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An ethnobiological assessment of *Rumohra adiantiformis* (samambaia-preta) extractivism in Southern Brazil

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Abstract. The fronds of *Rumohra adiantiformis*, also known as '7-weeks-fern,' 'leatherleaf' or 'samambaia-preta,' are used worldwide as florists' greenery. Costa Rica and the USA cultivate and export *R. adiantiformis*, whereas in South Africa and Brazil this trade is based on extractivism. In Brazil, *R. adiantiformis* is harvested in the Atlantic Forest biome; 50% of the production comes from the slopes of the 'Serra Geral' (state of Rio Grande do Sul), where some 2000 families harvest and trade *R. adiantiformis* as their main source of revenue. However, harvesting, trading and transporting wild ornamental species is illegal in the Atlantic Forest, This study evaluates *R. adiantiformis* extractivism in hilly areas of Rio Grande do Sul, from an ethnobotanical/ethnoecological perspective. The study reveals that emic perceptions on the sustainability of *R. adiantiformis* extractivism are in agreement with relevant ecological data. The regeneration areas on the slopes of the Serra Geral have the highest plant density ever reported for *R. adiantiformis*; its extractivism has low environment impact and generates significant income for local communities. Further studies of these areas are important in order to support neoextractivism as a suitable form of use of the state's biodiversity.

Introduction

Rumohra adiantiformis (G. Forest) Ching fronds are very popular in the international flower market, because they maintain their appearance well after harvesting. This species, known as 7-weeks-fern and leatherleaf in the international trade, and samambaia or samambaia-preta (black-fern) in Brazil, is distributed widely in Australasia, South and Central America, southern Africa and some Indian Ocean islands (Geldenhuys and van der Merwe 1988). In the late 1930s, *R. adiantiformis* was adapted to cultivation in irrigated shaded nurseries in the State of Florida (USA), and has since become very popular worldwide as florists' greenery. Currently, Florida and Costa Rica are the

major producers; Florida trades with American and European markets (Mathur et al. 1983), while Costa Rica exports to America, Europe and Japan. Abundant natural populations of *R. adiantiformis* are found in South Africa and Brazil, where it is economically exploited though extractivism (Milton 1987; Geldenhuys 1994; Miguel et al. 2005).

In Brazil, *R. adiantiformis* extractivism takes place in Atlantic Forest biome in the South and Southeast regions (Conte et al. 2000; Hanazaki 2001; Coelho de Souza 2003), especially in the state of Rio Grande do Sul. *R. adiantiformis* can be found throughout the state, but is particularly abundant on the slopes of the 'Serra Geral,' a part of the Atlantic Forest included in the Mata, Atlântica Biosphere Reserve. It is estimated that more than 50% of the *R. adiantiformis* traded in Brazil comes from Rio Grande do Sul (Anama/PGDR-UFRGS 2003; Miguel et al. 2005). According to Gerhardt (2002), *R. adiantiformis* extractivism was established in the 1970s as a major survival strategy for small-scale agriculturists in these steeply sloping areas. This activity played a crucial role in avoiding economically induced rural exodus, and for preserving the social organization associated with traditional family economic patterns. *R. adiantiformis* extractivism became increasingly intensive in the following decades, attracting an increasing number of families prevented from cultivating in their own land due to environment legislation (Brazil 1993), by the limited availability of appropriate areas for harvesting, or due to rural exodus of the majority of youngsters. It is currently estimated that some 2000 agricultural families in the Northeast region of Rio Grande do Sul are involved with harvesting and trading *R. adiantiformis* fronds as their major source of income. Unfortunately, agriculturists do not have control of the complete trade network, a situation that renders them extremely dependent on middlemen.

Although *R. adiantiformis* extractivism is currently of great importance in the municipal economies in the Northeast region of Rio Grande do Sul, it is illegal under the State Forest Law (Rio Grande do Sul 1992). According to Ribas et al. (2002), the trade (trading activity SCharles) of *R. adiantiformis* is unstructured, both in terms of the organization of the actors and the lack of information about the extractivism itself, this situation is related to both the illegality and the informality that characterize this trade. The purpose of this study was to evaluate the extractivism of *R. adiantiformis* in the Atlantic Forest slopes in Rio Grande do Sul from an ethnoecological perspective.

Methodology

The survey was done between 2000 and 2002 (bimonthly visits of 3–4 days each) in the municipalities of Osório, Caraá and Maquiné. The main focus was the extractive community of 'Fundos da Solidão' in Maquiné. Confirmation of *R. adiantiformis* correct identity was done by botanists at the Universidade Federal do Rio Grande do Sul (voucher number ICN122597, Herbarium of the UFRGS).

At 'Fundos da Solidão,' 22 families were identified as belonging to profiles I and II of the production system typology, as proposed by the social economic diagnosis conducted at Maquiné (Anama/PGDR-UFRGS 2000). The profiles I and II are characterized by family agriculturists who live on the slopes of the steep valley and possess small land holdings unsuited for commercial plantations. The major economic activity of these families is *R. adiantiformis* extractivism and is complemented by non-mechanized subsistence agriculture. At Fundos da Solidão, 60% of the families are associated with extractivism to some degree, and 47% have *R. adiantiformis* extractivism as their main source of income (followed by rural pensions, 33%) (Anama/PGDR-UFRGS 2003; Miguel et al. 2005).

These 22 families were accompanied by participant observation (Amorozo 1996; Etkin 1993). Open and semi-structured interviews (Viertler 2002) were also used with families members to elicit information on *R. adiantiformis* extractivism, biology, and management. Based on the interviews, key informants were identified as being knowledgeable and active in harvesting and trading activities; participant observation was conducted with these key informants during *R. adiantiformis* harvest, transporting and processing.

Results

Extractivism

Based upon the preliminary interviews, five families were selected as key informants. Each family was accompanied twice during *R. adiantiformis* harvest, transporting and processing. Collection of *R. adiantiformis* fronds is done as a family activity (usually, husband and wife), and has four steps: (1) extracting on slope areas; (2) transporting to storage sites; (3) preparing the 'mala' (*R. adiantiformis* trading unit, consisting of approximately 60 fronds); and (4) delivering the produce to the middlemen. In order to obtain 100 'malas,' the family's work requires three to four 3-h shifts: two or three shifts for selecting, cutting and transporting fronds to the storage site, and one more to prepare the 'malas.' A 'mala' is worth US$ 0.12; on average, weekly revenue derived from *R. adiantiformis* varies from US$ 12.50–25.00 (for contrast, the current Brazilian minimum wage fluctuates around US$ 85.00 per month). The family quota is decided beforehand by the middlemen, varying from 50 to 100 'malas' per order, with 1–2 orders per week.

Collection areas are assigned to families; a family either has 'possession' of or rents a given collection area. Collection areas are usually located along the trails in second-growth forest towards the hilltops. The collection is manual, generally with the aid of a knife. The following characteristics are used to select fronds: (a) color (dark green); (b) texture (stiffness characteristic of the mature frond); and (c) sori (preferably absent). In the wintertime, sori are acceptable given the scarcity of mature fronds.

After collecting the fronds and tying up the bundles, the harvesters carry them over their shoulders (Figure 1) towards the storage areas, sometimes making use of a horse. This activity demands transporting very heavy loads (an average of 25 kg for 50 'malas'). Storage sites are close to the rivers in order to facilitate conservation of frond freshness, or by roads close to the middlemen's trucks. The 'malas' are arranged in a big pile, splashed with water and covered with *Hedychium coronarium* L. leaves or plastic canvas (Figure 2), where it stays for 3 days. On the third day the 'malas' (Figure 3) are tied up with pieces of rope, previously provided by the middlemen, and the load is finally delivered on the fourth day.

Ethnoecology

Table 1 presents ethnoecological information on *R. adiantiformis* management obtained through the interviews conducted throughout this study, as well as from a previously conducted project ('Projeto Samambaia Preta') that specifically aimed to obtain data on *R. adiantiformis* biology, management and production, as well as a socio-economic profile of the harvesting communities (Anama 2002; Anama/PGDR-UFRGS 2003; Miguel et al. 2005). During the 'Projeto Samambaia Preta' standard biology inventories were made in order to evaluate the species' stocks and to determine if extractivism had a significant impact on the species' natural populations, a set of data relevant to this discussion. The project revealed that this particular stage of forest regeneration allows for the continuous growth of the species, as this second growth forest provides appropriate amounts of light and shade.

It is common sense among harvesters that 'the more you take the ''samambaia,'' the more it grows…' (Table 1), which can be explained by the fact that this is a rhizomatous species demanding moderate shade. The species' growth is favored by the additional light reaching the plant after harvesting of mature fronds, as well as from removing surrounding vegetation. According to Homma (1996), the extraction of a plant part characterizes extractivism collection, since the plant's growth matrix is preserved. The extractivits also state '…in 10 or 15 years the ''samambaia'' will be finished.' This perception is in accordance with the fact that *R. adiantiformis* occurs in second-growth forest during its early and medium regeneration stages; as the natural succession progresses, with increasing shade, the area suitable for the species growth decreases. Therefore, the biological data obtained by the Projeto Samabaia Preta is in agreement with the traditional (emic) view on the sustainability of *R. adiantiformis* frond extractivism, both pointing to its viability.

Based on interviews and participant observation, it is estimated that an average family collects as much as 576,000 fronds/year (200 'malas'/week). According to Miguel et al. (2005), the second-growth areas studied present

Table 1. Ethnoecological information of *R. adiantiformis* management in south Brazil.

Parameters	Indigenous perception (as close as possible to original phrasing)	Biological data (from Miguel et al. 2005)
Extractive sites	'capoeira sparse or dense' 'samambaia' fronds become apparent after 3–4 years in areas free of management ('pousio') or cleared by fire 'samambaia likes best areas that were previously used to cultivate sugar cane and were subsequently burned'	Occurrence on initial (11,36% of relative value of cover) to medium (44,14% of relative value of cover) regeneration stages
Features of fronds from areas of early regeneraion stage	'samambaia comes more in sparse capoeira' 'samambaia from sparse capoeira comes with more fronds and is more seedy'	Fronds are more stiff, therefore more durable; smaller sizes and greater quantities
Features of fronds from areas of medium regeneration stage	'on dense capoeira the fronds are smoother, has no seeds and lasts less'	Fronds are smoother, therefore in its more marketable shape, but less durable and in smaller quantities
Extration units (areas with denser occurrence of *R. adiantiformis* fronds)	'bolas or malhas'	Places with *R. ndinntiformis* high density between 13.76 a 86.8 fronds/m^2 Although denser areas do exist it is not clear why they occur or even if it refers to a single or many individuals
Criteria for frond selection	'it must be in good conditions, it can not be over dried ('sapecada', it can not have seeds'	The adult fronds in good conservation conditions are collected, preferentially without sori
Harvest periodicity	'Twice or three times per year' 'the more you take the ''samambaia,'' the more it grows' when it is cut, one has to take it all out, so that it sprouts again and fronds will then be symmetrical. It is like banana, one collects, cuts and it comes again strong'	In experiments on 5×5 m plots to compare fronds from non-management (no cuts) areas with areas where cuts were done twice a year (as in traditional management) with adult fronds with more than 30 cm revealed no significant differences regarding number of fronds or average size of fronds
Seasons	'The summer is the best period to extract samambaia'	No differences were found for availability or frond size through the year. Young fronds are less abundant in late winter and early spring

Table 1. Continued

Parameters	Indigenous perception (as close as possible to original phrasing)	Biological data (from Miguel et al. 2005)
Sprouting	2 periods of buds growing are identified, corresponding to early spring and late summer, when greater care is needed in order to avoid stepping on new sprouts	The number of sprouts decrease in the fall and increase in early spring
Area needed for a year harvesting	'it is hard to tell because the areas are very different… 3 areas could be enough for a year harvesting… if the areas are good, more or less 4 or 5 hectares'	The productivity of areas varies from 7 to 66 fronds/m^2. In average 56% of fronds were found to be collectable adults in most areas, an estimated 16.8 collectable fronds/m^2 in an area with 30 frond/m^2.
Availability	*'in 10 or 15 years the 'samambaia' will* be finished' 'what will finish with the ''samambaia'' is the capoeira'	Forest regeneration diminishes *R. adiantiformis* availability *R. adiantiformis* extractive areas) due to excessive shadow. The intensive extraction in rented areas is another significant factor that may contribute to diminishing resources over time

considerable variation, producing from 6.7 up to 137.5 fronds/m^2 (average of 51 [$\pm$49.6] fronds/m^2), of which 11% are harvestable (mature) fronds in these areas. Based on this data, and considering that both traditional information and biological data suggest that a given area can be harvested twice a year in a sustainable manner, an average extraction of 5.8 ($\pm$5.2) mature fronds/m^2 can be estimated. Based on this estimation, the minimum area needed for a family earning US$ 96.00/month (US$ 11 in excess of the minimum wage) can be estimated as 5 ha of second growth Atlantic Forest in early to medium stages of regeneration. Again, this estimate is in accordance with the traditional information obtained from the interviews (Table 1).

Discussion

According to Miguel et al. (2005), the slopes of the Solidão valley were occupied at the end of the XIX century by small holder farmers (the forefathers of the current residents) coming from the coast and southern cities. Up to the 1960s, the local agricultural economy was essentially based on family units, principally subsistence farming complemented by some degree of trading (e.g., beans, pigs, corn, sugar cane, tobacco). Between the 1950s and 1970s, the valley was increasingly occupied; according to current residents, all areas currently occupied by second growth were once occupied by sugar cane. From the 1970s on, sugar cane and tobacco cultivation became prohibitive for small farmers, due to decreased soil fertility and an ever increasing population, with consequent demand for housing areas, As a result, vegetable cropping became increasingly common in flat areas. Subsequently, the modernization of vegetable cropping rapidly increased the value of land in the flat areas suitable for machinery, leaving few alternatives for traditional local communities and stimulating rural exodus. According to Gerhardt (2002), this socio-economic history has greatly influenced forest regeneration. The key factors of this process include: rural exodus, migration of remaining labor from slopes to flat areas, restricted availability of flat areas, problems with land management associated with forest legislation, and replacement of agriculture by extractivism (in this case, stimulated by an increasing national demand for *R. adiantiformis*). The fact that *R. adiantiformis* is an abundant species on second growth slopes greatly facilitated the consolidation of this pattern of extractivism.

In 1970s the growing national market for *R. adiantiformis* attracted traders from São Paulo to this region, acting as intermediaries for other Brazilian states. Local middlemen started to organize the transport of *R. adiantiformis* fronds to sites closer to federal highways, and in time *R. adiantiformis* collection became one of the few economic activities for the remaining communities.

The fact that the slopes of the Atlantic Forest in Rio Grande do Sul are regarded as a major production center of *R. adiantiformis* must be considered

in terms of the abundance of *R. adiantiformis* as a stage in natural forest succession. Although *R. adiantiformis* is abundant in anthropic areas, its stocks are currently diminishing. Likewise, studies of *R. adiantiformis* in African Cape forests show that fern density and performance must be considered relative to its temporary phase in the regrowth and development of the forest towards maturity (Geldenhuys 1994). In Rio Grande do Sul, the last 30 years have been characterized by forest regeneration following the end of agricultural use and a significant arboreal stratum is emerging (Nodari et al. 2000). It is not rare to hear the harvesters comment that 'in 10 or 15 years the ''samambaia'' will be finished' and 'what will finish with the 'samambaia' is the capoeira' (Table 1). It is also stated that 10 years ago *R. adiantiformis* fronds were harvested three or four times as easily as nowadays.

The density of *R. adiantiformis* fronds vary widely. In southern African Cape forests the density of the *R. adiantiformis* varies from 0.1 to 9 fronds/m^2, depending on its location in cool moist mountain forests, warmer river valley forests, and coastal scarp (Milton and Moll, 1988; Geldenhuys 1994). At Ilha Comprida (São Paulo, Brazil) the density varies from 0.3 in forested areas to 5 fronds/m^2 in more open areas (Conte et al. 2000). In Maquiné, the density varies from 7 to 66 fronds/m^2 (Table 1, Miguel et al. 2005); to our knowledge this is the highest *R. adiantiformis* density so far reported.

Based on this data, we suggest that *R. adiantiformis* could be sustainable managed in Atlantic Forest slope areas by managing the second growth to avoid excessive shade. This apparently viable alternative is jeopardized by the legal impossibility of clear-cutting vegetation taller than 3 m (Rio Grande do Sul 1998), a condition easily and quickly attained under local ecological conditions. To comply with the current law one is obliged to bring to a halt the natural succession, a necessary condition to maximize *R. adiantiformis* production. Moreover, current law limits family harvesting to the short term and with limited areas, preventing medium and long term planning.

According to Kageyama and Reis (2002), *R. adiantiformis* extractivism is a typical activity of communities using natural resources in an environmentally friendly way. The management of *R. adiantiformis* comprises with the Brazilian legislation for areas of permanent preservation, and also conforms to the aims established by the State forest legislation for the development of municipalities in the sloping areas of Rio Grande do Sul (Fepam 2000), since it is an activity that allows the selective sustainable harvesting of native vegetation. This study suggests that a family must be able manage 4–5 ha of areas containing *R. adiantiformis* to earn relevant revenue. Ideally, studies should be carried out to evaluate the socioeconomic viability of managing such areas in association with subsistence cultivation and complementary economic activities. Although the biology of this species suggests that its extractivism is indeed sustainable from an environmental perspective, the resolution of social and economical questions is necessary.

Conclusion

This study revealed that regeneration areas on the slopes of the Serra Geral in the State of Rio Grande do Sul have the highest density ever reported for *Rumohra adiantiformis*. Further studies of these areas are important to support neoextractivism as a suitable form of using the biodiversity in Rio Grande do Sul. In this context, the legalization of *R. adiantiformis* extractivism should be regarded as a conservation investment for the Atlantic Forest at Rio Grande do Sul.

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