Community-based use of mangrove resources in St. Lucia.

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Abstract.

The sustainable use of mangrove forests can effectively contribute to their conservation. The experience with an integrated conservation-development project in St. Lucia showed that charcoal producers using mangrove fuelwood resources in a Marine Reserve Area have successfully changed their harvesting practices, reversing a trend of mangrove destruction. The conditions under which this change occurred included strengthening the organization of local users and their resource-use rights, and building a community-based management system, leading to the avoidance of open-access conditions. Surveys of the mangrove, undertaken before and after management intervention, showed that while the mean stand diameter of the fuelwood trees did not change significantly, there was an increase in the density of stems and in total basal area of timber.

Key words.

Mangrove swamps; rural development; fuelwood; charcoal; common property resources; renewable energy sources; Caribbean; St. Lucia.

Introduction

Mangroves, frequently treated as a non-renewable resource[1], can be a renewable resource under appropriate management, providing a sustainable supply of food, timber and fuel for human use. At the same time, mangroves provide important ecosystem functions such as wildlife habitat, fish nursery areas, shoreline protection and water quality maintenance and they contribute to biological productivity by recycling nutrients from leaf decomposition.[2]

As with some of the other biologically critical and highly productive marine communities (e.g. coral reefs), mangroves have been disappearing rapidly but there is little detailed documentation of their destruction.[1] As many as one million hectares of mangroves may be lost yearly worldwide[3], ~~but~~ there are few figures specifically for the Caribbean. Mangrove development requires flat and protected shorelines which are scarce in many Eastern Caribbean islands. Thus, mangroves are limited and vulnerable to disturbance in many islands, including St. Lucia.

St. Lucia (Fig. 1) has about 200 ha of mangroves, and the 40 ha Mankòtè mangrove on the southeast coast is the largest of the 14 principal mangrove areas.[4] Mankòtè is a basin mangrove cut off from the sea for much of the year. It contains the four most common mangrove species found in the region, white mangrove (*Laguncularia racemosa*), red mangrove (*Rhizophora mangle)*, black mangrove

(*Avicennia germinans*) and buttonwood (*Conocarpus erecta*) Fig. 1

The Mankòtè mangrove was once covered with well developed trees. The area was part of a U.S. military base during World War Two, and little or no exploitation took place. After the base closed down in 1960, the area became public land, and was used for a variety of purposes including seasonal fishing, bird hunting, crabbing, therapeutic bathing and as a source of wood for charcoal production and for construction. The area has also been used as a waste disposal site for local households and businesses. Decades of uncontrolled use and indiscriminate waste dumping has left Mankòtè in a highly degraded condition.

Studies undertaken since 1981 documented, nevertheless, that the area was being used extensively by local people for a variety of potentially sustainable purposes. Unlike much of the adjacent public lands, use of the mangrove appeared to be regulated to some extent by the community of users, particularly the charcoal producers[5].

Charcoal making, undertaken by small-scale producers, is an important cottage industry in St. Lucia. Charcoal-makers in Mankòtè work individually or in small groups, helping one another on a reciprocal basis. Each producer uses one named cutting area per season (two seasons per year, before and after the rains), and rotates cutting areas, returning to a cut-over area after about two years.

Charcoal-producers cut selectively in strips of 10 to 20m, zig-zagging to access clusters of suitable stems. Cutting area of each is generally known to others in a given season; this helps avoid conflicts. Related individuals often cut in adjacent areas to facilitate exchange of help. Cut stems are placed in rectangular pits dug in the forest floor, about 4 - 6m long, partially covered with grass or leaves and then with soil, and fired for about three days. The charcoal is then bagged in old flour sacks, each sack holding about 22kg and selling for about EC $30 (US $11 in 1992). Charcoal is retailed in smaller lots in the town market and in rural areas.

The three or four producers that started in the early 1960s have increased to 15-20 in the early 1990s. From a loose group, the producers, with CANARI's assistance, have organized themselves into an informal cooperative. Their cutting rights, tenuous at best until the recent years, have become recognized as customary rights, although as of 1992, they still lacked formal rights to use public land or legal authority to manage resources.

For many St. Lucians, charcoal remains the cooking fuel of choice because it is slow-burning, easy to transport, it imparts a pleasant taste to food, it can be purchased in small amounts at low cost, and it produces less smoke than fuelwood. The Mankòtè mangrove has been the main supply of charcoal to some 15,000 residents of Vieux Fort and the surrounding communities in the southeast of the island. The alternative cooking fuel is bottled gas, but for most households charcoal is as least as important, particularly for longer cooking tasks. Since charcoal production was a major consumptive use of the mangrove, and the activities of producers posed a visible and immediate threat to the remaining forest, conservation planning was directed primarily at charcoal producers.

The Mankòtè mangrove had already been identified in 1981 as a priority area for conservation[5] by the Eastern Caribbean Natural Area Management Programme (ECNAMP, later renamed CANARI). A descriptive survey was carried out in 1985 and a monitoring programme was started in 1986. The initial goals were to describe and monitor the status of the Mankòtè mangrove, the level of use, and to assess the practices of the mangrove users. Based on this information, the ultimate objective was to ensure the conservation of the mangrove, while providing the resource users with social and economic benefits from the sustainable use of the mangrove and alternative resources.

The project entailed two major components. First, to improve the existing use of Mankòtè by means of community-based management, and second, to reduce the pressure on the mangrove. A plantation of alternative fuelwood for charcoal-making was started in 1983, using *Leucaena leucocephala*. As this plantation did not live up to initial expectations, development effort was broadened from 1987 onwards to include a community vegetable garden. This second component of the project has been described in more detail elsewhere.[5] The present paper focuses on the mangrove conservation and sustainable charcoal production aspect of the project.

This case study is significant because it pertains to mangrove conservation, and more generally because it pertains to the conservation of a diversity of fuelwood resources which are under pressure in various parts of the world such as India and Africa[6]. The study is an example of an integrated conservation-development project (ICDP),[7] and has a number of relatively unusual characteristics. First, it is based on <u>strengthening</u> the organization of local users and their resource use rights,[8] rather than trying to eliminate them, and the building of common property institutions.[9] Second, it is based on building a community-based management system to provide user incentives to conserve,[10] rather than relying on conservation by government control. Third, it employs integrated rural development approaches to diversify the economic base of the community which may otherwise have no alternative but to destroy its own resource base.[11]

These characteristics do not make the Mankòtè mangrove management project altogether unique. But the strength of the case study is the continuity over some ten years, and the availability of a time-series of biological data to assess the resource before and after management intervention, and to determine whether or not the level of harvest could be sustained.

The Mankòtè mangrove was designated a Marine Reserve Area under St. Lucia's Fisheries Act in 1986. Bird hunting was eliminated soon after and waste dumping, which was the major degrading use, has almost been stopped. The use of the mangrove for scientific and educational purposes started in the mid 1980s, and for visitors' tours in the early 1990s.

Methods

The structure of the mangrove community was studied using strip transects.[12] Transect lines were run through the mangrove and the diameter at breast height (dbh) was determined for all trees greater than 25mm dbh, within a distance of 2.5m either side of the line. The transect was divided into subplots of 10m in length, and $50m^2$ in area. Four transects were surveyed in 1986, and repeated in approximately the same locations in 1989 and 1992. The total area of the four transects varied between 0.5 and 0.6ha. The data from the dbh measurements were used to calculate stem density, basal area, and mean stand diameter defined as the diameter of the stem of mean basal area.[12] The means of stand diameter and density were compared between successive surveys using the Mann-Whitney non-parametric test.[13]

The number of bags of charcoal produced each month was monitored by one of the charcoal producers. A number of bags were weighed and the mean was used to give an estimate of the weight of charcoal produced. The charcoal producers' cutting practices, production methods and social organization were monitored by field visits, interviews and participant-observation techniques.

Results

Table I

Table I shows the density of stems of the four species of mangrove trees in each of the four transects, and the total stem density of all species in the area surveyed, in 1986, 1989 and 1992. The total stem density increased between 1986 and ~~1898~~ 1989, but this was not significant. There was a significant ($p = 0.01$) increase in mean stem density from 1989 to 1992.

Table II

Table III

Table II shows the mean stand diameter (dbh) of all species. Mean stand diameter did not vary significantly among surveys during the study period. Table III shows the change in basal area, as m^2 per hectare, for all species. The basal area increased more than four-fold during the study period, and in 1992 was significantly ($p=0.05$) higher than in 1986 or 1989.

Fig. 2

Charcoal production from the Mankòtè mangrove is given in Figure 2. Production shows seasonal variation, with low levels coinciding with the rainy season when access to the mangrove is more difficult. The data from 1985/86 and 1990 are similar. It appears that 1989 was a low year due to the inactivity of several key producers. Production in 1991 was the highest recorded, but given year-to-year variations, it probably is not safe to conclude that production has increased over the study period.

Field observations and interviews indicate that the practice of clear-cutting in the mid 1980s has been replaced by a practice of selective cutting of the larger stems and avoidance of damage to smaller stems. Cutting is done in such a way that does not kill the stump and allows coppicing. Some of the larger trees, mainly black mangrove, are left uncut to provide shade for the ground and for saplings. Red mangrove along water courses are also conserved.

Discussion

The results showed that stem density increased significantly from 1986 to 1992. This increase applied particularly to the white mangrove but less so to red and black mangrove. The mean stand diameter did not change greatly, thus the observed increase in basal area was the result of improved regeneration and density, rather than an increase in the age of the trees. The increased regeneration in the 1992 survey is particularly important as it follows a year of relatively high charcoal production in 1991.

We believe that the improved regeneration is the result of the change in cutting practices that were particularly noticeable in the 1989-92 period. This is in contrast to the clear-cutting and indiscriminate slashing observed in the earlier years.

The rotation of cutting areas is a major feature of this indigenous management system. Management in Mankòtè is not a traditional system; it dates back only to the 1960s, and it has become more of an orderly system only in the last few years. It is not formalized as in a commercial forest rotation system with identified blocks, and as in the more sophisticated mangrove management systems in Southeast Asian countries.[14] The Mankòtè practice is simply based on going to a location which has good-sized stems and cutting in zig-zagging strips before relocating in a new area in the next season. There is no regularized rotation by producers, no formal rules of allocation (e.g. by lottery), but simply constant communication, first-comer's rights and mutual respect for one another's cutting areas.

From a forestry management point of view, the cutting cycle at Mankòtè is much too short compared, for example, with figures given in Hamilton and Snedaker.[2] However, a two-year rotation does not mean that the trees which are cut are two years old. Since charcoal-producers obtain their wood by selectively cutting the larger shoots from stumps, the stems actually harvested may have been growing through two or more cutting cycles.

The net effect of these cutting practices, however, is that a cover of larger trees cannot, under these circumstances, be restored. The cutting pressure has to be reduced. The maturation of the *Leucaena* fuelwood plantation outside the mangrove area promises to make it possible to reduce pressure on the mangrove and to lengthen the cutting cycle. Together with other alternative rural development measures,[5] it may be possible to lengthen the cycle permanently and to allow trees in some areas to mature and restore the mangrove forest. The important point is that, as of the late 1980s, the overall trend of degradation of the tree cover has been reversed.

What are the conditions behind this reversal, and the change in the outlook and management practices of the charcoal-producers? The simplest explanation, confirmed by the users themselves, is that the Mankòtè mangrove has shifted in the 1980s from an open-access to a communal property regime (following terminology of Feeny *et al.*[15]). That is, the wood products of an area that used to be freely open to all potential users is now used mainly by an organized community of charcoal producers.

a limited number of

The more secure resource use rights of the charcoal-producers precipitates a change in behaviour and attitude. Instead of cutting wood indiscriminately, the security of tenure makes it possible to cut with more care and conserve for the medium-term or even for the long-term. Note that under open-access conditions, a "tragedy of the commons" is a rational response. Only when property rights are specified, as private property, communal property or enforceable state property, does it become rational to use resources sustainably.[16]

Perhaps a major lesson from the case study is that integrated conservation-development projects have good potential to be effective if they can lead to the avoidance of open-access conditions, and to the specification of property rights. This does not preclude the preservation of a core area, or specified species and resources. What it does provide is a social contract by which the local community of resource users have certain rights and responsibilities. This has also been experienced with the development of a management strategy for edible sea urchin.[17] Conservation-development is a trade-off, but a trade-off which can have net positive value for overall management. This is because the community of users with specified rights can help enforce rules that avoid open-access conditions, not because the users necessarily believe in conservation (although conservation education has certainly helped), but because avoiding open-access is also in their best interests.

The future conservation of Mankòtè mangrove requires the formalization of management and a plan for co-management by the charcoal producers and government is in preparation. The primary responsibility of the charcoal producers is to use methods that ensure regeneration and the long-term sustainability of the harvest, and most of these methods are already in use. The producers have also recommended the adoption of a minimum harvestable stem diameter of 50mm. Their other responsibilities include the preservation of a number of large trees as sources of seeds, preservation of red mangrove along waterways, collaboration in monitoring the status of the mangrove and co-operation with other legitimate users. Government would be responsible for establishing management rights, providing advice and technical assistance and ensuring that the resource continues to be used sustainably.

With an increased level of management, the assignment of cutting areas may require a more formalized process ~~will need more formality~~. Based on the present informal rotation system, the mangrove will be zoned to ensure that the cutting cycle is at least two years, and that there is adequate provision for the various other uses, such as seasonal fishing, crab collecting, therapeutic bathing, guided tours and research. Research will continue, with the assistance of the charcoal producers, to monitor the effectiveness of this co-management initiative.

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Table I. Mankòtè mangrove. Density of stems >25mm dbh (expressed as number.m^{-2}). Means for all species in all transects were not significantly different between 1986 and 1989, but were significantly different ($p=0.01$) between 1989 and 1992. (R.m. = *Rhizophora mangle*; L.r. = *Laguncularia racemosa*; A.g. = *Avicennia geminans*; C.e. = *Conocarpus erecta*)

	Year and transect number											
	1986				1989				1992			
	1	2	3	4	1	2	3	4	1	2	3	4
Sp.												
R.m.	0.01	0.04	0.05	0.00	0.00	0.00	0.19	0.00	0.01	0.11	0.24	0.00
L.r.	0.03	0.04	0.09	0.08	0.07	0.08	0.09	0.13	0.27	0.44	0.66	0.33
A.g.	0.01	0.00	0.01	0.02	0.02	0.02	0.00	0.01	0.05	0.06	0.00	0.03
C.e.	0.00	0.01	0.00	0.01	0.01	0.02	0.01	0.03	0.04	0.02	0.04	0.15
All spp.	0.10				0.17				1.98			

Table II. Mankòtè mangrove. Mean stand diameter in mm of stems >25mm dbh.

Transect	Year 1986	Year 1989	Year 1992
1	29	31	32
2	35	42	35
3	40	37	36
4	32	37	37
Mean	34	37	35

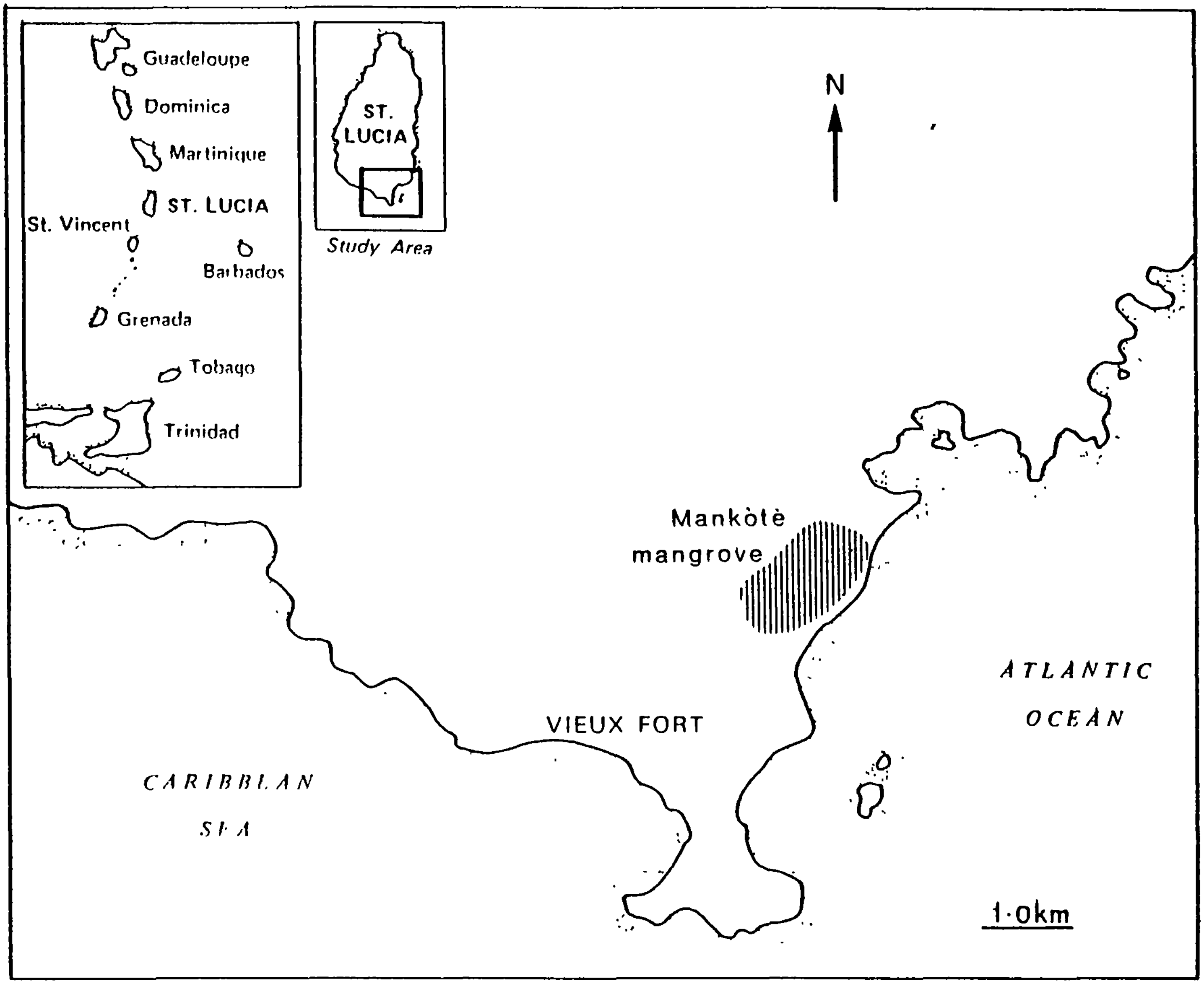
Table III. Mankòtè mangrove. Basal area of stems >25mm dbh. (expressed as $m^2.ha^{-1}$).

Transect	Year		
	1986	1989	1992
1	0.378	0.757	2.715
2	0.903	1.708	6.219
3	1.942	2.774	6.134
4	1.340	1.739	4.160
Mean	1.141	1.745	4.807

Captions.

Figure 1. The study area.

Figure 2. Charcoal production in Mankòtè mangrove, tonnes per month. Number of producers: 13 in 1985; 11 in ~~86~~ 1986; 10 in 1989; 11 in 1990; 14 in 1991.


Guadeloupe
Dominica
Martinique
ST. LUCIA
St. Vincent
Barbados
Grenada
Tobago
Trinidad
ST.
LUCIA
Study Area
N
Mankòtè
mangrove
VIEUX FORT
ATLANTIC
OCEAN
1·0km

CHARCOAL PRODUCTION, MANKOTE MANGROVE   Tonnes per month, 1985/86; 1989 - 1991