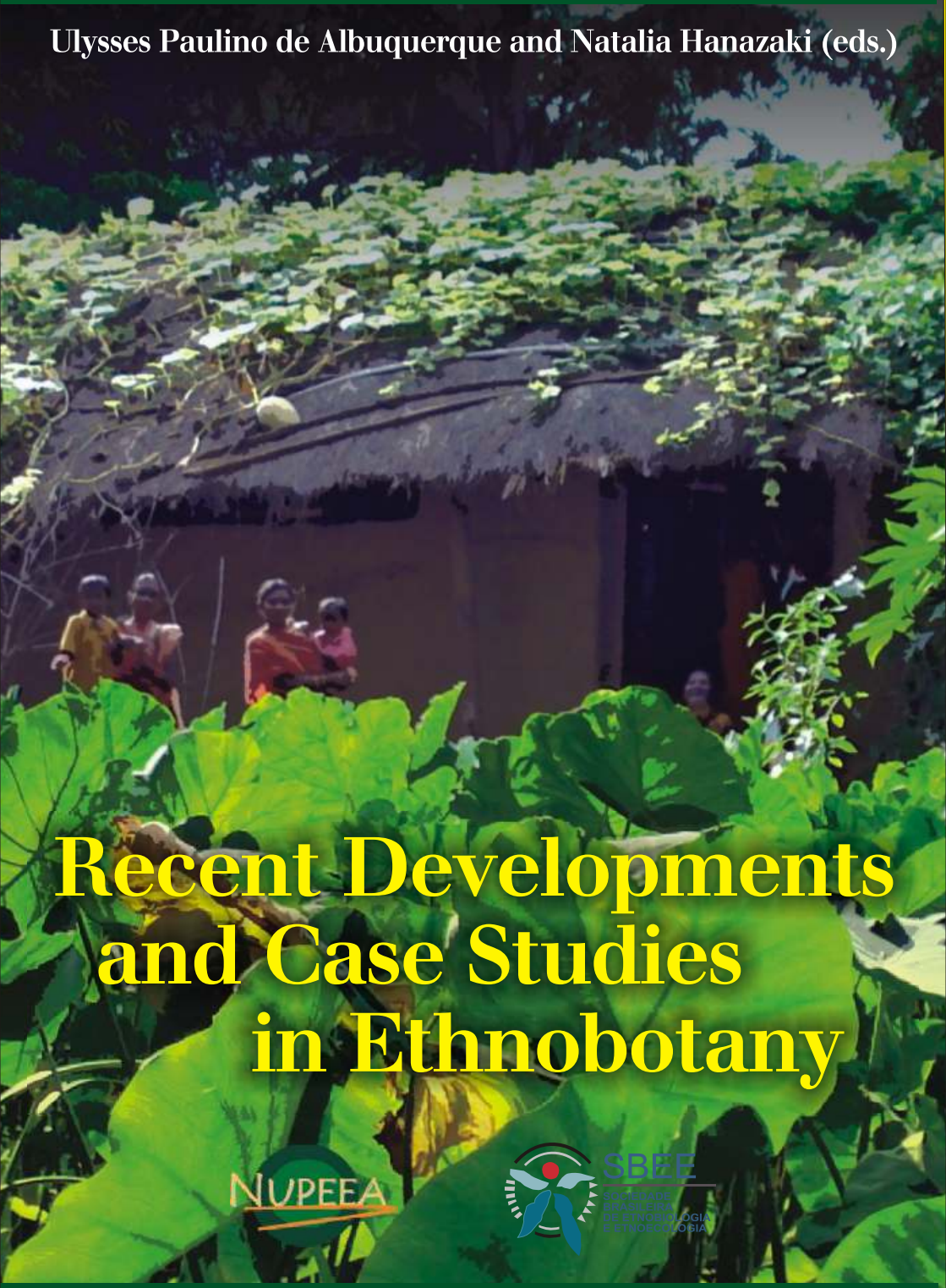
Ulysses Paulino de Albuquerque and Natalia Hanazaki (eds.)



Recent Developments and Case Studies in Ethnobotany

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Chapter 16

Cultivation of *Manihot esculenta* Crantz ssp. *esculenta* and landscape dynamics at Santa Catarina Island, Brazil

Mariana Bender[1,2]; Ana Luiza Assis[3]; Erasmo Tiepo[4]; Natalia Hanazaki[1] & Nivaldo Peroni[1].

Introduction

Manioc (*Manihot esculenta* Crantz ssp. *esculenta*) cultivation is widely distributed in Central and South America. The genus *Manihot* is Neotropical and its occurrence ranges from latitudes 33° north to 35° south (Rogers & Appan 1973). Due to several factors, such as the domestication process, the importance to Amerindian people and to the rural people as a whole, and the clonal and sexual propagati*on system, Manih*ot esculenta comprises high intraspecific diversity. Therefore, manioc varieties could be an outcome of *Manihot esculenta* and native species breeding during its domestication process (Piperno & Pearsall 1998). Moreover, the selection of varieties for cultivation could also contribute either to enhance or to reduce intraspecific diversity (Boster 1985).

The vegetative growth of *M. esculenta* is utilized by human populations for crop growing and material propagation (Martins 2005), enabling varieties' management for cultivation and amplifying the manioc culture distribution through trade networks. The intraspecific diversity of manioc can be recognized under different ethnovarieties which are identified by different names in traditional communities. Peroni (2004) defines ethnovariety as a group of individuals with high intra-variety

1 Universidade Federal de Santa Catarina, Departamento de Ecologia e Zoologia, Laboratório de Ecologia Humana e Etnobotânica, Campus Trindade, 88010-970 Florianópolis, SC, Brasil.
2 Master student from Ecology post-graduation program, Universidade Federal de Santa Catarina.
3 Master student from Plant Genetic Resources post-graduation program, Universidade Federal de Santa Catarina.
4 Agronomist, MSc Plant Biology, Universidade Federal de Santa Catarina

genetic identity, being either clones or genetically similar individuals identified by a specific local name.

In the coast of Peru, archeological records of manioc crops date from six thousand years (Pearsall 1992). Thus, manioc's domestication probably took place among eight and 10 thousand years ago (Fraser & Clement 2008). It was during the Pre-Columbian era that the cultivation of manioc dispersed through the lowlands of South and Central America, as well as the Caribbean (Martins 2005; Fraser & Clement 2008). Therefore, the first voyager's narrations following the European discovery of South America allude to manioc – *aipim* and *mandioca* – being widely cultivated in the South American lowlands.

The *aipim* is also referred to as sweet manioc (*mandioca doce*), *mansa* or *macaxeira*, and differs from the *mandioca* (bitter manioc) because of its low concentration of cyanogenic glucosides being edible even raw. Nevertheless, bitter manioc's cyanogenic potential requires processing for consumption as flour, for example. The domestication process of these two groups of *M. esculenta* probably occurred separately (Peroni *et al.* 2007).

The history of cultivation system of manioc crops was marked mainly through the slash-and-burn or shifting cultivation systems, an indigenous cultural inheritance. In this system, the central unit is the *roça* (cleared land for cultivation), established by traditional agriculturists through cutting and burning vegetation, releasing nutrients to fertilize the soil (Martins 2005). An additional feature of the slash-and-burn culture is the transition from one crop farming unit to another, in a shifting system. This agricultural system is evenly replicated along the Brazilian territory (Martins 2005). The abandoned fields allow plant communities to reestablish, producing a mosaic of *roças* in different successional stages.

Manioc seeds can be dormant in the soil and germinate during the clearance and burning of old swidden fields (Sambatti *et al*. 2001; Elias *et al.* 2001; Peroni 2002; Martins 2005; Pujol *et al.* 2007). This characteristic creates conditions for the complex evolutionary dynamics of the species, because individuals germinated from seeds can be originated from past plantation cycles and can cross with individuals of current varieties. This type of event favors the amplification of genetic diversity and the emergence of new varieties (Sambatti *et al.* 2001; Peroni 2004; Martins 2005, Rival & Mackey 2008).

In Santa Catarina Island, field preparation for crop cultivation comprised forest clearance, burning and cultivation (Brito 1932; Piazza 1956) in plains and hills. Fields abandoned for at least 15 years were also incorporated into the shifting system (Silva 2005). In earlier times, Tupi-Guarani groups grew manioc, maize, yam, cotton, pepper and tobacco in the island (Cecca 1996). Narratives from the beginning of 16th century provide evidences of trades

between Amerindian and European ships, being the manioc flour or *farinha de pau* one of the most important items traded. Azorean colonizers expanded manioc cultivation in Santa Catarina Island, where a great number of mills were established from 1768 onwards (Silva 2005).

Currently, there are few working mills on the island, which activities are mostly for subsistence (Silva 2005). The local decline of traditional agricultural activities led to the reduction of manioc cultivation, affecting cultural and ecological processes tied to *M. esculenta*. Thus, it is imperative that the sites where *M. esculenta* cultivation is practiced by local traditional populations in Santa Catarina Island are known, and which methods and aspects associated to these crops linger in those communities. Moreover, defining the processes of landscape dynamics following the manioc shifting system might promote insights regarding the historical exploitation and the conservation status of the islands' forests.

Our main objectives were to (i) determine the management practices of *aipim* and *mandioca* used by traditional farmers at Tapera do Sul and Sertão do Ribeirão communities of Santa Catarina island south region; (ii) identify the ethnovarieties cultivated in the past and present by farmers in these communities; (iii) analyze the community traditional knowledge associated with *M. esculenta* cultivation; and (iv) investigate the dynamics of landscapes linked to the cultivation of *M. esculenta* in the community of Tapera do Sul, identifying the species related to old *roças* areas, currently fallowing at different successional stages.

Material and Methods

Santa Catarina Island, Sertão do Ribeirão and Tapera do Sul

Santa Catarina Island was originally covered by Atlantic rainforest and associated ecosystems such as sandy beaches, rocky shores, *restingas* (coastal dunes environment), marshes and mangroves, as well as lagoons and lakes (Cecca 1996; Horn-Filho *et al.* 2000). In a traveler's description (in *Ilha de* Santa Catarina - *Relatos de viajantes estrangeiros nos séculos XVII e XIX*), Langsdorff regarded "tall and dazzling trees such as timber, fig ... and cedar" as abundant (Berger 1996). In the same collection of travellers' descriptions organized by Berger (1996), he considered that the island was, according to Shelvocke, "covered by inaccessible forests, in such wise that to, with the exception of plantations, there are no clearings in the woods" (Berger 1996 p. 46). In the 18th century, the arrival of Azorean immigrants enhanced the vegetation exploitation – for shifting agricultural practices and timber harvest – in the island. Areas of exuberant vegetation, mostly the rainforest ecosys-

tem, were rapidly degraded on account of the agricultural activities of that period (Naka & Rodrigues 2000). Also, historical reports from the 18th and 19th centuries, such as Krusenstern in 1803/1804, depict the landscape modification by native vegetation exploitation (Krusenstern in Berger 1996, p. 153). Currently, the island vegetation is a mosaic of active and abandoned pastures, secondary forest at different succession stages – low and tall secondary growth – and only 2% of virgin tropical forests with modest anthropogenic disturbance (Bastos 1998).

In the 18th century, the increase in *M. esculenta* cultivation enabled the activities of hundreds of mills that were constructed in the Santa Catarina Island (Silva 2005). The Tapera do Sul and Sertão do Ribeirão communities' main activities were based on manioc cultivation for flour production, and sugar for sugar-cane rhum (*Cachaça*). In 1794, there were 350 flour mills in the island (Silva 2005). The area of Tapera do Sul, Caieira da Barra do Sul and Naufragados communities has the second highest number of mills in the austral region of the island, reaching 1.13 archeological sites/Km² (Silva 2005).

Data sampling and analysis

We surveyed two different communities from the south part of Santa Catarina Island: Sertão do Ribeirão and Tapera do Sul. At Sertão do Ribeirão we interviewed residents who currently plant or have planted manioc in the region through a semi-structured protocol. These interviews included the free listing of manioc ethnovarieties known by the agriculturists, regardless of current cultivation or not. After that, the interviewee was asked about the origin of each ethnovariety, form of acquisition, donations made, characteristics of the ethnovariety, toxicity and if was still cultivated. This interview was done with all the people who cultivated manioc. We visited the current *roças* of manioc in the community, as well as homegardens in which the species was grown.

At the community of Tapera do Sul we established two sample premises: informants should inhabit the area for a period longer than 20 years; and should be agriculturists cultivating or who had cultivated *M. esculenta*. We applied semi-structured protocols and utilized digital photographs for landscape dynamics data collection. From the first informant random encountered, we solicited the indication of further informants that could be incorporated in our sample. Interviewees were informed on the research content and objectives previously. All informants accepted being interviewed. Questionnaires recorded data on socioeconomic profile of traditional agriculturists,

cultivation, sweet and bitter manioc cultivars, management, and trade networks. When possible, we visited the crop area for cultivation and fallow fields identification by the informant. Digital photographs were applied to register the vegetation of fallow fields identified by local agriculturists, enabling inferences on landscape dynamics. Plant species of different fallow fields were identified *in situ* and through photographs.

Socioeconomic data was analyzed through descriptive statistics. We estimated the varietal diversity applying Shannon-Wiever diversity index to citation frequencies. A diversity curve – rarefaction of ethnovariety richness according to citations or interviews – contrasting the number of *M. esculenta* ethnovarieties mentioned by Tapera do Sul and Sertão do Ribeirão agriculturists and a divresity curve of ethnovarieties cultivated and known by the local informants of Tapera do Sul and Sertão do Ribeirão were obtained using the software EcoSim version 7.0 (Colwell 2004).

Results and discussion

Socioeconomic aspects

We conducted fourteen interviews at Sertão do Ribeirão community. Eight respondents were male and six were female. Among informants, only four were non-native to the community, and were born at different Santa Catarina Island communities such as Lagoa do Peri, Vargem Pequena, Rio Vermelho and the nearby city of Bom Retiro. Only 7.1% (n=1) of the interviewees had more than 70 years old, 14.3% (n=2) had between 60 and 70 years, 50% (n=7) had between 50 and 60 years and 28.6% (n=4) had less than 50 years old. All informants possess houses and only one family has an income smaller than two Brazilian minimum wages. Regarding marital status, 12 interviewees were married, one was a widower and the other was divorced. Two respondents main income were based on agricultural activities. All of them grow *M. esculenta* for family consumption and only one informant trades manioc when there is some surplus. Three respondents did not have *roças*, cultivating manioc solely on their homegardens, though two of them benefit from the family *roça* and assist on its management.

Seven interviews were conducted with Tapera do Sul local agriculturists. Six informants were male and one was a female. Five informants were born in the community and the other two interviewees are from Caieira da Barra do Sul and Santinho, both in Santa Catarina Island. 71.4% (n=5) of the informants were older than 70 years and 28.6% (n=2) had between 50 to 60 years old. One agriculturist does not have a house of its own and five survive with

an income correspondent to one Brazilian minimum wage. Five informants from Tapera do Sul are married, one is a widower and one is divorced. Bitter and sweet manioc cultivation is still practiced by four informants, two interviewees abandoned manioc faming and one informant grows manioc on his backyard for familiar consumption. The informants which are not cultivating manioc currently have alternative income. Those who grow manioc crops depend on agriculture to enhance their retirement income.

Ethnovarieties

At Tapera do Sul the interviewees mentioned 22 manioc ethnovarieties (Tab. 1), of those eleven are sweet varieties and eleven are bitter manioc cultivars. The number of varieties mentioned by agriculturists varied from six to 12 with a mean of 9.14 (SD=1.86) ethnovarieties/informant. Informants were questioned regarding sweet and bitter manioc diversity separately. The toxic ethnovarieties are mostly categorized as *mandiocas* (bitter), whereas non-toxic cultivars are *aipins* (sweet). Only one ethnovariety (*Aipinzão*) was cited as toxic by six (85.7%) informants, and categorized as a sweet variety by one agriculturist (14.3%). At Sertão do Ribeirão, regardless the terminology, the ethnovariety *Aipinzão* is categorized as toxic by local traditional people.

Table 1: Sweet and bitter manioc ethnovarieties cited by traditional agriculturists from Tapera do Sul community, Florianopolis, Brazil.

Sweet	**Bitter**
Amarelo	Aipinzão
Casca-amarela	Branca
Casca-roxa	'Do Sul'*
Curtura	Folha-redonda
da vó	Franciscale
Eucalipto	Frescal branca
Japão	Paulina
Pêssego	Prata
Rosinha	Roxinha
Vassoura	Sete-casta
Vassourinha	Zulinha

*'*do sul*' ethnovariety was mentioned once, as is regarded as originating from a site to the south (Laranjal).

At Sertão do Ribeirão community we registered 30 ethnovarieties (Tab.2),

of which 14 were bitter manioc and 15 were sweet. Regarding one ethnovariety (*Aipim do governo*) there was disagreement among respondents; two considered it as a bitter and one as a sweet variety. The number of varieties mentioned by agriculturists varied from three to 13 with a mean of 6.33 (SD=3.08) ethnovarieties/informant.

Table 2. Sweet and bitter manioc ethnovarieties cited by traditional agriculturists from Sertão do Ribeirão community, Florianopolis, Brazil.

Aipim	**Mandioca**
(Aipim) amarelo	(Mandioca) azulinha
Aipim branco	(Mandioca) folha redonda
(Aipim) vassourinha	Mandioca prata
(Aipim) casca roxa	Aipinzão
Aipim cacau	Amarelinha
Aipim vassoura	Baguenta
Aipim preto	Mandioca branca
Aipim curtura	Roxinha
Aipim japão	Mandioca
Aipim roxo	Mandioca preta
Aipim da vó	Platina
Aipim cascudo	Mandioca 7 cascas
Aipim rosinha	Olho de pomba
Aipim pêssego	Francisquela
Aipim outro	(Aipim) do governo

The ethnovarieties mentioned by Tapera do Sul agriculturists are equivalent to those cited by Sertão do Ribeirão dwellers with the exception of the bitter manioc ethnovarieties *do sul* – originally from Laranjal locality – , *frescal-branca* and *paulina*; in addition to the sweet manioc variety *eucalipto*.

The terminology of manioc ethnovarieties presented differences from Sertão do Ribeirão to Tapera do Sul communities, *e.g.*, *sete-cascas* and *sete-casta* bitter manioc; *Francisquela* and *Franciscale* bitter manioc. According to Balée (2006), vocabulary changes might depict alterations in landscape knowledge, *i.e.*, as landscapes change with time, the local knowledge related to those sites might suffer from modifications as well. Even though associated with time, vocabulary modifications are also related to space, being influ-

enced by dialects, speeches and local expressions. There was no consensus in the ethnovariety *eucalipto* terminology, once this variety was referred to as being the same variety as the *vassourinha* manioc by two interviewees. Among manioc ethnovarieties from Sertão do Ribeirão, many are assigned according to plant physical aspects such as leaf shape and color, pulp color, root and stem bark color (see also Assis 2007). The varieties *amarelo*, *casca-roxa*, *rosinha*, *vassoura* and *vassourinha* sweet maniocs, which were also mentioned by Tapera do Sul informants, are named based on morphological features.

Bitter manioc ethnovarieties mostly cultivated or present in agriculturists' crops at Tapera do Sul were *Aipinzão* and the *branca* bitter manioc. Among sweet manioc ethnovarieties, those most cited were the *pêssego* variety, followed by the *casca-roxa* and the *amarelo* sweet maniocs. The ethnovarieties currently cultivated are: *pêssego* and *casca-roxa* sweet maniocs and *branca* bitter manioc. At Sertão do Ribeirão, the mostly cultivated sweet maniocs were *branco* and *amarelo*, and the *casca-roxa* variety was the seventh most cultivated. The diversity curve contrasting the cultivated ethnovarieties from Sertão do Ribeirão and Tapera do Sul (Fig. 1) reveals that the curve for varieties from the Sertão tends to stabilization, whereas the curve obtained for Tapera do Sul indicates that a greater sampling effort is required for proper evaluations of ethnovarieties cultivated in that site. Nevertheless, very few agriculturists keep sweet and bitter manioc crops at Tapera do Sul, and the varieties cultivated would probably be equal to those cited by the informants in our survey. In other words,

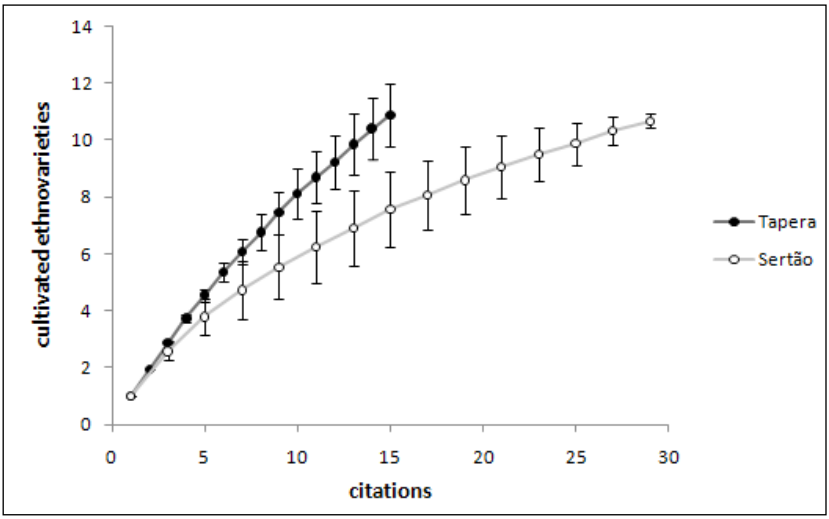

Figure 1. Diversity curve comparing the ethnovarieties of *M. esculenta* cultivated by agriculturists from Sertão do Ribeirão and Tapera do Sul, Florianopolis, Brazil.

there are no more agriculturists at Tapera do Sul to be interviewed since the agriculture activities at this site is disappearing.

A second diversity curve applied for ethnovarieties cited and cultivated by local agriculturalists of Sertão do Ribeirão (Fig. 2A) and Tapera do Sul (Fig. 2B) reveals different relations between known and cultivated varieties. At Sertão do Ribeirão the diversity curve for cultivated varieties is clearly different and lower than the diversity curve for known varieties (Fig. 2A), that indicates the loss of plant genetic diversity of *M. esculenta,* due to reductions in its cultivation. At Tapera do Sul the diversity curve for cultivated manioc varieties is shorter but follows the same pattern than the diversity curve for known varieties, what could be a sample effect not securely indicating the loss of associated knowledge. However, at Tapera do Sul the interviewees were older than at Sertão do Ribeirão, and this could reflect that the loss of knowledge in both communities might be more related to the lack of transmission of manioc cultivation and its associated knowledge for younger generations. Many genetic resources of crops such as manioc are human artifacts and its survival relies on human populations (Clement 1999). Even though the species' sexual reproduction capacity has been preserved, the incorporation of voluntary individuals germinated by seeds from the manioc seed bank and the incorporation of clones of these individuals into the crops enhances and sustains the genetic diversity of *M. esculenta* (Martins 2005). In this way, the management practices and the traditional knowledge around this species are core to the dynamics of the varietal diversity (Peroni 2004; Peroni *et al.* 2007).

In relation to network exchanges of *M. esculenta* ethnovarieties at Tapera do Sul community, four informants (57.1%) pointed their neighbors as the main sources of cultivars, two agriculturists (28.5%) informed that varieties of *ramas* (stem sections used for vegetative propagation) were selected from their own crops and one (14.4%) informant mentioned 'friends' as variety suppliers. Some informants did not ascribe origins to cultivated or known ethnovarieties, identifying the cultivars as "*from Tapera do Sul*". Twelve different sources of sweet and bitter manioc ethnovarieties were cited: Caieira da Barra do Sul, Campeche, Costeira, Laranjal, Pinheira, Saco dos Limões, Sertão do Ribeirão, Tapera do Sul, all these sites are located at Florianópolis municipality or at nearby municipalities; in addition to Antônio Carlos, Londrina, Paulo Lopes and Termas de Jurema, which are farther places. While investigating the origins of Sertão do Ribeirão ethnovarieties, it became clear that varieties network exchanges (through exchanging stem sections) between communities are very common. Different municipalities were cited as varieties sources such as Paulo Lopes, Governador Celso Ramos and Santo Amaro da Imperatriz, as well as the communities of Santa Catarina Island like Lagoa do Peri, Caeira da Barra do Sul and Rio Vermelho.

Stem exchanges are diffuse within the community. For example, following crop harvesting one of the informants leaves a stack of stems shade protected nearby the road, for those who would like to get stems. The majority of agriculturists often do not recall the exact origin of the stems. In most cases, varieties are donated and those who received it should provide the material transportation. One informant mentioned granting the variety donator with manioc flour. Emperaire & Peroni (2007) stress that trade networks are important tools for the conservation of local varieties diversity.

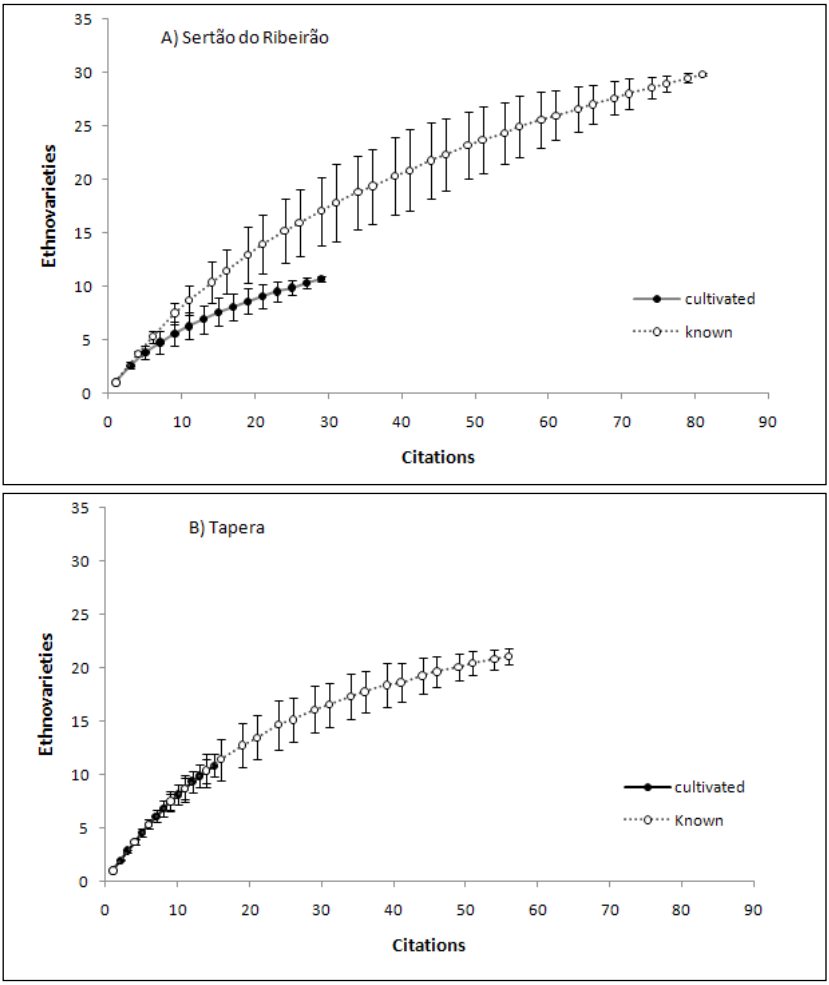

Figure 2. Diversity curves for cultivated and known ethnovarieties of *M. esculenta* according to traditional agriculturists from Sertão do Ribeirão (A) and Tapera do Sul (B), Florianopolis, Brazil.

Management of M. esculenta

The planting season of *M. esculenta*, according to agriculturists, begins in August and might extend until December. Moreover, informants also mentioned factors such as moon phase and soil conditions. Here, an agriculturist elucidates why the planting season initiates in mid-august:

"*...in the earliest August days the soil is still cold…*" *V.M.L*

In this passage, the appropriate moon phase for manioc cultivation is described as:

"...in the waning quarter the stems are short, and with many root…"D.M.S.

The wane moon phase (*vazante*, in agriculturists' terminology) is associated with thick and fewer roots. In contrast, the waxing moon (*enchente*, in agriculturists terminology) provides thin and many roots. Moreover, local agriculturists perceive *M. esculenta* individuals originated from seed germination but these voluntary individuals are regarded as vulnerable to pests ("*raiz bichada*") and are not considered appropriate for multiplication as clones to further cultivation, once "*the seed is no good*" (D.D.C) or "*results in only one deep root*" (V.M.L) when cultivated.

In the case of manioc the incorporation of individuals originated from seed germination is a central component in the evolutionary dynamics of the species and in the generation of new varieties for cultivation (Elias & McKey 2000; Sambatti *et al*. 2001; Peroni 2002; Martins 2005; Peroni *et al.* 2007; Rival & McKey 2008). For local farmers from Santa Catarina Island the practice of controlling against the occurrence and incorporation of individuals originated from seeds reduces the potential to amplify the intraspecific diversity. This stresses the need for efficient exchanges of varieties through social networks to keep the varietal diversity, because within the *roças* there is a small possibility to incorporate the genetic diversity from crosses between varieties and even between other species of the genus *Manihot* (Martins 2005). The management practice of the selection against voluntary individuals from seeds reduces the sustainability of the manioc crop system production, and can increase the vulnerability of current varieties to pests and diseases.

Another management technique during the first stages of cultivation is related to stem sections care/ nursing. Two informants (28.5%), for instance, described stem plantation under trees in order to protect varieties from weather conditions, such as frosting. Later on, stems are transplanted to cultivation fields. In the past, maize, beans and manioc were cultivated in the same *roças*, according to five (71.4%) agriculturists from Tapera do Sul. Po-

tatoes, banana, coffee and yams were also cited as cultivars present in *roças*. Beans and maize are important livelihood products still cultivated in Sertão do Ribeirão fields.

The harvest season usually occurs two years following the plantation (n=3; 42.8%) and begins in May (n=4; 57.2%). At Sertão do Ribeirão community, manioc is harvested from May onwards, before winter. The management of *roças* areas is clearly separated into two technique procedures applied for sandy soil *roças* and *roças* situated on hills, where the soils have more clay. Fire used to be applied for soil fertilization due to nutrients released from charcoal, exclusively in forest gaps and *roças* on hills. Sandy soil *roças* are cleared manually or using the plow. Two agriculturists mentioned the fertilization of sandy soil fields previous to *M. esculenta* cultivation, mainly with manure. Shifting agriculture, or slash-and-burn, was the typical manioc cultivation system at Tapera do Sul community. However, this method was abandoned and replaced throughout the years, due to this practice banishment.

At Sertão do Ribeirão, traditional agriculturists' families apply the chopping technique (*desbastada*) following winter. Manioc plants lose its leaves during the winter season. Later, when leaves regrow, agriculturists cut the stems on a technique identified as *debastada*, which "*results in stronger and bigger roots*". This management technique might be related to the lack of propagation material, once *roças* are planted after winter, from three to six months after manioc harvesting, and those stem sections prepared during the harvest season may be either no longer suitable for planting or been lost. Thus, to start a new *roça* the farmer can make use of the stems cut by *debastada* technique, without damaging the root. This is only possible due to the agronomic disjunction, in which the consumed part of the plant is different from that used for propagation (Martins, 2005). Though, this practice was not mentioned by Tapera do Sul dwellers.

There was no consensus among interviewees in relation to the fallow period, in which *roças* are abandoned and new cultivation areas are utilized. Fallow periods ranging from two, three, five, six and ten years were cited. Old *roças* in different succession stages were identified by informants, including two and three year fallow *roças* to areas abandoned for over 40 years.

Landscape dynamics and vegetative succession of roças

According to Ballé (2006) landscape is defined as a mosaic of elements as space, time, history and nature, biologic communities and human societies.

A portion of environment encoded in speech.

During ecological succession occurs the growth and regeneration cycle of a forest, in which different phases such as the clearing stage, construction and forest climax can be distinguished according to its unique characteristics. During this cycle, there is a sequential addition or replacement of species in the community, accompanied by changes in the abundance of previously present species and in the local physicochemical conditions, resulting in gradual or abrupt community changes.

The fallow fields used by local farmers were classified into four categories according to years of abandonment: fields with one to three years, fields up to 10 years, 15 to 20 years and more than 40 years of natural regeneration. The initial stage of vegetative regeneration is characterized by an herbaceous shrub formation. Areas with up to three years of abandonment of *M. esculenta roça*s present abundant *Melinis minutiflora* (Poaceae) and shrub species such as *Dodonea viscosa* (Sapindaceae) and *Baccharis dracunculifolia* (Asteraceae).

Roças with ten or less years of natural regeneration present an initial tree formation. Initial stage species recorded were *Dodonaea viscosa* (Sapindaceae), *Baccharis dracunculifolia* (Asteraceae), and *Ilex brevicuspis*, *I. dumosa* (Aquifoliaceae), *Psidium cattleianum* (Myrtaceae) and *Mimosa bimucronata* (Leguminosae-Mimosoidae).

Areas categorized as fallow fields abandoned for 15 to 20 years comprise greater number of tree species when compared to previously described *roças*. In addition to species established in fallow fields of less than 15 years of abandonment, we identified *Alchornea triplinervia* (Euphorbiaceae), *Guapira opposita* (Nyctaginaceae), *Hieronyma alchorneoides* (Euphorbiaceae), *Miconia cabucu* (Melastomataceae) and *Myrcia rostrata* (Myrtaceae). Moreover, these areas canopy structure is taller than 10 years old *roças* or less.

Fallow cultivation fields of over 40 years of regeneration constitute a secondary succession stage. The dominant species in the canopy is *Schizolobium parahyba* (Fabaceae).

Succession stages following deforestation in Santa Catarina Island were categorized – from low to tall secondary growth – by Caruso (1983) in four phases: *initial stage* areas are occupied by herbaceous plants; *capoeirinha* is dominated by shrubs; *capoeira* consists mainly of shrubs and small trees, and the stage before a secondary succession is the *capoeirão*, with medium high trees.

According to agriculturists interviewed at Tapera do Sul, some fields have been used to manioc cultivation for over 100 years. Information concerning timber extraction for trade and the exploitation of vegetation for shifting cultivation fields indicates landscape changes and dynamics over the years

(Bender *et al.* 2009). According to Silva (2005), the southern region of the island preserves a few remnants of Atlantic rainforest on its slopes, along with *roças*, pastures and secondary vegetation. Thus, the rainforest of the region is mostly of secondary succession stage, whereas the primary forests are restricted to steep places, inaccessible to agricultural activities and logging (Silva 2005).

Although cultivated and worn out areas regenerate in the shifting cultivation system, the full vegetation recovery occurs slow and gradually. Moreover, there are no evidences that the fauna associated to primary forests eventually return to areas of secondary succession. Studies are required in order to estimate the ecological importance of these ancient *roças* to Atlantic rainforest communities. Currently, there is only 7.5% of the original extent of the Atlantic rainforest (Myers *et al.* 2000). Therefore, the Atlantic rainforest is one of the most threatened ecosystems in the world and is considered one of the 25 global hotspots (Myers *et al.* 2000) and a priority area for biodiversity conservation (Galvão & Rodrigues 2006; Leitão-Filho 1987). However, we have to consider the role of the traditional cultivation system in maintaining the vegetation cover, when compared to other activities which result in the full replacement of the vegetation by urban or industrial areas, for example.

At Tapera do Sul we observed a tendency towards the erosion of *M. esculenta* traditional knowledge once there are few people sustaining crops of bitter and sweet manioc, and the majority is elderly. In other words, this community's traditional knowledge related to manioc might be lost in the coming years if its members fail to pass on their experience to future generations. Thus, we emphasize the need to examine carefully issues such as knowledge sharing – associated with manioc cultivation – within the community.

In addition to the conservation status of the Atlantic rainforest ecosystem and its biodiversity, the culture associated to manioc cultivation also appears to be threatened. Although historically important to the Santa Catarina Island, today there are few communities which maintain this activity for subsistence such as Sertão do Ribeirão and Tapera do Sul dwellers. Unfortunately, the decline of bitter and sweet manioc cultivation traditions is related to the loss of ethnovarieties biodiversity and the knowledge associated to this culture.

The conservation of manioc flour mills in the south region of Santa Catarina Island, including Tapera do Sul and Sertão do Ribeirão, sets the initial step to rescue the culture of *M. esculenta* in Florianópolis. Another approach to encourage knowledge transmission is workshops, gathering young and elderly from the communities, to teach ethnovarieties knowledge

and management practices. This indigenous and Azorean cultural heritage should be preserved for future generations once it is part Santa Catarina native's history and identity.

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Ana Luiza Assis is a Biologist (Universidade Federal de Santa Catarina - UFSC, 2008), and is in the process of obtaining a master degree in Plant Genetic Resourses (UFSC, 2009-2011). Her master's thesis is about landscapes units managed in areas of Forest with Araucaria and its implications for domestication of landscapes and species. Her lines of work are ethnobiology and biodiversity conservation.

Erasmo Nei Tiepo is an Agronomist (UFSC, 1999) and holds a master degree in Plant Biology (UFSC, 2005). His main interests are floristic reseraches, environmental restoration, ethnobotany and conservation biology.
Mariana Bender Gomes is a biologist (Universidade Federal de Santa Maria, 2008) and is in the process of obtaining a master degree in Ecology (Universidade Federal de Santa Catarina, 2008 – 2010). Her main interests and lines of work are ethnoecology, ethnozoology of reef fishes, shifting baselines syndrome and conservation of threatened fish species.

Natalia Hanazaki is an Ecologist (Universidade Estadual Paulista "Júlio de Mesquita Filho" UNESP/Rio Claro), holds a master in Ecology (Institute of Biology, Universidade de São Paulo, 1997); and a doctor degree in Ecology (Institute of Biology, Universidade Estadual de Campinas, 2001). Associate professor of the Department of Ecology and Zoology, Center of Biological Sciences, Universidade Federal de Santa Catarina, where coordinates the Laboratory of Human Ecology and Ethnobotany.

Nivaldo Peroni is Agronomist, holds a master degree in Genetics and Plant Evolution at University of São Paulo (ESALQ – USP), and has a Doctor degree in Plant Biology at the State University of Campinas (Unicamp), Campinas, Brazil. Currently he is the vice-president of Fisheries and Food Institute (FIFO) and a researcher at the Post-graduation Program on Plant Genetic Resources at the Universidade Federal de Santa Catarina.