A Journal of Plants, People, and Applied Research
Ethnobotany Research & Applications

Economic Botany of an Endemic Palm Species (*Butia catarinensis* Noblick & Lorenzi) in Southern Brazil

Leonardo Kumagai & Natalia Hanazaki

Research

Abstract

Butia catarinensis Noblick & Lorenzi is an endemic palm that occurs on sandy soils in coastal areas of southern Brazil, where its fruit are used as food. The objective of this study is to analyze the production chain aspects of *B. catarinensis* and to identify different stakeholders involved in its production in order to better understand the relationship between local people and this palm. The focus of this research is the Areais da Ribanceira, a common area where local residents harvest *B. catarinensis* fruit. The fruit are used on a domestic scale to produce *B. catarinensis* rum, and at an industrial scale to produce ice cream and popsicles, which are commercialized locally and in nearby municipalities. These products also reach the capital of Santa Catarina State, 80km from the harvesting area. The practice of this low impact activity can provide environmental, economic and social sustainability for the local community.

Introduction

Urban and industrial expansion in coastal areas poses several threats to local peoples' livelihoods, as well as, to the ecosystems that they depend upon (Gregory & Mattingly 2009, Hanazaki 2003, Nelson *et al.* 2010). The dependence on forest remnants as a way to increase the family income, or even as a main source of income, is a reality for several local communities in the world (Diegues 1988, Ticktin 2004), and these resources can be transformed into 'socio-biodiversity products'. On the Brazilian coast, the Atlantic Forest is one of the most threatened terrestrial biomes of the world (Lira *et al.* 2012), which includes associated threatened ecosystems such as the **restinga** (Falkenberg 1999, Marques *et al.* 2011).

The **restinga** is a type of sand dune vegetation that varies from a shrub-dominated vegetation to tree-dominated forests up to 15 m tall (Falkenberg 1999). This vegetation is distributed over sandy soil mosaics, gradients of coastal to inland zones, and is rich in shrubs and tree species from the families Myrtaceae (E*ugenia, Myrcia, Marliera*), Fabaceae (*Andira*), Euphorbiaceae (*Croton*), and Malpighiaceae (*Byrsonima*) (Falkenberg 1999).

Different authors have described the use of plant resources from **restinga** areas. Fonseca-Kruel and Peixoto (2004), and Miranda and Hanazaki (2008) studied useful species associated with local knowledge and local traditions of fishers from Arraial do Cabo and Ilha do Cardoso, respectively. Silva and Peixoto (2009) studied two medicinal species commercialized in a public market in Rio de Janeiro with potential problems of mistaken collection, which can result in difficulties related to environmental monitoring of **restinga** resources. Plant resources from **restingas** can be harvested for different purposes, such as artisanal fishing traps, without resulting in a decrease in diversity when based on traditional practices (Oliveira & Hanazaki 2011). The central idea behind socio-biodiversity products is based on the assumptions that these products protect

Correspondence

Leonardo Kumagai, Universidade Federal de Santa Catarina, PPG Biologia Vegetal, Caixa Postal 476, Campus Universitário, Trindade, CEP 88040-900, Florianópolis, Santa Catarina, BRAZIL, <leokasampaio@gmail.com>

Natalia Hanazaki, Universidade Federal de Santa Catarina, Depto de Ecologia e Zoologia, Campus Universitário, s/n, Sala 007, Bloco B, térreo- Córrego Grande, 88040-900 Florianópolis, Santa Catarina, BRAZIL, <natalia@ccb.ufsc.br>

Ethnobotany Research & Applications 11:143-152 (2013)

Published: August 12, 2013

www.ethnobotanyjournal.org/vol11/i1547-3465-11-143.pdf

and respect cultures and traditional knowledge, which is essential for the conservation of global biodiversity (Agarwal & Narain 1992, Belcher 2003).

Butia catarinensis Noblick & Lorenzi is a short palm about 2 m high when adult, whose ovoid fruit range from 1.4 to 2.6 cm in length and grows on sandy soils (paleodunes) in altitudes from 3 to 30 m a.s.l. (Lorenzi *et al.* 2010). Usually the species grows in dense clusters amid the **restinga** mosaic (Figure 1) (Kumagai & Hanazaki 2013, Reitz 1974, Rosa *et al.* 1998), also described by Saint-Hilaire in 1820 (Saint-Hilaire 1978).

The versatility of species from the Arecaceae family is widely reported in ethnobotany studies (Araújo & Lopes 2012, Macía 2004). Macía *et al.* (2011) emphasized that this versatility in use is due to the palm's characteristic of meeting basic subsistence needs and its great importance in traditional indigenous cultures, as well as for small rural farmers. According to Coradin *et al.* (2011), *B. catarinensis* is one of the Brazilian native plant species of economic value, due to its potential as a food and fiber source. However, the importance of *B. catarinensis* is underestimated and can be improved both through an *in-situ* conservation and *ex-situ* cultivation perspective. The conservation status of this species is of concern since much of its original occurrence area has been lost due to highways, urban growth and forestry (Bourscheid 2011). Nowadays, the registered uses for *B. catarinensis* include jellies, jams, liqueurs and as a flavoring agent for rum (Buttow *et al.* 2009 , Kumagai & Hanazaki 2013, Rosa *et al.* 1998). However, other uses have become popular, such as using the pulp for manufacturing ice cream (Buttow *et al.* 2009). According to Buttow *et al.* (2009), there is a considerable potential to expand the uses of the *B. catarinensis* plant, mainly for culinary purposes, such as the production of sweets, juice and liquor.

The objective of this study was to analyze aspects of *B. catarinensis* production chain, with focus on harvesters from Areais da Ribanceira, a rural area in the Imbituba municipality (Santa Catarina State), in order to identify the different stakeholders involved in its production and better understand the relationship between local people and this palm.

Study site

This study was located in the area of Areais da Ribanceira, in the municipality of Imbituba (28° 12' 12'' S - 48° 40' 40" W), central-south Santa Catarina coast, in southern Brazil. Areais da Ribanceira comprises an area of about 2000 hectares with **restinga** as the predominant vegetation, as well as areas of farming and sand dunes with no vegetation cover. **Restinga** vegetation is defined as floristically and physiognomically distinct communities, located

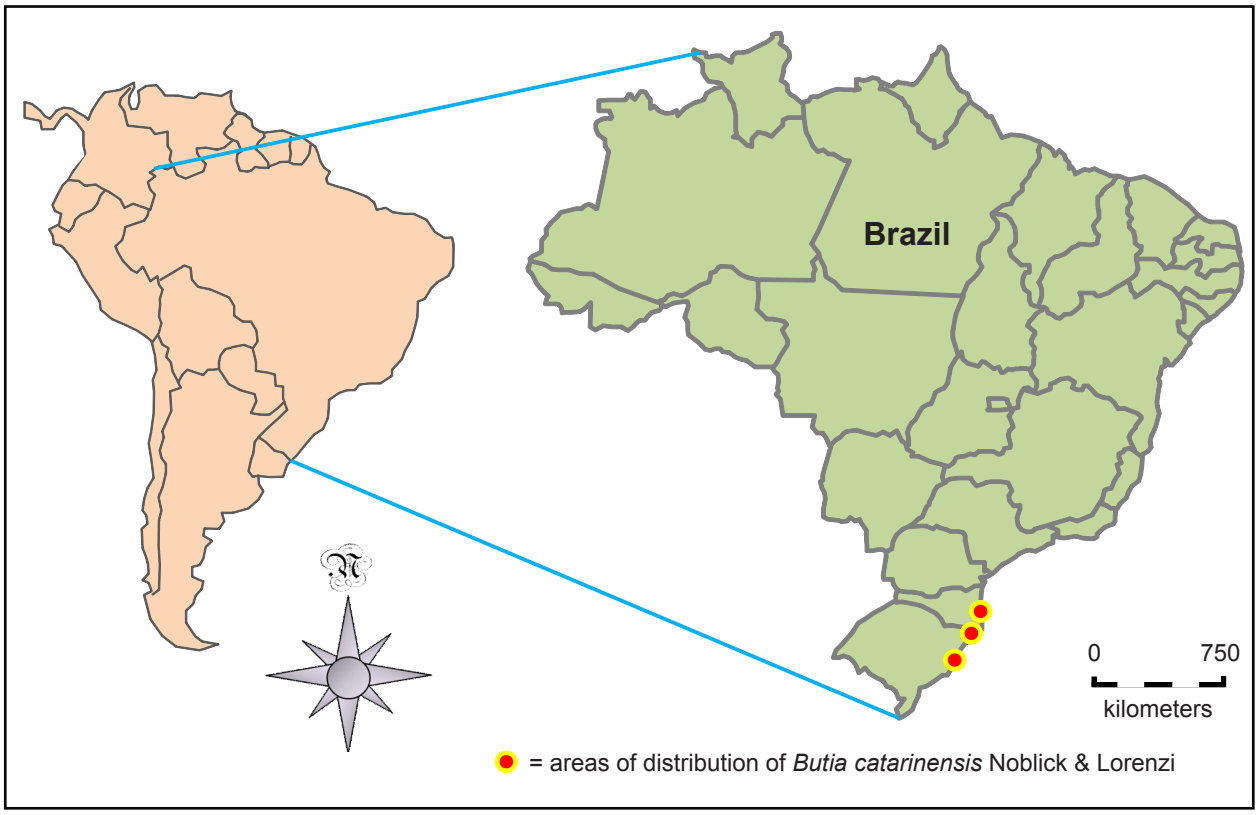

Figure 1. Distribution of the Brazilian endemic palm, *Butia catarinensis* Noblick & Lorenzi.

in sandy terrains of marine, fluvial, or windy origin (or a combination of all three), dating from the Quaternary period, usually with less developed soils (Falkenberg 1999). According to Falkenberg (1999), this type of ecosystem is found from the southern to northern Brazilian coast, with large extensions in Santa Catarina State. The farmers and harvesters who use the region are from nearby neighborhoods, and commonly use and manage the area. *B. catarinensis* is harvested from the entire area, and farming occurs in the lowlands within the **restinga** mosaic, where they also harvest other resources such as medicinal plants (Zank & Hanazaki 2012). Climate is subtropical, with no dry season (annual precipitation varies from 1500 to 1700mm), and average temperatures varying between 19º and 20º C (Pandolfo *et al.* 2002).

Local people who live there rely on plant resources for their livelihoods, a reality similar to the communities living close to **restinga** areas along the coast of southern Santa Catarina State. This is an area of high economic and conservation interest. From one perspective, it is located close to an urban area and a large port, on the other hand it is a fragile area of **restinga** with priority for conservation due to its natural and cultural attributes. Among these attributes are small-scale agriculture with high agrobiodiversity and the harvesting of *B. catarinensis* fruit (Kumagai & Hanazaki 2013).

Methods

Data collection occurred between 2009 and 2010, after establishing the research goals and obtaining prior informed consent from the community. The prior informed consent was obtained individually from interviewees involved with other steps of the production chain. Data was collected through participant observation, participatory research tools and semi-structured interviews (Albuquerque *et al.* 2010, Alexiades 1996) with open questions regarding the local knowledge on harvesting, uses and commercialization of *B. catarinensis* (Appendix A). Parts of these data were discussed in other publications (Hanazaki *et al.* 2012, Kumagai & Hanazaki 2013). The following were the criteria used for the inclusion of interviewees in this study: those farmers who plant crops in **restinga** areas or harvest *B. catarinensis* from Areais da Ribanceira area; and live in one of the five villages surrounding the Areais, which includes Divinéia, Ribanceira de Baixo, Barranceira, Aguada and Nova Brasília villages. Two harvesters also act as middlemen.

Other information about the production chain was obtained through semi-structured interviews on management practices, amounts of fruit collected, buyers and sellers, fruit productivity, pulp productivity, ice cream productivity (Appendix B). For these interviews different stakeholders in the production chain were sampled using the snowball method (Albuquerque *et al.* 2010, Alexiades 1996). Two main sources of entries were utilized, one being the main harvesters and the second being ice cream factories from Imbituba, Garopaba and Florianópolis, who offer products made from *B. catarinensis*.

The currency information (in Brazilian reais (BRR)) was converted to United States dollars (USD) using the exchange rates for December 2012 (1 USD = 2.059 BRR). Three voucher specimens of *B. catarinensis* were collected and deposited at the herbarium of the Universidade Federal de Santa Catarina (FLOR).

Results

A total of 32 harvesters and two middlemen were interviewed, and five ice cream or popsicle factories were visited. The five factories are identified by capital letters from A to E. Two are located in Imbituba (C and D), two in Florianopolis (A and B) and one in Garopaba (E) (Table 1).

Current uses of *B. catarinensis* are focused on its fruit, which are used for the production of juice, pulp, ice cream, popsicles, and to steep in rum. Popsicles and ice cream are the main products made from *B. catarinensis* in the Areais da Ribanceira region. The market for *B. catarinensis* popsicles reaches the neighboring municipalities, including the city of Florianópolis, about 80 km north. For this purpose, during the season each harvester collected from 5-15 kg of *B. catarinensis* fruit daily. Fruit are harvested from the Areais da Ribanceira region by local residents (Figure 2), which are mainly middle-aged men and young school-aged people. Gathering occurs daily during the high season (December-March), shortly after the work/school day. Fruit are sanitized in basins with water, wrapped in plastic bags in portions of 3 kg and finally marketed directly to ice cream factories in Imbituba (C and D).

One of the harvesters also acted as a middleman, receiving the already cleaned and packed fruit from other collectors,

Table 1. Ice cream and popsicle factories that produce *Butia catarinensis* Noblick & Lorenzi products.

Factory	Municipality	Person Interviewed	Location of *B. catarinensis* purchase	Product Distribution Range
A	Florianópolis	Nutritionist in charge	Florianópolis (5 km)	30 km
B	Florianópolis	Owner	Laguna (120 km)	30 km
C	Imbituba	Owner	Imbituba (2 km)	80 km
D	Imbituba	Buyer	Imbituba (1 km)	80 km
E	Garopaba	Manager	Imbituba (30 km)	15 km

Figure 2. Fruit of *Butia catarinensis* Noblick & Lorenzi being harvested, Santa Catarina State, Brazil.

and stored the fruit in a freezer to be marketed. He sells these fruit to an ice cream factory (E) in the neighboring municipality (Garopaba, 30 km away) (Figure 2). The ice cream factories in Florianópolis (A and B), the largest city in the region and also the capital of Santa Catarina, buy their fruit primarily from a farmer in the same municipality, but factory B also buys fruit from producers in the Laguna municipality, about 34 km south of Imbituba. The ice cream factories from Imbituba (C and D) market their products from Imbituba to Florianópolis, and factory D has over 200 shops. The factories in Florianópolis only sell locally, within their own shops (Table 1 and Figure 3).

For all factories the yield of fruit to pulp weight was 50%. In order to remove *B. catarinensis*'s pulp mechanically, pulping has been adapted to more resistant blades in industrial mixers. After pulping, the nuts are discarded.

The ice cream factory in the city of Garopaba (E) is the oldest and has been producing *B. catarinensis* ice cream for over 25 years. Most of its raw material comes from a preserved area on a private farm, but they still prefer to purchase the fruit from two known harvesters, who usually bring fruit from the city of Laguna (45 km away). The owner of E, who claims himself as the sole holder of their recipe, makes homemade ice cream. In the 2010 season they produced and commercialized about 1,000 liters of ice cream. In this interview the store manager did not report on income and on the cost/benefit of making *B. catarinensis* ice cream.

The ice cream factories in Imbituba (C and D) bought the fruit from local collectors. The production of popsicles began in 2004 for both factories. They bought bags with 1 kg of fruit for about USD 1.50, and produced popsicles that were sold to final consumers for USD 0.75. In 2009, the ice cream factory D purchased 1,000 kg of fruit, which yielded 500 kg of pulp and produced 15,000 popsicles. In the same year factory C produced 1,000 liters of ice cream per month in the 2010 season. It is important to note that the summer season (with greater movement of tourist in the region) happens before the fruiting season, and only factory C had frozen fruit from the previous season for the production of popsicles in the summer.

For factory B, 3 kg of pulp yielded 8 kg of ice cream. For factory A, 12 kg of pulp yielded 100 liters of ice cream. Factory B used to sell its ice cream in their own shop for USD 11.50 per kg, while factory A sold a pack with 2 liters of ice cream for USD 6.60, and an ice cream scoop for USD 3.00. Considering the four factories (A to D), each kilogram of fruit pulp yielded an average of 3.6 kg (± 0.822 kg) of ice cream, and each dollar invested in fruit yielded an average of USD 8.42 (± $ 2.33, Table 2). These calculations are only illustrative, since this analysis does not consider the cost of other raw materials used in the manufacturing of ice cream or popsicles, nor other costs associated with its production, such as those related to labor, energy and marketing.

Other than those main uses, the palm leaves can be used for handcrafts and the whole plant can be used in gardening and landscaping. The production of *B. catarinensis* rum (cachaça **de butiá**) occurs on a small scale, mainly for household consumption. The rum from sugarcane, usually from a local distillery, costs USD 1.50 per liter. After the immersion of *B. catarinensis* fruit, a liter can be sold for about USD 5.00. Annual production of *B. catarinensis* rum averages 10 liters per harvester, among 23 interviewees who reported this practice. Most of this production is used for personal consumption, as an apéritif, or as a gift to relatives. Fifteen interviewees reported the production of *B. catarinensis* rum to bargain for fish in the local harbor. Usually this product is commercialized under the name of **uísque de bolinha** ('small balls' whiskey), and the species *B. catarinensis* is preferred over other

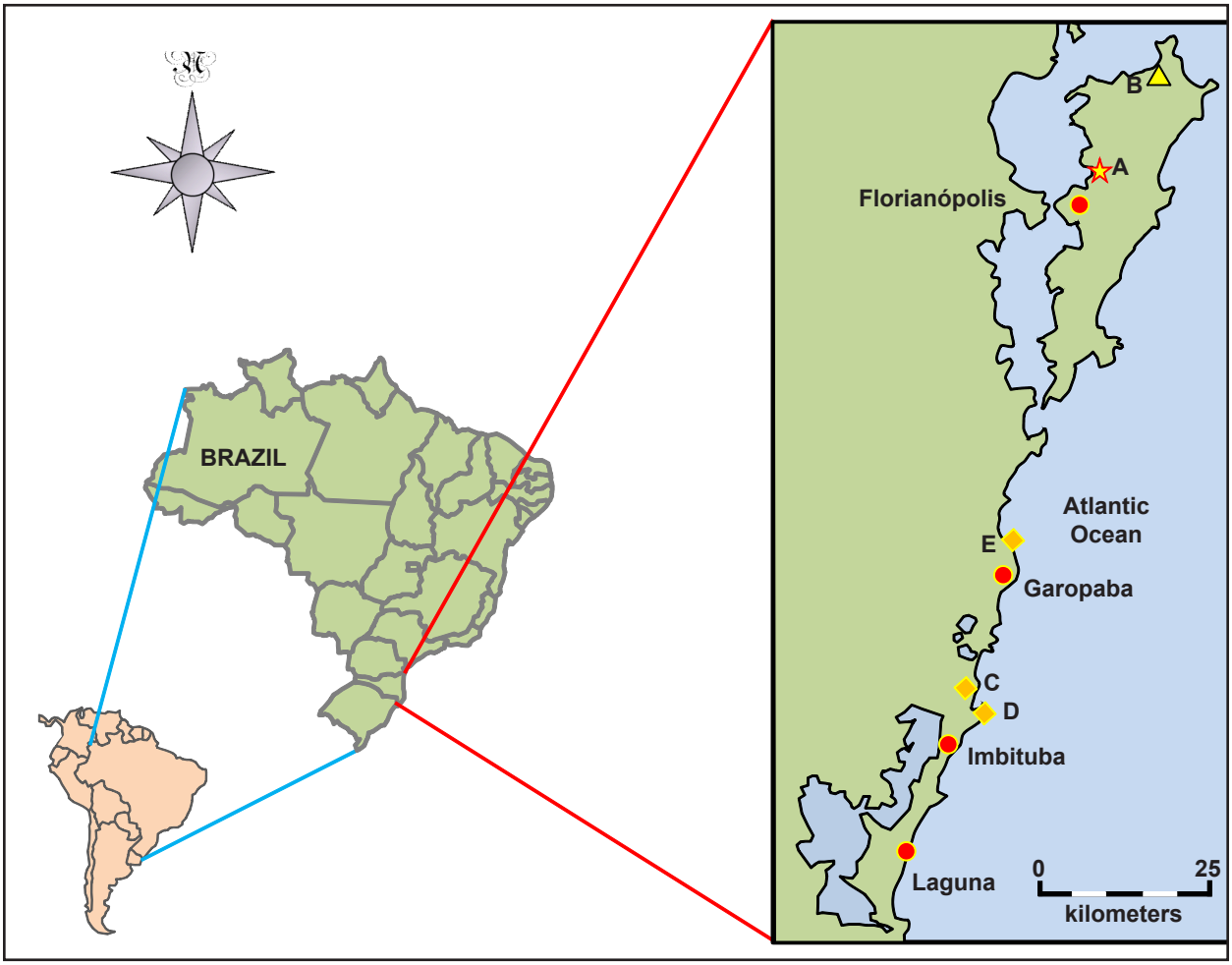

Figure 3. Ice cream and popsicles factories (A, B, C, D and E) in Santa Catarina State, Brazil, using fruits of *Butia catarinensis* Noblick & Lorenzi. Gray strip at right inset corresponds to Areais da Ribanceira; star indicates the factory that buys fruit from Florianópolis; triangle indicates the factory that buys fruit from Laguna; diamonds indicate the factories that buy fruits from Imbituba; circles indicate major urban centers.

Table 2. Yield of ice cream per kg of fruit pulp at factories in coastal Santa Catarina State, Brazil, and income per U.S. dollar invested in *Butia catarinensis* Noblick & Lorenzi (not considering other production costs).

Factory	A	B	C	D
Yield (kg)	4.70	2.70	3.50	3.60
Income (US$)	7.24	5.73	10.00	10.70

Butia species due to the smaller size of the fruit, which are best suitable to be put through the bottle's mouth (Figure 4).

Discussion

This is the first registration of the local production chain of *B. catarinensis*. Farmers who use the area of Areais da Ribanceira and people who live in its vicinity are the main harvesters of *B. catarinensis* fruit (Kumagai & Hanazaki 2013), which are sold mainly to local ice cream and popsicles factories, directly from the harvester or through few middlemen. For the harvesters the income obtained with *B. catarinensis* is a supplement to their monthly wages. The fruit collected in the area of Areais da Ribanceira, after processed as ice cream or popsicles, are sold in a radius of about 80 km from their place of extraction.

The purposes of use of *B. catarinensis* are similar to what Buttow *et al*. (2009) and Buttow *et al*. (2010) registered among *Butia* spp. users in the state of Rio Grande do Sul and Minas Gerais (Table 3).

B. catarinensis has a great potential to supplement the income of small-scale farmers in the region. Beyond the use of raw *Butia* fruit or pulp for the ice cream and popsicle industry, there are other potential uses for the leaves in handicrafts, the nut for oil, and the entire plant as or-

Figure 4. Bottle of *Butia catarinensis* Noblick & Lorenzi rum (cachaça **de butiá** or **uísque de bolinha**).

namental. The use of the juice could be broadened locally, similar to what occurs in northern Minas Gerais (Faria *et al*. 2008a) where *Butia capitata* (Mart.) Becc. juice is a supplement to the school lunch. Thus, the fruit of *B. capitata* are used as a source of fibers, vitamin A, vitamin C and potassium (Faria *et al*. 2008a). Genovese *et al*. (2008) showed that *Butia* spp. fruit have a significant amount of vitamin C (43 mg/100 gf.w.), and this perception was also present in the local knowledge of the interviewees from the Areais da Ribanceira. The nut oil from *Butia odorata* (Barb. Rodr.) Noblick can be used for biodiesel production (Sganzerla *et al*. 2009). These uses point out other potentials of the species' nut, which can be locally exploited, especially when considering that the ice cream factories discard the nuts (Table 3). For other species of this genus, Faria *et al*. (2008b) presented the high energetic value in the *B. capitata* nut, which contains lauric acid (C12:0) potentially exploitable for soap, plastics and rubber production, also highlighting its bactericidal activity and use to enrich animal fodder.

Table 3. Uses registered for *Butia* spp. in Brazil.

Butia spp.	Uses	Author
Butia odorata (Barb. Rodr.) Noblick	Jelly, jam, ice cream, candies and desserts. Leaves for handicrafts.	Buttow *et al.* 2009, 2010
B. odorata	Biodiesel potential	Sganzerla *et al.* 2009
Butia capitata (Mart.) Becc.	Juice	Farias *et al.* 2008a
B. capitata	Juice	Genovese *et al*. 2008

Adding value to the first steps of the production chain is also an interesting way to enhance the process, through the standardization of collection practices and pulping and freezing within the community. Even more important is the incentive for management of remaining *B. catarinensis* clusters and to foment the restoration of the areas within the natural occurrence range of this species, since this is an endemic species highly threatened by urban expansion.

For a species that has lost much of its range in Santa Catarina State to highways, urban growth and forestry (Bourscheid 2011), it is urgent to direct efforts to conserve this species. Our main argument is that this is a sociobiodiversity product, already identified as an undervalued resource (Coradin *et al.* 2011), which can be conserved through its controlled use and management. Fruit harvesting for ice cream factories should be considered with caution, since it represents the most intense collection and can occur in

higher amounts with an expansion of the market. In a recent review on the management of palms in South America, Bernal *et al*. (2011) pointed out that managed species are remarkably fewer than used species, suggesting that harvesters often disregard the fate of the species they use. These authors suggested that future research should address the production evaluation in response to management practices, combined with actions directed to all stakeholders involved in the human/palm system. Thus, the comprehension of the production chain is even more relevant for sociobiodiversity products, as well as, to fully comprehend bottlenecks for *in-situ* management and cultivation. For example, cultivation might be a future problem for this plant, in an *ex-situ* experiment with controlled water and temperature it took more than 12 months for seeds to begin germinating with a low percentage of success (7.5%) (Sampaio *et al.* 2012).

This study also revealed that the longevity of the local community could contribute to **restinga** conservation. If not threatened by a market expansion, the practice of a low impact activity such as the harvesting of *B. catarinensis* fruit can have both socio-economic and environmental sustainability for the local community, when in conjunction with the goals of environmental conservation of fragile but highly threatened ecosystems, such as the **restinga**.

Acknowledgements

We would like to thank ACORDI (Community Farmer's Association of Imbituba) and all of the interviewed harvesters and stakeholders. P. Queiroz who helped with data collection. Lastly, we thank CNPq for financial support for fieldwork (478954/2009-3) and the research productivity scholarship (306895/2009-9) for N. Hanazaki; also to CAPES/PNADB for L. Kumagai's Masters scholarship.

Literature Cited

Agarwal, A. & S. Narain. 1992. *Towards a Green World*. Centre for Science and Environment, New Delhi.

Albuquerque U.P., R.F.P. Lucena. & L.V.F.C. Cunha. 2010. *Métodos e Técnicas para Coleta de Dados Etnobiológicos.* NUPEEA, Recife, Brazil.

Alexiades, M. 1996. *Selected Guidelines for Ethnobotanical Research: A field manual*. New York Botanical Garden, New York, New York.

Araújo, F.R. & M.A. Lopes. 2012. Diversity of use and local knowledge of palms (Arecaceae) in eastern Amazonia. *Biodiversity and Conservation* 21(2):487-501.

Belcher, M.B. 2003. What isn't an NTFP? *International Forestry Review* 5(2):161-168.

Bernal, R., C. Torres, N.E. García, C. Isaza, J. Navarro, M.I. Vallejo, G. Galeano & H. Balslev. 2011. Palm management in South America. *Botanical Review* 77(4):607-646.

Bourscheid, K. 2011. *Butia catarinensis*, butiá-da-praia. Pp. 151-155 in *Espécies Nativas da Flora Brasileira de Valor Econômico Atual ou Potencial: Plantas para o Futuro - Região Sul*. Organized by L.A. Coradin, A. Siminski & A. Reis. Ministério do Meio Ambiente, Brasília.

Buttow, M.V., R.L. Barbieri, R.S. Neitzke & G. Heiden. 2009. Conhecimento tradicional associado ao uso de butiás (*Butia* spp., Arecaceae) no sul do Brasil. *Revista Brasileira de Fruticultura* 31(4):1069-1075.

Buttow, M.V., C.M. Castro, E. Schwartz, A. Tonietto & R.L. Barbieri. 2010. Caracterização molecular de populações de *Butia capitata* (Arecaceae) do Sul do Brasil através de marcadores AFLP. *Revista Brasileira de Fruticultura* 32(1):230-239.

Coradin, L., A. Siminski & A. Reis. 2011. *Espécies Nativas da Flora Brasileira de Valor Econômico Atual ou Potencial: Plantas para o Futuro - Região Sul*. Ministério do Meio Ambiente, Brasília.

Diegues, A.C. 1988. *Diversidade Biológica e Culturas Tradicionais Litorâneas: O Caso das Comunidades Caiçaras*. NUPAUB-USP, São Paulo, Brazil.

Falkenberg, D.B. 1999. Aspectos da flora e da vegetação secundária da restinga de Santa Catarina, sul do Brasil. *Ínsula* 28:1-30.

Faria, J.P., F. Almeida, L.C.R. Silva, R.F. Vieira, D.B. Silva & T.S. Agostini-Costa. 2008a. Caracterização da polpa do coquinho-azedo (*Butia capitata* var. *capitata*). *Revista Brasileira de Fruticultura* 30(3):827-829.

Faria, J.P., D.B. Arellano, R. Grimaldi, L.C.R. Silva, R.F. Vieira, D.B. Silva & T.S. Agostini-Costa. 2008b. Caracterização química da amêndoa de coquinho-azedo (*Butia capitata* var. *capitata*). *Revista Brasileira de Fruticultura* 30(2):549-552.

Fonseca-Kruel, V.S. & A.L. Peixoto. 2004. Etnobotânica na Reserva Extrativista Marinha de Arraial do Cabo, RJ. *Acta Botanica Brasilica* 18(1):177-190.

Genovese, M.I., M. Da Silva Pinto, A.E.S.S. Gonçalves & F.M. Lajolo. 2008. Bioactive compounds and antioxidant capacity of exotic fruits and commercial frozen pulps from Brazil. *Food Science and Technology International* 14(3):207-214.

Gregory, P. & M. Mattingly. 2009. Goodbye to natural resource-based livelihoods? Crossing the rural/urban divide. *Local Environment* 14(9):879-890.

Hanazaki, N. 2003. Comunidades, conservação e manejo: o papel do conhecimento ecológico local. *Biotemas* 16(1):23-47.

Hanazaki, N., S. Zank, M.C. Pinto, L. Kumagai, L.A. Cavechia, N. Peroni. 2012. Etnobotânica nos Areais da Ribanceira de Imbituba: compreendendo a biodiversidade vegetal manejada para subsidiar a criação de uma reserva de desenvolvimento sustentável. *Biodiversidade Brasileira* 2(2):50-64.

Kumagai, L.S. & N. Hanazaki. 2013. Contributions of ethnobotany and ethnoecology of *Butia catarinensis* Noblick & Lorenzi for the conservation of an endangered area in southern Brazil. *Acta Botanica Brasilica* 27(1):13-20.

Lira, P.K., L.R. Tambosi, R.M. Ewers & J.P. Metzger. 2012. Land-use and land-cover change in Atlantic Forest Landscapes. *Forest Ecology and Management* 278:80-89.

Lorenzi H., L.R. Noblick, F. Kahn & E. Ferreira. 2010. *Flora Brasileira Lorenzi: Arecaceae (Palmeiras).* Instituto Plantarum, Nova Odessa, Brazil.

Macía, M.J. 2004. Multiplicity in palm uses by the Huaorani of Amazonian Ecuador. *Botanical Journal of the Linnean Society* 144(2):149-159.

Macía, M.J., P.J. Armesilla, R. Cámara-Leret, N. Paniagua-Zambrana, S. Villalba, H. Balslev & M. Pardo-de Santayana. 2011. Palm uses in Northwestern South America: a quantitative review. *Botanical Review* 77(4):462-570.

Marques, M.C.M., M.D. Swaine, & D. Liebsch. 2011. Diversity distribution and floristic differentiation of the coastal lowland vegetation: implications for the conservation of the Brazilian Atlantic Forest. *Biodiversity and Conservation* 20(1):153-168.

Miranda, T.M. & N. Hanazaki. 2008. Conhecimento e uso de recursos vegetais de restinga por comunidades das ilhas do Cardoso (SP) e de Santa Catarina (SC). *Acta Botanica Brasilica* 22(1):203-215.

Nelson, E., H. Sander, P. Hawthorne, M. Conte, D. Ennaanay, S. Wolny, S. Manson, & S. Polasky. 2010. Projecting global land-use change and its effect on ecosystem service provision and biodiversity with simple models. *PLoS ONE* 5(12):e14327.

Oliveira, F.C. & N. Hanazaki. 2011. Ethnobotany and ecological perspectives on the management and use of plant species for a traditional fishing trap, southern coast of São Paulo, Brazil. *Journal of Environmental Management* 92(7):1783-1792.

Pandolfo, C., H.J. Braga, V.P. Silva Jr., A.M. Massignam, E.S. Pereira, V.M.R. Thomé & F.V. Valci. 2002. *Atlas climatológico do Estado de Santa Catarina*. CIRAM/EPAGRI, Florianópolis, Brazil.

Reitz, P.R. 1974. *Flora Ilustrada Catarinense, Palmeiras.* Herbário Barbosa Rodrigues, Itajaí, Brazil.

Rosa, L., T.T. Castellani & A. Reis. 1998. Biologia reprodutiva de *Butia capitata* (Martius) Beccari var. *odorata* (Palmae) na restinga do município de Laguna, SC. *Revista Brasileira de Botânica* 21(3):281-287.

Saint-Hilaire, A. 1978. *Viagem de Curitiba a Santa Catarina*. Itatiaia EDUSP, São Paulo, Brazil.

Sampaio, L.K.A., N. Peroni, & N. Hanazaki. 2012. Influência da despolpa do fruto e do choque térmico na germinação de *Butia catarinensis* Noblick & Lorenzi. *Revista Brasileira de Biociências* 10(1):127-130.

Sganzerla, M., J.K. Ruts, G.B. Voss, R.C. Zambiazi & J.F. Chim. 2009. *Extração de Óleo das Amêndoas de Frutos de Butiá (Butia capitata e Butia eriosphata) por Três Diferentes Métodos*. XVIII Congresso de Iniciação Científica, XI Encontro de Pós-Graduação, I Mostra Cientifica da Universidade Federal de Pelotas, Pelotas, Brazil.

Silva, I.M. & A.L. Peixoto. 2009. Abajurú (*Chrysobalanus icaco* L. and *Eugenia rotundifolia* Casar.) commercialized in Rio de Janeiro, Brazil. *Brazilian Journal of Pharmacognosy* 19(1B):325-332.

Ticktin, T. 2004. The ecological implications of harvesting non-timber forest products. *Journal of Applied Ecology* 41:11-21.

Zank, S. & N. Hanazaki. 2012. Exploring the links between ethnobotany, local therapeutic practices, and protected areas in Santa Catarina Coastline, Brazil. *Evidence-Based Complementary and Alternative Medicine* 2012:1-15.

Appendix A. Questions asked during the semi-structured interviews with harvesters of *Butia catarinensis* Noblick & Lorenzi, in Santa Catarina State, Brazil. Interviews consisted of open questions regarding the local knowledge on harvesting, uses and commercialization of *B. catarinensis*.

1. Where does the name butia come from?
2. Is butia the palm or the fruit?
3. For what is it used?
4. Are there different types of butia?
5. What is the most useful part of the butia?
6. In what months of the year does butia flower?
7. In what months of the year does butia bear fruit?
8. How long does it take to flower again?
9. How many bunches are produced per year for each plant?
10. How many bunches ripen at a time for each plant?
11. What animals/bugs/insects/birds visit the flowers?
12. What animals/bugs/insects/birds eat the fruit still on the bunch?
13. What animals/bugs/insects/birds eat the fruit on the ground?
14. What animals/bugs/insects/birds eat the nut?
15. What do you think happens to the fruit after they eat?
16. Have you ever seen a butia sapling?
17. Is there any plant that always grows near the butia?
18. What is the soil like where butia grows?
19. Is there a difference in the type of fruit depending on where the butia is harvested?
20. Where is the butia more abundant?
21. Were there formerly more butia than today? How much and where?
22. Do you know people who collect butia to sell?
23. What is the amount used for mattresses? (asked only when it applies)
24. What is the amount used for hats? (asked only when it applies)
25. Have you ever used the butia palm? (asked only when it applies)
26. How long ago did you stop using butia? (asked only when it applies)
27. Why do you not use it anymore? (asked only when it applies)

Appendix B. Questions asked of harvesters, middlemen and buyers regarding the production chain of *Butia catarinensis* Noblick & Lorenzi, in Santa Catarina State, Brazil. These questions were asked as part of semi-structured interviews on management practices, amounts of fruit collected, buyers and sellers, fruit productivity, pulp productivity, and ice cream productivity.

1. How do you harvest butia fruit?
2. Do you harvest only mature/ripe bunches?
3. How many bunches do you collect per plant?
4. How much time/distance does it take to reach the harvesting area?
5. How much time do you spend collecting fruit? * Estimate cost/benefit of this activity
6. How many kilograms do you collect per day?
7. To whom do you sell the butia?
8. Do you take care of the butia plant?
9. How much do you harvest per week?
10. Where do you keep/store the fruit?
11. For how long?
12. Do you sell it in bunches?
13. How do you sell the bunch?
14. Do you sell only the fruit?
15. How do you sell the bag/Kilo?
16. To where/whom do you sell?

Questions for Middlemen

1. Who buys the fruit?
2. How are the fruit bought?
3. To whom do you sell the fruit pulp?
4. Do you store the fruit/pulp in some way?
5. For how long?
6. Do you sell the fruit in bunches?
7. How do you sell these bunches?
8. Do you only sell fruit?
9. How do you sell the bag/Kilo?

Questions for Ice Cream Factories

1. Is the ice cream available seasonally or year-round?
2. How much butia is required for a kilogram of pulp?
3. From whom do you buy the butia?
4. How do buy the butia?
5. How do you sell the ice cream?
6. What is the amount of ice cream/popsicles produced per month?
7. What is the amount of ice cream/popsicles sold per month?
8. Where do you sell the processed product (ice cream)?