

Community management of floodplain lakes of the middle Solimões River, Amazonas State, Brazil: a model of preservation in transformation

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Introduction

This article deals with the transformations and adaptations undergone by a general preservation model for lakes and their fisheries stocks that was adopted in the middle Solimões region, Amazonia, Brazil, focusing on the experience in three member communities of the Preservation and Development Group (GPD). This general model has been dispersed in the area of the Tefé Archdiocese by means of the Catholic Church's work in forming base communities beginning in the 1980s, and consists basically in the delimitation of lakes controlled by the communities (categorized as lakes of maintenance and of procreation) and of open or free lakes.

At the same time, this work seeks to analyze the interaction among different variables—internal and external, social and ecological—in these communities, and understand how this interaction defines the possibilities and the scope of these transformations and adaptations as well as the survival of the initiative for controlling community lake access and use and avoiding the degradation of the lakes' fisheries stocks.

This work presents preliminary data of research in progress that make part of a largest Project named ACRI (Amazon Community-Based Resource Management Research Initiative). Thus it is an early reflection on some of the issues that have oriented the research. Among the issues, noteworthy are the practical problematics of a natural resource management model based in a “subsistence ideology” in socioeconomic terms, and in a “preservationist” perspective, in ecological terms.

1. Preservation of lakes in the Middle-Solimões River

The middle Solimões region, in the state of Amazonas, Brazil, has been the stage, in the past 20 years, of the emergence of dozens of local community-management initiatives concerning lakes and their fisheries resources. Two complementary dynamics, though opposite, have led to the appearance of these management initiatives: a) the action of the Catholic Church in the formation of base communities and local leadership, influenced by the concepts of Liberation Theology, and b) the increase in pressure on fish stocks, provoked by the growth in demand from regional urban centers, especially Manaus, with the creation of its industrial axis and commercial zone.

Riverine populations in the middle Solimões region have historically alternated economic strategies that combine extractivism and agriculture. In terms of fisheries resources, artisanal fishing of pirarucu (*Arapaima gigas*) was for a long time one of the most important activities. The caught and salted pirarucu was sold to patrons, who in exchange furnished provisions and work material—characteristic of the patronage system, which still persists in the region, although weakened. The fishing of pirarucu, however, was carried to the point of resource exhaustion in many of the region's lakes by the early 1970s.

It was roughly in this period that the two dynamics mentioned above gained strength. The Catholic Church was present in the middle Solimões from the beginning of colonization, and in a more organized way starting in 1897 through the work of the “espiritano” priests (the parish of Tefé, however, having been founded in 1759), but it was not until the 1960s that it focused energy on building communities in the region’s rural areas (Lima, 1997). The Community Education Movement (MEB) was founded in 1963 in Tefé, and in the following year began work with adult literacy. As time progressed, a project of leadership formation was incorporated into the literacy work, and eventually the Pastoral Council added its support to create Christian Base Communities (CEBs).

In the 1970s and 80s, families that lived isolated on the banks of the region’s rivers and lakes also began to be joined together in communities. Following the precepts of Liberation Theology, these communities were caused to reflect not only on spiritual issues, but also on material issues that generated poverty and exploitation. Liberation Theology preached that the Catholic Church should opt in favor of the poor and fight with them against injustice in resource distribution.

In the area of the Tefé Archdiocese, which includes the counties of Tefé, Itamarati, Carauari, Juruá (Caítaú), Jutaí, Fonte Boa, Uarini, Alvarães, Japurá (Limoeiro) and Maraã, with a population of around 200,000 and a land area of approximately 250,000 km², the application of Liberation Theology principles contributed to the emergence of a consistent lake-preservation movement.

With the decadence of pirarucu fishing in the areas nearest to Tefé, the region’s primary urban center, riverine populations returned to subsistence agriculture and agro-extractivist activities. In this period, fishing in the region went through an important transformation process, motivated not only by the introduction of new fishing technologies such as the use of nets and ice, but also by the presence of large boats (*geleiras*) originating in Manaus and Tefé, dedicated to commercial fishing (activity that was encouraged by the Federal Government beginning in the 1970s through incentives for equipping the fishing fleet and greater availability of refrigeration in Amazonia). Thus the communities watched fishing intensify in the floodplain and *terra firme* lakes, and perceived a drastic reduction in their fish stocks. Hence, conflicts arose between floodplain residents and commercial fishermen (Barthem, 1999a).

The perception of a scarcity of fish for family subsistence was channelled into discussions in the CEBs, and the lake preservation movement was encouraged and supported by the Catholic Church, especially by Brother Falco (*espiritano* priest), responsible for the Pastoral Council of the Tefé Archdiocese and great enthusiast and spokesman for regional lake preservation.

We can identify three phases in this lake preservation movement:

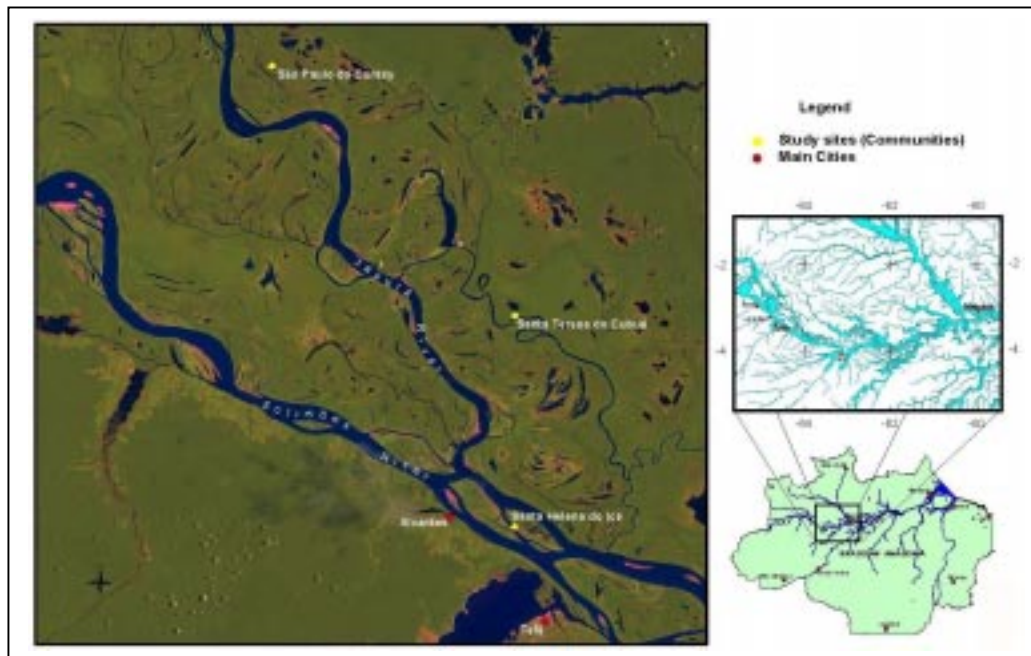
- a) Pioneering fase: Marked by the physical presence of Brother Falco, this phase lasted from 1980 to 1986, the year of his death. The first experiences began to arise in 1982, when the bases of a preservation model were launched, to be spread into every archdiocese as time passed.
- b) Expansion period: Even with the death of Brother Falco, the preservation movement continued moving forward with the support of the Tefé Archdiocese and its support bodies, among them the MEB, the Pastoral Council, and the Land Pastoral Commission (CPT), reaching a larger number of communities. This phase lasted until 1992, when the Preservation and Development Group (GPD) was created.
- c) GDP action: The communities involved with preservation sought an organization independent from the church, and during the discussions generated by ECO 92, decided to create the GPD. Currently the GPD brings together 26 communities from Tefé, Alvarães, and Maraã counties. This phase was characterized by attempts to promote changes in the initial preservation model in an effort to link preservation efforts with a financial return for the communities.

2. The GPD and the assembling of the communities

According to the registry of the Tefé Archdiocese, through its legal advisory, more than 330 preserved lakes exist in the 10 counties that comprise its area of influence. These lakes are classified as lakes of procreation and maintenance. The communities linked to the GPD, however, are involved in preserving 45 lakes and streams, 14 being classified as for procreation and 31 as for maintenance or subsistence. Sixteen communities are located on the banks of lakes and streams of *terra firme* areas, 7 in floodplain regions, and 3 in transition areas between floodplain and *terra firme*, in which families develop utilization strategies for both environments. Eight communities are located in Tefé County, and the others in neighboring Alvarães (9), and Maraã (9) counties. Families total around 440, with approximately 2,300 individuals.

Created in 1992, the GPD continues to have the Catholic Church as its principal support, by means of the Tefé Archdiocese. As such, pursuing autonomy in the process of assembling communities linked to lake preservation, separating evangelism activities from those related to natural resource management, seems to be a challenge, especially in the sense of coordinating communities in which the Church does not have a strong presence or in which the presence of other religious groups is predominant.

Figure 1. Location of communities in the study, in relation to the cities of Tefé and Alvarães



For the communities, an external challenge has also appeared with some force in the past two years: the increase in squatting by fishers from other areas, and the immobilization of community families who are often associated with external fishers and interested in the relaxing of rules concerning lake access and use control. Of the 26 communities affiliated with the GPD, at least 16 have records of squatting in the past two years. These communities are located primarily in floodplain regions or in proximity to large *terra firme* lakes.

Three communities were selected for deeper field research. These communities are located in floodplain areas. They are:

- a) Santa Helena do Ic : This was the first community to be involved with the lake-preservation movement in the region, in 1982, and one of those that confronts greatest

- external pressure concerning resources, with a high number of squatters recorded in 1998 and 1999.
- b) São Paulo do Coracy: Preservation activities began in 1986. In 1999 the community had its first experience with a planned fish harvest (*despesca*) in one of its preserved lakes.
 - c) Santa Tereza do Cubuá: Despite having begun preserving its lakes in the mid-1980s, the idea was abandoned. In 1992 the community returned to preservation, now under direct guidance by the GPD. Residents held a *despesca* in 1998.

These three communities are located near the city of Tefé (Figure 1), situated approximately 600 km from Manaus, in Brazilian Amazonia. The Solimões and Japurá rivers are the principal rivers that bathe the region's floodplains. These plains possess a mosaic of water bodies, which branch in connection with the rivers, forming lakes and streams in the region's remote floodplain areas.

3. Characterization of the study areas

3.1. The floodplain of the middle-Solimões

The floodplain is characterized by a system of wet periods (which last from March to July) and dry periods (from July to February), generating a water-fluctuation amplitude of approximately 10 meters each year. This seasonal fluctuation is a consequence of the also seasonal distribution of rains in the region. During the wet period, water fills the floodplain forests, and fish are spread throughout the forest floor, supplying a large stock of food. As the water level diminishes at the end of the season, forests are drained and lakes are formed, where the fish remain concentrated throughout the entire dry period. It is these permanent lakes that are the targets of the management systems of the communities under study.

The principal features of the floodplains in this region are the seasonally swamped forests, also called *igapós*; the open water bodies or lakes; and the open palm swamps, which exist in lowland areas (lower than the swamped forests), are permanently floodable, and have dense vegetation.

The swamped forests have so thrived in the floodplain that their total extent is probably greater than that of the lakes and palm swamps, attaining around 100,000 km² or more, if one includes forests around small streams (Goulding, 1997). This type of forest may be swamped from 3 to 11 months per year, depending on the local topography and the intensity of annual floods. In general, the seasonal inundations cover vast extensions of the floodplains during an average of 4 to 7 months per year. Swamp vegetation attains heights comparable to *terra firme* vegetation, despite having a different species composition. This type of swamp is an extremely important roe habitat for the majority of Amazonian fish species, because it furnishes considerable food as well as shelter to the young and mature individuals (Goulding, 1997).

The majority of floodplain lakes are formed by the seasonal inundation. During the flood, lakes link together, forming an enormous blade of continuous water. In the dry season after the draining of the waters from the swamped forests, it is possible to discern the limits of floodplain lakes. In this period, the great majority of aquatic animals have two options: migrate to the floodplain lakes or to the river channels. Neither of these environments offers sufficient food to the animals, however, which in the wet season are rarely found in the open areas of the lakes. Aside from the lack of food, fish also confront a lack of oxygen in the dry season as well as a high concentration of predators in the lakes (Henderson, 1999).

3.2 The communities of Santa Helena do Icé, São Paulo do Coracy, and Santa Tereza do Cubuá

The communities of Santa Helena do Icé, São Paulo do Coracy, and Santa Tereza do Cubuá present some common characteristics as well as aspects that differentiate them. The three communities are located in floodplain areas and were created in the process of formation of CEBs by the Catholic Church in the area of the Tefé Archdiocese. The three are involved in the lake management process and are affiliated with the GPD. Despite these and other common aspects, they also present important differences and have attained different results in their efforts to control access to and use of the lakes they preserve.

We may say that the communities of São Paulo do Coracy and Santa Tereza do Cubuá are presently experiencing greater success in their management initiatives concerning the lakes and their fisheries resources, whereas the community of Santa Helena do Icé, which was for many years taken as a regional model of preservation, has in the past two years witnessed the dissolution of its control strategy for Icé Island's lakes, which included the participation of other nearby communities, and become unable to deter squatting by fishermen from Tefé and the degradation of local fish stocks.

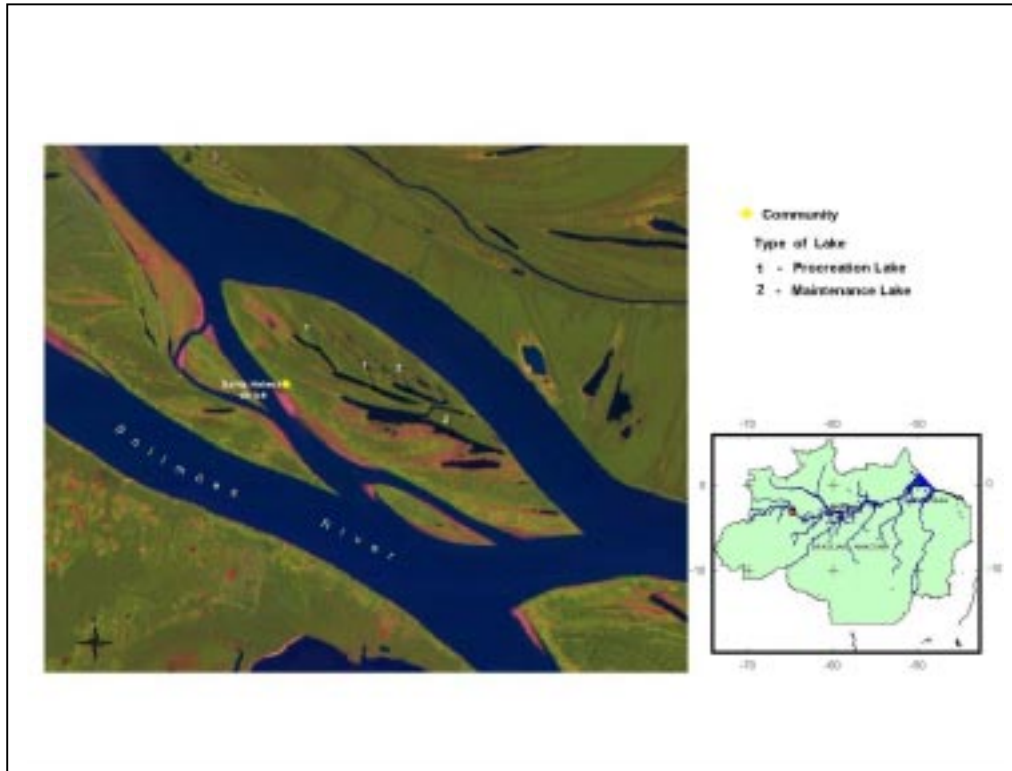
The community of Santa Helena do Icé is located on the Island of Icé, at the confluence of the Japurá and Solimões rivers, in Alvarães County (Figures 1 and 2). The first generations of current community residents arrived on the island in the 1930s and dedicated themselves mainly to the fishing of pirarucu. The patronage system defined social relations. In the 1940s, cattle raising was introduced onto the island, taking advantage of the natural grassland. Cattle were raised for milk and as savings for the families settled there. In the 1950s, jute cultivation was introduced, which lasted until 1980, when it stopped being planted. The planting of jute caused problems for raising cattle, which went out of practice in the community in the early 1970s. In this period, pirarucu fishing also went into decline, due to the difficulty in finding the fish in the island's lakes. With the decline of jute in later years, island residents began to dedicate themselves to agricultural activities, especially the planting of bananas. Manioc, beans, vegetables, and some floodplain fruits were also important in this phase.

The lake preservation initiative on the Island of Icé began at the end of 1982. Initially, it involved the island's residents, without any community yet having been formed. The work of community formation accompanied development of the preservation movement, when the communities of Santa Helena (1986) and São Joaquim were formed. There are four preserved lakes: Cacau and Icé (procreation) and Furado and Urubu (maintenance). In 1989, in a sectorial meeting of the Community Ecclesiastical Organizations of the Pananin¹ Sector, it was decided that all of the sector's communities would assume the preservation initiative for Icé Island's lakes. Along with Santa Helena and São Joaquim, seven more communities were integrated into the process. Some members of the community of Santa Helena, however, were always at the forefront of the work. The sectorial meetings were the principal deliberative forum concerning lake management. As such, the work of evangelization became confused with that of strengthening the base communities with collective action for controlling island lakes.

The pressures exercised against the preservation of island lakes were strong and squatting occurred continually, despite a guard that was established. In 1998 and 1999, occupation by armed groups of up to 60 people was recorded, the squatters having come from Tefé with support from residents of the island itself. These instances resulted in a destabilization of the preservation movement and in the exhaustion of the island's fisheries resources, after 15 years of prohibition of commercial fishing. Santa Helena's residents, now reduced to 5 families, await the end of the flood to evaluate whether or not to continue with preservation, restricted to the lake of Cacau, closest to the community.

¹ The Archdiocese of Tefé organized the CEBs in sectors, joining up to 10 communities within a single area.

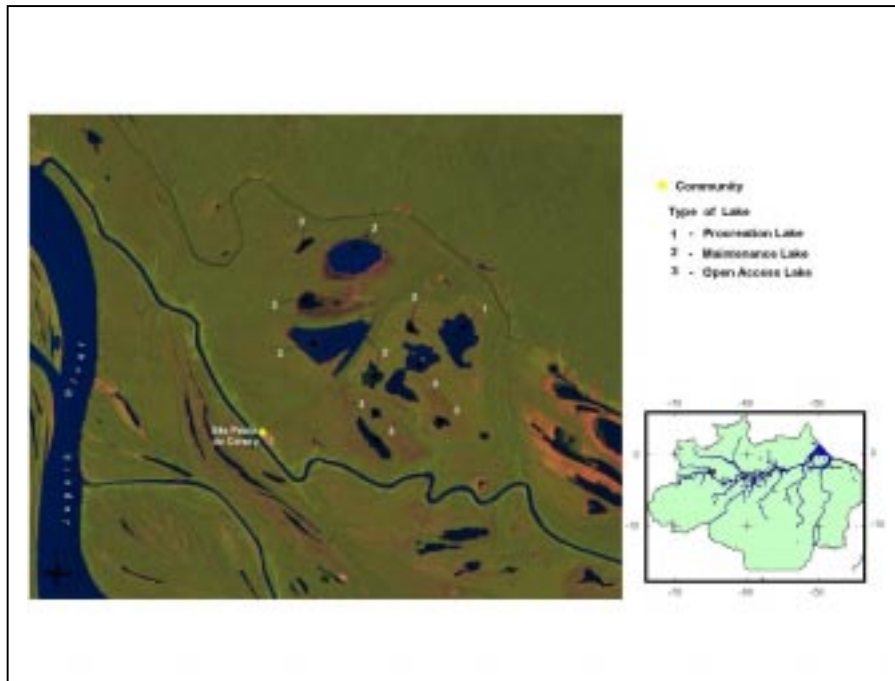
Figure 2. Island of Ic e and the community of Santa Helena



Located on the banks of the Coracy River (Figures 1 and 3), Mara  County, the community of S o Paulo do Coracy has preserved three lakes since 1986. They are Itu  (procreation) and Campina and Tambaqui (maintenance). Campina Lake, however, has been informally preserved for around 40 years, through the initiative of one of the residents of the area who did not permit people from other areas to fish in Campina Lake. There exist about ten so-called “free lakes” in the community’s proximity, used for commercial and subsistence fishing by the families of S o Paulo do Coracy and of neighboring communities.

The first residents arrived in the 1930s. They were involved with extractivist activities (rubber tapping), hunting for hide sales, and agriculture, in an economic system also dominated by the patronage system. In summer, the principal economic activities were rubber tapping and the production of manioc flour, and in winter, the fishing of pirarucu. In the 1970s, jute was introduced, entering into decline in the early 1980s. From the mid-1970s, fishing gained importance for local residents. In the same period, large, commercial fishing boats began activity in the area, making use of ice and nets. In 1985, banana planting was introduced, which became the community’s principal source of income until 1999, when a large flood destroyed the banana plots. With the difficulties of banana planting, fishing activity was intensified.

Figure 3. Community of São Paulo do Coracy



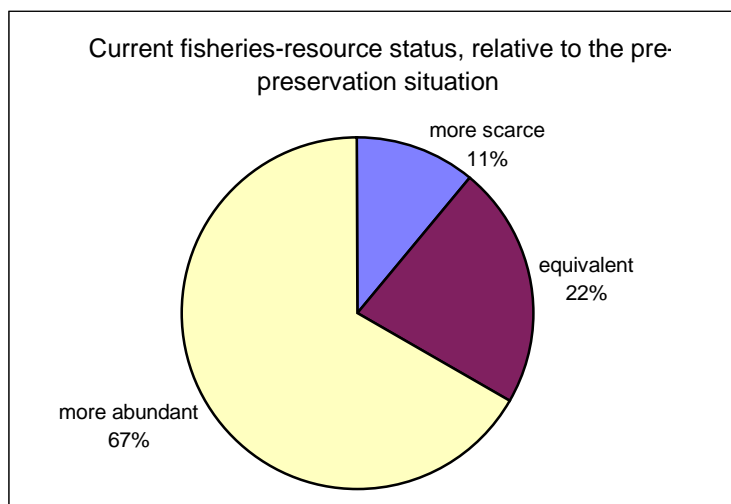
The community of Santa Tereza do Cubuá is located on the banks of the Cubuá River (Figure 1), Maraã County. It is the largest of the communities in the study, with 38 families, totalling 178 individuals. It contains two preserved lakes: Galçal (procreation) and Marumaruá (maintenance). The first residents arrived in the 1910s. As in the other two communities, the economic activities were historically distributed among agriculture, fishing, and livestock raising. In recent years, however, fishing has assumed a predominantly subsistence character, mainly due to the income obtained through banana raising. The flood of 1999 also destroyed these banana plots, provoking serious difficulties for the residents.

The community was created in the 1980s, when the first lake preservation initiative began. The Church's presence in this community is lesser than in the other two. After some time, preservation was discontinued and the work of community organization also entered into decline. Only in the beginning of the 1990s did the families return to organizing themselves as an association and seek support from the GPD for reassuming preservation and deterring the constant arrival of fishers from other communities and even from the city of Tefé for fishing in the community's lakes.

The three communities employed systematic and collective patrol of the preserved lakes, especially in the periods in which squatting tends to increase, such as the period in which waters are ebbing. In the three cases, however, the systematic watch is not currently being kept. In São Paulo do Coracy and in Santa Tereza do Cubuá, regular visits are made to the lakes to track the presence of fishers in the lake.

A common point among members of the communities in the study is the perception that the management initiative has contributed to the preservation and/or recovery of local resources. This positive perception goes beyond fisheries resources, reaching also timber and wild game, which shows that the lake management process had the effect of influencing a concern with the conservation of other natural resources.

Graphic 1. Perception of the community members of São Paulo do Coracy concerning effects of the lake management initiative.



In the communities studied, according to residents' perceptions, the management initiative has succeeded in increasing fish stocks, principally in the preserved lakes. In the communities of Santa Helena and Santa Tereza, 100% of those interviewed responded that the fisheries resources are more abundant now than before the management. In São Paulo do Coracy (Graphic 1), 67% of those interviewed find that the fisheries resources are more abundant, the other 33% being individuals dedicated to commercial fishing. For this type of activity, they have to compete with other users in the free lakes. In all the communities investigated, 100% of those interviewed who perceive a greater abundance in fisheries resources relate this increase in fish stocks to the lake preservation management process.

4. A management model in transformation

The lake preservation model disseminated by the Catholic Church beginning in the early 1980s embodies basically preservationist characteristics. That is, it encourages the non-use of resources, reinforcing the idea that for them to be preserved it is necessary that they be maintained untouched. And even when used, resources must be taken only at the subsistence level, thus contributing to the definition of another notable characteristic of lake management in the middle Solimões. Starting with this model, the communities that were integrated into the movement in turn defined their usage lakes in three categories:

- a) procreation lakes, in which fishing is not permitted (also called "sanctuaries");
- b) maintenance lakes, in which fishing is permitted exclusively for the subsistence of community families; and
- c) free lakes, where access to the resource is not regulated by the community.

The communities defined the status of each one of their lakes, basing the separation on characteristics of accessibility, size, and productivity, among others. The lakes of lesser accessibility were generally chosen as lakes of procreation. As they were more difficult to reach, they would be more protected from squatters and from their own community members. These lakes would serve as fish reproduction zones, for the repopulation of other lakes and flooded areas in the wet season, so as to keep fish stocks from diminishing to unsustainable levels.

The choice of maintenance lakes, however, seems to have been influenced more by the availability of existent lakes in proximity to the communities. Normally they are larger than the procreation lakes and should, in principle, answer to the subsistence needs of the families. Entry

into maintenance lakes is prohibited for fishers from outside the community, and even members of the community may not practice fishing with a commercial character in these lakes. These measures were intended to reduce pressure on fish stocks in these reservoirs.

Commercial fishing may only be practiced in free lakes, to which access is not controlled. As such, community members who fish with the objective of marketing the product must compete with other users in the lakes over which the community does not exercise control.

In one sense, the definition of this lake management model answers a concern for the guarantee of the subsistence of the families that formed the recently-created communities. As we saw previously, the formation process of the region's rural communities was associated with the emergence of these initiatives for controlling access to the lakes. Thus, participation in the preservation movement created a possibility for collective action among families, strengthening the recently created community ties.

In another sense, however, the definition of this general preservation model did not answer the exclusive concern with subsistence. In truth, it could be understood as a strategy for legitimizing the control that residents wanted to exercise over the lakes and a justification for excluding other users. The "subsistence ideology" ends up acting as a mechanism for reducing conflicts with commercial fishers, with whom community members compete for the fisheries resources.

In studying lake management in the lower Amazon floodplain, McGrath et al. (1999: 67-68) defined two different strategies of fisheries resource use. For small producers, in which fishing is artisanal, for subsistence, and integrated with other economic activities (principally agriculture) it is more important to have high fishing productivity, by which they can spend less time to guarantee their basic animal-protein needs. The logic of the commercial fishers, on the contrary, emphasizes production over productivity:

In the managed lake, management is oriented toward subsistence, although some commercial fishing is permitted.... The higher-productivity fishery required by artisanal fishers and smallholders contributes to total production in several ways. Fishing provides a regular source of animal protein for family subsistence. The sale of fish products provides cash income for basic household needs during the growing season, and any surplus income can be used to pay for day labor, seeds, and other agricultural expenses.

In the middle Solimões region, even though we can identify strategic differences between commercial fishermen and the families that preserve the lakes, and that this conflict of interest pressures community local management initiatives, it is possible to identify some factors of differentiation in relation to the general model adopted in the lower Amazon:

- a) Even in the maintenance lakes, intended for subsistence fishing, fishing activity is small. Fish for daily food is normally taken from other reservoirs. Individual fishing in maintenance lakes is normally discouraged, and the difference between these lakes and the procreation lakes is marked principally by the sanctuary status given to the latter. The maintenance lakes are not untouchable, but do not represent, in the communities under study, an important source for families' subsistence. Unlike in the floodplain region of the lower Amazon, commercial fishing is not permitted on the part of individuals. We perceive here the influence of the "preservationist" component of the management model adopted in the middle Solimões.
- b) On the other hand, the perceived benefits of preservation are calculated principally in terms of the presence of large quantities of fish with high commercial value, such as the pirarucu and the tambaqui (*Colossoma macropomum*). It was these fish that were most pressured by predatory fishing. And the increase of the quantity of these fish confirms, to

- the communities, the validity of their efforts in managing the lakes. At the same time, they constitute potential sources of economic return to the communities.
- c) Commercial fishing, when practiced by families involved with the preservation movement, occurs in the “free lakes” and in river beds. These families adopt philosophies identified with the small producers (high productivity) for the lakes that they preserve and with the commercial fishers (high production) for the other lakes.

It is necessary to emphasize that opposition to the control of lakes also occurs internally, among the members of the community as well as historical residents of the areas in which initiatives for control of reservoir access and use emerge. The definition of a simple management model fulfilled two functions at the internal level: It facilitated the monitoring activities and did not require technical knowledge or inversion of external financial resources for its implementation. The communities, as such, were able to develop a certain degree of autonomy in the management of their lake management initiatives. This autonomy, as we will see, brought about transformations of the general model and adaptations by the communities in response to specific challenges and opportunities that arose in their different circumstances.

Finally, the simplicity of the basic rules that defined the general preservation model adopted in the middle Solimões region seems to have contributed decisively to its rapid dissemination throughout the area of the Tefé Archdiocese, being transformed into a pattern for conflict resolution among users of the region’s floodplain and *terra firme* lakes. The model became recognized by public bodies, such as town governments and IBAMA (the Brazilian Institute of the Environment and Renewable Natural Resources).

4.1 The adaptation of the general model by communities

The original preservation model, whose basic characteristics still persist, ended up constituting an incentive for the underutilization of the fisheries resources. The prohibition of commercial fishing and the existence of other reservoirs for subsistence fishing resulted in the loss of the lakes’ immediate importance to the communities. The lack of a perceived direct result of preservation efforts, one that would build on the initial perception that fish stocks had increased considerably after exercise of control began, created problems for continuation of management initiatives and brought some communities to rethink their model of resource utilization.

This process of adaptation of the general model by communities did not completely solve the need for more practical results of preservation efforts. Socioeconomic and environmental factors began to exert pressure on the initially established model, which was being transformed in response to the communities’ needs, desires, and perceptions. On the other hand, the initiative to control access to and use of fisheries resources ended up influencing other economic activities and the use of other natural resources as well.

Communities transformed the general preservation model in three identifiable ways:

- a) to allow more flexibility in the commercial use of managed fisheries resources;
- b) to create a more complex system of resource use rules; and
- c) to integrate other natural resources into the preservation process, with the emergence of control initiatives for access and use of resources such as hunting and timber.

It is possible to accompany the process of these transformations by taking as example the community of São Paulo do Coracy. Prior to the introduction of the preservation process, the families who lived in the area practiced commercial fishing in all the nearby lakes. Fishing and agriculture were always economically important activities. Upon the start of the preservation process, communities refrained from fishing in procreation lakes and reduced fishing in maintenance lakes, including subsistence fishing. The flood of 1999 (the largest flood since 1953), however, damaged agricultural activities, especially banana cultivation. Without

agricultural products to sell, the community decided to relax rules against commercial fishing in one of the maintenance lakes (Campina).

Beginning with a community decision, the families organized a harvest (*despesca*) of the lake, collecting 1,316 kg of tambaqui. This *despesca* permitted the payment of the community's debts and the survival of community members during that period. Another *despesca* is being prepared for this year. In this example, the drastic variation in flood level combined with the transformations in the original management model to create a situation in which the community decided in favor of commercial use of fisheries stocks in their preserved lakes. Even before the flood, however, the community was already studying how to take commercial advantage of Campina Lake's fisheries stocks (and in fact had already made an unsuccessful attempt to do so). Of note is that the *despesca* followed some rules:

- a) the fishing was restricted to tambaqui, fish with high commercial value in the region;
- b) only fish considered adult were taken from the lake;
- c) the *despesca* was done by the members of the community itself, working in a joint effort; and
- d) the resources obtained with the activity were returned to the community for the payment of a loan, for the purchase of a boat and a motor, and for the paying off of family debts with the community association, with only the remaining portion being distributed among the men who participated in the *despesca*.

Another innovation made by the community of São Paulo do Coracy was an agreement regarding the fishing of pirarucu. By this agreement, fishing of pirarucu is permitted in Campina Lake, since it is perceived that there is a "real need," as much for the individual as for the community. The individual who obtains approval to fish pirarucu must return 2/3 of the profit to the residents' association, money that is normally utilized for the purchase of fuel for the light generator. Even having obtained approval for pirarucu fishing, the fisher must limit the quantity of fish caught to that which was established by the community.

The community of Santa Tereza do Cubuá also held a *despesca* in 1998. The fishing also was restricted to tambaqui, with care taken to avoid smaller fish. The resources obtained (with the sale of the 3,290 kgs of fish caught) were distributed among the families of the community, with a percentage returned to the residents' association. On the Island of Ic e, the process of opening of the lakes to commercial fishing was marked by an intense conflict of interest among the communities of Santa Helena and S o Joaquim, and is identified by residents of Santa Helena as one of the motives for weakening preservation on the island, which would open doors to future squatting.

Having defined procreation and maintenance lakes, the communities began gradually adopting other rules of fisheries resource use, in agreement with the needs and perceptions of the communities. Frame 1 exemplifies this process in the community of S o Paulo do Coracy. The new rules were intended mainly to regulate the periods of permitted fishing and the materials used for it in maintenance lakes, and around the communities during flood periods.

In S o Paulo do Coracy, the community recognized that it was not enough merely to preserve certain lakes, but that in the wet season the flooded forest areas are of great importance for fish, so fishing with nets was prohibited in such areas within the community.

The process of preservation of lakes and fisheries resources ended up influencing the preservation of other natural resources. As an example of this transformation, we may cite the community of Santa Tereza do Cubu a, which over time adopted rules for controlling hunting and wood extraction within the community area, and delimited a nesting zone for birds, denominated "Passaral," to be a sort of ecological sanctuary where any type of anthropic action is prohibited.

Frame 1. Rules and agreements for natural resource use defined in assemblies by the community of S o Paulo do Coracy.

Rules and Agreements	Year
Guard to be kept over preserved lakes	1993
Fishing for market sale prohibited in the community area during the flood season	1993
Large-mesh net fishing prohibited in maintenance lakes unless previously approved by the community	1994
Large-mesh net fishing prohibited in the community area during the flood season	1996
Extraction of wood for market sale prohibited in the community area unless previously approved by the community	1996
Construction of a new access route to Campina Lake and abandonment of an older route, to deter intrusion by squatters	1999

In Santa Helena do Icé as well, the community decided to prohibit hunting and wood extraction for market sale within the community area, through the influence of the preservation process. In São Paulo do Coracy, among other initiatives, steps toward reforestation were taken in some areas with trees of wood considered noble.

5. A political ecology of the preservation movement

This study of three communities involved with lake management in the middle Solimões region points to complex relationships among endogenous and exogenous factors and ecological characteristics, which together determine the different results reached by individual communities in preservation of fisheries resources.

A significant gap in the common-pool resource theory is the inadequate emphasis given to the influence of dominant socioeconomic processes in a society over local initiatives to restructure natural resource management. In focusing on the institutional development process, on creation of rules and norms of resource access and use, and the factors that carry this process to success, the opportunity has been lost to explain local processes from more general dynamics that shed light on management.

The approach of political ecology, beginning with observation of relationships between the environment and socioeconomic processes, helps to complement the attempt to understand human use of natural resources. Political ecology would be the synthesis between two theoretic perspectives: political economy and cultural ecology. In general terms, political economy contextualizes a certain social group (community) in relation to a region, nation, or even to the global system, and cultural ecology examines the adaptations of social groups to the local environment and to demographic factors (Sheridan, 1996). It thus permits understanding and interpretation of local experience in the context of global processes of environmental and economic change (Rocheleau et al., 1996; 04).

Sheridan (1996: XVII), following in the footsteps of Eric Wolf in his theorizing about political ecology, affirms that:

The ecology of any human community is political in the sense that it is shaped and constrained by other human groups. The exploitation, distribution, and control of natural resources is always mediated by differential relationships of power within and among societies. At the same time, however, the resources being exploited impose certain constraints as well—constraints that modify the political force fields emanating from outside the community in question.... [Peasant societies] are constantly engaged in a creative dialectic between both local and external forces.

Political ecology relates social and environmental issues to the handling of the competition for resources. In competition for resources, two antagonistic groups do not only increase the social tension and violence in frontier areas, but also accelerate levels of environmental degradation. Schmink & Wood (1987: 44) speak of “environmental effects of the class conflict in Amazonia.” With that, they give new meaning to Hardin’s insight concerning the “tragedy of the commons:” a “rational response on the part of individuals to the market’s demand can carry a common pasture to degradation” (Schmink & Wood, 1987: 45). It is the “tragedy of the commons,” thought to begin with class antagonisms and in a market context.

Taking political ecology as a theoretic referential, it is possible to relate some aspects that assume importance in the lake management done by the communities under study, the challenges and opportunities that they confront, and the answers that they are seeking in order to give continuity to the preservation movement and to guarantee ecological and social results. We can identify, then: a) location relative to the principal consumer markets and degree of accessibility to preserved lakes; b) social and political context; c) migrations; d) economic strategies and pattern of natural resource use; e) variations in the levels of flood and drought; and f) interaction with other regional actors.

a) location relative to the principal consumer markets and degree of accessibility to preserved lakes

In addition to relative proximity to Manaus, the main urban center in the state of Amazonas, whose demand for fish puts pressure on stocks of the middle Solimões region, it is necessary to analyze also the effects of the different locations of the communities under study in relation to the principal regional markets, the cities of Tefé and Alvarães. Tefé is the largest fish consumer market in the region. In 1992, the local market received 1,983 tons of fish (Barthem, 1999b). On the other hand, according to community informants, the majority of lake squatters reside in the city of Tefé.

The community of Santa Helena do Icé (Figure 1) is, among the communities studied, the closest to the cities of Tefé and Alvarães. Next in terms of distance in relation to these centers comes the community of Santa Tereza do Cubuá. Finally, the most distant is the community of São Paulo do Coracy. The lakes controlled by these and other communities linked to the preservation movement attract commercial fishers by the larger quantity of fish, including those of high commercial value, compared to the region’s free lakes.

Another aspect to be taken into account concerns the accessibility of the preserved lakes. Again, the community of Santa Helena, located on an island, has the greatest degree of accessibility, and the managed lakes can be accessed from the Solimões and Japurá Rivers across channels. The communities of São Paulo and Santa Tereza have their lakes positioned far from the banks of the Coracy and Cubuá Rivers, respectively. In Santa Tereza, in the dry periods, access is yet more difficult than in São Paulo.

The distance and the poorer accessibility of the lakes impede access to the resource, and consequently increases the cost of fishing, diminishing productivity and profits. As such, it is understandable that the community of Santa Helena is subject to greater pressure by commercial fishers.

On the other hand, the lessened accessibility to the lakes may also cause problems for local management initiatives. Difficult access to a lake means higher costs for guaranteeing guard patrol and for subsistence fishing by community members. The community of Santa Tereza is a good example of these difficulties: Its lakes, both procreation and maintenance, are difficult to access and thus are rarely visited by members of the community, who make use of a small stream that exits the lake and passes nearby the community for subsistence fishing.

Squatting by commercial fishers coming from Tefé or nearby communities has been crucial for the continuity of the local lake management initiatives. The community of Santa Helena is an example: Until 1997 it maintained control of the lakes, their being among the lakes with greatest

fisheries stocks in the region (Raimundo, Sr. João Cavalcante, Marcos, personal communication), but after dozens of squatting incidents, intensified in 1998 and 1999, these lakes had their fisheries stocks drastically reduced, contributing to the dissolution of the local management initiative.

b) sociopolitical and economic context

The middle Solimões region experienced a conflict-ridden process between parties interested in conservation and parties interested in economic exploitation of natural resources. In the area of the Tefé Archdiocese, taken as a field of analysis, two sustainable-development reserves exist (Mamirauá and Amanã) and one extractivist reserve (of the middle Juruá, in Caruarari County). The office of the National Center for the Sustainable Development of Traditional Populations (CNPT) in Tefé is planning the creation of four more extractivist reserves in the region.

The creation of these areas, in turn, is related to the work developed by the Catholic Church by means of the Tefé Archdiocese, but the existence of these conservation units exacerbates the conflict of interest and increases pressure on areas not included in the reserves. In 1998, conflicts were intensified and occupation of preserved lakes and of protected areas increased considerably, the same occurring in 1999. Occupation of lakes in the Mamirauá Reserve and on the Island of Icé also have a political side, as these areas are taken as symbols of the movement for the preservation of the region's lakes. The dissolution of the management initiative in the community of Santa Helena thus assumes an important political significance for sectors against the movement.

The increase in squatting coincides with the election of the region's principal fish trader and owner of an ice factory as vice-mayor of Tefé County. As a result of these armed intrusions, made principally by fishers residing in Tefé who are prohibited from fishing in some of the lakes of greater fishery stock in the region (many having been preserved for more than 10 years), several local management initiatives began to encounter serious difficulties.

c) migrations

The three counties in which communities affiliated with the GPD are located have passed through an accentuated process of urbanization, especially Tefé County, the region's main urban center. Table I presents the data from the population evolution in the counties of Tefé, Alvarães, and Maraã from 1980 to 1996. In these 15 years, the urban population in Tefé increased by approximately 200%. In general, with less incidence in Maraã County, the rural population has remained stable in absolute terms, but with a decline in terms of percentage of the total population of these counties. Despite that, the rural population in Alvarães and Maraã counties is still greater than the urban population. When we consider, however, the total population of the three counties, we see that in 1996 the urban population already represented 62% of the total, while in 1980 this percentage was 35%.

Table 1. Population evolution in Tefé, Alvarães, and Maraã counties (1980-1996)

	Tefé			Alvarães			Maraã		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
1980	30,854	15,863	14,991	10,078	1,141	8,937	10,082	1,044	9,038
1991	53,970	39,057	14,913	8,487	3,356	5,131	11,838	2,199	9,639
1996	62,616	47,698	14,918	13,336	4,780	8,556	14,021	3,295	10,726

Source: Demographic Census of IBGE (1980, 1991, 1996)

Without speculating about the motives behind this rural-urban migration, we can identify two separate impacts that this migration exercises over the preservation movement. One is that it increases the demand for fish in the urban centers, as well as the population contingent in the cities that practices commercial fishing (even though in an artisanal form), fishing probably being

the main source of employment for the migrant populations. The growth in demand and in number of people involved with fishing increases the pressure on the region's fishery stocks, pressure that is exercised on the preserved lakes in the form of squatting.

Conversely, the migration reduces the contingent of individuals in the direct work of preservation in the communities, especially for guarding the lakes. Tables II and III present the population evolution in the communities of São Paulo do Coracy and Santa Helena do Icé. Even though the populations in these rural communities normally fluctuate, we can perceive a significant reduction in the population contingent in the two communities, for which we obtained reasonably trustworthy historical data.

Table II. Population evolution in the community of São Paulo do Coracy (1986-2000)

	Families	Individuals
Uncertain, but after 1986	23	138
1990	18	123
1996	17	109
2000	13	72

Table III. Population evolution in the community of Santa Helena do Icé (1995-2000)

	Families	Individuals
1995	07	33
1996	08	40
2000	05	19

This analysis may be complemented when we consider the population structure of the communities under study (Table IV). The population structure gives us an indication of the individuals that are migrating. Both in São Paulo do Coracy and in Santa Tereza do Cubuá, more than half of the population consists of children ages 14 and under. Field observations inform that this is due to the large number of young couples, many of whom have children still quite young. Migration seems to be more advantageous for older couples with children who need to study in cities. The situation in Santa Tereza appears more favorable in light of the larger population, resulting in a greater number of individuals who can act for preservation. The case of Santa Helena do Icé does not follow the pattern of the other two communities and presents a more complicated population picture in relation to preservation activities, as well as to the total population contingent (only 19 people), concerning population age distribution.

Table IV. Populational structure in São Paulo do Coracy, Santa Helena do Icé, and Santa Tereza do Cubuá

	São Paulo		Santa Helena		Santa Tereza	
<i>0-14 years</i>	38	53%	10	53%	91	51%
<i>15-29 years</i>	17	24%	-	-	55	31%
<i>30-44 years</i>	09	12%	06	32%	18	10%
<i>45-59 years</i>	03	04%	01	05%	12	07%
<i>more than 60 years</i>	05	07%	02	10%	02	01%
Total	72	100%	19	100%	178	100%

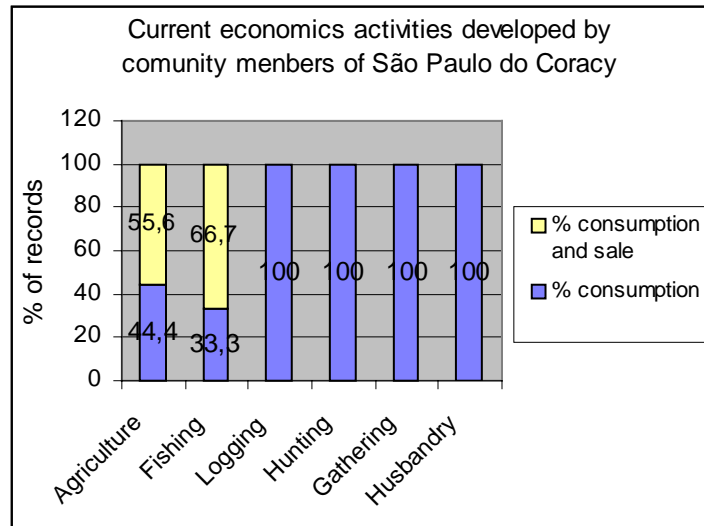
d) economic strategies and pattern of natural resource use

Despite the apparently similar environmental conditions, the three communities in the study offer differences regarding natural resource use, as much at present as in the past. Currently,

agriculture and fishing are the predominant activities, but with different importance ascribed in each one of the communities.

In São Paulo do Coracy, fishing was quite an important commercial activity in the past and continues being so at present. Agriculture is also a traditionally commercial activity (Graphic 2). In Santa Tereza do Cubuá as well, agriculture has traditionally been a commercial activity. Fishing, on the other hand, is basically a subsistence activity. In compensation, other activities have been exploited commercially, such as hunting, logging, and animal husbandry (Graphic 3). In the community of Santa Helena also, fishing has been developed merely for subsistence, there being no financial entry for families into fishing activities. In this community, most families include members who are retired or salaried workers.

Graphic 2. Commercial and subsistence activities in São Paulo do Coracy

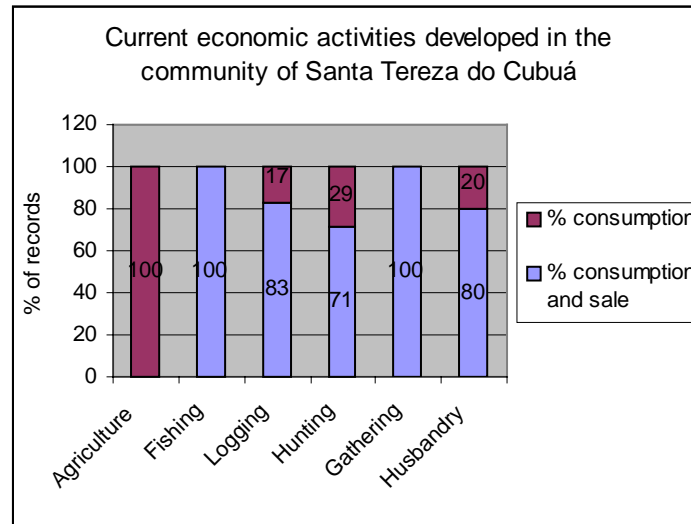


As we saw, the general management model, preservationist and geared toward subsistence, provoked underutilization of fisheries resources, which were not exploited commercially by the communities within their own lakes. Observing the three communities, we can verify that the intensity of transformation of the original model is also related to the way in which each community uses its resources. The utilization potential of managed resources can express the community's willingness to negotiate to allow an activity that is favorable to its residents from an economic point of view.

The communities of São Paulo (to a greater degree) and Santa Tereza began to consider some marketing parameters for fish originating from their preserved lakes, in accordance with the community's needs, without damaging the general management model. In Santa Helena, whose community members did not permit fishing as a commercial activity even before preservation (except during the period of pirarucu fishing, as mentioned in the beginning of the work), opted to maintain the philosophy of the initial model, receiving no economic return within the management activity.

Resource use forms also influenced squatting, for the very reason that the fisheries stock becomes extremely abundant in the preserved lakes and the communities that hold control of the lakes do not utilize the resource. Along with the diminished guard patrol, the fact that the communities do not use the resource serves as an incentive to the squatter, exactly because the fishery resource is held in common.

Graphic 3. Commercial and subsistence activities in Santa Tereza do Cubuá



e) variations in the levels of flood and drought

The transformations and adaptations through which the general preservation model passed in the three studied communities, as well as the possibilities for success of the collective resource-control actions employed there, were influenced by the occurrence of a great flood in 1999. The effects of this flood were greatest in the communities of São Paulo do Coracy and Santa Tereza do Cubuá, whose main income source were the banana plots. With the flood, all of the banana plots were destroyed, creating a disaster situation in these (and in many other) floodplain communities of the middle Solimões. In Santa Tereza do Cubuá, the community members managed to replant only 10% of the banana plots, in light of the lack of offspring for other plantings. Also, harvesting of bananas should be restarted only after a full year has passed after the planting.

The destruction of the banana plots resulted in strategy changes in the two communities. In São Paulo do Coracy, the main strategy adopted was the intensification of commercial fishing in non-preserved areas. The accomplishment of a community *despesca* in the lake and the relaxing to certain forms of commercial fishing by individuals are closely related to the occurrence of the flood. In Santa Tereza do Cubuá, many community residents decided to leave temporarily for the city of Tefé in search of employment. Almost a year after the occurrence of the flood, some families have not yet returned. Great pressure arose, too, for another *despesca* to be made in Lake Marumaruá. The association leadership, however, has not agreed for two consecutive years.

f) interaction with other regional actors

The form and the intensity of relations between the members of the communities under study and the Catholic Church, taken as the main external mediator in the process of local lake management in the middle Solimões region, are also varied. In Santa Helena do Icé and in São Paulo do Coracy, the Church had a greater presence in the formation of community leadership (local leaders also being catechists, pastoral representatives, presentors in communities formed for the activities of the CEBs) and in the beginning of the community lake preservation.

In Santa Tereza do Cubuá, despite the Catholic Church also being present and its representatives having acted to encourage the start of preservation in the 1980s, the principal local leaderships are not identified with the agents trained by the Tefé Archdiocese or the external support offered by the GPD for preservation. There is also the presence of members of an

evangelical church who act in preservation, which is not the case with the two Adventist families who live in São Paulo do Coracy, who have historically been the main internal opposition to the movement.

The action of the Tefé Archdiocese as external mediator in local lake-management initiatives was marked by the concern, in view of Liberation Theology, for giving autonomy to the base communities. This concern can be perceived in the communities studied, which do not consult the Church in decisionmaking. The most direct influence in the process was given on the Island of Icé, where sector meetings were the forum which brought together communities involved with preservation.

6. Final considerations

For each community, the aspects mentioned above interact in different ways and influence the results thus far attained through the efforts to control access to and use of lakes and of their fisheries resources. Despite integrating the same general preservation model and seeking coordination together with the GPD, the communities of São Paulo do Coracy, Santa Helena do Icé, and Santa Tereza do Cubuá have presented different results, from the dissolution of the management initiative, like that verified in Santa Helena, to transformations and adaptations recorded in the communities of São Paulo do Coracy and Santa Tereza do Cubuá.

Is the continuation of the management initiative in the communities of São Paulo do Coracy and Santa Tereza do Cubuá, then, related with a greater capacity to transform and adapt a general lake-preservation model dispersed by the Catholic Church in the middle Solimões region? Are the problems encountered by the community of Santa Helena do Icé, then, related to a greater unwillingness to modify the model initially established for the management of its lakes?

If, in an early moment, the simplicity of the general preservation model spread in the area of the Tefé Archdiocese seems to have been a fundamental factor for its rapid dissemination among riverine communities dealing with problems of controlling access and use of lakes and their fisheries resources, through time it is the capacity to transform and adapt this general model that determines the continuity of the initiative and avoids the degradation of the resource. This capacity is defined starting with the way in which the community organizes itself around this collective action. A series of social and ecological variables place challenges and differing levels of pressure on the communities studied.

The success of lake management initiatives in the middle region of the Solimões River thus reflects the capacity to adapt the general model to recent challenges. In the face of these challenges, the former resource-management model, which focused on guaranteeing subsistence to community families, is shifting toward a model that combines subsistence with marketing of the fisheries resource.

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