Biodiversity and Conservation **9**: 597–615, 2000.
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Diversity of plant uses in two *Caiçara* communities from the Atlantic Forest coast, Brazil

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Received 29 April 1999; accepted in revised form 10 August 1999

Abstract. *Caiçaras* are native inhabitants of the Atlantic coast on southeastern Brazil, whose subsistence is based especially on agriculture and artisanal fishing. Because of their knowledge about the environment acquired through generations, *Caiçara* people can play an important role in Atlantic Forest conservation. An ethnobotanical study was conducted within two *Caiçara* communities (Ponta do Almada and Camburí beach, São Paulo State, Brazil), focusing on plant uses. In 102 interviews, 227 plant ethnospecies were quoted, mainly for food, medicine, handicraft and construction of houses and canoes. People from studied communities depend on the native vegetation for more than a half of the species known and used. Using diversity indices, plant uses are compared between studied communities and between gender and age categories within each community. We found quantitative differences in the knowledge about plants between gender categories for each kind of use (medicinal, food and handicrafts). Older and younger informants also have different knowledge about plants for handicraft and medicine, but not for edible plants.

Key words: Atlantic Forest, biodiversity, *Caiçara*, diversity indices, ethnobotany, plant uses

Introduction

The Atlantic Forest is considered one of the tropical hot spots for conservation, since it is an area of high biological endemism and threatened by devastation (Myers 1988). That threat goes beyond biological patrimony, reaching also human communities that could be disappearing faster than the forest itself (Lino 1992; Plotkin 1988).

In the Atlantic Forest, *Caiçaras* represent populations that have a strong interaction with the environment (Diegues 1983, 1994), whose subsistence is based especially on agriculture and artisanal fishing. *Caiçara* communities can be of great importance to Atlantic Forest conservation, due to their knowledge about nature, acquired through generations. *Caiçaras* are native inhabitants of the southeast of Brazil, descendants of Indians and Portuguese colonists, with influences from African culture (Marcílio 1986; Mussolini 1980). Their knowledge about the Atlantic forest includes how to cultivate land, knowledge about animals and plants, and specific fishing technology (Begossi 1995).

Native populations can play an important role for the environment, maintaining or even increasing its biodiversity (Anderson and Posey 1989; De Miranda and Mattos 1992; Diegues 1994). Given and Harris (1994) reinforce the importance of local knowledge to *in situ* conservation, in which evolutionary processes are not static as in *ex situ* conservation (Frankel and Soulé 1981; Brush 1995).

Concerning *Caiçara* people from the Brazilian southwest coast, studies such as those of Begossi et al. (1993), Born (1992), Figueiredo et al. (1993, 1997) and Rossato (1996) focused on the use of plant resources, mainly as raw material for handicrafts, and as medicinal and edible resources.

In this paper we analyze the knowledge and use of plants in two *Caiçara* communities, identifying similarities and differences through basic ecological quantitative analysis as diversity measures. Considering the high biodiversity in the Brazilian Atlantic Forest (Gentry 1992; Mori et al. 1981), and the dependence on the local natural resources for *Caiçara* communities, we expect to find a high diversity of known and used plants on this communities. The objectives of this paper are to verify if there are differences in knowledge about plant use between two *Caiçara* communities, Ponta do Almada and Camburí Beach, and within the studied communities, between gender and age categories.

This study is part of a larger study about human ecology and ethnobotany of *Caiçaras* of southeastern Brazil (Begossi 1995; Figueiredo et al. 1993, 1997; Hanazaki et al. 1996; Rossato 1996). Both the communities chosen were located between sites already studied by Begossi (1995) and Rossato (1996), such as Puruba, Picinguaba and Casa de Farinha.

Study site

Camburí beach is located inside the Núcleo Picinguaba of Serra do Mar State Park, and Ponta do Almada is at the southern limit of the Núcleo. Both are inside the Atlantic Forest Biosphere Reserve (Lino 1992). The two communities studied are located in Ubatuba Municipality, São Paulo State, Brazil (Figure 1). There are 31 houses of native inhabitants in Ponta do Almada, with about 125 residents. There are about 70 houses of local inhabitants in Camburí beach and 300 residents. Both communities are similar in social and economic aspects, such as level of education and their main economic activities.

Usually families are relatively small, with an average of five people in Almada, with two adults and three children ($n = 26$ families), and in Camburí with an average of four people, two adults and two children ($n = 35$ families).

Most of the interviewed inhabitants are *Caiçaras* (87% in Almada and 95% in Camburí), which means they were born there or come from nearby communities, such as Ubatumirim, Taquari and Trindade. Other communities of the region show

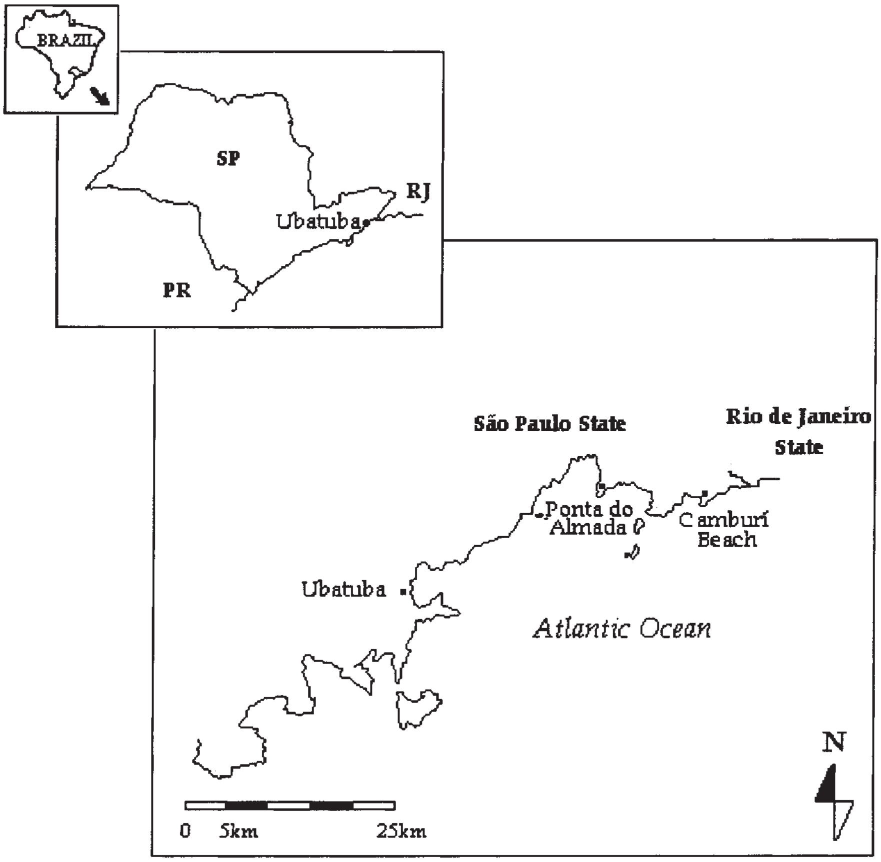


Figure 1. Study site.

similar percentages of native *Caiçaras* (Puruba and Picinguaba: 86% each, Búzios island: 75%, Gamboa: 93%, Jaguanum: 80%) (Begossi 1995).

In both communities, only 32% of the population is illiterate. In general, men dedicate themselves to fishing (76% in Almada and 61% in Camburí) and to agricultural activities (35% in Camburí. In Almada none of the men interviewed considered agricultural activities as an important activity). Among women, the main occupation is housekeeping (76% in Almada and 92% in Camburí).

In Almada the percentage of inhabitants, men and women, that dedicate themselves to supporting tourism is also high (64%). Tourism includes activities such as seasonal rent of houses and working as housemaids. In Camburí, tourism activities (which are practised by 50% of the residents) are the sales of refreshments and renting backyards for campers during the tourism season (summer).

Methods

Data from plant uses were drawn from open-ended interviews regarding knowledge and uses of plants for medicine, handicraft, food and other uses. Adult inhabitants of both sexes were interviewed in each community, between March 1994 and June 1995 (102 interviews; 45 at Ponta do Almada and 57 at Camburí beach). We asked questions about plants actually used or known as used by the informant.

Plants quoted in interviews were collected with the help of local residents, herborized, and identified by Hermógenes de Freitas Leitão-Filho and Jorge Y. Tamashiro. Collected material was registered and deposited at Campinas State University Herbarium.

Quantitative methodology was recently used in several ethnobiology studies with ethnobotanical data (Benz et al. 1994; Phillips and Gentry 1993a,b; Prance et al. 1987; Toledo et al. 1995). Quantitative analysis, such as the use of diversity measures, allows objective comparisons between the folk knowledge from different communities or between different use categories within communities (Begossi 1996; Figueiredo et al. 1993, 1997; Hanazaki et al. 1996; Phillips and Gentry 1993b; Rossato 1996).

Diversity indices (Simpson and Shannon–Wiener), evenness and species richness curves were assessed for the plants cited in the interviews, and according to their use categories (Magurran 1988), with p_i as the proportional abundance of the ith species and n_i is the number of individuals (quotations) for the ith species.

Statistical comparisons of Shannon–Wiener index were made through t-test (Hutcheson 1970; Magurran 1988), where N = number of quotations and S = number of species (richness).

For each ethnospecies we considered the folk plant name given by interviewees. An exception was made for plant species for which informers gave two or more folk names to the same scientific species. For example, the local names *chapéu de sol* or *amendoeira* (*Terminalia catappa* L.) refer to only one botanical species. In other cases where there was not complete agreement among the informers, such as with the *cidreiras*: *capim cidreira* and *capim cidrão* (*Cymbopogon citratus* (DC.) Stapf.) we considered them as one ethnospecies, and *capim cheiroso* and *capim santo* (*Cymbopogon citratus*) as another ethnospecies, even though the scientific names were the same. For informers who considered *capim cheiroso*, *capim santo*, *capim cidreira*, and *capim cidrão* as synonyms we compute just one citation of the plant, under the most common folk designation.

Diversity measures were calculated for three main use categories (medicinal, handicraft and food plants) and for gender and age categories in each use group. Age categories were divided into adults under 40 years old and over 40 years old. These categories were chosen based on other ethnobotanical studies for *Caiçara* communities (Figueiredo et al. 1993, 1997; Rossato 1996).

Besides their importance as tools that may help understanding human-environmental interaction (Begossi 1996), diversity indices have some limitations.

Qualitative information about which species composes the samples are lost because diversity measures considers different species and uses as equally important, when they could have different importance (Phillips and Gentry 1993a). Diversity measures such as richness are also very sensitive to small sample sizes. Shannon–Wiener index has a moderate sensitivity, and Simpson index has low sensitivity to sample size (Magurran 1988: 79). To cope with this problem, rarefaction curves can be calculated, but another drawback is the loss of information because both richness and abundance have to be known before rarefaction (Magurran 1988: 10).

Results and discussion

Knowledge and use of vegetation

In 102 interviews, 227 ethnospecies were quoted, corresponding to 214 scientific species and 74 botanical families. Important botanical families were shown in Table 1. At Ponta do Almada 152 plant ethnospecies were quoted, corresponding to 146 scientific species from 60 botanical families. At Camburí 162 ethnospecies were equivalent to 155 scientific species from 62 botanical families.

The following use categories were considered: plants for medicine, plants for food (edible) and plants for handicrafts (including house and canoe construction). Plants quoted in these categories do not include industrialised products or plants and vegetables bought in the city. The category 'others' includes ornamental plants and

Table 1. Number of species given for the main botanical families cited at Ponta do Almada (45 interviews) and Camburí Beach (57 interviews). Only families quoted in at least 10% of the interviews are shown.[a]

Family	Ponta do Almada	Camburí Beach	Both communities
Asteraceae	8	10	13
Lamiaceae	10	6	12
Poaceae	12	8	12
Euphorbiaceae	9	6	10
Myrtaceae	6	9	10
Bignoniaceae	4	8	8
Number of botanical families quoted	60	62	74

[a] Other families quoted in less than 10% of the interviews: Acanthaceae, Alismataceae, Anacardiaceae, Annonaceae, Apiaceae, Apocynaceae, Araceae, Arecaceae, Balsaminaceae, Bombacaceae, Boraginaceae, Bromeliaceae, Caesalpinaceae, Caprifoliaceae, Caricaceae, Cecropiaceae, Chenopodiaceae, Chrysobalanaceae, Clusiaceae, Combretaceae, Convolvulaceae, Crassulaceae, Cruciferae, Cucurbitaceae, Dilleniaceae, Dioscoriaceae, Ebenaceae, Elaeocarpaceae, Fabaceae, Guttiferae, Hypoxidaceae, Lauraceae, Lecythidaceae, Leguminosae, Liliaceae, Loganiaceae, Lythraceae, Malvaceae, Melastomataceae, Meliaceae, Menispermaceae, Mimosaceae, Monimiaceae, Moraceae, Musaceae, Myristicaceae, Myrsinaceae, Nyctaginaceae, Orchidaceae, Oxalidaceae, Passifloraceae, Piperaceae, Plantaginaceae, Polypodiaceae, Quinaceae, Rosaceae, Rubiaceae, Rutaceae, Sapindaceae, Sapotaceae, Scrophulariaceae, Solanaceae, Trigoniaceae, Urticaceae, Verbenaceae, Zingiberaceae.

plants to feed birds, and were not considered on the diversity estimations per category because of the small number of quotations. Table 2 shows the most cited species at Ponta do Almada and Camburí Beach.

Both cultivated and wild species are included in the study. Among the identified species, about 33% were cultivated or managed in some way, while 67% were considered wild species. Here we considered wild species as the species directly extracted from the vegetation, without any kind of management.

The medicinal plants were the most cited at Almada with 51% of quotations, while at Camburí this percentages for medicinal, handicraft and food plants were almost equal with 35%, 36% and 32% of the citations (Table 3).

In Table 2, the most quoted plants for medicinal purposes were used against colds, flu, stomach and liver aches, fever, worms, bronchitis child diseases, as sedatives, and against general aches. Handicraft plants were used mainly for canoes and oars, and also for house building. The main edible plants were cultivated in *roças* (swidden plots) (Oliveira et al. 1994) or orchards near the houses, only for subsistence.

Some species from Table 2 (such as avocado – *Persea americana* Mill., banana – *Musa acuminata* Colla, *boldo* – *Coleus barbatus* Benth., fennel – *Foeniculum vulgare* Gaertn., American worm seed – *Chenopodium ambrosioides* L., mint – *Mentha piperita* L., orange – *Citrus sinensis* (L.) Osbeck, cassava – *Manihot esculenta* Crantz, and maize – *Zea mays* L.) were also frequently cited in other Atlantic Forest's *Caiçara* communities, such as Puruba, Sertão do Puruba, Casa de Farinha, Picinguaba, Vitória Island (Rossato 1996), Búzios Island (Begossi et al. 1993), and Gamboa (Figueiredo et al. 1993). Other species mentioned in Ponta do Almada and Camburí Beach and frequently cited by the communities above were trumpet tree – *Tabebuia cassinoides* (Lam.) A. P. DC., sweet potato – *Ipomoea batatas* (L.) Lam., tropical cedar – *Cedrela fissilis* Vell., beans – *Phaseolus vulgaris* L., fig tree – *Ficus insipida* Willd., inga – *Inga sessilis*, lemon grass – *Cymbopogon citratus* and pennyroyal – *Cunila spicata* L. The frequent mention of these species shows their importance as natural resources to Atlantic Forest's *Caiçara* communities.

About 51% of the species cited were considered native to the Atlantic Forest, 37% were considered as exotic to the Atlantic Forest, 2% were considered weeds and 10% were undefined as exotic, native or weed. The majority of native plants were cited as used for handicrafts. Among the native plants, some fruits are also important as a secondary food resource, such as the Clusiaceae *bacupari* (*Garcinia gardneriana* (Planch. & Triana) Zappi) and many Myrtaceae (Brazilian cherry – *Eugenia uniflora* L., *gumixama* – *E. brasiliensis* Lam., Brazilian grape – *Myrciaria floribunda* (West. & Wild) Berg, *cambucá* – *Plinia edulis* (Vell.) Sobral, *araçá* – *Psidium cattleyanum* Sabine, and guava – *P. guajava* Raddi). Food plants cultivated in orchards or *roças* are mainly exotic to the Atlantic Forest.

Although more than half of the species was native, the species most frequently quoted for medicinal purposes are exotic, being also used in other regions of the world. According to Panizza et al. (1982) and Manns (1995), some of these plants

Table 2. Plants cited in 45 interviews at Ponta do Almada and 57 interviews at Camburí Beach, Ubatuba municipality, Brazil. Only plants cited in at least 10% of the interviews are shown.[a] Uses: F = plants for food, M = plants for medicine, H = plants for handicraft, O = plants with other uses. AL = percentage of quotations at Ponta do Almada, CB = percentage of quotations at Camburí beach. Status: n = native from Atlantic Forest, e = exotic, w = weeds.

Family / Biological species	Folk name (English name[b])	Uses	Voucher number[c]	AL (%)	CB (%)	Status
Apiaceae						
Foeniculum vulgare Gaertn.	erva doce (fennel)	M	74508 SCR	16	16	e
Arecaceae						
Astrocaryum aculeatissimum (Schott) Burret	brejaúva	H	33739 NH	13		n
Euterpe edulis Mart.	palmito, jiçara	HFO		20		n
Asteraceae						
Baccharis trimera (Less.) DC.	carqueja (carque)	M	43709 AB	18	5	n,w
Bidens pilosa L.	picão, picão preto (beggar ticks, bur marigold)	M	33735 NH	7	14	n,w
Matricaria chamomilla L.	camomila (wild chamomile)	M	33766 NH	31	11	e
Bignoniaceae						
Jacaranda puberula Cham.	caroba	M	33769 NH		11	n
Tabebuia cassinoides (Lam.) A.P.DC.	caxeta (trumpet tree)	H	37862 AB, 74472 SCR	7	11	n
Caesalpiniaceae						
Schizolobium parahyba (Vell.) S.F. Blake	guapuruvu, bacurubu	H	74493 SCR	16	23	n
Cecropiaceae						
Cecropia glaziouii Snethl.	embaúba	MH		13	4	n
Chenopodiaceae						
Chenopodium ambrosioides L.	erva de santa maria (American worm seed, goosefoot)	M	33776 NH		12	e
Convolvulaceae						
Ipomoea batatas (L.) Lam.	batata doce (sweet potato)	F			19	e
Crassulaceae						
Kalanchoe sp.	saião (Palm Beach bells)	M	35401 NH	9	12	

Table 2. Continued.

Family Biological species	Folk name (English name[b])	Uses	Voucher number[c]	AL (%)	CB (%)	Status
Euphorbiaceae						
Hyeronima alchorneoides Allemão	aricurana, urucurana	H	33777 NH	7	11	e
Manihot esculenta Crantz	mandioca (cassava)	F		11	25	e
Pausandra morisiana (Casar.) Radlk.	guacá	HF	74375 SCR	11	25	n
Fabaceae						
Phaseolus vulgaris L.	feijão (beans)	F		7	16	e
Lamiaceae						
Coleus barbatus Benth.	boldo	M	33740 NH	31	23	e
Cunila spicata L.	poejo (penny royal)	M	35382 NH	9	18	e
Melissa officinalis L.	erva cidreira (lemon balm)	M	74494 SCR	42	18	e
Mentha piperita L.	hortelã (mint)	MF	35364 NH	27	7	e
Lauraceae						
Laurus nobilis L.	louro (laurel bay)	H	31842 AB		14	e
Persea americana Mill.	abacate (avocado)	MF		11	12	e
Meliaceae						
Cedrela fissilis Vell.	cedro (tropical cedar)	HM	40282 AB	29	35	n
Mimosaceae						
Enterolobium contortisiliquum (Vell.) Morong.	timbuiba	H		13	32	n
Inga sessilis (Vell.) Mart.	ingá (inga)	H	35397 NH	27	37	n
Moraceae						
Ficus insipida Willd.	figueira (fig tree)	H	35372 NH	16	4	n
Musaceae						
Musa acuminata Colla	bananeira (banana)	MF		22	19	e
Myristicaceae						
Virola bicuhyba (Schott ex Spreng.) Warb.	bacubixaba	FO			11	n
Myrtaceae						
Eugenia uniflora L.	pitanga (Brazilian cherry)	MF	33738 NH	13	5	n
Psidium guajava Raddi	goiaba (guava)	MF	12227 AB	11	11	n
Poaceae						
Cymbopogon citratus (DC.) Stapf.	capim cidrão, capim cidreira (fever grass, lemon grass)	M	33745 NH	13	14	e

Cymbopogon citratus (DC.) Stapf.	capim cheiroso, capim santo	MF	35392 NH, 35398 NH	22	11	e
Saccharum officinarum L.	cana (sugarcane)	MF	33747 NH	4	26	e
Zea mays L.	milho (maize)	F		4	14	e
Rutaceae						
Citrus limon (L.) Burmann f.	limão (lemon)	MF	33758 NH	11	4	e
Citrus sinensis (L.) Osbeck	laranja (orange)	MF		22	9	e

[a] Other plants quoted in less than 10% of interviews: *Abuta* sp., *Achillea millefolium* L., *Achyrocline satureoides* DC., *Adiantum capillus-veneris* L., *Aegiphila sellowiana* Cham., *Ageratum conyzoides* L., *Aleuritis moluccana* (L.) Willd., *Allium fistulosum* L., *Anacardium occidentale* L., *Ananas comosus* (L.) Merr., *Annona squamosa* L., *Artocarpus integrifolia* L., *Aspidosperma* sp., *Asplundia* sp., *Attalea compta* Mart., *A. dubia* (Mart.) Burret, *Averrhoa carambola* L., *Bambusa* sp., *Beta vulgaris* L., *Boerhaavia diffusa* L., *Bombacopsis glabra* (Pasq.) A. Robyns, *Cabralea canjerana* (Vell.) Mart., *Cajanus cajan* (L.) Millsp., *Calophyllum brasiliense* Camb., *Capsicum annuum* L., *C. flexuosum* Sendtn., *Carica papaya* L., *Cariniana legalis* (Mart.) Kuntze, *Cassia fistula* (L.), *Cayaponia tayuya* (Vell.) Cogn., *Chenopodium album* L., *Chorisia speciosa* A. St.-Hil., *Chusquea* sp., *Cinnamomum zeylanicum* (L.) Blume, *Citrus reticulata* Blanco, *Cocos nucifera* L., *Coffea arabica* L., *Cordia curassavica* (Jacq.) Roem. & Schultes, *Costus spicatus* Sw., *Croton floribundus* (L.) Spreng., *Cucurbita pepo* L., *Cupania racemosa* (Vell.) Radlk., *Cuphea carthaginensis* (Jacq.) J.F. Macbr., *Curatella sambaiba* (A. St.-Hil), *Cymbopogon martinii* (Roxb.) Wats., *Citharexylum myrianthum* Cham., *Daucus carota* L., *Davilla* sp., *Dieffenbachia* sp., *Dioscorea alata* L., *Diospyros kaki* L., *Echinodorus macrophyllus* (Kunth) Mich., *Eclipta* sp., *Elephantopus mollis* H.B.K., *Eriobotrya japonica* Lindl., *Eriotheca pentaphylla* (Vell. & K.Schum.) A. Robyns, *Eryngium* sp., *Eucalyptus* spp, *Eugenia aquea* Burm., *E. brasiliensis* Lam., *Garcinia gardneriana* (Planch & Triana) Zappi, *Hibiscus tiliaceus* L., *Hymenaea courbaril* L., *Hypoxys decumbens* L., *Hyptis* sp., *Impatiens* sp., *Imperata brasiliensis* Trin., *Indigofera suffruticosa* Mill., *Inga* sp., *Jacaranda* sp., *Justicia* af. *hylobates* Leonard, *Laguncularia racemosa* (L.) Gaertn., *Lecythis pisonis* Camb., *Lepidium virginicum* L., *Lycopersicum esculentum* Mill., *Mabea brasiliensis* Müll. Arg., *Machaerium nyctitans* (Vell.) Benth., *Magonia pubescens* A. St.-Hil., *Mammea americana* L., *Manilkara subsericea* (Mart.) Dubard., *Melinis minutiflora* Beauv., *Mentha* sp., *Merostachys* sp., *Miconia cinnamomifolia* (Mart. ex DC.) Naudin, *Mikania* sp., *M. cordifolia* (L.f.) Willd., *Mimosa pudica* L., *Mirabilis jalapa* L., *Momordica charantia* L., *Monstera* sp., *Morus nigra* L., *Myrciaria floribunda* (West.& Wild) Berg, *Myristica sebifera* (Sw.), *Myrocarpus frondosus* Allemão, *Nectandra mollis* (Humb., Bonpl.& Kunth) Nees, *Ocimum* sp., *O. gratissimum* L., *O. micranthum* Willd., *Ocotea* sp., *Passiflora alata* Dryand., *Pera glabrata* (Schott) Baill., *Petroselium sativum* L., *Philodendron* sp., *P. imbe* Schott, *Phyllanthus corcovadensis* Müll. Arg., *P. niruri* L., *Piper arboreum* Aubl., *Plantago major* L., *Plinia edulis* (Vell.) Sobral, *Potomorphe umbellata* (L.) Miq., *Psidium* sp., *P. cattleyanum* Sabine, *Quiina glaziovii* Engl., *Rapanea ferruginea* (R. & P.) Mez, *Rheedia* sp., *Rollinia ubatubensis* Maas & Westra, *Rosa* sp., *Rosmarinus officinalis* L., *Ruta graveolens* L., *Sambucus australis* Cham. & Schltdl., *Schinus terebinthifolius* Raddi, *Scoparia dulcis* L., *Sechium edule* Sw., *Senna* sp., *Serjania erecta* Radlk., *Sida* sp., *S. santanimnensis* H.C. Monteiro, *Siparuna* sp., *Sloanea monosperma* Vell., *Smilax spicata* Vell., *Solanum* sp., *S. americanum* Mill., *S. inaequale* Vell., *Sorocea bomplandii* (Baill.) W.C. Burger, Lanj. & Wees. Boer, *Stachytarpheta polyura* Schauer, *Strychnos* sp., *Syagrus* sp., *S. pseudococos* (Raddi) Glassman, *Symphytum officinale* L., *Syzygium jambos* (L.) Alston, *Tabebuia* sp., *T. avellanedae* Lorentz ex Griseb., *T. impetiginosa*(Mart. ex A.P.DC.)Standl., *Terminalia cattapa* L., *Tibouchina* sp., *T. estrellensis* (Raddi) Cogn., *T. pulchra* (Cham.) Cogn., *Trema micrantha* (L.) Blume, *Trigonia* sp., *T. nivea* Camb., *Tynnanthus elegans* Miers, *Urtica* sp., *Vernonia lindbergii* Baker, *V. polyanthes* (Spreng.) Less, *Xanthosoma* sp., *Zanthoxylum rhoifolium* Lam., *Zingiber officinale* Roscoe.

[b] English names were based upon Brako et al. (1995) and Begossi et al. (1993).

[c] Collected by AB: Alpina Begossi, NH: Natalia Hanazaki and SCR: Silvia C. Rossato.

Table 3. Comparisons of diversity indices between the communities studied. S = Richness, $H'(10)$ = Shannon–Wiener index on base 10, $H'(e)$ = Shannon–Wiener index on base e; D = Simpson index, I = number of informants, N = number of quotations, P = percentage of quotations.

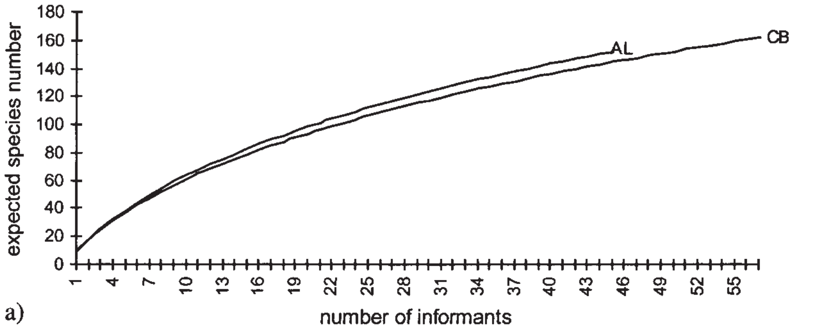
	S	$H'(10)$	$H'(e)$	D	I	N	P
Almada, all plants	152	1.99	4.59[a]	67.03	45	434	100
Camburí, all plants	162	1.98	4.57[a]	60.23	57	541	100
Almada, medicinal plants	76	1.70	3.92[b]	33.94	45	222	51
Camburí, medicinal plants	68	1.66	3.83[b]	34.25	57	187	35
Almada, handicraft plants	54	1.56	3.61[c]	25.15	45	130	30
Camburí, handicraft plants	64	1.54	3.54[c]	20.59	57	194	36
Almada, food plants	39	1.41	3.23[d]	15.81	45	89	20
Camburí, food plants	48	1.42	3.28[d]	15.44	57	175	32

[a] $t = 0.43$; $d.f. = 959$; $P > 0.05$ (n.s.).
[b] $t = 1.05$; $d.f. = 406$; $P > 0.05$ (n.s.).
[c] $t = 0.64$; $d.f. = 318$; $P > 0.05$ (n.s.).
[d] $t = 0.36$; $d.f. = 205$; $P > 0.05$ (n.s.).

were commonly used in many Brazilian regions and have confirmed pharmaceutical properties, as *Coleus barbatus* (eupeptic), *Chenopodium ambrosioides* (against worms and to breathing infections), *Mentha* sp. (eupeptic and carminative), *Cunila spicata* (to treat bronchus fever diseases) and *Citrus sinensis* (as tranquilliser). In many parts of the world, including Europe and North America, *Melissa officinalis* is broadly used as sedative, tonic, or to treat nervous disorders (Blackwell 1990; Sarer and Kokdil 1991). *Cymbopogon citratus* is also used to treat nerves and gastrointestinal disorders all over Brazil and in many parts of the world (Wannmarcher et al. 1990; Lorenzetti et al. 1991).

The small difference of the Shannon–Wiener index between the two communities (Table 3) is not significant. In this sense there is no difference between the diversity of plants cited in the two communities for general plant knowledge and use. Rarefaction curves based on the total of all interviews (Figure 2a) were very similar between Almada and Camburí, and also reflect this pattern. This result was expected because of the similarities in cultural, social and economic aspects between the communities studied. Indices are also very similar to diversity indices found by Rossato (1996) at near continental *Caiçara* communities, such as Puruba (Beach, 22 informers, $H' = 1.92$, $D = 58.14$; Sertão, 28 informers, $H' = 1.92$, $D = 55.87$), Picinguaba (83 informers, $H' = 2.06$; $D = 77.12$) and Casa de Farinha (18 informers, $H' = 1.85$; $D = 55.98$).

Although richness and number of citations varied between the communities in each group (plants for food, medicine and handicraft), Simpson and Shannon–Wiener indices were very close (Table 3). In fact, there are no significant differences between the diversity indices from each category.



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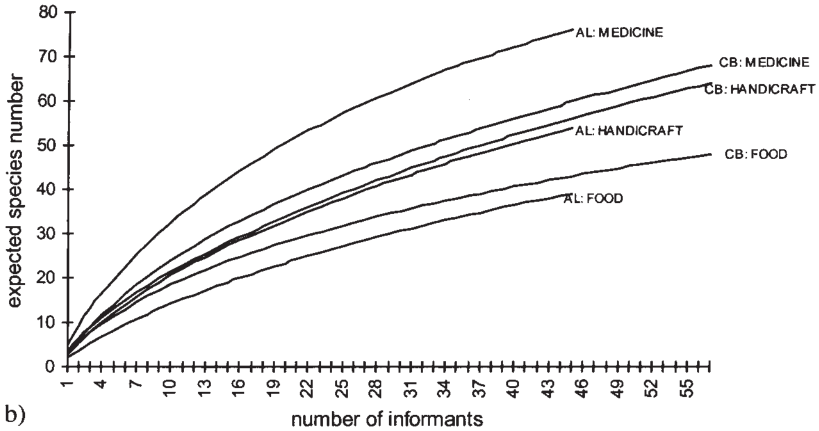


b)

Figure 2. Rarefaction curves based on the number of informants per plant in each community (AL: Ponta do Almada; CB: Camburí beach). (a) For all plants; (b) In each category of use.

Rarefaction curves (Figure 2b) are similar within each use category. Larger discrepancies were found among medicinal plants, reflecting the higher medicinal species richness found at Almada.

The diversity of medicinal plants was higher than for some nearby islands such as Itacuruçá (Figueiredo et al. 1993), Búzios (Begossi et al. 1993) and Vitória (Rossato 1996). This trend is suggested by island biogeography theory (MacArthur and Wilson 1967), which hypothesises that species diversity should be lower in islands than in continental or continuous areas. Higher diversities were found among the communities studied and nearby *Caiçara* communities (Rossato 1996). Among these communities (Camburí, Picinguaba, Casa de Farinha, Almada and Puruba) the diffusion of knowledge should also affect plant uses, because of their geographical proximity (less than 25 km) and the existence of an old trail linking Ubatuba (São Paulo State) to Paraty (Rio de Janeiro State) (Lima 1985).

The diversity of plants known and used by human populations could be affected by the plant diversity in the environment. Prance (1995) emphasised the high species diversity in the neotropics, and the high level of endemism in some regions, as the

Atlantic Forest (Mori et al. 1981). However, the Shannon–Wiener diversity index for medicinal plants at Ponta do Almada ($H' = 1.70$) and at Camburí beach ($H' = 1.66$) are similar to the lowest indices analysed by Begossi (1996) for medicinal plants in other world regions. Begossi (1996) compared the diversity of known and used plants in 10 communities (in Brazil, Spain, Guatemala, Nicaragua, Peru, Thailand and Tonga). For medicinal plants, the lowest index were $H' = 1.30$ in Nicaragua (based on 16 informants – Dennis 1988), $H' = 1.69$ in Nicaragua (809 informants – Barrett 1994) and $H' = 1.70$ in Guatemala (300 informants – Girón et al. 1991); the highest indices were $H' = 2.20$ in Barcarena, Brazil (17 informants – Amorozo and Gély 1988) and $H' = 2.16$ in Thailand (9 informants – Pake 1987).

It is possible that the species diversity available in the environment was not directly correlated with the diversity of plants used by *Caiçaras*, because many medicinal plants mentioned in the interviews are not native species from the Atlantic Forest. However, it is also possible that the plant diversities obtained at Ponta do Almada and Praia do Camburí were underestimated because people do not cite all plants they know and use in just one interview. The easy access to health care and hospitals in the city, and the reduction of activities like subsistence agriculture along with the growth of activities associated to tourism could contribute to the loss of knowledge about plants.

Gender and age comparisons

Gender and age comparisons were done for medicinal, food and handicraft groups separately. In both communities, men quoted more medicinal plants than did women. There is no significant difference between men and women for medicinal plant uses at Almada. According to expected richness curves for medicinal plants (Figure 3a), it is expected that women would know more medicinal plants than men, but this difference decreases as the number of interviews increase, up to the 20th to 22nd interview, when expected richness equalises; we observed then an inverse trend with increasing curves for men and stabilising curves for women. At Camburí there is significant differences between diversity indices for gender, and rarefaction curves follow the same pattern as at Almada.

At Almada, older people quoted more medicinal plants than did younger people. At Camburí the inverse occurred: younger people quoted more medicinal plants than older people (Figure 3b). For the same number of informers, expected species richness is higher for people of 40 years old or more at Almada, and for people under 40 years old at Camburí.

Gender and age comparisons for handicraft plants showed significant differences (Figure 4). For the same number of informants, in both communities men cited a higher diversity of handicraft plants than women (Figure 4a). This difference is very clear, with increasing curves for and stabilising curves for women. Besides different sample sizes in age categories, for the same number of interviews older people

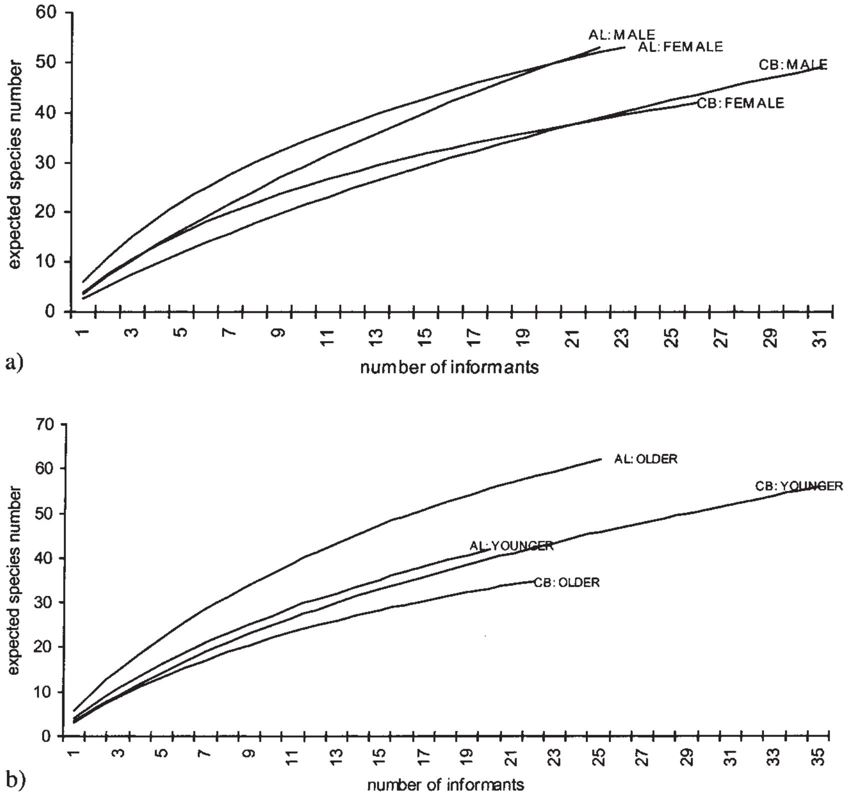
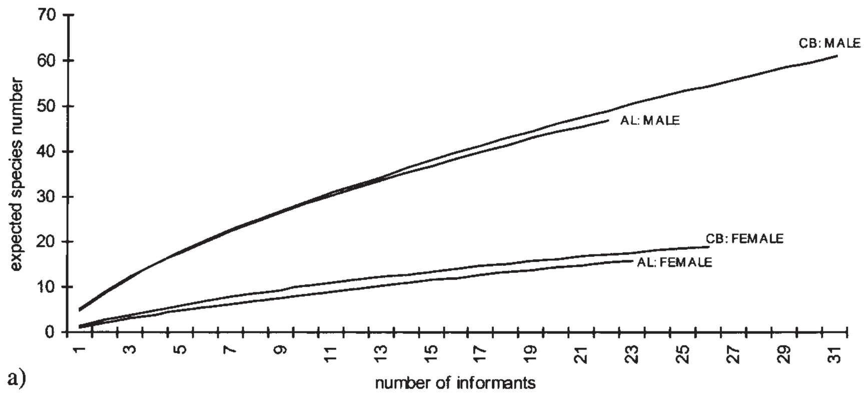


Figure 3. Plants for medicine: rarefaction curves based on the number of informants per plant in each community (AL: Ponta do Almada; CB: Camburí Beach). (a) For gender categories. Ponta do Almada: $H'_{FEMALE} = 3.65$, $H'_{MALE} = 3.76$, $t = 1.02$ ($P > 0.05$), $d.f. = 200$; Camburí beach: $H'_{FEMALE} = 3.50$, $H'_{MALE} = 3.82$, $t = 3.39$ ($P < 0.01$), $d.f. = 199$; (b) For age categories. Ponta do Almada: $H'_{YOUNGER} = 3.45$, $H'_{OLDER} = 3.69$, $t = 2.54$ ($P < 0.05$), $d.f. = 185$; Camburí beach: $H'_{YOUNGER} = 3.75$, $H'_{OLDER} = 3.35$, $t = 4.60$ ($P < 0.01$), $d.f. = 174$. Shannon–Wiener indices were calculated with base *e*.

cited a higher diversity of handicraft plants than younger people in both communities (Figure 4b).

At Almada women cited a higher diversity of food plants than men (Figure 5a). For food plants, we found no significant difference between gender categories at Camburí, or between age categories in both communities (Figure 5b).

It would be expected that women and men have distinct skills and knowledge relating to the use of natural vegetation (Kainer and Duryea 1992). According to Maikhuri and Gangwar (1993), in tribes of northwest India, women possess less knowledge when compared to men but for the cases of infants they know more. In some *Caiçara* communities, women knew more about medicinal plants than men because women were generally closest to medicinal plant processing (Figueiredo et al. 1993). A different trend is observed in other places: at Puruba, Sertão do Puruba, Casa



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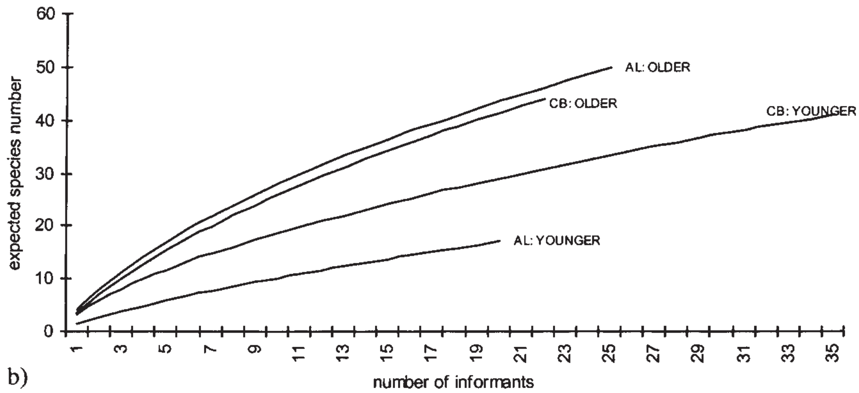

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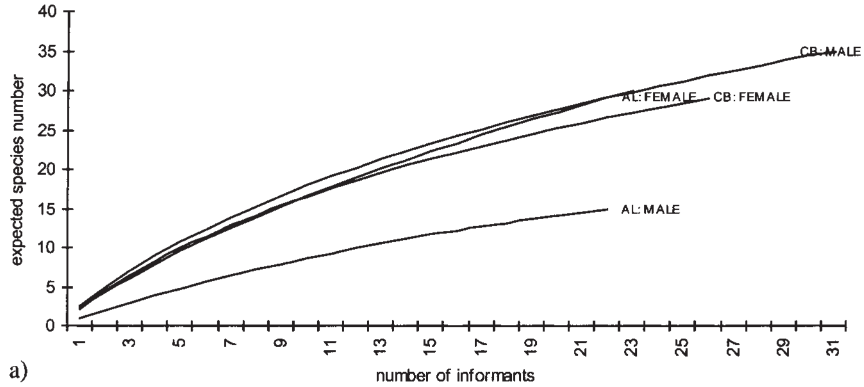
Figure 4. Plants for handicraft: rarefaction curves based on the number of informants per plant in each community (AL: Ponta do Almada; CB: Camburí Beach). (a) For gender categories. Ponta do Almada: $H'_{\text{FEMALE}} = 2.59$, $H'_{\text{MALE}} = 3.44$, $t = 6.30$ ($P < 0.01$), $d.f. = 60$; Camburí beach: $H'_{\text{FEMALE}} = 2.72$, $H'_{\text{MALE}} = 3.55$, $t = 6.50$ ($P < 0.01$), $d.f. = 98$; (b) For age categories. Ponta do Almada: $H'_{\text{YOUNGER}} = 2.62$, $H'_{\text{OLDER}} = 3.62$, $t = 7.67$ ($P < 0.01$), $d.f. = 49$; Camburí beach: $H'_{\text{YOUNGER}} = 3.17$, $H'_{\text{OLDER}} = 3.53$, $t = 3.08$ ($P < 0.01$), $d.f. = 191$. Shannon–Wiener indices were calculated with base *e*.

de Farinha and Vitória Island, Rossato (1996) found that men knew more medicinal plants than women, and explained this differences by the influences of migrants and by their greater interaction with vegetation because of their casual activities as users of forests, or as *mateiros* (woodsmen).

These casual male activities as *mateiros* are also reflected in their knowledge and use of handicraft plants. Among *Caiçaras*, men performed the main handicraft works, such as manufacturing canoes and oars, for which native species were frequently used.

We also found gender differences for edible plants at Almada, where women knew a greater diversity of plants for food than men. Agricultural activities were most frequently performed by women, and this can explain their greater knowledge about



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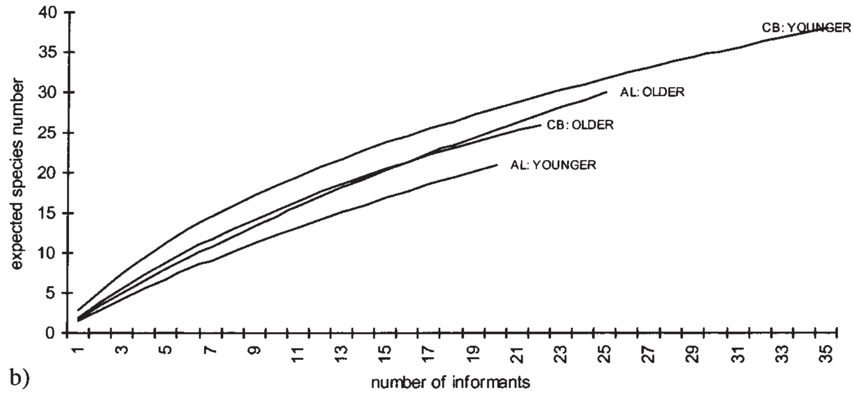

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Figure 5. Plants for food: rarefaction curves based on the number of informants per plant in each community (AL: Ponta do Almada; CB: Camburí Beach). (a) For gender categories. Ponta do Almada: $H'_{\mathrm{FEMALE}} = 3.14$, $H'_{\mathrm{MALE}} = 2.49$, $t = 4.08$ ($P < 0.01$), $d.f. = 63$; Camburí beach: $H'_{\mathrm{FEMALE}} = 3.04$, $H'_{\mathrm{MALE}} = 3.13$, $t = 0.66$ ($P > 0.05$), $d.f. = 171$; (b) For age categories. Ponta do Almada: $H'_{\mathrm{YOUNGER}} = 2.92$, $H'_{\mathrm{OLDER}} = 3.06$, $t = 1.00$ ($P > 0.05$), $d.f. = 88$; Camburí beach: $H'_{\mathrm{YOUNGER}} = 3.17$, $H'_{\mathrm{OLDER}} = 2.98$, $t = 1.32$ ($P > 0.05$), $d.f. = 130$. Shannon–Wiener indices were calculated with base *e*.

edible plants. Women usually possess a refined perception about plants cultivated in *roças* or swidden plots (Boster 1985; Ribeiro 1995: 115–119).

A replacement of small-scale agricultural activities by fishing activities (especially among men) and by activities related to tourism among *Caiçara* populations is occurring recently (Diegues 1983; Begossi et al. 1993; Begossi 1995; Hanazaki et al. 1996). This change is contributing to the loss of knowledge about both cultivated and wild plants.

Concerning medicinal plants, older people are usually better informers than younger people. According to Phillips and Gentry (1993b), with *mestizos* from Tambopata (Peruvian Amazon) medicinal plant knowledge is largely confined to older people. In contrast with learning about edible plants, which can be discovered by trial-and-error, the process is more complex with medicinal plants. These authors consider knowledge about medicinal plants to be the most vulnerable kind of knowledge to acculturation. With *Caiçara* from Búzios Island (Begossi et al. 1993), Gamboa (Figueiredo et al. 1993), Puruba and Sertão do Puruba, Casa de Farinha, Picinguaba and Vitória Island (Rossato 1996), higher medicinal plant diversities were quoted by older informers, except at Sertão do Puruba, probably because of the influence of migrants from other Brazilian States in this community. Trends in loosing knowledge about medicinal plants can be explained because young people usually visit clinics and health services instead (Begossi et al. 1993; Figueiredo et al. 1993).

Some complementary hypotheses can be proposed to explain the inverse trend observed at Camburí about the knowledge of medicinal plants between age categories: a) younger people were more open to interviews than older people, and then quoted higher diversities of medicinal plants; b) older people could be interacting less with vegetation, and older residents were often more enthusiastic in talking about Camburí's prosperous past than talking about current plant uses or their current life.

According to Phillips and Gentry (1993b), informants of different ages have different levels of ethnobotanical knowledge, and they found that among *mestizos* from southeast Peru the knowledge about plants for construction and commercial purposes (including plants used for timber and canoes) appeared to peak between 30 and 50 years old. Here we found that concerning plants for handicraft uses, people older than 40 years old clearly know more about the natural vegetation than younger ones in both Ponta do Almada and Camburí beach.

Concerning plants for food, we found no differences in the diversity of plants mentioned by younger and older people. Phillips and Gentry (1993b) also stated that the knowledge about edible plants in gained early in life and increases only slowly with age.

Conclusions

People from Ponta do Almada and Camburí beach depend on the native vegetation for more than half of the species known and used. *Caiçaras* also know and use many exotic plants especially for medicinal purposes.

Quantitative analysis shows their usefulness in analysing ethnobotanical data based in interviews, allowing comparisons among communities and categories. It is important to have both quantitative and qualitative methods combined to study the ethnobotanical knowledge and to make these data useful in managing and conserving natural resources.

With respect to plant uses for medicine, handicrafts, and food, there is no difference between the two communities studied. The diversity of plants known and used for medicinal purposes was similar to the diversity found in other *Caiçara* communities, and higher than in nearby Brazilian islands. There is not a direct relationship between the diversity of the use of medicinal plants and the diversity of plants in the environment, but most of the plants used by the *Caiçaras* are not native from Atlantic Forest. Women and men have different knowledge about plants, especially with plants for handicrafts. Older and younger informants also have different knowledge about plants for handicraft and medicine, but not for edible plants.

This knowledge should be urgently considered on *in situ* biological conservation programs since both biological and cultural diversity are threatened in Atlantic Forest region, and a loss of knowledge about plants may be occurring at the sites studied due to the reduction of agricultural activities along with the growth of activities related to tourism. Conservation programs may allow the survival and the permanence of these native populations in their environment, encouraging traditional activities and considering their knowledge about vegetation.

Acknowledgements

This work is part of Natalia Hanazaki's Master degree thesis, supported by FAPESP (process number 95/1659-6). We thank FAPESP (92/1390-9 and 94/6258-7) and CNPq (400366/92.4) for financial aid for the fieldwork. Alpina Begossi also thanks CNPq for a research productivity scholarship. We thank S.C. Rossato for the help with the plant collection. Thanks to M.C.M. Amorozo, N. Nordi and two anonymous referees for critical readings and suggestions on previous versions of this manuscript. Special thanks to people of Almada and Camburí for their kind cooperation that made this study possible, specially to Maria Aparecida and Nilo, Tião, Isaac, Maria Virginia and Genésio, and Maria Aparecida and Antonio.

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