CULTURAL AND ECOLOGICAL RESILIENCE AMONG *CAIÇARAS* OF THE ATLANTIC FOREST COAST AND *CABOCLOS* OF THE AMAZON (BRAZIL)

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Introduction

The aim of this study is to review ecological-cultural aspects of Brazilian native populations that descend from Indian and Portuguese, from the Atlantic Forest coast (*caiçaras*) and from the Amazon (*caboclos).* Following the definition by Berkes and Folke (1992), the objective is to analyze their *cultural capital* or the factors related to *caiçara* and *caboclo* adaptations to the environment, including its modifications. These factors are reviewed in the light of ecological concepts, such as of *resilience*. Examples from the Atlantic Forest coast will be concentrated on the southern coast of Brazil, and from the Amazon, from the States of Acre, Amazon and Tocantins (Figure 1)

The term *resilience* is widely known from ecological literature, being part of the concept of stability. According to Putman and Wratten (1984), there are three *facets* of stability in ecological systems: constancy (lack of change), resilience (ability to recover and continue functioning after disturbances) and inertia (ability to resist to perturbations) Holling (1992) defined that cycles are part of structuring processes in which organisms are members and that these cycles are organized by four functions: exploitation, conservation, release and organization In this case, resilience is determined by release and reorganization sequence. In the words by Berkes and Folke (1994), resilience is the magnitude of disturbance that can be absorbed before a system changes In such a case, resilience includes also the inertia defined by Putman and Wratten (1984). Toft (1986) defines resilience as rate of return to equilibrium Naturally, equilibrium here has dynamic properties, and might be a *point equilibrium* (the system returns quickly), an *oscillatory damping* (the system return slowly or with oscillations) or as a *stable limit cycle*, in which populations fluctuate regularly through time.

When thinking on cultural resilience, we might consider the cultural aspects that help maintaining ecological resilience, or in the behavior that might minimize or even prevent ecological disturbances Cultural behavior has interesting attributes, which might be useful to point out here. In one hand, it is the high flexibility of human behavior that made humans adaptable to different environments, that helped human to overcome climatic Pleistocene changes, and to respond quickly to a variable environment (Boyd and Richerson, 1981) On the other hand, human behavior may be very conservative and hard to change, (such as traditions) by what is called *cultural inertia* (Boyd and Richerson, 1985).

In ecological terms, we might observe different consequences from cultural inertia. In one case, an environment may change and the behavior might be not useful anymore in this new set of conditions. In this case, a cultural tradition might be a load (like a genetic load, a cultural load). In other cases, traditions might improve ecological resilience by preventing overexploitation of systems or by helping them to recover. In still other cases, a behavior that appears useless might be useful just in certain specific situations. Examples of behavior of *caiçaras* and *caboclos* fit in these three categories.

Another point, tracing other associations between cultural and ecological systems, concerns to the views of community organization by Clements and Gleason (Ricklefs, 1979). Contemporaneous concepts in community ecology recognize that the Gleasonian concept of *open communities* represents better natural communities. The

Gleasonian concept, called the *individualistic hypothesis* (Whittaker, 1975), considers that species do not form clear groupings that may characterizes bounded types of communities As stressed by Levin (1992), what we call a community or ecosystem is an arbitrary subdivision of a continuous gradation of local species assemblages. Thus, communities are not well integrated, moving in masses; they include species that respond individualistically to temporal and spatial variations This approach includes the idea of *edge effects.* These effects include competition with invaders, increased predation and parasitism as well as higher extinction probabilities (Aisen and Feinsinger, 1994). Studies of forest fragments are suited to observe edge mosaics. According to Malcom (1994), edge effects give rise to a peculiar community, because some species increase in abundance and others decrease close to the edge. These concepts from community ecology may have interesting implications to cultural ecology, comparing native Indians with neotraditional communities (Figure 2).

During a long time in history, human communities were isolated, with a few or scarce "edge effects". Even in this century, isolated Indian communities were found all around the globe. However, after the sixties, and associated with an increasing global economy (Sassen, 1991), we could hardly find an isolated human community. In spite of the relative isolation of some native communities, they do not have well defined cultural boundaries Their cultural boundaries are mixed with other close communities and with the society (including market values and pressures). These cases are exceptionally clear in native non-indian communities, such as the *caiçaras* and *caboclos* of Brazil. As pointed out by Marcílio (1986), in a study on the *caiçaras* of Ubatuba, peasant economies are characterized by opposition to both native Indian and industrial economies.

The flexible cultural boundary of native communities might diminishes their cultural inertia, and make them more open to absorb cultural values that might increase or decrease ecological resilience. Examples are shown in this study. I will first describe the Atlantic Forest coastal *caiçaras* and their communities (knowledge, technology, property institution and rights), followed by correspondent descriptions on Amazon *caboclos*, and ending with a general discussion including the rules and institutions related to both communities.

The Atlantic Forest coast

Tropical rainforests cover only 7% of the earth surface, but contain more than half of the world biota (Wilson, 1988). The Atlantic and Amazon forests are the most rich forests in the world. The delimitation of the boundaries of the Atlantic rain forest is still a controversial point. Nevertheless, Brazilian forests are divided in two major groups: of Amazon and Atlantic origins. In the south/southeast Brazil, the coastal plain forest, slope forest and high altitude forest are part of the Atlantic forest (Joly, Leitão-Filho and Silva, 1991).

In the five centuries of occupation, the Atlantic forest exploitation was concentrated in *pau brasil* (*Caesalpina echinata*) followed later by many other timber woods, in the extraction of heart of palm (*palmito - Euterpe edulis*) and *xaxim* (*Cyathea* spp.) and the cultivation of sugar cane, coffee and cocoa (in Bahia State) (Joly, Leitão-Filho

and Silva, 1991) The Atlantic Forest is represented today by sparse rainforest remnants along the Brazilian coast, from the south to the northeastern coast. As part of a "hot spot" area, which include habitats with many species in great danger of extinction (Wilson, 1992), the last remainings of the Atlantic forest (about 5% of the initial vegetation cover - Myers, 1988) are included in the Biosphere Reserve Program (MAB/UNESCO) (Lino, 1992). Nevertheless, between 1985-90, about 536 thousands of ha have been deforested (Capobianco, 1994).

The Atlantic rainforest is a tropical forest with high endemism and diversity. For example, about 55% of arboreal species are endemic. In the coastal plain forest, where most *caiçaras* live, important families are Myrtaceae, Melastomataceae, Lauraceae, Celastraceae, Fabaceae, Mimosaceae, Anacardiaceae and Compositae In deforested areas, shrubs and colonizing plants predominate, especially *embaúbas* (*Cecropia*) and *quaresmas* (*Tibouchina*). Soils are shallow, sandy and have usually low fertility (Joly, Leitão-Filho and Silva, 1991, Leitão-Filho, 1982, 1987).

Demographic reduction or extinction of many animal species was one of the results after centuries of exploitation of the Atlantic forest. Among the vertebrates, the Atlantic forest fauna is small in size (with the exception of tapir - *Tapirus terrestris*). Its fauna has also a high endemism and diversity and the group of batrachians is known for a fantastically endemism. The Atlantic Forest is rich in simians, in spite of having less monkey and marmoset species than the Amazon forest. (Coimbra, 1991).

The *caiçara* communities studied are located in the northern coast of São Paulo State and southern coast of Rio de Janeiro State, such as Puruba and Picinguaba (Ubatuba District), Búzios and Vitória Islands (Ilhabela District) and Sepetiba bay (Itacuruçá District) (Figure 1). All communities have low population densities, ranging from 26 (Gamboa, Itacuruçá) to 100 (Picinguaba and Jaguanum Island) families.

The caiçaras of the Atlantic coast

Caiçaras are descendants of Indians and Portuguese, and have culture and technologies that derive from these influences. Some African influences may be found especially in religious feasts. African slaves arrived in the 18th and 19th centuries, representing 39% of the population of Ubatuba in 1836 (Marcílio, 1986). Japanese migrants, in this century, influenced the *caiçaras* especially with technological innovations for fishing, such as the *cêrco* (floating chambers of nets)(Mussolini, 1981).

The first inhabitants of the southern Brazilian coast were the Tupinambá Indians. After the Portuguese arrival, the people of this coast participated in the economic cycles, such as sugar cane (including production of sugarcane rum) and coffee (França, 1954; Marcílio, 1986). The *caiçaras* are native inhabitants of this coast, having a living based on the natural resources from the forest and sea and practicing small-scale agriculture and fishing.

Agriculture is usually based on manioc (the main crop), but also includes potatoes, yam, beans (Begossi *et al.*,1993) In the southern coast of Rio de Janeiro State, banana plantations are very important. The processing of manioc, to produce flour, still have strong Indian influences, and include mechanisms to get out the cyanidric acid, by using round baskets called *tipití*. Agriculture played an important economic role for the *caiçaras* till the fifties, when it began to be substituted by fishing as a source of cash The low price paid for manioc compared to fish explains this economic shift (Begossi *et al.*, 1993; Diegues, 1983). Fishing is now the main source of cash for many coastal *caiçaras*. It is performed at the sea and in the rivers of the forest, usually close to the river mouths.

Plants are also used by the *caiçaras* for a variety of purposes, such as food, medicine, handicrafts and construction. For example, at Búzios island, about 61 species are used for food, 53 for medicine and 32 for house, canoe construction and handicrafts, at Sepetiba Bay, about 100 plants are used for these purposes, and at Puruba and Picinguaba more than 200 species were mentioned as useful (Begossi *et al.*, 1993; Figueiredo *et al.*, 1993; Rossato, 1995) As observed, the intense use of fish and plants by the *caiçaras* show that in spite of their proximity to large Brazilian cities, such as Rio de Janeiro and São Paulo (Figure 1), they still maintain a very close interaction with nature.

Local Knowledge

Caiçaras have a deep knowledge of the rain forest coast where they live. Specific knowledge on natural resources include forms of land cultivation, especially for manioc cultivation; knowledge on animals and plants, such as on their uses and avoidances (taboos); knowledge on the classification of nature (ethnosystematics and ethnotaxonomy) and on appropriate technology

- Land cultivation: in spite of a relative large amount of studies on land cultivation by Amazonians (*caboclos* or Indian populations), there are a few studies dealing with land management by the *caiçaras* Similarly with the cultivation by the *caboclos*, the *caiçaras* practice shifting cultivation and do manipulate species diversity

Roças (small plots where manioc, beans and potatoes, among others, are cultivated) and *hortas* (small gardens next to houses for green vegetables) are in general included in *caiçara* agriculture. The dry season (July-October, November) is the time to prepare plantations (Begossi *et al.*, 1993) Manioc is the basic crop, represented especially by *Manihot esculenta*, which include many varieties. Manioc species include varieties with high content of cyanogenic glucosides (HCN) in the edible part of the root cortex (bitter manioc or *mandioca brava*) which are used for preparing flour, and varieties with low cyanidric acid content, called *mandioca mansa* or *aipim* (sweet manioc), which are eaten after cooking (McKey and Beckerman, 1993). Cury (1993) studied the *caiçara* cultivation of manioc in detail, in populations of the Vale do Ribeira (southern coast of São Paulo State).

According to Cury's study, plantations (*roças*) occur in open fields inside the natural vegetation, helping increasing diversity and also favoring natural selection to occur

Cultivated and wild species are planted close (in sympatry), maintaining the gene flow among species through hybridization. Native agriculture, in the absence of fertilizers, pesticides and irrigation leave open space to natural selection, being thus the result of strong selective pressures. Therefore, the planting of manioc through vegetative propagation, the habit to get in old *roças* material for new *roças*, and the planting of different varieties in a random distribution favors intraspecific hybridization, increasing diversity and leaving natural selection to act on new combinations McKey and Beckerman (1993) stressed the importance of sexual reproduction and the hybridization with wild relatives that contribute to produce variation in the quantity of HCN among species and varieties of manioc.

Manioc cultivation is still very traditional, and, in spite of the economic changes that led *caiçaras* to focus more on fishing rather than on cultivation, families still maintain houses, called *casa de farinha* (flour houses) to process manioc. One *casa de farinha* attends usually an extended family, which includes more than one nuclear family. As residence is usually virilocal, such as at Búzios Island (Begossi, 1989) and Aventureiro (Vilaça and Maia, 1989) the flour houses usually attend to nuclear families that are located close to fathers' houses

The traditional management of the *roças* is an example of cultural resilience, or, in other words, of attitudes that increase the ecological resilience of the *caiçara* community. Oliveira *et al.* (1994) studied the methods of slash and burn of the *caiçaras* of the community of Vila do Aventureiro (Grande Island, coast of Rio de Janeiro State), which includes about 90 individuals (Figure 1) Manioc is planted in a typical polyculture, with beans, yam, maize, rice, abobora, papaya, sweet potatoes and water melon. The forest is then cleaned and burned, calcium and magnesium increases in the soil whereas aluminum decreases, increasing thus the soil fertility In the fallow period, other species are planted, such as the *cobi* (*Anadenanthera colubrina*), an important Leguminosae that helps in fixing nitrogen. As stressed by the authors, through this method there is reposition of nutrients, erosion is minimized, and there is no need for chemical pest control. A low population density is the condition for the system to work, because land must be available for fallow periods. Manioc, being a crop with a low input and a low risk (McKey and Beckerman, 1993), represents a practice with a high resilience, which has contributed to its wide spread in South America.

- Knowledge on animals and plants - uses and classification: a high diversity of animals and plants are used by the *caiçaras*. Their knowledge include animals and plant uses, taboos and folk biosystematics.

Common marine animals used for food and sale are, at Búzios and Vitória Islands, bluefish (*Pomatomus saltatrix*), squid (*Loligo sanpaulensis*) and halfbeak (*Hemiramphus balao*); at Puruba and Picinguaba, snook (*Centropomus parallelus*), mullets (*Mugil* spp.), cutlass fish (*Trichiurus lepturus*), sand drum (*Micropogonias furnieri*), kingfish (*Menticirrhus americanus*) besides freshwater catfish from Puruba or Quiririm rivers; and, at Sepetiba Bay, shrimp (*Pennaeus schmitti*), sand drum, mullets, weakfish (many Sciaenidae) and kingfish. Fish is the main source of animal protein used by the *caiçaras* For example, at Búzios Island, about 68% of animals consumed are fish (Begossi

and Richerson, 1993), at Puruba Beach, 52% and at Gamboa, Itacuruçá Island, 67% (Paz and Begossi, *in prep.*).

There are many fish food taboos among the *caiçaras*. There is an association of these taboos to different factors, such as carnivorous fish, toxic fish and medicinal fish . A study on Búzios Island by Begossi (1992), showed that carnivorous fish, such as bonito (*Auxis* sp. and *Euthynnus alleteratus*) and bluefish, are usually avoided as food when persons are ill; other fish are avoided because they are toxic, such as pufferfish (*Sphoeroides spengleri*) or because they might be toxic (*Gymnothorax funebris*). In this case, (as among other fish avoided at Búzios), there is an interesting coincidence among fish that have been known to cause *ciguatera* in other regions and the avoidances of *Buzianos*. *Gymnothorax* species have been found with ciguatoxin in some areas It might be an adaptive behavior conserved by *cultural inertia*, if in the past there were cases of ciguatera in the region, or it might be an adaptive behavior if there are cases of ciguatera in the region. There are no records or data on ciguatera at Búzios Island. Nevertheless, cases of ciguatera are usually known through information gathered among native communities (Lewis, 1984). The case of food taboos related to medicinal animals are exemplified by avoidances of ray (the eggs are used for hemorrhages) and especially of lizard (81% of *Buzianos* use lizard fat for snake-bites, among other uses).

Similar fish food taboos were observed in other *caiçara* communities (Gamboa, Puruba and Picinguaba), such as on pufferfish, catfishes, rays, sand drum and sharks, among others. Some taboos only occur in specific situations, such as avoidances during men or women diseases. Examples are the avoidance of ray, bonito, catfishes, mullets and sharks.

Plant uses reflect both Indian and Portuguese practices. Besides manioc growing and processing, many medicinal plants are non native herbs, commonly known, such as mint (*Mentha* spp.), spearmint (*Laurus nobilis*), wormwood (*Arthemisia absinthium*), cress (*Lepidium virginicum*) and pennyroyal (*Cunila spicata*). The medicinal plants most quoted in the *caiçara* communities studied (Figure 1) were avocado (*Persea americana*), orange (*Citrus sinensis*), *boldo* (*Coleus barbatus* and *Vernonia condensata*), balm (*Lippia citriodora*), fennel (*Foeniculum vulgare*), and wormseed (*Chenopodium ambrosioides*). On the other hand, most plants used for house and canoe construction are native trees, such as anjelywood (*Jacaranda* sp.), *aracurana (Alchornea iricurana)*, *guapurubú* (*Schyzolobium parahyba*), species of *Tabebuia* and of *Aspidosperma* (Begossi *et al.*, 1993; Figueiredo *et al* , 1993, Rossato, 1995). A relative loss of knowledge on medicinal plants was observed among the young generation of *caiçaras* of Búzios Island and Sepetiba Bay (Figure 1), showing a decrease in local cultural variability. Loss of variability represents a decrease in cultural and ecological resilience.

The knowledge of the *caiçaras* on natural resources includes more than just the use of animals and plants *Caiçaras* classify and name organisms; probably their ethnotaxonomy, as other features of their culture, is a mixture of old and new traits, which may be acquired through contacts with other fishers that come from outside, in a typical neo-traditional sense (Berkes and Folke, 1994). Begossi and Figueiredo (1995) found 115 folk fish species (corresponding to 105 species) and 73 folk species at Sepetiba Bay

(corresponding to 66 species) Binomials are an important part in the ethnotaxonomy of the *caiçaras*, ranging from 20% at Sepetiba to 35% at Búzios island This frequency corresponds to what is usually found for small-scale cultivators, which tend to have more detailed taxonomies than foragers (Brown, 1985).

As other neotraditional communities in Brazil, the *caiçaras* believe in forest guardians, the *caipora* or *curupira*, *mãe da mata* (forest mother), and *boitatá*; in spirits that protect the animals (*anhangá*), in spirits that protect reproductive animals *(Tapiora*) and spirits of the water, who punish too ambitious fishers (*Mãe d'Água*) (Diegues, 1994).

- **Technology:** fishing is performed with canoes (paddled or motor) and with different hooks and nets For example, from the southern coast of Rio de Janeiro State to the Northern coast of São Paulo State, we observe: motor and paddled canoes used with encircling nets for fish and shrimp at Gamboa, Itacuruçá Island; boats used with set gillnets at Jaguanum Island and Picinguaba; paddled canoes used with encircling nets at Puruba and Quiririm rivers, besides the beach seines used at Puruba Beach, paddled or motor canoes used with hook and line at Búzios and Vitória islands.

Since the study by Forman (1970), on a coastal population of northeastern Brazil, special attention was given to the local knowledge of local people concerning technology changes. Forman claimed that an innovation might be 'rationally' discarded due to local inappropriate features, such as on the non-adoption of boats by raft fishermen. Alexander (1975) pointed out that innovations without attention to the social context might be useless or unfruitful Many innovations suited to environmental conditions and beneficial to people tend to be absorbed by communities, as occurred with the *lambreta* at Búzios Island (Begossi and Richerson, 1991). The adoption of the *lambreta*, a jig to catch bluefish, at Búzios island shows that fishermen had a sharp perception on their needs and of the benefits of this jig. Technological changes from outsiders, without including the knowledge of the ecological and social context, as well as the demands from the community, have a high probability of failure. Innovations in ecological and cultural vacuums (Alexander, 1975) may decrease the resilience of a system (culturally and ecologically).

The Amazon Forest

Amazon supports about 20% of the world vascular plant species and 2,500-3,000 fish species (Bennett, 1992). The Amazon rainforest includes sets of different environments and vegetations, that ranges from dense forest to areas with sandy soils and sparse vegetation According to Prance (1978) the vegetation types of the Amazon include the non-flooded forest (*terra firme*), inundated forests, non-flooded and flooded savannas (on *terra firme* and on *várzea*, respectively), *campina*, montane vegetation, coastal vegetation and river beaches. The *terra firme* represents 85% of the Amazon, which includes dense forest with tall trees and large biomass, liana forests, low forests, *campina* (a low dense type of vegetation on white sand), and bamboo forests, among others. The *várzea* compreends periodically flooded areas by white water rivers and the *igapó* includes periodically flooded areas by black water rivers or the permanently flooded swamp forest

Some types of Amazon vegetation are the result of human practices, serving as indicators of past human activities Balée (1989) reviewed such vegetation types, which are the *babaçu* (*cocais*) forests, made up of *Orbignya martiana,* covering 197 thousands Km^2; forests including *Elaeis oleifera* (*caiaué*); forests with a high frequency of palms; the *campina* vegetation, with white sandy soil; *bamboo* (*Guadua* spp.) forests, occurring in 85 thousands Km^2, the *apête*, or forest islands planted by the Kayapó; forests of nuts (*castanhas - Bertholletia excelsa*), occupying 8 thousands Km^2, , and the liana forest (*mata de cipó*), covering about 100 thousands Km^2, which are considered to occur along with fertile soils.

Amazon diversity, especially in the *várzea*, is high, including about 250 species of plants per hectare (Prance, 1978). Setz (1993), sampling forest fragments close to Manaus, in Central Amazon, found 552 species, being important the families Leguminosae, Sapotaceae, Chrysobalanaceae, Lauraceae, Annonaceae, Moraceae, Lecythidaceae and Melastomataceae Salomão *et al.* (1995) sampled 21 sites of 1 ha each, in the States of Pará, Maranhão and Rondônia, and found 790 species of plants of 68 families (10 cm diameter at breast height); among these, 108 species included 20 or more individuals (3 palms), showing an enormous diversity.

Soils in the Amazon range from the fertile alluvial soils of the *várzea*, to oxisols to the poor sandy soils. As pointed out by Wambeke (1978), the most frequent soils in the *terra firme* are oxisols. Mammal distribution in the Amazon follow the edaphic and vegetation variability. Large areas covered by poor soils have a lower mammal productivity (Emmons, 1983). In a classical study, Fittkau and Klinge (1971) showed that the animal biomass in the Amazon is relatively small; in Central Amazônia it is 0.02% of the total biomass.

In 1968, the German limnologist H. Sioli classified the Amazon rivers as of white waters (*águas brancas*), such as the Amazon and many tributaries of the west and southwest; of clear waters (*águas claras*), such as Tapajós and Tocantins; and of black water (*águas pretas*), such as the Negro. Most white water rivers come from the Andes, having a high quantity of sediments in the water and forming the *várzea.* The Amazon *várzea* is known for having supported high density populations, due to their fertile soils and to a high concentrations of aquatic animals (McGrath *et al.*, 1993). Clear water rivers come from Guianas and Central Brazil being associated to oxisols (latosols). Black water rivers have a very low quantity of sediments, being associated to podzol soils (Sioli, 1985).

About 85% of Amazon fishes are from the superorder Ostariophysi, of which 43% are Characoidei and 39% Siluriformes (catfishes) (Bayley and Petrere, 1989) Amazon fisheries include both diffuse and large scale fisheries. The first occurs in small towns or among scattered riverine fishermen, including subsistence fishing. The second is practiced in large cities as Manaus and Belém (Figure 1). Among 32 fish species landed in the Manaus market in 1978, 72% were represented by four species: *tambaqui* (*Colossoma macropomum*), *jaraqui* (two species of *Semaprochilodus*) and *curimata* (*Prochilodus nigricans*) (Petrere, 1989). Descriptions of Amazonian fishermen and fisheries are found in Goulding (1979), Smith (1981) and Veríssimo (1895).

In Brazil, Legal Amazon includes nine States or 5 million of Km^2 Estimates of deforestation rates in the Brazilian Amazon have varied, because the methods and areas used for estimations also varied Data from 1991 showed about 10,5% of forest cleared (426,000 Km^2), almost the size of the State of California (Fearnside, 1993). According to Moran (1993), the conversion of land to pasture, mining and timber activities are the main sources of deforestation in the Amazon Cattle ranches, in particular, have been encouraged by Brazilian government policies, in spite of studies showing the environmental degradation related to them (Fearnside, 1979, 1980) Recent studies (Reiner *et al.*, 1994) have shown the consequences for the soil and vegetation of rainforest lands used for pasture. Shifting cultivation has a low impact because small areas are cleared and there is evidence of management of fallow periods by natives. Ranchers account for about 70% of deforestation (Fearnside, 1993).

The caboclos

Small-agriculturists, fishers and collectors represent the typical Amazon inhabitants. In 1948, J. H Steward described 'culture areas' in the Amazon including small-agricultors in the northern part of the Amazon river (*Guianas*), *Juruá-Purus*, southern of Amazon river and central Brazil (*Tupian*). Hunting and gathering was restricted to the western and southern margins of tropical forests (Meggers, 1975).

Caboclo culture has a subsistence based on small-agriculture and fishing. Like the *caiçaras*, the *caboclos* descend from both Indians and Portuguese, and to a lesser extent, they may have African influences. According to Moran (1974), the *caboclo* culture started with the Portuguese arrival (1500-1850), following a phase of acculturation and an extractive economy based on rubber (1850-1970: rubber-boom). Moran's study shows that the *caboclo* can be a rubber or nut collector, a horticulturist, a canoe paddler, a fisherman, usually earning a living from many or some of these activities.

Caboclo living is based on small scale agriculture with the cultivation of manioc, maize, rice, beans, water melon and papaya and fishing in the rivers, *igarapés* (small rivers) or *igapós* (flooded forest). River water level is usually an important aspect in the life of the *caboclos*, because their subsistence is managed and adapted to such conditions. When the water is low ("summer"), fishing is an important activity; when the water is high, in the wet season ("winter"), hunted animals tend to be important for subsistence.

Amazon includes different kinds of environments, and the *caboclo* living is closely tied to such environments This study is focused on riverine *caboclos* and small-agriculturists from the Tocantins River, the Extractive Reserve of the Upper Juruá and from the Transamazon highway

Local knowledge

Like the *caiçaras* the caboclos share a deep knowledge on their surroundings Perhaps differently from the *caiçaras*, the *caboclos* are more heterogeneous not only because of the high diversity of Amazon environments, but also because of the different degrees of interplays they have with society. For example, when studying the fishermen that live in the banks of the Tocantins river, I noticed a different relation to subsistence and to fishing technology Fishermen from cities such as Imperatriz (Maranhão State) used boats and nets for fishing, besides depending more on industrialized resources whereas more isolated riverine fishermen used hook and line and paddle canoes and practice small-agriculture. Therefore, a stronger or weaker dependence on natural resources may influence the contemporaneous knowledge of the *caboclo*. Naturally, there are different *caiçara* communities, but the degree of heterogeneity is higher among the *caboclo* communities.

- **Land cultivation**: like the *caiçaras*, manioc cultivation and the production of manioc flour are typical of the *caboclo* subsistence. Slash-and-burn techniques are used for cultivation and a variety of fruits from trees and from the high diversity of palms are collected in the forest One of the best examples of how local knowledge forms a basis for a successful living in the Amazon forest is given by studies by Morán (1977, 1979, 1990) among settlers of the Transamazon highway located close to Altamira (Pará State). In the seventies, southern (23%), northeastern (30%) and center-western (13%) migrants were, along with *caboclos*, the settlers along the highway in a Brazilian government program. In spite of the high credit given to southerns by the Brazilian Government the local knowledge of the *caboclos* made them more successful compared to the new settlers.

The high expectation of southerner success by the Brazilian Government was based on experience, residential stability, previous credits and initial capital (Morán, 1983). *Caboclo* choice of lands included the more fertile sites, which included plants associated with soil fertility (Morán, 1990), and their practices were the planting of manioc and tobacco in small plots, through the techniques of slash-and-burn. Southerners, on the other hand, cleared big areas to plant rice, maize and beans. Cattle were raised by them, whereas *caboclos* raised pigs and chicken. Besides the higher fertility of the *caboclo* sites, they also had lands with slower decrease in fertility than lands of the new settlers. The *caboclo* production was twice yield per hectare, and included a diversified cropping which allowed higher incomes than rice farming, less expenditure in consumption, greater use of local technology and of involvement of family labor (Morán, 1983).

-**Local knowledge on plants and animals:** a variety of plants are used by the *caboclos*, many of them used for medicinal practices (Amorozo and Gély, 1988). The heterogeneity of *caboclo* knowledge is noticed also in their use of plants. While there are communities with a detailed knowledge on medicinal plants, other communities seem to have lost part of this knowledge. In spite of 300 species mentioned as used by caboclos (rubber-tappers) of the Extractive Reserve of the Upper Juruá (Empéraire and Delavaux, 1992) , part of the practice on medicinal plants is being substituted by the use of industrial medicine. This is, at least in part, due to the activity of local politicians that in some

Amazon areas distribute medicines as part of political campaigns, pushing local people to depend on industrialized drugs and to stop using their traditional medicine. One of the projects developed at this Extractive Reserve was to restore the local knowledge on plant uses, using local people in health posts In these posts, people are trained to teach the cultivation and uses of local medicinal plants to the population.

Animals are an important part of the *caboclo* diet. In the dry season, fish is usually an important protein source, and in the wet season, game meat is essential. Game among Transamazon settlers included agoutis (*Agouti* sp.), paca (*Agouti paca*), peccaries *Tayassu tajacu* and *T. pecari*), deer (*Mazama* sp.) and tapir (*Tapirus terrestris)*, besides different monkey species (Smith, 1976). We observed that game was a very important protein source in the wet season at the Upper Juruá, when deer, peccaries, monkeys, and small-rodents were hunted (Begossi and Amaral, 1994).

The dry season (June-October) is the time of the fishing season. Fish consumption includes many catfishes of the Pimelodidae family (one of the most important Amazon fish family) such as *mandí* (species of *Pimelodella*, *Pimelodina* and *Pimelodus*) and surubim (*Pseudoplatystoma fasciatum*), Curimatidae (*Prochilodus nigricans*), as well as species of the family Anostomidae (*piau*). At the Upper Juruá, the Loricariidae (small fishes, with a hard body texture, locally called *bode*) are very important for consumption (Begossi and Braga, 1992; Begossi and Amaral, 1993).

Food taboos are part of *caboclo* culture. These prohibitions occur in relation to game and fish Tabooed fish or game are called *carregado* by both *caiçaras* and *caboclos*, *bravo* among some *caiçaras* and *reimoso* among *caboclos*. The meat of tapir, collared peccary, nine-banded armadillo and tortoise are strong taboos (*muito reimosos*); taboos are white-lipped peccary, paca, agouti, rabbit and monkeys, and game not tabooed ("clean", "mild") are deer, fowl, chicken and cattle (Smith, 1976).

The fish that are food taboos among *caboclos* of Itacoatiara (Smith, 1981) are, among others, pirapitinga (*Colossoma bidens*), matrinchão (*Brycon* spp) and curimatá. At the Tocantins River, Begossi and Braga (1992) found that many medicinal fish are avoided as food, such as species of ray, jaú (*Paulicea lutkeni)*, and poraquê (*Electrophorus electricus*), among others. At the Upper Juruá, *caboclos* use ray and traíra (*Hoplias malabaricus*) for medicinal purposes, which are also avoided as food (Begossi and Amaral, 1993).

Similarly to the *caiçaras*, the *caboclos* also avoid eating certain species of fish during illness. These are usually carnivorous fish, such as surubim, barbado (*Pinirampus pirinampu*), jaú and pirarara (*Phractocephalus hemiliopterus*), among others. Some of the taboos mentioned by Smith (1981) refer to this category, when the meat is classified as *carregada* or *reimosa*. The origin of this concept is, according to Smith (1981), still unclear, but it may be related to the Latin *rheum* (thick fluid) and to Hippocratic medicine. In reality, the same concept is used by both *caiçaras* and *caboclos*, communities geographically separated. The same relation among fish tabooed and medicinal fish or carnivorous fish is also found among both *caiçaras* and *caboclos* (Begossi, 1992, Begossi and Braga, 1992) The possible adaptation or pre-adaptation in avoiding carnivorous and

medicinal fish is a cultural behavior that might increase the resilience of communities, because people avoid eating the toxic fish and conserve the medicinal ones

Caboclos believe in animal spirits, such as *mães de bicho*, which steal the shadow of hunters that kill too many of each species. *Curupira* is a very well known Brazilian folk It is a forest guardian represented by a small man with feet turned backward who punishes hunters too ambitious, by attracting them to the forest till they get lost (Moran, 1974) These beliefs may serve as cultural rules that in practice function as conservation measures - an *etic* interpretation in Harris' (1976) terms.

Nature is also classified through an ethnotaxonomy. There are examples from ethnoichthyology (Begossi and Garavello, 1990; Morán, 1990) and ethnomedicine (Maués, 1990).

- **Technology:** the fishing technology diversity is high in Amazon and related to the different riverine communities Nets and cast nets are very common in the Amazon rivers, but a variety of jigs, harpoons (*arpão, zagaia, bicheiro*) and traps are found - explosives and piscides are also found (Goulding 1979; Smith, 1981). Since the beginning of this century, migratory species (such as species of *Semaprochilodus, Colossoma* and *Brycon*) were caught with seines (a Portuguese introduction) and bombs (Ribeiro and Petrere, 1990). Paddled canoes are an important technology for both fishing and transportation in the Amazon.

Cultural and ecological resilience of caiçaras and caboclos

Neotraditional populations may have, in some aspects, a higher resilience than Indian or more isolated communities, because of their cultural flexibility. The position of neotraditional communities fitted as Gleasonian boundaries (Figure 2), being more open or mixed up to society than Indian communities, allows them a higher flexibility. Because of a different culture, language and habits native Indians are less liable to communicate and absorb or react to society This is illustrated by the Brazilian Indian communities that 'survived', such as the Guarani, Terena, Guajajara, Tikuna and Macuxi and that show demographic increases in spite of more than 200 years contact. These societies, still maintaining an ethnic identity, show biological adaptations to diseases and cultural abilities in dealing with society, including political organizations (Gomes, 1988). Thus, the ability and flexibility of communities in interacting with the larger society are factors that may increase their cultural and ecological resilience

For both *caiçaras* and *caboclos* manioc cultivation and the process of producing flour is an adapted practice to soil and rain forest conditions, which comes from native Indians Their participation in local (sometimes family) markets by selling manioc flour guarantee other daily necessary items (clothes, matches, sugar, salt and so on) . Cash is also obtained by selling agricultural products (beans, fruits) and fish. Fish commercialization is a fundamental channel for cash in both Atlantic Forest coast and Amazon The change from agricultural to fishery products, among the *caiçaras*, responding

to market pressures in the fifties, increased their resilience because increased their chance of survival (a similar economic change was also observed for the riverine *caboclos* - McGrath *et al.*, 1993). Individuals that entered fishing activities had a better economic performance, which was followed by the other individuals of the community A higher resilience means a higher probability of 'community survival' (through individual behavioral strategies), and, apparently, neotraditional communities benefits from such economic flexibility. Therefore, market and society participation of *caboclos* is one form to increase their *cultural resilience*, along to behaviors that might increase their ecological resilience, such as techniques (traditional and neotraditional). The cultural behaviors that increase the ecological resilience of the communities of *caiçaras* and *caboclos* include their practices of diversified cropping, of increasing manioc diversities, of taboos and beliefs.

The *etic* reasons behind food taboos might be the conservation of species (Reichel-Dolmatoff, 1976) or to avoid overexploitation (such as avoidance of medicinal animals - Begossi, 1992; Begossi and Braga, 1992). Some *caboclo* beliefs seems close related to conservation and have even an *emic* significance in this sense. These are cultural behaviors that help increase ecological resilience.

The interesting aspects of these neotraditional populations, and what differentiate their resilience from that of Indian communities, are their ability to cope with a mixed culture, in which cultural traditions go along with innovations. Naturally, some innovations decrease cultural and ecological resilience. The loss of knowledge on nature use also decreases cultural and ecological resilience, such as the loss of knowledge on medicinal plants observed among *caiçaras* and caboclos of the Extractive Reserve of the Upper Juruá.

On the other hand, the ability of *caboclos* to cope with innovations is what permitted them to 'innovate' in the Amazon, dealing with different groups from society, such as politicians, scientists and government planners. Rubber-tappers create Extractive Reserves, an ecological novelty that should increase their resilience They are defined as "forest areas inhabited by extractive populations granted long-term usufruct rights to forest resources which they collectively manage"(Schwartzman, 1989). Economic evaluations on such reserves are found in Salafsky *et al.* (1993). Extractive Reserves are a form of common resource management following the definition by Gibbs and Bromley (1989) in which resources are managed by rules from the user-group and that uses are conditional upon the interdependent behavior of group members. When the rubber-tappers of the Extractive Reserve of the Upper Juruá started to work together with ecologists from Brazilian universities, they were trying to increase their probabilities to have a sustainable use of nature, therefore increasing their ecological resilience.

The maintenance of an ecological and cultural system is linked to the rules and rights that exists in a community, and to the mechanisms in which such rules are enforced and sustained. Cultural traditions, property rights and institutions are these mechanisms.

Property rights among caiçaras and caboclos

There are several cases of resource tenure systems in fisheries (Berkes, 1985) The first in recognizing the property rights of coastal Brazilian fishermen was Forman (1967), studying the secretion of spots among fishermen from Coqueiral (Alagoas State). Cordell (1978) observed the division of fishing areas among coastal fishermen from Bahia State. Lima (1989 *apud* Diegues, 1994) observed rules and division of spots concerning net fishing in the beach of Itaipu, Rio de Janeiro State

Among the southern *caiçaras*, informal family rights were observed concerning places to set gillnets at Búzios Island and concerning fishing areas used by artisanal fishers at Sepetiba Bay (Begossi, *in press* - a) Property rights of individuals, families or communities are an important condition for local management, because they depend on the exclusion of outsiders Groups are able to exclude users and to regulate joint uses (Berkes *et al.*, 1989). Contrarily to the *caboclos or seringueiros* (rubber-tappers) of Amazon, the *caiçaras* usually deal with that in a very informal way, without institutions or associations to maintain or defend these rights.

At Sepetiba Bay, fishers were active against intruders in the bay, involving the local politicians and the local press (Begossi, *in press* - a). Fishermen's tactics and strategies of fishing may be also influenced by territorial conflicts. Results from optimal foraging analysis on fishers (Begossi, 1992a) show that shrimp fishermen from Gamboa (Itacuruçá Island, Sepetiba bay) were leaving the patches (fishing grounds) later than predicted by the model, trying to get more shrimp out of each patch. Thus, pressure from industrial fishing may push local fishers to a less conservative behavior. It is difficult to evaluate if this behavior decreased or increased the ecological resilience of fishers from Gamboa. If fishers were just getting more shrimp, without overfishing, this was a form to react to industrial fishers, "marking their spots" and increasing their resilience, on the other hand, if this behavior led to overfishing (which it is hard to believe based on the yield from artisanal production), fishers were decreasing their ability to cope with perturbations coming from industrial fishing.

State interferences are also a form that interfere into neotraditional communities, changing their resilience. Many *caiçara* populations are located in parks (such as the State Park of Serra do Mar - *Parque Estadual da Serra do Mar*), in Biological Reserves (*Reserva Biológica Estadual da Praia do Sul*- Grande Island, Aventureiro) or Biosphere Reserves, where there are a set of State rules for fishing and for agriculture. One of this includes the prohibition of slash-and-burn techniques at the *roça* (Sales, 1994), observed in communities such as of Ponta da Almada and Vitória Island, among others. If the *caiçaras* cannot grow up their manioc, they would have to buy it in the markets along with other products. Therefore, they will need more cash available, through exploitation of natural resources or through tourism. In the first hypothesis, this may led to a decrease in their ecological resilience and in the second case, to an increase in their resilience.

Fishers from the Lower Amazon river have developed new management strategies for lake fisheries, involving the exclusion of outsiders and regulating fishing activities (McGrath *et al.*, 1993). According to the authors, territorial fishing in Amazon is

especially related to lakes, because they are important for subsistence, are enclosed bodies of water and because *caboclos* see a direct link between local fishing pressure and productivity Comparing with the *caiçaras*, the most organized form of territorial fishing (including conflicts) was observed in a bay (Sepetiba). Nevertheless, *caboclo* arrangements and organizations are more developed than of *caiçaras*.

Institutions of caiçaras and caboclos

The *caiçaras* are in constant contact with outsiders and with economic and cultural influences of the Brazilian society. Their economy, in spite of being based on the a petty commodity (Diegues; 1983, 1994; Sider, 1986) has capitalist features. For example, at Búzios Island the lineage system interacts with the capitalist system through the role of different buyers (Begossi, *in press* - b). *Caiçaras* have been always engaged in the economic cycles of the region (Begossi *et al.*, 1993), and have continually changing features, in spite of small changes observed in their life pattern. Neotradional societies are probably very good representatives of the Gleasonian concept of communities, because of their interaction with society in different degrees. *Caiçara* changes were also observed through their engagement in Pentecostal religions and associations. Even in very small *caiçara* communities, two or three different kinds of churches may be found (God Assembly, Christian Congregation, Adventists - Begossi, *in press* -b). The *caboclos*, on the other hand, followed a different pattern of institutional development.

Caboclos, influenced by the Liberation Theology and leftist parties, built strong political organizations and movements, that culminated in the common management of resources through extractive reserves. In the case of the Alto Juruá, State of Acre, communications channels among the scattered families along the Juruá river were fulfilled by the radio *Verdes Florestas*, which transmitted all kind of messages. Certainly, this was a primary condition for guaranteeing the local organization of rubber-tappers, which are integrated in their National Council The political organization and movement of rubber-tappers in the Amazon is an example that promoted an increase in their cultural resilience, followed by an increase in their ecological resilience, when the Extractive Reserves were created.

Those differences in institutional arrangements of the *caiçaras* and *caboclos* led them to follow different paths. While the *caiçaras* seem, with a few exceptions, like the fishers from Sepetiba Bay (Begossi, *in press*- a), not organized politically, or with just emerging organizations, the *caboclos* are extremely well organized and willing to defend their needs. The results are that *caboclos* seem more successful at least in not diminishing the resilience of their cultural and ecological systems. Extractive reserves, are a form to diminish disturbances, while trying to increase the resilience of the systems in a neotraditional way, including non-voluntary and voluntary ecological, economical and cultural changes. Non-voluntary changes are the ones which occur as a consequence of the contact with society; the voluntary changes are the result of organized contacts with part of the society in order to improve the management on the use of natural resources.

Outcomes

In spite of their geographical separation, *caiçaras* of the Atlantic forest coast and *caboclos* of the Amazon have many interesting points in common regarding the knowledge of the tropical forest environment and to cultural rules. In spite of a higher heterogeneity of the Amazon environment compared to the Atlantic forest, both are high diversity environments and top priorities for conservation.

Properties rules were observed for both *caiçaras* and *caboclos*, but their *outcomes* are completely different. The institutional arrangements of *caiçaras* and *caboclos* involved different interactions to society, leading probably the *caboclos* to an increase in their resilience through their political organization.

The outcome of the *caboclos* is the creation of Extractive Reserves and alliances with native Indians, including meetings of the Forest People (*Povos da Floresta*) Extractive Reserves were conceptualized and formed by the rubber-tapper movement, which achieved international status through their organizations, reinforced after the killing of one of its leaders, *Chico Mendes*. Extractive Reserves are an innovation and a tentative for the local management of resources.

The Upper Juruá Extractive Reserve was created in 1990, and efforts of the rubber-tappers, associated also to researchers, culminated in a preliminary management plan in 1994. These efforts include sets of different projects, related to biodiversity, social-economy, local knowledge (Cunha *et al.*, 1993, 1994), education and health

The creation of Extractive Reserves included heavy changes in the local economy, because land has to be given to rubber-tappers, breaking down the old system of economic exploitation between the rubber-tapper (*seringueiro*) and the landowner (*seringalista*). Description of this system is found elsewhere (Rancy, 1986). The creation of such reserves involved conflicts with local politicians and with landowners, as well as the creation of a new economic system for the reserve inhabitants in order to put in practice a common and local management of resources. It is a challenge that depends on people to be locally organized in order to defend their resources and to exclude outsiders.

Caiçaras lack genuine political organizations and the different political patterns of *caiçaras* and *caboclos* created different forms to deal with natural resources. Naturally, the extractive tradition in the Amazon was a first step that associated with new ideas and organizations led to the Extractive Reserves. On the other hand, the *caiçaras* remained strongly tied to tourism, and, being influenced by Pentecostal doctrines, ended more isolated and less flexible (culturally speaking) than the *caboclos*. The creation of Extractive Reserves in the Atlantic Forest or of any local resource management institutions will depend on preliminary steps in order to build local political arrangements among the *caiçaras* towards natural resource management.

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