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How can local representations of changes of the availability in natural resources assist in targeting conservation?

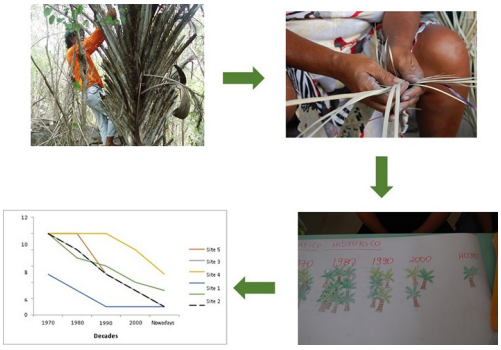
Juliana Loureiro Almeida Campos [a,*], Elcida de Lima Araújo [b], Orou G. Gaoue [c,d,e], Ulysses Paulino Albuquerque [a]

[a] Laboratório de Ecologia e Evolução de Sistemas Socioecológicos, Centro de Biociências, Departamento de Botânica, Universidade Federal de Pernambuco, Cidade Universitária, 50670-901 Recife, Pernambuco, Brazil
[b] Laboratório de Ecologia Vegetal dos Ecossistemas Nordestinos, Departamento de Biologia, Universidade Federal Rural de Pernambuco, Avenida Dom Manoel de Medeiros s/n, Dois Irmãos, 52171-900 Recife, Pernambuco, Brazil
[c] Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, TN 37996, USA
[d] Faculty of Agronomy, University of Parakou, 01, BP 123, Parakou, Benin
[e] Department of Geography, Environmental Management and Energy Studies, University of Johannesburg, APK Campus, Johannesburg, South Africa

HIGHLIGHTS

- More experienced local extractivists tend to harvest leaves in a more sustainable manner than did young and inexperienced ones.
- The extractivists of *Syagrus coronata* leaves reported a decline in the palm populations.
- The extractivists of *S. coronata* leaves primarily associate such decline to the farming practices of non-indigenous people that lease lands in the area.
- The implementation of conservation strategies for *S. coronata* palm may be limited by the fact that the extractivists recognize the land lease system as the major threat for the species, which is one of the main income generator by this indigenous group.

GRAPHICAL ABSTRACT



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ABSTRACT

The use and appropriation of natural resources by human groups may be strongly related to the perception that these groups have of the abundance or scarcity of these resources. Researches on environmental representation can be useful to understand the criteria involved in the selection and use of natural resources, to verify if people realize changes in the availability of these resources and the possible causes of these changes and to elaborate conservation strategies, if necessary. However, if people are not realizing these changes, of if they do not perceive themselves as a cause of such scarcity, the developing of conservation strategies will be very difficult to implement. We investigated the drivers of sustainable harvest of *Syagrus coronata* (Mart.) Becc. (ouricuri palm) leaves by the Fulni-ô indigenous people in northeastern Brazil and accessed the representation of changes in the availability of the populations of this species over time. We obtained information about events that, from the point of view of the palm harvesters, pose threats to *S. coronata* populations. More experienced local harvesters tend to harvest leaves in a more sustainable manner than did young and inexperienced harvesters. The Fulni-ô reported a decline in *S. coronata* populations. However, they primarily associate such decline to the farming practices of non-indigenous people that lease lands in the area. Although the Fulni-ô people perceived a shortage of such

* Corresponding author.
E-mail addresses: loureiroju@hotmail.com, loureiroju61@gmail.com (J.L.A. Campos).

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resource, our findings indicate that the implementation of conservation strategies for the ouricuri palm may not be so easy to implement, once it affects one of their main income sources (land lease), which is recognize as the major threat for the species by harvesters. Ours results showed that the relationship between perception of scarcity and ease of implementation of conservation actions should be contextualized.

1. Introduction

The proximity between human populations and the natural environment promotes development of intimate relationships with available resources, generating and modifying local ecological knowledge systems about them (Sieber et al., 2010). These knowledge systems can enable human groups to develop strategies for resource conservation (Lykke, 2000), helping in target efforts for conservation of threatened species and ecosystems, besides providing sustainable management practices (Fraser et al., 2006). Previous studies proposed approaches to integrate local ecological knowledge in the formulation of biodiversity management plans (Fraser et al., 2006; López-Hoffman et al., 2006; Gaoue and Ticktin, 2009; Schmidt and Ticktin, 2012).

The reasons for conducting research in conservation of nature with the help of local ecological knowledge are based, on the one hand, on the argument that people who use natural resources are dependent on them. Thus, it is reasonable to suggest that the management practices of local people will be directed to conservation (Ghazoul, 2007), especially when they notice a decline in resource availability (Salo et al., 2013). However, this is not always true, like, for example, in the case of common-pool resources. When resources (natural or labor) are shared, the logical tendency would be the abuse by individual interests, leading to the exhaustion of these resources (Hardin, 1968). This was evidenced recently in the research conducted by Wilson et al. (2015), which have found continued degradation of the fishery in the Dominican Republic over time. At the same time, Revollo-Fernández et al. (2015), showed the differences between gender in common-pool resource extraction, in which women changed their behavior towards lower extraction compared to men. In this sense, Ostrom et al. (1999) stressed the importance of a shared set of norms for cooperative and sustainable management of common property resources.

Additionally, other situations like harvest for commercial purposes and the wide range of usage of species may lead to unsustainable harvest by local populations (López-Hoffman et al., 2006; Lucena et al., 2007; Meke et al., 2016). Therefore, if changes in resources availability are not appropriately perceived by local people, the adjustments of harvesting practices that ensure the sustainability of the resources may be delayed or overlooked and, in this case, conservation strategies may have less effective outcomes (Lu, 2001; Bodin and Crona, 2008).

As people perception of natural resources is strongly related to the way they will use them (Alessa et al., 2008; Medeiros et al., 2015), understanding the representations of changes in resource availability and the factors influencing its uses are critical to formulating conservation and management strategies that meet local needs (Ghimire et al., 2004; Gaoue and Ticktin, 2009; Fernández-Llamazares et al., 2016). For example, elders and people who have more experience in harvesting natural resources probably accumulated more knowledge about them (Hanazaki et al., 2013), thus, tend to extract these resources in a less detrimental way. However, the body of evidence showing that experience and residency time of local people may positively correlate with extent of local ecological knowledge with direct implications for a more sustainable use of resources is still scarce (but see Ticktin and Johns, 2002, López-Hoffman et al., 2006, Ticktin et al., 2006).

Harvest is very important for learning about natural resources, once the environment promotes the contact between harvesters and these resources (Byg and Balslev, 2001). The sensorial contact promoted by harvest favors the learning about the resources and motivates conservation, once emotional responses will be awakened during this process (Soulé, 1988). For example, people who collect woody resources presented greater knowledge about them in comparison to people who buy or receive them by other people (López et al., 2015). In the same way, people who harvest natural resources more frequently probably will know a greater number of harvest sites, so these variables can also be positively related with sustainable harvest.

In this study, we investigated the techniques used by the Fulni-ô artisans in Águas Belas, Pernambuco, northeastern Brazil, to obtain leaves from *Syagrus coronata* (Mart.) Becc (ouricuri) to test how harvesters experience affects their knowledge and the sustainability of harvest. We aimed to understand their representations of changes in abundance of such species populations over time. The Fulni-ô possesses an ancient and culturally important relationship with the ouricuri palm tree, whose leaves are used for production of household and ritualistic handicrafts and commerce (Pinto, 1956). We worked specifically with the harvesters group to answer the following questions: (i) Do experience in harvest, frequency of harvest and number of harvest sites explain the sustainability of this practice? (ii) Have the palm harvesters noticed changes in abundance of species populations over time? (iii) What factors were noticed by the local harvesters as threats to the populations of *S. coronata?* We expect more experienced Fulni-ô harvesters to obtain resources more frequently, know a higher number of sites and harvest leaves in a more sustainable manner.

2. Material and methods

2.1. Study area

This study was conducted in the Fulni-ô indigenous land which is located in the municipality of Águas Belas (9°07′03″S, 37°07′06″W) and is 311.2 km far from Recife, the capital of Pernambuco state, northeastern Brazil. The municipality has an area of 885.986 km^2 and its current population is around 42,566 inhabitants (CONDEPE/Fidem, 2015). Águas Belas is part of the Ipanema river basin and is part of the Caatinga, a vegetation which is characterized by xerophytic, deciduous and thorny species (Araújo et al., 2007). The climate is semi-arid (BSHW', Köppen, 1948) with two well-defined seasons: the dry season, spanning from 5 to 9 months of the year, and a short rainy season (Prado, 2003), which occurs from May to July. The mean annual temperature of the municipality is 25 °C and the mean annual precipitation is 600 mm (CONDEPE/FIDEM, 2006).

2.2. Study species

The *Syagrus coronata* (Mart.) Becc. palm tree, commonly known as ouricuri, licuri, licurizeiro and coqueiro-cabeçudo, can be found in Brazil in the states of Pernambuco, Alagoas, Sergipe, Bahia and northern Minas Gerais (Lorenzi, 2010). The species inhabits Caatinga and semideciduous forests, as well as areas of transition to the Caatinga and campo rupestre (Noblick, 2017), a phytophysiognomy of the Cerrado biome, with vegetation that occurs at altitudes above 900 m, composed of rocky outcrops and acidic and nutrient poor soils (Benites et al., 2007). *S. coronata* has a single, erect stipe, from 3 up to 12 m high, ultimately replaced by distinctive closely-spaced leaf scars, arranged in rows (Noblick, 2017). The leaves are rigid and whitish inside (Lorenzi, 2010), usually spiraled distributed along the stipe and persisting just beneath the crown (Noblick, 2017). The species is monoecious, and male and female flowers are found in the same