CONSERVATION OF GENETIC RESOURCES: A STUDY WITH MEDICINAL PLANTS ON THE COAST OF PARANÁ - BRAZIL

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Introduction

The Atlantic Rainforest is a complex ecosystem of great importance, as it shelters a significant portion of the biological diversity of Brazil and the world. High levels of wealth and endemism associated with destruction in the past have made the Atlantic Forest one of the 34 biodiversity *hotspots* in the world (Mittermeier *et al.*, 2004). According to Myers *et al.* (2000), the forest is considered one of the largest centers of biodiversity on the planet with high levels of endemism. It is included among the eight priority areas of the world in terms of conservation strategy.

A considerable part of this biome is located in the coast of the state of Paraná. Extensive areas of native vegetation are protected by state and privately-owned parks and reserves. There are seven cities in the coast of Paraná: Antonina (968,97 km^2), Guaraqueçaba (2,159.33 km^2), Guaratuba (1,326.88 km^2), Matinhos (111.56 km^2), Morretes (686.59 km^2), Paranaguá (665.83 km^2) and Pontal do Paraná (216.29 km^2). The total area, which corresponds to 3% of the state's territory, borders Vila de Ararapira (São Paulo) in the north, Sahi-Guaçu River (Santa Catarina) in the south, the Atlantic Ocean in the east, and "Serra do Mar" (Portuguese for "Sea Ridge") in the west. Currently, 82% of the region's area is dedicated to conservation, since it has the largest continuous area of preserved Atlantic rainforest (PIERRI et al., 2006, p. 150) (**Figure 1**). There are five Sustainable Use Conservation Units in the region (one that is federal and four which are

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state-run), as well as 14 Protection Conservation Units (five federal ones, eight that are state-owned, and one which is run by the city council). In addition, the region has thirteen Private Natural Reserves (GÓES, 2014). The vast extension of preserved nature in the coast of Paraná, which has great environmental value in the current political context of concern for the protection of nature and biodiversity, has made it possible for most of its territory to be located in conservation areas (PIERRI et al., 2006).

Figure 1. Coast of Paraná – Source: ICMBio (2017).

Due to the natural diversity of the region, there is a growing body of research focusing on the relationship between the genetic resources available in the forest, its local cultural diversity, and the sustainable use of natural resources (MACHADO, 2017; MUNIZ, 2017; SILVA, QUADROS, MARIA NETO, 2015). Within this perspective, we understand genetic resources as the variability of plants that are part of biodiversity. These resources have attracted socioeconomic interest, and have the potential of being used in genetic improvement programs, in biotechnology, and in related areas (VALOIS, 1996).

Traditional knowledge, which comes from local (caiçara) populations in the region, has the role of contributing to research that enables the emergence of new medicines or other herbal chemicals. However, it is necessary to formulate other strategies for conservation, domestication and for research with native species, in order to guarantee that sustainable agricultural management replaces the pressure caused by extractivism. This type of action aims to subsidize local producers, to enable the development of work and income that comes from agroforestry products, through sustainable territorial development (NUNES et al., 2012).

Therefore, the objective of the present study was to present the genetic resources available in the forest, as well as the local cultural diversity and the sustainable use of natural resources in the coast of Paraná, with the aim of adding value to traditional forms of knowledge the local community has about medicinal plants which is important for the discovery of new chemical compounds. Another objective was to reflect upon the possibilities of income generation for small farmers. Our approach is based on the theoretical framework of collective management of natural resources and common goods, in an attempt to reflect upon the ways in which social, economic, political and cultural relations model and affect environmental change.

Use and conservation of biodiversity by traditional communities

The practices, habits, knowledge and values of traditional communities are imbricated in the relationships they have with one another and with the biodiversity of the ecosystems of which they are part. They are also related to the biodiversity that they manage for their subsistence. Diegues (2004) has discussed the ways in which traditional populations manage and even tame biodiversity, at the same time as they attribute a symbolic value and a usage value to all living beings. "Traditional populations not only live with biodiversity, but they also name and classify living species based on their own categories and names" (DIEGUES, 2004, p. 33).

These communities generally make use of land, water and forests in a simple way, without individual ownership over resources. This is also how they constitute their traditional territories. Haesbaert (2004) affirms that the concept of territory is not restricted to the material dimension (land), but demands an integrative conception which also involves political (power relations), economical (usage), cultural (symbolic) and natural (land, water, vegetation) aspects. A territory is a space defined and delimited as a result of power

relations between the subjects (SOUZA, 2001); that is, it is these subjects who produce the territory, based on the space which they have to start with (RAFFESTIN, 1993).

Medicinal plants as a genetic resource of the local populations

Medicinal plants from the Atlantic rainforest constitute a different case altogether, in terms of this coastal forest. This happens not because of the disappearance of its species, which is still a cause of concern, but because of its promising potential. A recent study at Universidade Estadual de Campinas (Unicamp) revealed the power of its biochemistry for the production of new medicines. With 710 species utilized to make 1,200 different types of medicine, which are used in the treatment of 147 diseases, the city of Registro/SP, in Ribeira Valley, was chosen for the field research. The region has two important characteristics: it is the largest remaining continuous area of the forest; and a large part of the herbal drugs that are produced through extractivism and are later traded are made with plants from this territory (BANDINI; CZEPAK, 2008).

It is believed that this type of exploration may foster the creation of sustainability proposals for the use of resources from the Atlantic rainforest; it may also create alternatives and give support for a number of communities in the regions covered by the forest. There is, however, a risk that such potential may be misused, which would threaten the ecological niche, cause genetic erosion, and bring the possibility of endangerment to some species, such as *Cephaelis ipecacuanha*, which has pharmacological importance and is now almost extinct (FERRO *et al*., 2006).

Collective management of natural resources through collective action and common goods

The theory of collective action has proved that it is possible for individuals to act collectively, on a shared and sustainable basis, through collective agreement, in order to manage natural resources. The theory has also shown the importance of communication, reciprocity and trust in the initiation and maintenance of collective or cooperative actions.

Ostrom (1990) opposed what" ecologist Garret Hardin in his 1968 essay entitled "The tragedy of the commons" had defended. In this essay, Hardin affirmed that common property regimes of groups and/or individual users would tend to the superexploration of resources, resulting in the destruction of nature. This would happen because the parties involved would try to maximize short-term profit. Two solutions would be suggested for this dilemma: impositions by private individual rights and/or by regulating governmental agencies. Ostrom and fellow researchers showed that what Hardin called common use was in fact free access and non-restrictive demand; that is, Hardin was confusing the forms of appropriating the environment. The main problem was the absence of ways to use the resources, and not their common existence. As stated by Elinor Ostrom and Margaret Mckean:

> "Common property" or "common property regime" refers to the agreements upon property rights through which groups share rights

> and responsibilities over resources. The term "property" is related to social institutions, not to natural or physical qualities that are inherent to the resources themselves (OSTROM; McKEAN, 2001, p. 80).

The "common property regime" (simply known as "common property" or "joint ownership") refers to the common access to resources that are collectively regulated by a group. Such access takes place through management rules regarding the inclusion and exclusion of users, in forests, fishing areas, and watersheds in various regions on the planet (OSTROM; TUCKER, 2009).

In making this differentiation, Elinor Ostrom established two fundamental contradictions: first, she denied, theoretically and empirically, that the problems associated with lack of sustainability simply derive from forms of use that are common in nature, and which are practiced by traditional populations (such as fishermen, peasants or those who practice plant extractivism); second, she revealed that the common property regimes are not relics from the past, but have had an important role in the current sustainable use of natural resources. Therefore, the research based on Ostrom's analyses has demonstrated that human groups do not use natural resources in an unbalanced way, as Hardin had supposed.

Research design

Collecting etnophatmacological data

The first stage of the research consisted in semi-structured interviews with residents from a traditional community in the coast of Paraná. In this stage, the participants listed all of the plants that they know in the region, including medicinal plants, edible plants, ornamental plants, timber, amongst others. "Snowball" sampling was used (ALBUQUERQUE *et al.*, 2010). This sampling method consists of participants themselves suggesting other people that they feel have great knowledge about plants in the region, until no other suggestions of new participants are made. A total of 25 subjects were interviewed. We identified residents with the most detailed accounts (both quantitatively and qualitatively) as key-participants in the research. We then asked these participants to fill in a checklist that identified the plants that are used and managed by the community. In this case, visual methods were used in order to obtain information about the usage of and knowledge about plants in the region (MEDEIROS *et al.*, 2008).

The collected material was pressed on site and labeled with information about each plant and where it was collected. Then, the material was placed in a greenhouse at 60ºC, and was later assembled and labeled, following usual herborization techniques. All of the collected material was incorporated into the Herbarium of the Federal University of Paraná (UFPR) or into the Botanical Museum of Curitiba (MBM). The identification of collected species was done based on specialized bibliography, reviews and available taxonomic studies, through identification keys as well as generic and specific descriptions. Identification was confirmed through morphological comparisons with previously

identified specimen, and through consultation with specialists in the research group (LAWRENCE, 1951; IBGE, 1992).

The research project was registered in the competent environmental agencies, so that collection and transportation of the samples for herborization could be done. It was also registered in the Genetic Heritage Management Council (CGEN, in Portuguese) of the National Ministry of Environment. Finally, the study was approved by the Ethics Research Committee of the Federal University of Paraná (Approval Number 771,360), and by the System of Authorization and Information on Biodiversity (Approval number 49770-2).

Extraction of essential oils

The collected material was transported to the laboratory in the Coastal Campus of the Federal University of Paraná (in Matinhos, PR). Oil extraction was done through hydrodistillation for 2 hours and 30 minutes, using a Clevenger-type apparatus. There were three repetitions with 100g of fresh material in 1L distilled water (WASICKY, 1963). In order to determine the moisture content of the plant material at the moment of extraction, three 20g samples were collected and dried in a FANEM 320 electric dryer, at 65 ºC up to the constant mass. The species that were collected with the aim of extracting essential oils were *Hedyosmum brasiliensis, Eugenia brasiliensis, Pimenta pseudocaryophyllus* (Gomes) L. R. Landrum, *Piper rivinoides*, *Piper arboretum, Piper dyospirifolium*, *Piper mosenii, Piper cernuum*, *Piper aduncum and Piper gaudichaudianum*.

Characterization of the chemical composition of essential oils

The chemical constituents of the essential oil were determined by gas chromatography/mass spectrometry (GC /MS). Identification of the chemical constituents was performed by comparing the mass spectra obtained for each compound with the Nist 98 library (Varian Inc.). A homologous series of *n*-alkanes of 6 to 20 carbons was injected under the same analytical conditions, in order to calculate the linear retention index of each constituent. The mass spectrum and the linear retention index were compared to those reported in the literature for safe identification (ADAMS, 2007).

Results and discussion

Our research identified the presence of over 70 medicinal, aromatic and food species cultivated and native to the Atlantic Forest. We highlight the presence of *Hedyosmum brasiliensis* (*Chloranthaceae* family), which the population uses for headaches. Preparation consists of "cleaning the leaf, putting alcohol on it, heating it up, and placing it over the forehead and back of the neck." When we looked for data on this species in the literature, we found that it contains essential oils with analgesic properties (GUEDES, 1997). Its essential oils have the following main constituents: □-terpineol (10.2%), curzerene

(8.9%), pinocarvone (8.4%) and □-thujene (7.1%) (KIRCHNER *et al.* 2010). Leaves from this species were collected from the Paraty-Guaratuba/PR community, in Paraná, for extraction. The essential oil from fresh leaves presented a yield of 0.6%.

The community also cited *Crinum americanum* (Amaryllidaceae family) .This species is considered useful in the treatment of cancer. In the literature, we found studies demonstrating the presence of alkaloids in the species (SILVA *et al.*, 2013). This class of substances is associated with cytotoxic and neoplastic effects. Samples of this species were collected for botanical identification and for preparation of plant extracts from the roots, rhizomes and leaves. The extracts were concentrated and they will be analyzed through liquid chromatography, in order to identify the alkaloids, present in the samples.

The accounts provided by residents of the Paraty community indicate that they use the leaves of a small palm tree called Guaricana (*Geonoma schottiana*, *Arecaceae* family) for the construction of roofs. This species is also used for the manufacturing of floral arrangements and mortuary crowns. However, the species is currently endangered, due to predatory extractivism in all of the sea ridge area in the state. When the local (caiçara) communities for building roofs used it, this was not a problem. However, from the moment in which extraction for commercial purposes started (including the construction of roofs for kiosks, which are largely used in flower shops), the situation worsened. In view of the cultural and environmental importance of the species, a national park (called Parque Nacional da Guaricana in Serra do Mar Paranense) was created. It has 49,286.87 hectares, and is located between the cities of Guaratuba, Morretes and São José dos Pinhais.

In total, 62 different species were mentioned 260 times, with very diverse uses (see **table 1**). There was a predominance of female (65%) over male (35%) participants, which was similar to previous studies. In most of the research about plants, there is a prevalence of women as main informants. This can be explained by the fact that in many societies women have had the responsibility for household chores and care (VASCONCELOS, 2001).

Table 1. Species cited by the communities on the coast of Paraná.

Popular name	Family	Scientific name	Frequency	Participant number	Uses cited by the interviewed participants
AVOCADO	Lauraceae	*Persea americana* Mill.	1	2	Fruit used as food. The dried seed, when grated, is used to make a tea with boiling water, which can be chilled and taken once a day.
PINEAPPLE	Bromeliaceae	*Ananas comosus* (L.) Merrill	1	1	Consumed as juice; the skin is boiled, also used through infusion without sugar; digestive action. Drink while warm.
SPANISH CHERRY	Sapotaceae	*Mimusops elengi* Linn.	1	16	The fruit *itself* and the milk released by the fruit, when not very ripe, can be used for skin healing, both for bruising and for mosquito bites.
BASIL	Lamiaceae	*Ocimum basilicum* Linn.	7	6; 13; 14; 17; 19; 21; 24	It can be used as a seasoning for fish, and as a natural repellent. The infusion of the leaves serves for fever, pain in the liver and sore throat.

APOAIA	N. I.	N. I.	6	1; 4; 5; 6; 8; 11	Fever.
ARAÇA-TINGA	Myrtaceae	*Myrcianthes gigantea* Legr.	3	5; 6; 10	Used with an alcoholic drink (*cachaça*)
ARITICUM DO MATO	Annonaceae	*Rolinia sylvatica* Mart.	1	3	Fruit *Edible.*
RUE	Rutaceae	*Ruta graveolens* Linn.	3	2; 4; 8	Infusion of leaves to combat lice; repellent; can wash infectious wounds. Abortive.
WORMWOOD	Asteraceae	*Artemisia vulgaris* Linn.	1	1	Ornamental plant used around houses. Infusion of the leaves can be used to repel moths, and serves as seasoning for birds.
ALOE	Asphodelaceae	*Aloe arborensis* Mill.	10	1; 2; 12; 15; 16; 17; 19; 21; 23; 24	Its nectar or *gelatinous pulp* serves for wounds and burns. Healing effect, its nectar can still be used as dandruff shampoo and hair straightener.

BACUPARI	Clusiaceae	*Gracinia gardneriana* (Planch. &Triana)	4	3; 5; 8; 22	Used with an alcoholic drink (*cachaça*)
INDIAN COLEUS	Lamiaceae	*Plectranthus barbatus* Andr.	11	1; 4; 6; 8; 13;14; 17; 19; 21; 23;24	Teas are made with infusion of leaves for digestive problems. Note: Taking too much can be toxic.
BUCUVA	N. I.	N. I.	3	11; 18; 20	Seeds can be used to make fire by hitting them against one another.
CAMBUCÁ	Myrtaceae	*Pliniaedulis* (Vell.) Sobral	2	11; 20	Food; also used with an alcoholic drink (*cachaça*)
LEMON GRASS	Cyperaceae		2	12; 24	Root infusion can be used for infections of the uterus, myoma and urinary tract infections.
YAM	Dioscoreaceae	Dioscorea sp.	10	1; 2; 4; 5; 6; 8; 10; 11; 13; 14	Food; roasted or stewed to make bread; when cut into slices, it can be used to bring down the fever from wounds.
CARÁ ESPINHO	Dioscoreaceae	*Dioscorea altissima* Lam.	4	1; 4; 6; 8	Food; it is collected from the bush in hills in the early summer.

STRING LILLY	Armarylidaceae	*Crinum americanum* Linn.	7	1; 4; 5; 6; 8; 10; 11	When boiled, it serves for stomach cancer (rich in alkaloids); the boil of the seed can be used for skin cancer and for hemorrhoids. Note: extremely bitter drink, difficult to drink.
CHAPÉU DE COURO	Alismataceae	*Echinodorus macrophyllus* (Kunth) Micheli	5	1; 2; 4; 8; 13	Infused leaves are used for rheumatism and joint infection.
CIDREIRA DO MATO	Chloranthaceae	*Hedyosmum brasiliensis* Miq.	9	1; 2; 4; 5; 6; 8; 10; 11; 13; 14	Leaves are used for fever, sunstroke and sinus infections (*analgesic effect*).
SHIMBILLO	Fabaceae	Inga sp.	7	4; 5; 6; 8; 10; 11; 14	Used as fruit.

ERMESTICA	N. I.	N. I.	3	11; 18; 20	The tree nectar is used to make fire and used as a candle; also used with an alcoholic drink (cachaça).
ERVA DE LAGARTO	Salicaceae	*Casearia sylvestris* Sw.	3	1; 2; 4	The infusion of the whole plant is used as a drink to help in rheumatism and for bathing.
WORMSEED	Amaranthaceae	*Dysphania ambrosioides* Linn.	1	1	Infusion of leaves is used for infections (for example, for women to take private baths in case of external infections).
ESTOPA	N. I.	N. I.	3	5; 11; 20	Used as wood to build and make handicrafts; it is a soft wood, easy to shape.
FIGATIL	Asteraceae	*Vernonia condensata* Baker.	1	1	Infusion of the leaves is used for digestion.
FIGUEIRA GOIABA	Moraceae	*Ficus gomelleira* Kunth.	4	5; 11; 18; 20	Wood that can be used in construction, and as firewood.
GARUVA	Lauraceae	*Cinnamomum glaziovii* (Mez.) Kosterm	4	5; 11; 18; 20	Hardwood formerly used to make canoes.
GELOUZINHO	Polygalaceae	*Caamembeca lauréola* (A. St.-Hil. &Moq.)	1	1, 4, 5, 6	The roots are used on bruises. It should be macerated; alternatively, a syrup with honey can be made and reduced in the fire.
GINGER	Zingiberaceae	*Zingiber officinale* Rosc.	8	1; 2; 12; 15; 16; 19; 23; 24	Used as seasoning; tea can be made from its root as an aid in sore throats. It has strong antibacterial effects; can be used to make juice.
GUACO	Asteraceae	*Mikania glomerata* Spreng.	10	1; 2; 12; 15; 16; 17; 19; 21; 23; 24	Infusion of the leaves is used for the flu and coughs.
GUANANDI	Calophyllaceae	Calophyllum brasiliense Cambess.	4	5; 11; 18; 20	Hardwood, used for construction.
BRAZILIAN FERN TREE	Fabaceae	*Schizolobium parahyba* (Vell.) Blake.	4	5; 11; 18; 20	It was used to make canoes.
GUAVA	Myrthaceae	*Psidium guajava* Linn.	4	5; 11; 18; 20	Construction; wood is easy to mold and is long lasting.
GUINEA HENWEED	Phytolaccaceae	*Petiveria tetrandra* Gom.	6	1; 4; 5; 6; 11; 12	It works as an insect repellent.
MINT	Lamiaceae	*Mentha spicata* Linn.	6	1; 7; 9; 12; 19; 23	Its leaves are soothing; it helps one sleep, and can be digestive; it can also be used as vermifuge.
IMBICURU	N. I.	N. I.	4	5; 11; 18; 20	Construction.
BRAZILIAN GRAPETREE	Myrtaceae	*Plinia cauliflora* Mart.	4	2; 4; 8; 14	One can make jam and tea from the fruit peel to combat diarrhea; also used with an alcoholic drink (*cachaça*).
JABUTITANA	Iridaceae	Eleutherine sp.	1	19	The bulb is boiled for treatment of diarrhea, and the leaves are infused with mint for treatment of fever. Yellow flower.

MAÇARANDUVA	Sapotaceae	*Manilkara huberi* Ducke	6	1; 4; 5; 6; 8; 11	Used with an alcoholic drink (*cachaça*).
MENTRUZ DO MATO	Brassicaceae	*Coronopus didymus* Linn.	1	3	It can be used (raw) in salads and in the treatment of stomach pains. Infusion in alcohol to rub on twisted areas and on the joints.
MILOME	Aristolochiaceae	*Aristolochia triangularis* Cham.	3	11; 15; 18	It is bottled, mixed with other herbs and mixed with cachaça. Used in the treatment of inflammations and rheumatic pains.
PALHADE COBRIR (COVERING STRAW)	Arecaceae	*Geonoma schottiana* Mart.	4	4; 6; 8; 10	Type of straw; it is braided to make mats used in covering houses (roofs); also used to make handicrafts and ornaments.
PAU DE ÓLEO	Fabaceae	*Copaifera trapezifolia* Hayne.	6	1; 4; 5; 6; 8; 11	It was formerly used as fuel for lamps; it can also be rubbed on twisted areas.
PAU VIGARIO	Fabaceae	N. I.	4	5; 11; 18; 20	Used as hardwood for construction; it can also be used to make canoes.
PENICILLIN	Amaranthaceae	*Alternanthera brasiliana* (L.) Kuntze.	7	1; 2; 6; 8; 10; 13; 23	One can make tea by infusing the leaves (for treating infections), or macerate the leaves and use them as plaster for bruised areas.
BLACK-JACK	Asteraceae	*Bidens hairy* Linn.	6	1; 4; 6; 10; 13; 22	Infusion of the seed or flower can be used to bathe the child when s/he has hookworm infection.
POAIA	Rubiaceae	N. I.	1	1	Used for treatment of fever.
YARROW	Asteraceae	*Achillea millefolium* Linn.	6	1; 4; 6; 7 9; 13	Infusion with leaves is used for chest pains, soothing and high blood pressure.
GALE OF THE WIND	Euphorbiaceae	*Phyllanthus niruri* Linn.	5	1; 2; 4; 8; 13	Infusion with leaves and roots is used as a drink, for the treatment of kidney stones.
SABUGUEIRO	Adoxaceae	Sambucus australis.	6	1; 4; 6; 19; 23; 24	Infusion of its leaves is used for skin problems and irritation (erysipelas).
BUSHY MAT-GRASS	Verbenaceae	*Lippia alba* Mill.	6	6; 7; 8; 9; 19; 24	Repellent for insects.
CUMBUNGI	Typhaceae	*Typha domingensis* Pers.	2	1; 25	Used to make crafts, and to weave mats and baskets.
ARROWLEAF ELEPHANT EAR	Araceae	*Xanthosoma sagittifolium* (L.) Schott.	11	1; 2; 4; 5; 6; 8; 10; 11; 13; 14; 25	Food; its new leaves can be braised and used in a number of dishes; its stem can be heated up, cut into slices and consumed as a hot salad (similar to asparagus).
TANCHANGEM	Plantaginaceae	*Plantago australis* Lam.	8	1; 2; 3; 5; 8; 11; 13; 25	Its leaves can be used as raw salad; infusion of seeds and leaves may be used for stomachache, for making gauzes and for cancer treatment.
TUCUM	Arecaceae	*Bactris setosa* Mart.	7	1; 2; 5; 6; 8; 11; 14	It can be eaten as a *fruit*; one can eat the part that envelops the seed, which can also be broken and consumed. The toasted seed is used to make a coffee-like drink.
BANANA UMBIGO	Musaceae	Musa spp.	4	1; 2; 4; 8	One can eat the banana *itself*, or boil the part from which it is removed; one can also remove four leaves and dice the white part to use in salads.

ACHIOTE	Bixaceae	*Bixa orellana* Linn	6	1; 4; 5; 6; 14; 25	It can be used for culinary purposes; one can macerate its seeds and use it as a spice; indigenous peoples used its dye, not only for ornamental purposes, but also as insect repellent.

It was possible to conclude the following: 2% of the used parts are flowers; 4% are the nectar and tubercle; 5% are seeds; 6% corresponds to the stem; 11% are fruits; 13% are roots (roots and tubercle are sometimes understood as being the same part, but we tried to be faithful to the information we gathered); and 2% corresponds to the whole plant. We also observed that making teas is one of the main forms of preparation of the plants for medicinal purposes; in this case, the leaves are the most widely used part (41%).

As part of our investigation, we analyzed the chemical components as well as the yield of the oil found in the dried leaves of three species of Myrtaceae: *Eugenia pyriformis*, *Eugenia brasiliensis and Pimenta pseudocaryophyllus* (Gomes) L. R. Landrum. *Pimenta pseudocaryophyllus* (Gomes) L. R. Landrum was collected in March 2016, in Barra da Ararapira (Guaraqueçaba/PR region).

According to the literature, these species have pharmacological potential, especially in terms of anti-hypertensive, anti-inflammatory, antioxidant, antimicrobial and analgesic effects. Research results on the *Myrtaceae* genus show the presence of Eugenol, Metileugenol, Trans-methyl-isoeugenol, Germacrene, Trien-8-one. The *Pimenta pseudocaryophyllus* species is used in Minas Gerais and São Paulo as a calming tea, as well as a tea for treatment of the flu. Some studies have demonstrated its effectiveness against bacteria such as *M. roseus, Bacillus cereus e Micrococcus luteu*. One of the results we obtained for the analysis of essential oil content was the following: *Eugenia pyriformis* (0.20%); *Eugenia brasiliensis* (0.27%); and *Pimenta pseudocaryophyllus* (1.99%). We can thus state that *Pimenta pseudocaryophyllus* (Gomes) L. R. Landrum has a high content of essential oils. Therefore, it also has strong potential for large-scale extraction research, and for pharmacological usage, due to the aforementioned properties.

We also carried out research with the *Piperaceae* genus. At this stage, we evaluated the content, chemical composition and seasonality of essential oils taken from dry leaves of the following species: *Piper rivinoides*, *Piper arboreum* and *Piper dyospirifolium*, *Piper mosenii, Piper cernum*, *Piper aduncum*, *Piper gaudichaudianum*, which are native from the Atlantic Forest in the state of Paraná. Sample collection took place in a protection unit at Bom Jesus Biological Reserve, in the city of Guaraqueçaba. There were significant differences between the essential oil content from the aforementioned native species of the *Piper* genus (Piperaceae), due to their seasonalities. The content for the *Piper cernum* species was 1.93% and 1.05%, for the winter and spring, respectively, while the content for the *Piper arboretum* species was only high in the summer (1.23%). The other species presented a low yield of essential oil. *Piper gaudichaudianum* presented the lowest yield, with a considerable variation among seasons (e.g., 0.13% in the spring). This result was similar to that obtained for *Piper arboreum* in the fall. *Piper aduncum* did not present considerable variation in terms of oil content; its highest value was 0.35% in the winter. The values for

Piper rivinoides were 0.93% and 0.99% for the winter and summer, respectively. For *Piper dyospirifolium*, they were 0.61% (spring) and 0.52% (summer). *Piper mosenii* presented low variation in oil content in the winter (0.49%), spring (0.45%) and fall (0.42%); in the summer, its yield was 0.60%. Seasonality is a factor that influences variation in terms of oil content. *Piper cernum* e *Piper arboretum* are two species that showed potential for future research.

In order to discuss strategies for the conservation of genetic resources in a context of sustainable territorial development, it is necessary to understand the processes of social reproduction of native peoples in consonance with their livelihoods. This should be done especially when it comes to comprehending the various dimensions they have in relation to their biodiversity. It is also important to guarantee the rights of these communities, including their traditional practices and *territoriality*.

Hence, to preserve a certain region, it is important to design projects that are specifically suited to that area, with equity and sustainability at all levels (social, cultural, ecological, environmental, territorial, and economic), through national and international policies.

Practices such as shifting agriculture and plant and animal extraction, as currently employed by traditional populations, are traditional management systems. They have forms of knowledge and techniques that have significantly contributed to the maintenance of biological diversity. Diegues and Arruda (2001) argue that biodiversity is not simply a natural product, but is in many cases the result of actions by human societies and cultures, especially those by traditional, non-industrial societies. For the authors, traditional knowledge and cultures may contribute to the maintenance of biodiversity in ecosystems, since such knowledge is often the result of the evolution of societies and their natural habitats.

In this study, we present some contributions to this debate, which may bring new actions. The first one is related to the need to generate opportunities for dialogue between Conservation Unit managers and users of biodiversity, since they are co-responsible for the common use of natural resources.

Based on a "common property regime," we observe that individuals and groups build strategies for using natural resources in accordance with their interactions with the environment and with their forms of usage through history. This means that these collective goods are part of a community's way of life. They are an expression of the realities of the community, of their culture and social reproduction.

For Ostrom, the interactions of these communities with the ecosystem contradict the "tragedy of the commons." This happens because these groups may benefit economically from nature when they are organized with a common objective, in which collective interests permeate individual interests. In practice, this proves that users tend to organize when they are engaged in face-to-face negotiation and have autonomy to change rules. This organization of individuals depends on the attributes of the resource system, on the users themselves, who inspire confidence in one another, on the benefits that will be achieved, and on the costs that are necessary to achieve them (*OSTROM et al.*, 2011).

"Trust" is one of the variables that are central to Ostrom's approach, which considers that individuals would not act if motivated solely by their short-term interests, but may agree to cooperate when there is reciprocity. This is the case, for instance, of a fisherman who may accept to come back to his village with fewer fish in his boat, as long as he has institutional guarantees or trusts the other residents not to consume all the fish in the lake. Shared norms, common knowledge, and rules established among those who make use of natural resources through time would therefore serve as forms of social capital. With such capital, groups may determine institutional arrangements to solve problems related to the use of common resources. In other words, formal and informal rules are important aspects for collective action, since they are the prescribed norms that specify which actions or results are required, prohibited or permitted, and which forms of punishment are authorized in case the rules are not followed (OSTROM *et al.*, 1994). Ostrom explains that many communities without advanced technical knowledge have developed intuitively through time, with processes of participatory, cooperative and democratic governance. They have established agreements, rules and associations that enable the efficient and sustainable use of common good resources (SIMÕES *et al.*, 2011).

Management of species and ecosystems by traditional communities show many possibilities for the development of these very same communities. Paul Little addresses the issue of ethnodevelopment as a combination of the debate on development and the recognition of cultural diversity, in face of the Market and the ways the State treats local communities. "Ethnodevelopment brings an ethnic perspective to the debates over self-determination of peoples, and in this process questions, at least partially, the excluding notions of national sovereignty" (LITTLE, 2002, p. 40).

We believe that in the current model in which we live, a great part of solutions will stem from small-scale approaches – individual agents and local initiatives that will be tested and proved. However, the system as a whole will also need mechanisms to disseminate and replicate these small successes. Furthermore, the institutional context and the processes that take place on a macro scale may create (or not) an adequate context for such exploration and local replication. Therefore, we need to search for solutions at all levels.

Conclusions

The recovery of traditional knowledge brings very important elements that contribute to scientific, cultural and technological development in the field of health and natural sciences. It brings possibilities for developing products that may benefit the Brazilian population, with respect for the rights of traditional populations, as established in biodiversity laws.

On the other hand, practices related to the popular use of medicinal plants are what many communities have as an alternative to the treatment of diseases and to their health as a whole. However, the continuity of these practices may be threatened by the interference of factors that are external to the social dynamics of these groups, such as economic and cultural pressures.

In regards to the species identified as genetic resources in the present study, a few reflections are in order. Studies are necessary to verify the possibility that traditional populations have to manage Guaricana, since part of the community is located inside the Santi-Hilaire/Langue National Park, and another part is located inside the Permanent Protection Area of Guaratuba. Studies may be conducted to verify the number of individuals and populations in the area, as well as to establish regeneration strategies that may be used to evaluate the sustainability of the species.

Bioprospecting presents itself on the coast of Paraná in the following way: first, as a source of new compounds of natural origin, with low toxicity; second, with the possibility of generating products with high added value, which may be utilized as raw material in different chemical areas; and finally, with new products for the improvement of human health and of the environment. In addition to the natural resources available in the coastal region of Paraná, one can also count on the traditional knowledge about medicinal plants that the local community has for the discovery of new bioactive compounds. This is especially important for the generation of income, since there is a history of use by the population of a vast number of species that need to be validated, and that can thus become available for cultivation and commercialization.

Now that knowledge about potential species is available, advances can be made in agronomic and phitotechnical research to establish breeding, cultivation and processing protocols, as well as implementation of *ex situ* collections or germplasm banks. This action will take place in partnership with federal, state, and municipal research and outreach programs in rural areas, with the aim of developing appropriate technologies that may be implemented by local farmers. This way we can cultivate these resources in a sustainable way, promoting social inclusion, income and the preservation of biodiversity.

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Original Article

CONSERVATION OF GENETIC RESOURCES: A STUDY WITH MEDICINAL PLANTS ON THE COAST OF PARANÁ - BRAZIL

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CONSERVATION OF GENETIC RESOURCES: RESEARCH WITH MEDICINAL PLANTS IN PARANÁ COAST

***Abstract*:** This study describes the use of native species of the Paraná Coastal. The work was carried out with traditional communities of the region with the objective of contemplating the genetic resources available in the forest, local cultural diversity and the sustainable use of natural resources. The approach taken to the interviewees followed a guideline, with information on the identification of respondents, data referring to Medicinal Plants and Non-Conventional Food Plants. There were 67 plants with some uses mentioned. It was identified that in the community 64% of the residents interviewed were retired and live on fishing and farming. It was observed that women have extensive knowledge about medicinal plants, men already know much more about tree species destined to the construction, either of boats or houses. It was verified the importance of the traditional knowledge about the medicinal plants for the discovery of bioactive compounds and income generation.

***Keywords*:** Sustainable territorial development, conservation of genetic resources, medicinal plants

CONSERVAÇÃO DE RECURSOS GENÉTICOS: A PESQUISA COM PLANTAS MEDICINAIS NO LITORAL DO PARANÁ

***Resumo*:** Este estudo descreve as potencialidades do uso sustentável de espécies nativas do Litoral do Paraná. O trabalho foi conduzido com comunidades tradicionais da região com o objetivo de contemplar o recurso genético disponível na floresta, a diversidade cultural local e o uso sustentável dos recursos naturais. A abordagem feita aos entrevistados seguiu um roteiro norteador, com informações sobre a identificação dos entrevistados, dados referentes às Plantas Medicinais e Plantas Alimentares não Convencionais e demais usos

da biodiversidade. Foram citadas 67 plantas com algumas utilizações. Identificou-se que na comunidade 64% dos moradores entrevistados eram aposentados e vivem da pesca e lavoura. Observou-se que as mulheres detêm amplo conhecimento sobre plantas medicinais, já os homens conhecem muito mais sobre espécies arbóreas destinadas à construção, seja de barcos ou casas. Constatou-se a importância do saber tradicional acerca das plantas medicinais para a descoberta de compostos bioativos e geração de renda.

***Palavras-chave*:** Desenvolvimento territorial sustentável, conservação de recursos genéticos, plantas medicinais.

CONSERVACIÓN DE RECURSOS GENÉTICOS: INVESTIGACIÓN CON PLANTAS MEDICINALES EN LA COSTA DE PARANÁ

***Resumen*:** El artículo describe el uso sostenible de especies nativas del Litoral del Paraná. El trabajo fue conducido con comunidades tradicionales de la región con el objetivo de contemplar el recurso genético disponible en el bosque, la diversidad cultural local y el uso sostenible de los recursos naturales. El enfoque de los entrevistados siguió un itinerario orientador, con informaciones sobre la identificación, datos referentes a las plantas medicinales y Plantas Alimentares no Convencionales y demás usos de la biodiversidad. Se han citado 67 plantas. Se identificó que en la comunidad el 64% de los residentes entrevistados eran jubilados y viven de la pesca y la labranza. Se observó que las mujeres poseen amplio conocimiento sobre plantas medicinales, ya los hombres conocen mucho más sobre especies arbóreas destinadas a la construcción. Se constató la importancia del saber tradicional acerca de las especies para el descubrimiento de compuestos bioactivos y generación de ingresos.

Palabras clave: Desarrollo territorial sostenible, conservación de recursos genéticos, plantas medicinales