

## Development of a locally-managed fisheries reserve at Discovery Bay, Jamaica

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### ABSTRACT

Jamaican north coast coral reef fish populations have been severely over-exploited. In 1976, the Discovery Bay Marine Laboratory (University of the West Indies) made preliminary moves toward reef management. In 1988, its Fisheries Improvement Programme began helping local fishing communities to introduce management measures. Products of this collaboration include the formation of fishermen's organizations; support for gear changes; and, in 1996, creation of the Discovery Bay Fishery Reserve. The Reserve depended on voluntary compliance and daily patrols. Legal protection was not obtained, funding for patrols ran out, and compliance declined. Lessons were learned by biologists, who found they lacked the training to manage people. They learned that changes in behaviour take longer to achieve than they had expected. The fishermen learned the value of group solidarity and saw some benefits to their catches. However, local action required government support in a co-management framework: legal protection for the Reserve was essential.

**Keywords** Jamaica, Coral reef fishery, Reserve

### Introduction

Fisheries throughout the world are declining because of over-exploitation, while management has been inadequate or non-existent (Pauly et al. 1998). Diverse methods are available for the limitation of fishing effort, but only a few are appropriate for artisanal multi-specific coral reef fisheries (Munro and Williams 1985). These are: limiting the number of fishers (e.g. by licencing); using more selective fishing gear (e.g. with larger mesh size); or establishing protected areas, known as fish sanctuaries or marine reserves, within which fishing is limited or (no-take reserves) banned. When over-fished reef areas are protected from fishing, the abundance, biomass and spawning potential of fish stocks within the protected area increase (Alcala 1981, 1988, Clark et al. 1989). Moreover, stocks may increase in adjacent, unprotected, areas through increased settlement of larvae and migration ("spillover") of juvenile and adult fish from the reserve (Alcala 1988, Russ et al. 1993, Sluka et al. 1997). The potential to enhance adjacent fisheries, while providing other conservation benefits, makes marine reserves attractive management propositions (Roberts and Polunin 1993, Bohnsack 1993).

Marine reserves are generally proposed by conservationists or fishery managers, who have an increasing body of ecological and economic theory to aid in planning (e.g. Appeldoorn 1997, Rodwell and Roberts 2000). With regard to social aspects, it is increasingly recognized that effective management requires the involvement of all users throughout the decision-making process (Munro and Munro 1984). However, there are relatively few case-studies on involving resource users in the initiation of marine reserves, particularly in the Caribbean (e.g. Jennings-Clark 1992). The present paper

describes the background, formation and operation of a marine reserve at Discovery Bay, Jamaica, and discusses the lessons learned by participants.

The Jamaican near-shore fishery is largely artisanal, carried out by a fleet of open canoes (each containing 1-5 men), or by swimmers, using traps, hook-and-line, spears and gill-nets (Aiken 1993). Fishermen work on or near the shallow coastal shelves (Fig. 1) and offshore banks, targeting fish in coral reefs and associated habitats. Stocks are over-exploited, especially near shore, and catch rates are very low (Munro 1983, Aiken 1993). Over-fishing is particularly severe along the north coast, where fishermen concentrate their effort on the narrow (<1 km) coastal shelf. As a result of the intense local fishing pressure, Jamaican north coast coral reefs are among the most overfished reefs in the English-speaking Caribbean (Hughes 1994, Roberts 1995). Quality fish such as grouper and snapper are scarce, the catch of other species is dominated by small, young individuals, and the destruction of breeding stock has reduced the possibility of replenishment.

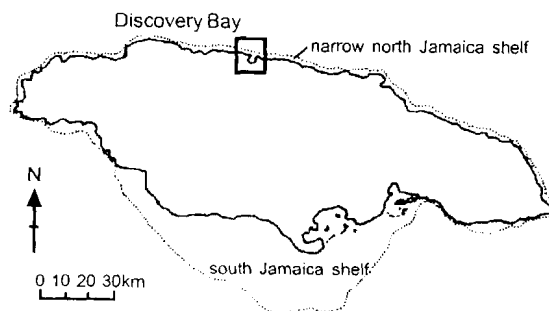


Fig. 1 A map of Jamaica, showing the 100 m depth contour, and the location of Discovery Bay.

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Despite the poor state of the fishery, economic pressures, intensifying in the 1990's, continue to drive men into fishing (Allison 1992, van Barneveld et al. 1996). Some have no alternative, some do a little farming, while others are supplementing income from partial or full-time employment. Since nearshore fish stocks are so accessible, they can be exploited at low economic cost down to levels that give very low economic returns. For example, the average catch in fish traps at Discovery Bay in 1990 was 0.18 kg/trap/day (Picou-Gill et al. 1996).

For years, it has been clear to university and government researchers that fish catches in Jamaica could be improved by better management (Munro 1974, Aiken and Haughton 1991). Among the many difficulties faced by managers is widespread lack of awareness about the possible benefits of proposed management measures, such as increased trap mesh size or the creation of protected areas. In the 1970s, one of us (JDW) pointed out that the north coast fishery presents opportunities, unmatched in the south, for localized research projects that could demonstrate the effectiveness of reef management. The fishermen operate from landing sites generally 5-10 km apart. They prefer to fish near home, and their long narrow fishing ground (Fig. 1) is roughly divided between adjacent communities. This comes about partly because boats on the north coast have limited range (Aiken 1993), but may also be reinforced by social mechanisms such as informal agreement (Berkes and Shaw 1986) or interference with traps (pers obs). Therefore, if one community introduces fishery management measures, there is a real chance for researchers to observe consequent changes in local fish stocks.

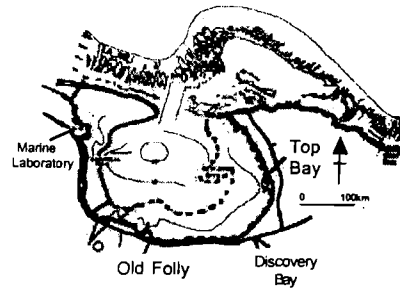
## Methods

### The study area and its fishermen

Discovery Bay is in the middle of the north coast of Jamaica (Fig. 1). The shallow-water marine environment, both outside and inside the bay (Fig. 2), is dominated by coral reefs and associated habitats (Woodley and Robinson 1977, Gayle and Woodley 1998). The reefs are best developed on the submarine shelf outside the bay. The entrance to the bay has been excavated to make a shipping channel, 12 m deep. In the middle of the bay there is deep water, with shallow sandy lagoons all around, supporting beds of turtle-grass, scattered coral heads and patch reefs. On the steep slopes towards the centre, coral reefs occur down to about 20 m, especially at Columbus Park and Red Buoy Reef. All reefs in the area were in good condition until hurricane Allen (1980) initiated a series of impacts (coral disease, *Diadema* mass mortality, coral bleaching) that led to a catastrophic decline (Hughes 1994).

The town of Discovery Bay is at the south-east corner of the bay (Fig. 2). At the south is Port Rhoades, the bauxite loading facility of the Kaiser Jamaica Bauxite Company. Other institutions include a small base for the Jamaica Defence Force Coastguard, a public beach, a

small hotel, Columbus Park (which is a historical site for tourists) and the Discovery Bay Marine Laboratory.



**Fig. 2** A map of Discovery Bay, showing the outlines of reefs underwater, and depth contours in metres. It also shows the locations of the Marine Laboratory and the two fishing beaches: Top Bay beach and Old Folly beach. The bold line traces the outline of the Fisheries Reserve, as established in 1996. The dashed line shows the extension proposed in 1998.

Fishermen operate from two fishing beaches (registered landing sites). The Top Bay fishing beach, on the east side of the bay, is chiefly used by people from the adjacent part of town (known as Top Bay). The Old Folly beach, adjacent to the bauxite loading pier, primarily serves the nearby community of Old Folly. In addition, both beaches are used by some people from other communities, usually further inland. The principal target area for Discovery Bay fishermen is the shelf outside the bay, which is roughly apportioned between the two beaches: after exiting the ship channel, men from Top Bay generally turn to the East, and those from Old Folly turn to the West (Allison 1992). Among those who fish within the bay are the young, the old, and others in bad weather.

### Initiation of coral reef management at Discovery Bay

In 1975, one of us (JDW) became Head of the Discovery Bay Marine Laboratory (DBML), the principal function of which was research on coral reefs. At that time, the coral reefs were in good condition, but he felt that they needed protection from the activities of scientists. Therefore, he instituted measures to control underwater research activities (Woodley 1987). Among other regulations, spear-fishing for food or sport was banned, partly to avoid the appearance of competition with fishermen. Despite the apparent good health of the reefs, the depletion of fish stocks to over-fishing was evident (Munro 1974). Signs of change in the benthic community might have been due to the removal of predatory and herbivorous fishes (Woodley and Robinson 1977). In 1976, with the aims of restoring more natural conditions in the vicinity of DBML and enhancing adjacent fisheries, JDW suggested to the Natural Resource Conservation Department, and to the Fisheries Division of the Ministry of Agriculture, that a Scientific Reserve should be established. The Reserve would have banned fishing (except for research) in the shallow waters

on the west of the Bay, and on the fore-reef to the west of the ship-channel entrance. The proposal was approved in principle. However, JDW recognized that to act on his plan would be an imposition on the fishing community, who had not been consulted. Not only would it be unjust but, most likely, unsuccessful. Without more staff or more time, he was unable to proceed much further, beyond organizing discussions of protected areas with men from the two local fishing beaches. He awaited an opportunity to obtain funds for a more ambitious programme of fishery education and intervention.

#### The Fisheries Improvement Programme

DBML, in collaboration with Trent University and with funding by CIDA, initiated the Fisheries Improvement Programme (FIP) in 1988. It was to work with the fishers (the general term; at Discovery Bay, the harvesters were all male). FIP's aims were: to assess the state of the fishery; to discuss the state of the fishery, and possible remediation, with local fishers; to help local fishers introduce fishery management measures; and then to monitor the effects of these measures on fish stocks (Sandeman and Woodley 1994). All this was to be accomplished within three years, which we now realize to have been very unrealistic. Fortunately, support from various agencies maintained the programme, at levels of staffing ranging from 1 to 5, for over twelve years. Initially, all personnel (including the authors) had been trained as biologists but after 1995, junior staff were recruited in Discovery Bay.

The primary contact of FIP staff with the fishing community was through collecting catch-and-effort data when boats returned to the fishing beaches in the mornings. General discussion of fishery-related matters was carried out by all FIP staff whenever possible, when they interacted socially with fishers (e.g. while waiting at the beaches for boats that were still at sea). Fishermen's knowledge and attitudes to fishery management were assessed by questionnaires (Vatcher 1996). At both of the fishing beaches, FIP staff erected notice boards, which were used for material of local and general interest such as educational displays, articles from the press, notices from the Fisheries Division and notices of local meetings. FIP also showed slides and videos, and encouraged visiting scientists to address the fishers.

In general, we (the FIP team) tried not to tell people what they should be doing. Rather, we told them what coral reef fishers were doing in other parts of the world, and explained why some of these activities were effective. With respect to fish sanctuaries and other protected areas, material from the Philippines and St Lucia was particularly useful. It was hard not to become promoters of management actions, but we recognized that our main role was to provide information to the fishers so that they could make their own decisions.

Early FIP research (Miller et al. 1996, Picou-Gill et al. 1996) confirmed that local fish stocks were indeed over-exploited. The use of small mesh wire-netting in fish traps was partly responsible for this and FIP staff initiated, in 1991, and successfully tested, a "mesh-exchange", which

introduced a larger mesh-size to the trap fishery (Sary et al. 1997). Partly as a result of our formal and informal education, some fishermen recognized the potential benefits from forming their own organization and, also in 1991, FIP helped them in the formation and operation of the Alloo Discovery Bay Fishermen's Association (Van Barneveld et al. 1996).

The existence of the Fishermen's Association facilitated group action, and was particularly important in the creation of a marine reserve. Our early surveys revealed that reserves were the least unpopular of proposed management measures, since they would affect people using all gear types equally (Vatcher 1996).

#### Results

##### Constraints to participatory management

There were some difficulties in trying to involve Jamaican fishermen in participatory management. First, there were widespread inappropriate beliefs. For example, many fishermen believed the sea was so huge that its resources were limitless and could not be depleted by man ("Fish can't be done"). Others thought the idea of fishery management was sacrilegious ("If fish in my trap, is God put it there"). Many fishermen who were aware of fishery declines were reluctant to blame them on fishing, and would suggest other causes. Secondly, in contrast to some Pacific societies, there is no indigenous tradition of marine area management in Jamaica. As a result, apart from limited territorial division between adjacent beaches (Berkes and Shaw 1986) the reefs were an open-access resource with fishermen in competition. Thirdly, related to that competition, there were high levels of rivalry and mutual distrust among fishers. Rivalries occurred between individuals, families and residential areas, between users of different gear types, between fishing beaches, and between coastal villages and towns.

##### Role of the ADBFA

The Alloo Discovery Bay Fishermen's Association (ADBFA) played a crucial role in bringing fishermen together and facilitating collaborative action at Discovery Bay. Nonetheless, inter-group rivalry was still evident. The ADBFA was established by men from the Old Folly beach (Alloo is the name of a nearby area) and although membership was open to all, few members were from Top Bay beach. Most members were trap or line, rather than spear fishers. The Association was successful in building a meeting hall at Old Folly beach. Also, with a little help from FIP, it secured two grants: one to build a gear-store and offices, the other to supply large-mesh wire for traps.

Although not every fisherman respected its authority, the ADBFA institutionalized the processes of meeting, and making decisions. After many discussions about possible fish sanctuaries, a meeting of the ADBFA in 1994 decided to "give it a try". The area selected, to be known as the Discovery Bay Fisheries Reserve (DBFR), was in shallow water on the west side of the Bay (Fig. 2). The men were unanimous that it should not include any of the fore-reef, which is the more productive area.

## History of the DBFR

### *Decision-making arrangements*

In 1995, at the suggestion of FIP, a Reserve Planning Group (RPG) was formed, and began to meet monthly. Its members were drawn from organizations with an interest in the waters of Discovery Bay, namely: ADBFA, Top Bay fishing beach, Jamaica Defence Force Coastguard, Kaiser Jamaica Bauxite Company, DBML. Two members of FIP acted as Chair and Recording Secretary. ADBFA was represented by four members and the other organizations by one each. FIP and the ADBFA were represented at every meeting, but attendance from the other entities was irregular. The RPG planned the creation and operation of the Reserve which was to be established by voluntary action of the fishermen before legal protection was sought. The RPG discussed public relations, details of the Reserve boundaries, how they were to be marked, and how restrictions on fishing were to be enforced. Its decisions were reached by consensus, and included adjustment of the boundaries to provide fishermen with an alternative fishing area for use during bad weather. The DBML set conspicuous markers around the outer boundary of the Reserve.

### *Protection of the DBFR*

Running costs for the Reserve had been included in a grant from the Kaiser Jamaica Bauxite Company to the University of the West Indies (UWI) for FIP. In 1996, the University entered into a contract with the ADBFA, under which the Fishermen's Association agreed to operate the Reserve, subject to the guidance of the RPG. The ADBFA would employ rangers to patrol the area, in exchange for monthly transfer of funds from UWI. The ADBFA selected four rangers and a supervisor, who were themselves fishermen or relatives of fishermen. They were trained by the JDF Coastguard and by rangers from the Montego Bay Marine Park. In 1996, daily patrols began, especially in the morning hours, when fishermen are generally most active. Since the Reserve was only voluntary, and not yet legal, the role of the rangers was advisory and educational. Nonetheless, most trap fishermen respected the local restrictions. The spearfishers, mostly boys, often did not, although they would say that they were only passing through on their way to the forereef.

### *Effects of protection*

Daily patrols continued, with occasional interruptions, into 1998. Meanwhile, fishermen noticed that fish numbers had increased within the Reserve, and trap fishers began to concentrate immediately outside its outer boundaries. Research by ICLARM concluded that indeed some fish species were larger and more abundant within the Reserve, and showed that it supplies some fish to reefs offshore for several kilometres to the east and west (Munro 1999). In 1998, men based at Top Bay beach, having seen the benefits of the Reserve on the western

side, asked that it be extended all around the Bay. The new boundary details were resolved by discussion among Top Bay fishers, and were accepted by the RPG. The extended Reserve covered 108 ha (Fig. 2).

### *Decline of protection and the lack of legal status*

As the money began to run out, the schedule of patrols and the number of rangers were cut back. In August 1999, the last rangers were laid off. Patrols were to be continued on a voluntary basis by the ADBFA and FIP but, for various reasons, only one such patrol was made. In any case, because the Reserve had no legal status, continued protection was hard to maintain. It was threatened by the activities of new fishers, some from outside Discovery Bay, and by other recalcitrant individuals unwilling to comply with voluntary restrictions. By 2000, in the absence of both legal status and active patrolling, even some individuals previously compliant with the restrictions were ignoring them.

FIP had sought to establish the Reserve as a protected area under the Natural Resources Conservation Act in 1997. A comprehensive management plan was required, which FIP staff (then reduced) found difficult to compile. Discussion with members of the Fisheries Division of the Ministry of Agriculture in 1999 established that it would be more appropriate, and quicker, to have the Reserve gazetted as a Fish Sanctuary under the Fishing Industry Act. Nonetheless, an explanatory document, including a brief management plan with precise co-ordinates of the proposed protected area, was requested. That was prepared, and sent to the Fisheries Division, early in 2000. By then, Division staff were involved in extensive litigation and, up to April 2001, they had no time for other work. Meanwhile, members of the ADBFA requested further changes to the Reserve boundaries, but the Reserve Planning Group had not yet met to discuss them.

## Discussion

The Discovery Bay Fisheries Reserve was established and maintained by voluntary action by local fishermen, assisted by staff of the Discovery Bay Marine Laboratory. We made mistakes and had some successes: all participants learned from their experiences.

### *Lessons learned by biologists*

Our (most FIP staff) training in fish biology and fishery management had not adequately prepared us for the self-appointed task of facilitating community action. First, it gave no training in how to work with people. Accustomed to pedagogic teaching, we expected fishermen to readily understand the potential benefits and to want to implement management at once. We did not appreciate that for adults to absorb new ideas and change their behaviour is a slow process, requiring many years. Secondly, our training encouraged us to believe that we knew what was best for the fishery. It was then difficult not to take an authoritarian approach. It requires considerable planning, restraint and patience for outside advisors to provide information in such a way that fishers

learn enough to make their own decisions, but feel that these decisions are indeed their own. Thirdly, because we thought we knew best, we were slow to appreciate that community education is a two-way process. We could learn from the fishers, both about the natural history of fish and other creatures, and about the societal context within which fishing was conducted. Fourthly, our training caused us to focus on what we thought was best for the overall fishery in the long term. While many fishers understood that there would be long-term benefits, all individuals had to face the short-term costs. It can be very helpful if management proposals include some compensation (as in the case of the "two-for-one" mesh exchange; Sary et al. 1997) or can be phased in slowly.

#### Lessons learned by fishermen

The fishers of Discovery Bay also learned some lessons from their attempts to manage the fishery. First, the fact that the ADBFA was able to attract outside funding was powerful evidence of the benefits of an organized group. Secondly, working together in the RPG and discussing management measures in wider groups, brought some rivalries into the open, although they are not yet much diminished. Thirdly, some fishermen learned that the Reserve was having a positive effect and adopted the practice of fishing close to its boundaries, as has been reported from Kenya (McClanahan TR pers. comm. 1996) and Florida (Haskell B pers. comm. 1998). Moreover, fishers from Top Bay had sufficient confidence in the Reserve to request its extension.

#### Lessons learned by all participants

Some lessons were learned jointly among all participants. First, they agreed that it was necessary for all parties to be in continual communication. This had not always been easy, because key individuals were distributed between different parts of Discovery Bay and Kingston, 140 km away. The fact that participants moved in different walks of life and social classes did not help. Secondly, but not unrelated, it was essential to build and maintain trust between individuals and thus between the institutions which they represented. A similar point was made by Kelleher (in press). Finally, all participants have learned that community action is not enough: legal status for the Reserve is essential. Legal protection for the Reserve would make it much easier for members of the ADBFA and other concerned citizens, to apply the restrictions on fishing. Moreover, the local Coastguard forces could participate in enforcement; at present, they are powerless.

#### Lessons for other Reserves

We pointed out above that fishermen might take a long time, in response to external advice, to change their fishing behaviour. When Discovery Bay fishermen agreed to establish a reserve in 1994, the idea had been discussed at their beaches by DBML personnel since at least 1981. The most difficult step was the first: for men to agree not to fish in even a small area. What made it easier was that

western Discovery Bay was not a very popular area with trap fishers, and those who did fish there, except for a few old men, also fished outside. After the protection of this area was seen by fishermen to increase the biomass of fish populations, expansion of the reserve (more than doubling its size) followed. Perhaps, in time, an extension on to the fore-reef, which would protect more adult fish and more spawning sites, could be negotiated.

The transfer of operational funding for the Reserve to the Fishermen's Association, including a 10% overhead for administrative costs, increased its sense of ownership and commitment to the Reserve. However, FIP had to provide assistance with their accounting.

The Discovery Bay Fisheries Reserve reached a peak of effectiveness in 1998. Its subsequent decline was due to the lack of funds to continue patrolling and the unexpected delay in obtaining legal protection, coupled with JDW's departure from Jamaica. If legal protection is obtained, physical protection by the Coastguard is likely to follow. We hope that the momentum of the Reserve project will then be restored, but it seems that continuing education and developmental facilitation will be required before the Reserve becomes self-sustaining.

Scientists and fishermen at Discovery Bay were proud of what was achieved by local community action. But local action alone is not enough: neither top-down nor bottom-up approaches to management can work in isolation. Best is some form of co-management, in which Government provides a framework of education, legislation and enforcement that is supportive of community participation in environmental management. The creation of the Discovery Bay Fisheries Reserve can be compared with the pioneering work of Angel Alcalá at Sumilon and Apo islands (Alcalá 1988, Russ and Alcalá 1999). In the Philippines, as in Jamaica, several years of discussion with facilitators were a necessary preliminary to community based management action (Alcalá A pers. com. 1995). The Philippine sites are legally protected, while at Discovery Bay protection is voluntary, but has been encouraged by paid rangers. At Apo Island, peer pressure and public shaming have been effective sanctions (Alcalá A pers. com. 1995). At all three sites adjacent fisheries were enhanced by reserve creation (Russ and Alcalá 1998, Munro 1999).

#### Conclusion

The fishing community of Discovery Bay established a voluntary no-take reserve, and fishery benefits became evident within two years. A local fishers' organization provided an initial forum for discussion and took responsibility for organizing patrols. A multi-agency group planned and co-ordinated the establishment and operation of the reserve. Several years of education and encouragement by personnel of the University of the West Indies facilitated the whole process. Fishers' compliance with voluntary restrictions on fishing declined when legal regulation and sanctions were not obtained, and because external funding, which was necessary to employ rangers, ran out. Community-based action needs top-down support in co-management with Government. It is not too late: if

the Discovery Bay Fisheries Reserve is legalized, it could be a lasting model for fishing communities elsewhere in Jamaica and the Caribbean.

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