et al.* 2010), sustainable management is still not a reality in the *Ribeira* River Valley. Therefore, pressure has increased in neighboring protected areas accessible by multiple and disguised poaching trails (Fantini *et al.* 2004, Romeiro & Barcia 1996).

3.1.3. Governance System: the Quilombola Territories

As discussed above, operational rules devised by the government grant *Quilombola* families with access to land, the forest and the palm tree within their territory. A plea for the recognition of a *Quilombola* territory has to be acknowledged by the *Fundação Cultural Palmares*, an agency of the Ministry of Culture, before the communities can demand collective land titles to INCRA (National Institute for Colonization and Agrarian Reform). In the state of São Paulo, INCRA works together with the state agency ITESP (Foundation for Land Tenure of State of São Paulo), that besides granting land titles also provides extension services (Futerma *et al.* 2015). The collective land title gives the

¹¹ Most of the biological research and management plans for the palm tree originate from the Agronomic Institute of Campinas or from the Federal University of Santa Catarina (Orlande *et al.* 1987).

community rights to access to the land, the forest and its resources; to withdraw natural resources from the territory for family's consumption; to decide how to manage the land, distribute assets among community members and devise rules for accessing and managing natural resources within the territory; and exclusion rights, to prohibit non-members from entering the community. Alienation rights remain in the hands of the government.

This configuration of rights, however, overlaps with more inclusive legislation protecting the forest and endangered species such as the *Euterpe edulis*. A disaggregation of the *Quilombola's* property rights in terms of bundles of rights (Schlager & Ostrom 1992) gives us a clearer picture of the "over-matching" of multiple forms of protection assigned to natural resources and the partial rights that emerge from this SES, showing that *Quilombola's* withdraw and management rights are in fact partial and shared with the state. Furthermore, *de jure* property rights can be respected and considered as *de facto* or not (Table 1, Figure 3). To give a clearer picture of the overlaps on the distribution of property rights for each dimension of the *Quilombola* SES, each right (access, withdraw, management, exclusion and alienation) was evaluated using a Likert-type scale from 1-5, according to existence and effectiveness of each type of right. Existence varied from 1 (property right does not belong to the *Quilombolas*). Effectiveness varied from 1 (property right exists *de jure*, but not *de facto*) to 5 (property right exists, is completely formalized and held exclusively by the *Quilombolas*). Effectiveness varied from 1 (property right exists *de jure*, but not *de facto*) to 5 (property right exists *de jure* and *de facto*) (Table 1, Figure 3).

Regarding the forest, partial management rights allow the *Quilombola's* to decide how to use its resources (such as cutting biomass for shifting cultivation), except on the areas covered with primary and secondary advanced forests, which covers most of the territories. In initial/intermediary secondary forests, land use is subject to a license from the government, but in open areas the communities associations, customary rules and households decide it. The same holds for *palmito* management. Withdraw of resources from the forest, including the *palmito*, is allowed for household consumption, but prohibited for commercial uses. In other words, there is an 'overlap' of multiple property rights and forms of protection assigned to territory, forest, and the palm, creating a sense of diffused and contested ownership. Furthermore, this system of protection and distribution of rights, along with the *E. edulis* biological and ecological characteristics (Appendix 1) and functioning illegal market, have contributed to create a mismatch of incentives for communities to develop sustainable management plans and agroforestry/plantation-based production systems.

Figure 3 shows that the right to access is the only one held exclusively by the *Quilombolas* for all the SES dimensions and that it is fully effective, that is, exists *de jure* and *de facto*. Alienation rights to any of the dimensions (territory, forest and palm tree), on the other hand, do not belong to the

communities, and are held exclusively by the government; although these rights are well established *de jure, de facto* they have diminishing values, showing the challenge faced by the government to govern the Atlantic Forest and its resources. *De jure* exclusion rights belong to the *Quilombolas* within their territories (right to exclude outsiders), but the rights pertaining to the use and management of the forest and the palm trees overlap with the authority of the government agencies (outsiders and *Quilombolas*). Their effectiveness (Figure 3) shows that territory exclusion rights are more effective than rights pertaining to the forest and the palm tree.

According to Schlager & Ostrom (1992), sustainable resource management requires at least users access, withdraw and management rights; exclusion rights improve the outcomes. When the *Quilombolas* withdraw and management property rights are considered (Figure 3, Table 1), they not only are never completely in the community's hands, but also are not very effective. Since access rights to all resources (territory, forest and palm tree) are completely held by the *Quilombolas*, as well as exclusion territorial rights, we may conclude that the concession of full rights to management and withdraw by the government to the communities associations could be a first step to try to achieve outcomes that are more positive. In the next section, we show how the property rights bundle affect the governance and sustainable management of *Quilombola* territories and resources (according to different design principles) (Anderies *et al.* 2004, Ostrom 1990).

3.2. Governing the Quilombola SES

Robust and sustainable common property regimes are governed by institutions crafted to facilitate the emergence of conditions such as those expressed in the design principles identified by Ostrom (1990, 2009). While there are no recipes as to how many or which combination of design principles are necessary and sufficient to build a robust system, meeting most of the them increases the probability of a successful and enduring outcome (Ostrom 1990, 2009; Cox et al. 2010). Therefore, analyzing the design principles of a SES helps us identify the problems involved in the governance of a common pool resource system, and discuss the improvements that can lead to a more robust system (Ostrom 2009). Each component of the *Quilombola* SES was evaluated according to its existence and effectiveness of each design principle using a scale from 1-5. Existence varied from (1) principle does not exist, to (5) principle exists and is completely formalized and recognized. Effectiveness varied from (1) principle exists but is not being applied, to (5) principle is completely applied (Figure 4 and Appendix 2). This approach is based on the methodology developed by the DURAMAZ II project (Sustainable Development in the Amazon) (Brondizio et al. n.d.).

	Ac	cess	With	draw	Manag	gement	Excl	usion	Alien	ation
	Existence	Effectiveness	Existence	Effectiveness	Existence	Effectiveness	Existence	Effectiveness	Existence	Effectiveness
Territory	Well defined; held by <i>Quilombolas</i> (5)	Right is recognized <i>de</i> <i>jure</i> and <i>de</i> <i>facto</i> (5)	Well defined; not all resources can be withdrawn from the territory; shared between <i>Quilombola's</i> and government (3)	<i>De jure</i> right exists, but <i>de</i> <i>facto</i> is partially respected (3)	Well defined; shared between Quilombola's and government; Quilombola's rights don't apply to primary and intermediate/ advanced secondary growth forests (3)	<i>De jure</i> right exists, but <i>de</i> <i>facto</i> is partially respected (3)	Well defined; held by <i>Quilombolas,</i> which can resort to state agencies and NGOs for help (5)	De jure right exists, but de facto some communities are still waiting for the government to pay a compensation to non- Quilombola private owners to be removed (4)	Well defined; held by government (1)	Right is recognized <i>de</i> <i>jure</i> and <i>de</i> <i>facto</i> (5)
Forest	Well defined; held by Quilombolas (5)	Right is recognized <i>de</i> <i>jure</i> and <i>de</i> <i>facto</i> (5)	Well defined; shared between Quilombola's and government; palmito and other resources extracted only for consumption (3)	<i>De jure</i> right exists, but <i>de</i> <i>facto</i> is little respected, especially for <i>palmito</i> (2)	Well defined; shared between <i>Quilombola's</i> and government; only secondary forest in initial stage can be managed (most of territory) (3)	De jure right exists, but de facto is not always respected, especially in the case of clearing the land for shifting cultivation (3)	Well defined; shared between <i>Quilombola's</i> and government (3)	De jure right exists, but de facto is partially respected due to invasions by outsiders (2)	Well defined; held by government (1)	De jure right exists, but de facto is partially respected, some resources are sold (bushmeat, crops from SC) (4)
Palm tree	Well defined; held by Quilombolas (5)	Right is recognized <i>de</i> <i>jure</i> and <i>de</i> <i>facto</i> (5)	Well defined; shared between <i>Quilombola's</i> (only for consumption) and government (2)	De jure right exists, but de facto is not respected (1)	Well defined; shared Quilombola's and government; management is allowed only in initial secondary forests, with management plan (2)	De jure right exists, but de facto is not respected (1)	Well defined; shared between Quilombola's and government (3)	De jure right exists, but de facto is partially respected due to invasions by outsiders (2)	Well defined; held by government (1)	De jure right exists, but de facto is not respected (1)
Existence – (1 Effectiveness	-(1) property right do	ts exists <i>de jure</i> , bu	it not <i>de facto</i> ; (5)	property rights exis	its, is completely for its <i>de jure</i> and <i>de fa</i>	cto;	exclusively by the Q	Juiiomboias;		

 Table 1 - Bundles of (partial) rights associated to each one of the main components of the Quilombola SES



Figure 3 – Property rights bundle's existence and effectiveness associated to the three dimensions of the *Quilombola* SES – Territory (A), Forest (B) and Palm Tree (*Euterpe edulis*) (C).



Figure 4 – Design principles associated to the three dimensions of the Quilombola SES (existence and effectiveness)

The first design principle – clearly defined boundaries – can be sub-divided into physical and social boundaries. As discussed previously for the *Quilombola* SES, physical boundaries regarding the territory and the forest (community, state or private area) exist and are clearly defined by customary laws and the rule of law. The territory boundaries are recognized by all the actors and are usually effective, except for the occasional invasion by outsiders for hunting or poaching *palmito*. Invasions were reported by a *Quilombola* community leader to have decreased after the land title was issued. In the case of the forest, limits are not always respected and hunting and poaching occur in private, community and state properties alike; for agriculture (shifting cultivation), though, the boundaries are respected. The physical boundaries for the palm tree are not only poorly defined, but are also permeable. The palm tree is widely dispersed on the forest remnants, can occur in patches, and there is no mapping of its area of occurrence (lack of information). Additionally, palms within community property, state reserves and private properties are subjected to poaching (see Figure 4 and Appendix 2).

Social boundaries exist and are clearly defined for the territory, the forest and the palm. The community's association is responsible for deciding who can live in the community, based on kinship and ancestral rights. Rules for allowing and accepting the inclusion of outsiders vary by community. Access and use to forest within state reserves are off-limit to any user; within *Quilombola* territory, they are clearly defined by customary and state laws, the community association or the households; in private properties access and use has to be authorized by the owner. Nevertheless, invasions occur, as explained above. The heart of palm extraction is off-limit in any type of property regime; however, *Quilombolas* are allowed to extract heart of palm within their territories. Therefore, although social boundaries exist for all the components of the *Quilombola* SES, forest areas, in private and state areas, are frequently invaded by poachers of *palmito* and by hunters, thus social boundaries can be considered as only partially effective (Figure 4, Appendix 2).

The existence of congruence between appropriation and provision rules and local conditions is an important design principle¹². In the *Quilombola* SES, they are largely well defined. Allowed types of land use and responsibilities of *Quilombola* residents in managing the territory are congruent, but conflict exists related to the use of forest and extraction of palm heart. Forest use is permitted under certain conditions (shifting cultivation and *palmito* management in initial/intermediary secondary forests), but the need for a license implies in high transaction costs. Rules defining provisioning

¹² Appropriation refers to the process of withdrawing units from a resource system, and appropriators are those who withdraw such units; provision refers to arrangements supporting the provision of a common-pool resource (Ostrom 1990: 31).

obligations, such as management that promotes forest regrowth, are unclear and in some cases contradictory. Regarding the palm tree, extraction for subsistence within *Quilombola* territories is allowed, but forbidden in other areas. However, the rules are not congruent with the high prices of heart of palm in the illegal market (Appendix 2).

Collective choice arrangements are well defined and effective in governing the territory. Individuals affected by the operational rules can participate as a member of the community association or in the association's meetings, contributing to modify them. In the case of the forest, individuals can only partially contribute to modifying existing rules via the community's association. Rules of law pertaining where to open agricultural plots (initial/intermediary secondary forests) and how to manage them (e.g., use of fire) cannot be modified, and a license is required for cultivating. Nevertheless, the *Quilombolas* have been putting political pressure on State Government, as well as researchers supporting such legislation, to change regulations (Futemma *et al.* 2015). In the case of the palm, individuals affected by the operational rules have no option to modify them.

Monitoring and sanctioning are recognized as very important for the robustness of a SES (Ostrom 1990, Ostrom 2009). Within the territory, land use and occupation are monitored by all members of the community and by inter-community information exchange. The community's association is usually informed when strangers move into the territory and looks for external help when needed (NGOs, Pastoral da Terra, ITESP), based on the rule of law. Community members that use the forest (for hunting, collection of NFTPs, and cultivation) monitor their resource use area for outsiders. State guards monitor the protected areas (state forests) for illegal activities such as hunting and poaching *palmito*, and the Environmental Military Police (EMP) monitors community, private and state forests, mainly after denouncements. The efficiency of monitoring the territory, the forest and the palm varies and is difficult to evaluate, but it is probably most efficient within the Quilombola territories (Appendix 2, Figure 4). Likewise, we had limited data and information to evaluate whether graduated sanctions decided by Quilombola communities have been enforced. In the forest, individuals caught by the EMP cultivating a plot without a license, hunting, or harvesting *palmito* are subject to punishment defined by Federal Law 9.605/1998 (Law of Environmental Crimes). The offender is taken to a police station and penalties include a fine, 1 to 3 years of confinement, or both (Bastos n.d.). A few years ago, for example, one of the main historical leaders of the community of Pedro Cubas was condemned to one year of house confinement (she was 69 years old) for cutting 0.21 ha of Atlantic Forest to cultivate subsistence crops¹³. In some cases, the community's association or a NGO pay for

¹³ http://tj-sp.jusbrasil.com.br/jurisprudencia/158301485/apelacao-apl-3236220098260172-sp-0000323-6220098260172/inteiro-teor-158301495

the fine, and a church-based supporting program (Pastoral da Terra) usually helps to pay a lawyer. Therefore, although monitoring and (not graduate) sanction mechanisms are in place, when the forest and the palm tree are considered the chance of being caught is very low, so their effectiveness was also considered limited (Appendix 2, Figure 4).

The discussion about monitoring and sanctioning shows that the *Quilombola* SES lacks rapid, low cost, local arenas for conflict-resolution (Ostrom 2009). With the exception of conflicts that are internal to the community and can be resolved by the association, conflicts involving the forest or the palm are negotiated directly with state officials (Environmental Military Police or a judge) and punishments are based on the rule of law. This unbalanced power relation between the *Quilombolas* and the state has contributed, in Romeiro and Barcia's (1996) opinion, to fuel the feeling of injustice and disrupted collective choice arrangements that were in place in the past, contributing to discourage a more sustainable use of the *palmito*. So, although *Quilombola's* rights to organize are completely recognized for the territory, they are only partially recognized in the case of the forest, and completely ignored in the case of the *Euterpe edulis* palm.

Lastly, since the Atlantic Forest is a large common pool resource, the *Quilombola* SES robustness would benefit of having a nested enterprise design principle. However, although the communities establish different relationships with state agencies and outside organizations for governing the territory (Futemma et al. 2015), the governance activities are not truly "organized in multiple layers of nested enterprises" (Ostrom 2009: 36).

4. Moving a step forward: evaluating conditions that could support a dynamic, adaptive system

Since Hardin's seminal paper (1968), the "tragedy of the commons" has been invoked to explain the environmental degradation that occurs when a group of individuals uses a scarce resource in common (Ostrom 1988, 1990). In the Atlantic forest in general, and the *Riberia* River Valley in particular, it has not been different. The *Euterpe edulis (palmito)* commons dilemma faced by the *Quilombolas* and other users has been frequently cited as an example of the tragedy (Fanelli *et al.* 2012, Fantini *et al.* 2004, Romeiro & Barcia 1996). This dominant conservation framework enacted recommendations of either privatizing natural resource systems or using central government control (Ostrom 1988), ignoring the theoretical advances based on empirical data analyzed by Elinor Ostrom and colleagues at Indiana University.

In the case study analyzed here, policy makers opted for a top-down governance system that has been imposed on *palmito* harvesters for at least 4 decades, together with the creation of protected areas (public property) and regulations for private owners to manage the resource. However, as the literature has shown (Chhatre & Agrawal 2008, Cole & Ostrom 2011, Ostrom & Cox 2010), neither private property, nor community lands or state protected areas are a panacea for overcoming the commons dilemma, and illegal *palmito* harvesting continues to be an ongoing lucrative enterprise. Although this scenario is not surprising (Fanelli *et al.* 2012, Romeiro & Barcia 1996), by breaking the property regimes in bundles of rights we have shown that the existence of partial and overlapping exclusion, withdraw and management rights can help to explain the diffused sense of ownership of the palm tree, while not providing effective mechanisms for assuring compliance to rules and monitoring of the resource.

In situations of change, such as those faced by the *Quilombolas* in the same period, the redistribution of rights by government (that holds the strongest property rights and is the default holder of all property rights) created overlaps between institutional arrangements and local conditions, leading to mismatches in incentives to manage the resource (Cash *et al.* 2006, Meinzen-Dick & Mwangi 2009, Yandle 2007). The conflicts that aroused have undermined the resilience and adaptive capacity of local social-ecological arrangements, even those developed over long periods as shown by Romeiro and Barcia (1996). The combination of overlapping systems of property rights, biological and ecological characteristics of the palm tree, and the structure of the informal/illegal economy has undermined the effectiveness of legislation, local efforts to carry out cooperative monitoring and local investment in sustainable management (Chhatre & Agrawal 2008, Cole & Ostrom 2011, Ostrom & Cox 2010).

While overlapping property rights arrangements put in place to address multiple goals (forest and species conservation, *Quilombola* territorial rights) create multiples degrees of exclusion, difficulties in monitoring a widely distributed species limit their effectiveness. These arrangements are also limiting the ability of *Quilombola* residents to effectively develop management plans that reconcile conservation and development goals, undermining the long-term sustainability of forest ecosystems and the *jucara* species. This arrangement creates contested claims over the resource and undermines cooperation in monitoring. Furthermore, the existence of informal markets and illegal extraction operating over large geographic areas undermines incentives to invest in long-term management and domestication of the palm (BRASIL 2007). Therefore, it is time to consider a shift towards a "multiple-layer, polycentric system that can be dynamic, adaptive, and effective over time" (Ostrom 2009; 45). In favor of such governance system is the fact that some of the internal uncertainties that affect efforts to organize appropriators for collective action (Ostrom 1990) have already started to be addressed in the case of the *Quilombola* SES. Initial information on the structure of the resource system (Fanelli *et al.* 2012), the impact of appropriators on the resource system (Fantini *et al.* 2004), forestry and agroforestry methods can help to improve the resource stock and sustainable management yields (Reis *et al.* 2000; Fantini *et al.* 2004), and existing ethnoecological knowledge on the *Euterpe edulis* palm (Barroso *et al.* 2010) are already available. Furthermore, the *Quilombola* communities are relatively homogeneous and not too big in size (Ostrom 2003), and all the actors involved the illegal extraction and trading of *palmito* recognize that the system has to be changed before the palm sock collapses (Nogueira 2003). This is a considered by Ostrom (2009) as a pre-condition for a group of users to solve their collective action problem.

Adaptive governance in complex systems such as the *Quilombola* SES requires information about technology, stocks, flows and processes in the resource system, conflict-resolution arenas, institutions that are adaptive (Dietz *et al.* 2003), and reduction of transaction costs for legal production. The state and federal governments have an important role here to provide mechanisms to backup local monitoring and sanctioning efforts. In such an environment, different policy option could be tested and verified, such as the concession of different bundles of rights from the government to the *Quilombola* communities and other actors, creating positive incentives for a more sustainable management of the palm tree (Wiebe & Meinzen-Dick 1998). In addition to revisiting existing rules and compliance instruments, monitoring and enforcement should focus on both ends of the *palmito* commercialization chain (Fanelli *et al.* 2012), particularly on vendors (e.g., restaurants, supermarkets) catering directly to consumers. Creating public awareness campaigns would go a long way to inform the general public about the environmental impacts and the health risks of buying *palmito* from illegal sources.

5. Conclusions

As Cole and Ostrom (2011: 46) predicted top-down systems are "not as successful as working with the users of a resource over time to develop a system that is well matched to the ecological system, as well as to the practices, norms, and long-term economic welfare of the participants." Although the Quilombolas are proprietors of the territory (Ostrom and Schlager 1996), more inclusive legislation

applied to the resources within their land that restrain their property rights. So, although they have a partial autonomy to change their own institutional structures, external authorities prevent them from making constructive changes that could lead the sustainable management and intensification of production of the *palmito* commons. Decentralization of authority and recognition of rights could help to provide incentives for *Quilombolas* to move from being exclusively appropriators to being providers of this common pool resource.

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ADAMS C. AND BRONDIZIO E. S. GOVERNING A LAYERED TERRITORY: OVERLAPPING PROPERTY RIGHTS AND THE MISMATCH OF **INCENTIVES IN AFRO-BRAZILIAN TERRITORIES**

APPENDIX 1 - THE PALMITO SES

Based on Ostrom (2007) modified by Epstein et al. (2013) and Vogt e al. (2015). Available data in bold. Not all the ecological data have been discussed in the paper.

Social, Economic, and S1- Economic development. S2- Demo S4- Government settlement policies. S5- M RESOURCE SYSTEM (RS) - THE QUILOMBOLA TERRITORY I- Sector: forests 2- Clarity of system boundaries: 2- Clarity of system boundaries of resource system: well defined (Atlantic Forest remnant in Ribeira River watershed) RS2a - Ecologically defined boundaries of resource system: recognized by customary and legal rules (territory) RS3c - Contiguous to large area of late secondary/primary forest in private, community and protected areas 3- Size of resource system in geographic area: 3,476 ha RS3a - Extent of resource system in geographic area: 3,476 ha RS3a - Extent of resource system in geographic area: 3,476 ha RS3a - Extent of resource system in geographic area: 3,476 ha RS3a - Extent of resource system in geographic area: 3,476 ha RS3a - Extent of resource system in geographic areas: 3,476 ha RS3a - Extent of resource system in geographic areas: 3,476 ha RS3a - Extent of resource system is configuration: various shapes RS3a - Extent of resource system stopes within the RS3a - Extent of resource system stopes over creeks RS3b - Resource system: pacture (738 ha, 3.7%), plots and households (1,897 ha, 10.2%)	Political Settings (S) graphic trends. S3- Political stability. arket incentives. S6- Media organization.	GS1- Government organizations: Federal – IBAMA (National	Institute); INCRA (National Institute for Colonization and Agrarian Reform); State of São Paulo - ITESP (Foundation for Land Tenure of State of São Paulo); CETESB (São Paulo State	Agency for Environment); FF (State Forest Foundation); Military Environmental Police; Civil Police	GS2- Non-government organizations: Quilombola Community	Associations; 1SA (The Socio-Environmental Institute); CPT (Land Pastoral Commission); MOAB (The Movement of Those Threatened by Dame).	GS3- Network structure		GS4- Property-rights systems: state/public (protected areas),	private, common property (Quilombola territories), de facto open	access	GS5- Operational rules (adapted from Futemma et al. 2015):	1. BOUNDARY rules	1.1- Family member: belong to a defined family within a	community in order to be eligible to use a land	1.2 - Community member: belong to a defined Quilombola	community/association in order to be eligible to use a land	1.3 - License: official license to use a land for farming	2. CHOICE/AUTHORITY rules	2.1- Animal production: define limits and conditions to raise	animals	2.2 - Fixed amount of land for agriculture: 2 ha	2.3 Fixed time for license: 5-10 years	2.4- Forest Use: define types of forest for farming (only Initial	Secondary Forest - < 10 years old and outside Areas for	Permanent Preservation)	
	Social, Economic, and I S1- Economic development. S2- Demog S4- Government settlement policies. S5- Mi DESCIECE EVETEM (DS) - THE OVERNMENT A TERPITORY	RS1- Sector: forests			RS2- Clarity of system boundaries:		RS2a – Ecologically defined boundaries of resource system: well	defined (Atlantic Forest remnant in Ribeira River watershed)	RS2b – User-defined boundaries of resource system: recognized	by customary and legal rules (territory)		RS3c – Contiguity of resource system to adjacent ecosystem of	same type: is contiguous to large area of late secondary/primary	forest in private, community and protected areas	RS3- Size of resource system:	RS3a – Extent of resource system in geographic area: 3,476 ha	(0.12 %) 1	RS3b - Resource system shape or configuration: various shapes	RS3c – Fragmentation dynamics: low levels of fragmentation ²	RS3d – Size of different habitat or ecosystems types within the	resource system: pasture (738 ha, 3.7%), plots and households	(1,897 ha, 10.2%)	RS4- Human-constructed facilities	RS4a – Facilitation of ecological movement: bridges over creeks	and rivers	RS4b - Impediments to ecological movements: roads,	households, fences

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55. Froductivity of system: 5.3. Sanctioning to Federal Law 9.605/1998; arrester middlement are middlement are middlement are set of an and an arrester middlement are set of an and arrester dynamics: tropical morsoon climate (Am Köppen); mean annual average temperature 23.9°C; mean annual RSS - Constitutional rules: Köppen); mean annual average temperature 23.9°C; mean annual RSS - Community species composition: mainly dense GSF- Constitutional rules: RSS - Community, species composition: mainly dense GSF- Constitutional rules: Acrossional stage (trajectory: mosal of price, Judicial System, Protected Areas staff) RSG - Equilibrium properties RSS - Community, species composition: mainly dense A1- Number of use: Acrons (Nilitary Environmental Police, Civil Police, Judicial System, Protected Areas staff) RSG - Equilibrium properties RSG - Enguency/ling of disturbances A1- Number of use: Acrons (Nilitary Environmental Police, Civil Police, Judicial System, Protected Areas staff) RSG - Enguency/ling of disturbances RSG - Enguency/ling of disturbances A1- Number of use: Acrons (Nilitary Environe, Civil System, Police, Civil System, Police, Civil System, Protected Areas staff) RSG - Enguency/ling of disturbances RSG - Enguency/ling of disturbances A1- Number of users:		(delegado)
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State		Drison ^{18,20}
RSS - Productivity of system: RSS - Productivity of system: RSSa - Resource dynamics: tropical monsoon climate (Am GSr- Constitutional rules: RSSa - Resource dynamics: tropical monsoon climate (Am GSr- Constitutional rules: RSSb - Community/species composition: mainly dense GSB- montoring search out by the S ombrophylous forest 4 GSB- montoring search on the finitary functionmental Police, civil police, judicial System, protected Areas staff) RSSb - Community/species composition: mainly dense GSB- montoring processes: carried out by the S RSSb - Successional stage/trajectory: mosaic of primary and (most) old growth secondary forests ACTORS (A) RS6b - Existence of alternative stable states and thresholds between A1- Number of users: Quilombolas, non-Quilombola palmiteric states RS6b - Existence of alternative stable states and thresholds between A2- Socioeconomic attributes of actors: RS6a - Extent of disturbances A2- Socioeconomic attributes of actors: RS6a - Extent of disturbances A2- Non-Quilombola splmiteric palmiterics RS6a - Extent of disturbances A2- Socioeconomic attributes of actors: RS6a - Extent of disturbances A2- Socioeconomic attributes of actors: RS6a - Extent of disturbances A2- Non-Quilombola splmiterics RS6a - Extent of disturbances A2- Socioeconomic attributes of actors:		5.3. Risk of being arrested varies up to 25%, especially for middlemen ¹⁶
RS5a - Resource dynamics: tropical monsoon climate (Am G57- Constitutional rules: Rightson in main anual average temperature 23.9°C; mean annual reinfral 1,521 mm, concentrated in summer ³ G59- Sometrical reperature 23.9°C; mean annual reinfral 1,521 mm, concentrated in summer ³ RS5b - Community/species composition: mainly dense ombrophylous forest ⁴ G58- Monitoring & sanctioning processes: carried out by the 5 ombrophylous forest ⁴ RS5b - Community/species composition: mainly dense ombrophylous forest ⁴ G58- Monitoring & sanctioning processes: carried out by the 5 ombrophylous forest ⁴ RS5b - Equilibrium properties RS6b - Equilibrium properties ATORS (A) RS6b - Extent of disturbances A1- Number of users: Quilombolas, non-Quilombola palmitelire states RS6b - Extent of disturbances A1- Number of users: Quilombolas, non-Quilombola palmitelire states RS6b - Extent of disturbances A1- Number of users: Quilombolas, non-Quilombola palmitelire involved, work 15-20 days/month; allowed to extract states RS6b - Extent of disturbances A2- Socioeconomic attributes of actors: RS6b - Extent of disturbances A2- Non-Quilombolas palmitelire RS6b - Extent of disturbances A2- Socioeconomic attributes of actors: RS6b - Extent of disturbances A2- Non-Quilombolas; poor rural and urbance RS6b - Extent of disturbances A2- Socioeconomic attributes of actors: R	RS5- Productivity of system:	GS6- Collective-choice rules:
Köppen); mean annual average temperature 23.9°C; mean annual rainfal 1,521 mm, concentrated in summer 3 Solution in summer 3 RS5 - Community/species composition: mainly dense ombophylous forest 4 CS8- Monitoring & sanctioning processes: carried out by the S of São Paulo government (Military Environmental Police, Civil Police, Judicial System, Protected Areas staff) RS6 - Equilibrium properties CS8- Monitoring & sanctioning processes: carried out by the S of São Paulo government (Military Environmental Police, Civil Police, Judicial System, Protected Areas staff) RS65 - Successional stage/trajectory: mosaic of primary and (most) old growth secondary forests ACTORS (A) RS65 - Existence of alternative stable states and thresholds between RS66 - Existence of alternative stable states and thresholds between states ACTORS (A) RS64 - Extent of disturbances A2.1 - Quilombolas; poor rural individuals, young men, part of table or work 15-20 days/month; frequently landless; poor rural and urban states A2.2 - Non-Quilombolas; poor rural and urban a2.3 - Middlemen; novok 40 work 15-20 days/month; frequently landless RS64 - Extent of disturbances A2.1 - Quilombolas; young men, part of table; dimetals, young men, part of table; dimeta	RS5a – Resource dynamics: tropical monsoon climate (Am	GS7- Constitutional rules:
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R56a - Successional stage/trajectory: mosaic of primary and (most) old growth secondary forests ACTORS (A) R56b - Existence of alternative stable states and thresholds between states A1- Number of users: <i>Quilombolas</i> , non- <i>Quilombola palmiteiro</i> R56b - Existence of alternative stable states and thresholds between states A1- Number of users: <i>Quilombolas</i> , non- <i>Quilombola</i> R56b - Extent of disturbances A2- Scioteconomic attributes of actors: middlemen, consumers A2- Ourlombolas: poor rural individuals, young men, part of full-time involved, work 15-20 days/month; allowed to extract palmito for own consumption; has community land R56d - Extent of disturbances A2- Non- <i>Quilombolas</i> palmiteiros: poor rural and urban individuals, young men, part or full-time involved, work 15-20 days/month; frequently landless R56d - Magnitude/intensity of disturbances A2.3 - Middlemen: have capital; pay for transport, bribes and fines; can control up to 10 palmiteiros; hire workers for extrac in private land; ¹⁸ A2.4 - Local lawyers ^{18,19} A2.5 - Local lawyers ^{18,19} A2.5 - Local lawyers; restaurants, supermarkets	RS6- Equilibrium properties	
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RS6e – Magnitude/intensity of disturbances RS7- Pradictability of exctam dynamice A4- I ocation: Ribeira River waterched São Baulo Brazil		A2.5 – Local direct buyers; restaurants, supermarkets
827- Dradictability of evetam dynamics	RS6e – Magnitude/intensity of disturbances	A3- History of use
	RS7- Predictability of system dynamics	A4- Location: Ribeira River watershed, São Paulo, Brazil

RS7a – Stochasticity/uncertainty of driving forces	A5- Leadership/entrepreneurship: yes; besides the <i>Quilombola</i> community associations most communities have other leaders
RS7b – Probability of driving forces leading to given outcomes	A6- Norms/social capital
RS7c – Variability (range) of driving forces	A7- Knowledge of SES/mental models: yes; <i>Quilombola's</i> have detailed ethnoecological and ethnobotanical knowledge about the palm tree ¹⁰
RS7d – Time period that may be predicted	A8- Dependence on resource: high; monthly income can be 5 times minimum wage ^{16, 18}
RS8- Storage characteristics	A9- Technology used: simple and has not changed for decades - mules, food, tarps, cutting knives, arms; gross expenditure <i>per</i> <i>palmiteiro</i> /year is US\$33.40 ¹⁹
RS8a – Nutrient source-sink dynamics: dystrophic soils, nutrient sink in growing biomass, nutrients temporally released by shifting-cultivation (SC) ⁵	
RS8b – Spatial and temporal patterns in storage: storage in 86.2% of territory (forested area); small patches (< 1 ha) of biomass temporally released by SC ^{2,5}	
RS9- Location: Ribeira River watershed, state of São Paulo, Brazil	
RS9a – Connectivity of resource system to nearby ecosystems of	
similar and different types: connected to large late secondary/	
primary torest areas in private, community and protected areas RS10 - Ecosystem History	
RS10a – Relevant geologic history	
RS10b – Natural disaster history: occasional flooding of the Ribeira River	
RS10c – Human use and disturbance history: pre-Colombian use	
by indigenous people; extraction of wood, animals and other	
resources during colonial period; since XVII century shifting cultivation, pasture, NFTP's extraction	
RESOURCE UNITS (RU) – EUTERPE EDULIS PALM TREES	
RU1- Resource unit mobility	
RU1a - Mobile resource unites	
RU1ai – Outflows	
RU1aii - Inflows	
RU1aiii – Patch dynamics	
RU1b – Stationary resource dynamics: yes	
RU2- Growth or replacement rate	
RU2a – Length of time to reproductive maturity: 6-10 years ^{6,18}	
RU2b – Source-sync population dynamics	
RU2c – Effective population size and reproductive rate: effective	
size unknown; annual population growth estimated in 24% (unmanaged forests) ⁶	
RU3- Interaction among resource units	

RU3a – Competition within species: intraspecific competition amongst seedlings for soil and water might be acute; seedlings are suppressed by immediate vicinity of adult plants ^{6,7}	RU3b – Competition between species	RU3c – Predation: herbivory by more than 50 species of birds, mammals, insects ^{9, 10, 17}	RU3d – Mutualism: pollination by bees and beetles ^{8,12}	RU3e – Multilevel trophic interactions/cascades: yes; large birds	and mammals are main seed dispersers; may be a keystone	Species in tragmented torests 2012	1101 Economic values inclusion income and he E timor	KU4a – Subsistence Value: nign; montniy income can be 5 times minimum wage ^{16, 18}	RU4b – Absolute economic value: high;	RU4c – Relative economic value: in managed plantations, cost is	US\$48/ha; average price of US\$2.25/kg of palmito; with annual	interest rate 6%, internal return is 18% and payback in 3 y. and 7 months: price payed by final consumer can vary 200% 14,18	RESOURCE UNITS (RU) - EUTERPE EDULIS PALM TREES	BIIS- Number of units-	NOT HUNDER OF AURON	populations in fragmented forest patches; in natural conditions,	mean density of adult palms 284 trees/ha; low densities in over	exploited forests; reproductive strategy uses large seedling bank,	averaging 12,000 seedlings/ha; monoecious palms; insect and	wind pointacion, bitu/ manimar-uispersar, anoganne benavior, selection favors heterozvootes: survival rate increases with size.	in larger classes it is high (0.94–1); density-dependent growth of	seedlings determines population structure; mortality highest	among smallest plants; annual mortality larger plants around	1%; annual flowering (August-December); seasonal fruiting; altitudinal variation of thenology and fruit production: neak of	flowering beginning of wet season; mean 1500–4800 fruits/ plant	in natural forests ^{6,8,11,12,14}	RU5b – Absolute size: unknown	RU5c – Relative size (pop. or individuals): mean 284–360 adult	plants/ha in other natural areas °	RU6- Distinctive markings:	RU6a – Natural distinctive markings: native, subcanopy palm	growing in primary and secondary forests (5–12 m); slow	growth; single stemmed; single seed; a 'key resource' for	rrugivorous biras, localiy exunct in some areas; listed as vulnerable in Brazilian list and threatened with extinction in São	Paulo's list ^{6,13}

RU6b – Artificial distinctive markings: heart of palm is a	
considered a delicacy	
RU7- Spatial & temporal distribution	
RU7a – Spatial patchiness: large distribution - Atlantic For from 15.2 - 20.5 nemetration through gallow forests to Da	irest
and Argentina); wet/swampy soils; current populations a fragmented; is a dominant species in preserved areas; car in concentrated areas (<i>nalmitais</i>) ^{6,9,11,19}	n grow
RU7b - Temporal patchiness	
ACTION SITINATIONS: INTED	
ACITON STITUTES INTER	
I1- Harvesting levels of diverse users: 30-120 palm trees/pe day ^{8, 16} ; 227 ha/year in one municipality ¹⁸	erson per 01- Social performance measures (e.g., efficiency, equity, accountability)
I2- Information sharing among users:	02- Ecological performance measures: palmito being
	overharvested; more palms are needed to fill a jar because of
	diminishing size; sustainable management should allow for harvest of aprox. 34.17 kg heart of palm/ha ^{8,14}
I3- Deliberation processes	03- Externalities to other SESs: impacts Atlantic Forest dynamics
14- Conflicts among users: extractors and environmental poli	ice/
protected area staff	
I5- Investment activities	
I6- Lobbying activities	
I7- Self-organizing activities	
I8- Networking activities	
I9- Monitoring activities	
I10- Evaluative activities	
Relation	ated Ecosystems (ECO)
EC01 - Climate patterns. EC02 - Poll	llution patterns. ECO3- Flows into and out of focal SES
1 - Based on the average size of the six <i>Quilombola</i> territories recognized and titled by INCRA (201	15): Porto dos Pilões, São Pedro, Maria Rosa, Ivaporunduva, Pedro Cubas and Galvão. Percentage in
relation to total area of Atlantic Forest remnant in the Ribeira River Valley - 2,830,666 ha (ISA 2005	38).
2- Total forested area (2000) in the territories of Pedro Cubas, Pedro Cubas de Cima, Sapatu and Si	São Pedro corresponded to 86.2% of total area. Remaining area corresponded to agriculture, pasture, roads
and houses (Adams et al. 2013);	
3 - CEPAGRI-UNICAMP (2011); 4 - Joly et al. (1999); 5 - Ribeiro Filho (2015); 6 - Silva Matos et al. (1	(1999); 7 - Bovi et al. (1978); 8 - Matos and Bovi (2002); 9 - von Allmen et al. (2004); 10 - Barroso et al.
(2010); 11 - Castro et al. (2007); 12 – Mantovani and Morelatto (2000); 13 – Galetti et al. 1999; 14 Galetti e Fernandez (1998): 19 – Orlande et al. 1987: 20 – Nogueira 2003	4 – Reis et al. (2000); 15 – Fadini et al. (2008); 16 – Fantini et al. (2004); 17 – Galetti e Aleixo (1998); 18 –

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Design Principles	Territory	Forest	Palm tree
Clearly defined physical boundaries	Boundaries well defined, based both on customary and state laws. Principle exists and is being applied, although territories are occasionally invaded by outsiders for poaching <i>palmito</i> and hunting. Existence (5). Effectiveness (4)	Forests are contained within state reserves, private and community properties. Boundaries are well defined. Principle exists and is being applied, although for some resources such as bushmeat and <i>palmito</i> (but not for agriculture), all properties are subjected to poaching. Existence (5). Effectiveness (3)	Not well defined. Palm is widely dispersed in different densities. Palm within community property, state reserves and private properties are all subjected to poaching. Existence (2), Effectiveness (1)
Clearly defined social boundaries	Boundaries are clearly defined. Community association decides who can live in the community, based on kinship and ancestral rights. Rules for allowing and accepting the inclusion of outsiders vary by community. Principle exists and is being applied, although territories are occasionally invaded by outsiders for poaching <i>palmito</i> and hunting. Existence (5), Effectiveness (4)	Access and use to forest within state reserves are off-limit to any user; within <i>Quilombola</i> territory, they are clearly defined by customary and state laws, decision by community association, or households; in private properties access and use has to be authorized by owner. Principle exists, but is partially applied. State reserves are invaded for poaching <i>palmito</i> and hunting; outsiders occasionally invade community land. Existence (5), Effectiveness (3)	Heart of palm extraction is off-limit in any type of property; however, it is allowed to be extracted for consumption by <i>Quilombolas</i> within the territories. The market is predominantly illegal. Rules limiting extraction outside of <i>Quilombola</i> territories and within protected areas are clearly defined, but mostly ineffective to control illegal extraction. Existence (5), Effectiveness (1)
Congruence between appropriation and provision rules and local conditions ¹	Appropriation (limits) and provision rules are largely well defined in terms of defining allowed types of land use and responsibilities of <i>Quilombola</i> residents to manage the territory. Conflict exist related to the use of primary and late secondary forest, and extraction of palm heart. Principle exists but sometimes is not followed. Existence (4), Effectiveness (3)	Appropriation rules are defined as above; forest use under certain conditions is allowed (shifting cultivation in initial/intermediary secondary forests) but transaction costs are high. Rules defining provisioning obligations, such as management that promotes forest regrowth, are unclear and in some cases contradictory. Principle exists but is not always followed. Existence (3), Effectiveness (3)	Appropriate rules are defined as above, allowing extraction for subsistence within <i>Quilombola</i> territories, and forbidding extraction in other areas. However, are largely ignored. Existence (4), Effectiveness (1)

(Ostrom 1990, Cox et al (2010).)

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Decian Principles	Territory	Rorect	Palm tree
Collective-choice arrangements	Individuals affected by the operational rules can participate as members of the community's association or in the association's meetings, contributing to modify them. Principle exists, and is applied. Existence (5), Effectiveness (5)	Individuals affected by the operational rules can participate as a member of the community's association or in the association's meetings, partially contributing to modify them. Rules of law pertaining where to open agricultural plots and how to manage them (e.g., use of fire) cannot be modified, and a license is required for cultivating. Nevertheless, the <i>Quilombolas</i> are putting political pressure on State Government	Individuals affected by the operational rules have no option to modify them. Existence (1), Effectiveness (1)
Monitoring	Land use and occupation is monitored by all members of a community and also by inter-community information exchange; community's association is informed when strangers move into the community and looks for external help when needed (NGOs, Pastoral da Terra, ITESP), based on the rule of law. Existence (5), Effectiveness (4)	Existence (3), Effectiveness (3) There is no system of community monitoring the forest outside of <i>Quilombola</i> territories, but members that use the forest (hunt, NFTPs, cultivate, poachers) monitor their resource use area for outsiders. The state environmental police monitors the forest, mainly after denouncements. In protected areas, state guards monitor the forest. Existence (3), Effectiveness (2)	The existence of consistent monitoring of heart of palm extraction within <i>Quilombola</i> territories is unclear and probably highly variable. <i>Quilombolas</i> who actively engage with forest resources (hunting, NFTPs, cultivation, heart of palm extraction) usually monitor trails for the presence of outsiders. Environmental police and protected area state guards monitor protected forests and roads/highways, mainly after
Graduated sanctions	Probably, established by the community's association. Existence (0), Efficiency (0)	In the forest, individuals caught by the EMP cultivating without a license, hunting or harvesting <i>palmito</i> are subject to punishment defined by Federal Law 9.605/1998 (Environmental Crimes). Penalties include a fine, 1 to 3 years of confinement, or both. In some cases, the community's association or NGOs pay for the fees, and a church supporting program (Pastoral da Terra) helps paying a lawyer.	Existence (3), Effectiveness (1) In the forest, individuals caught by the EMP harvesting <i>palmito</i> are subject to punishment defined by Federal Law 9.605/1998 (Environmental Crimes). Penaltics include a fine, 1 to 3 years of confinement, or both. In some cases, the community's association or NGOs pay for the fees, and a church supporting program (Pastoral da Terra) helps paying a lawyer. Existence (3), Effectiveness (1)

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Design Principles	Territory	Forest	Palm tree
Conflict-resolution	Yes. Community association.	Partial. Community association can help to	No rapid, low cost, local arenas exist for
mechanisms		solve community's conflicts regarding the use	solving conflicts between users and users
	Existence (5), Effectiveness (0)	of the forest, but no low cost arenas for solving	and officials. Fines and punishments are
		conflicts with state officials. Fines and	based on the rule of law and enforced by the
		punishments are based on the rule of law and	Environmental Military Police. Palmiteiros
		enforced by the Environmental Military Police.	can be arrested and need a lawyer to help
		Existence (3), Effectiveness (0)	them.
			Existence (1), Effectiveness (0)
Minimal recognition of	Yes.	Partial.	No
rights to organize	Existence (5), Effectiveness (4)	Existence (3), Effectiveness (0)	Existence (1), E Effectiveness (0)
Nested enterprises	Varies. Quilombola communities have	No	No
	different relationship with state		
	agencies and outside organizations.	Existence (0), Effectiveness (0)	Existence (0), Effectiveness (0)
	These relationships tend to be stronger		
	with the state agency that oversees		
	Quilombola areas (ITESP) and a		
	national NGO (ISA).		
	Existence (3), Effectiveness (3)		
Appropriation: refers to the p	rocess of withdrawing units from a resour	ce system; appropriators are those who withdraw s	such units;
Provision: refers to the arrang	gements for the provision of a common-po	ol resource (Ostrom 1990: 31).	
Existence: (1) principle does	not exist; (5) principle exists and is compl	etely formalized and recognized	
Effectiveness: (1) principle e.	xists, but is not being applied; (5) principle	e is completely applied.	
In both cases, "0" means that	it was not possible to evaluate the princip	le.	