

Banning the Use of Pots and Other Management Introduced in Bermuda to Protect Declining Reef Fish Stocks

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ABSTRACT

In response to continually declining catches of grouper and an intensification of a fishery for multi-species reef fish, such as parrotfish, wrass, surgeonfish, snapper and angelfish, the Bermuda government in 1990 banned the use of pots. Concomitant with the fish pot ban has been a ban on the use of nets for taking reef fishes, the introduction of seasonal bag limits for grouper capture and the establishment of seasonally protected areas closed to fishing of all kinds during summer spawning periods.

This paper discusses the rationale used for introducing these extreme measures, the response of the fishery and a preliminary look at the effectiveness, after one year, of introducing these measures.

KEY WORDS: Banning fish pots, Bermuda, rationale, response.

INTRODUCTION

Bermuda is a small group of islands in the Atlantic Ocean situated on top of a truncated volcano and located 900 kilometers east of North Carolina at 32°N and 64° W. Bermuda is the most northerly location of reef-building corals and coral and algae reefs, and derives most of its marine fauna from the Caribbean and Bahamas.

The Bermuda Platform and off-lying banks are comprised of a total reef area which, measured out to the 200-meter depth contour, encompasses approximately 1,000 square kilometers. The two off-lying banks are located 22 kilometers and 37 kilometers southwest of the island, respectively, and rise to form relatively flat plateaus at about 60 meters deep. The demersal fishery of Bermuda has been limited to areas within the 200 meter contour (Figure 1).

The major fishery for reef fish at Bermuda, as throughout much of the Caribbean has, in recent years, been based on the use of wire mesh fish pots. In general, these fisheries can be described as heavily exploited, multi-species, non-selective fisheries. These characteristics limit the options for the management of any designated species or group of species.

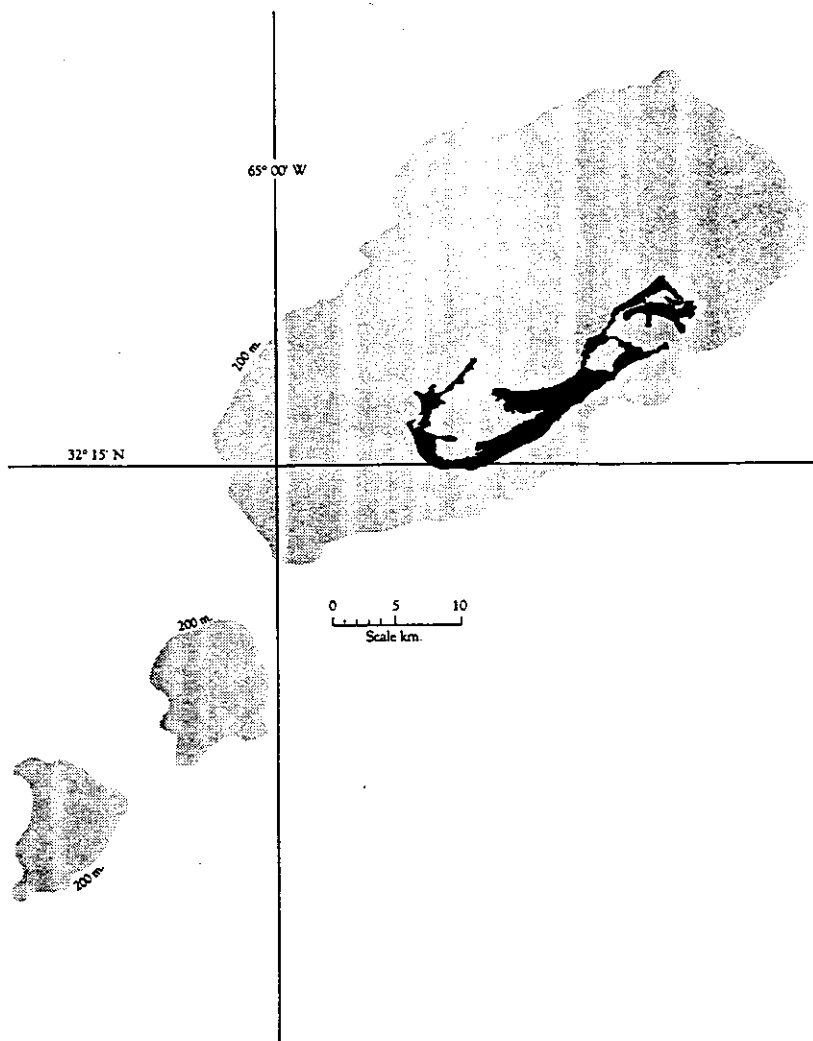


Figure 1. Bermuda islands and off-lying banks.

FISHERIES DEVELOPMENT

Bermuda had a subsistence fishing industry from its earliest settlement until the end of the nineteenth century. When industries other than agriculture and fisheries began to develop, the fishing industry supplied food to residents working in the other industries and to the tourists.

Prior to the second World War, refrigeration for the storage of catch was scarce and virtually all vessels had live wells (Mowbray, 1949). The fish and lobsters were brought ashore alive, and those not sold immediately were stored in fish ponds and floating cars. In order to be able to keep the fish alive, fishing was conducted primarily in shallow water and when the fish were taken deeper, they were handled carefully and their swim bladders were punctured to enable them to swim upright.

It was only after World War II that Bermuda fishing took on a specialized, occupational character (Anderson, 1984). There were significant, technological advances in the production of fiberglass vessels; the diesel engines for small vessels; electric, gasoline and hydraulic winches; depth sounders; loran and ready access to refrigeration. The maximum size of fish pots that could be handled by the industry increased from 1.3 meters to 3 meters. This represented a doubling of linear measurements but an exponential increase in volume. Live wells were replaced by ice boxes, and the average size of vessels increased from 6 meters in 1945 to just over 9 meters in 1985.

In the 1950s (Figure 2), the annual foodfish harvest totalled approximately 450,000 kg. and consisted of an estimated 70% grouper (grouper and rockfish); 20% snapper; 9% jack, mackerel and tuna and 1% other species (hogfish) (Bardach *et al.*, 1958). Two-thirds of the fish consumed locally was supplied by the industry and one-third was imported. During the intervening years to 1989, the total catch of foodfish slowly increased to about 620, 000 kg per year. The composition of this catch, however, changed steadily so that by 1989 (Figure 3), 19% of the catch consisted of grouper; 10% snapper; 15% jacks; 25% tunas and related species and 31% was comprised of miscellaneous reef fish, such as parrotfish, porgy, grunt, triggerfish, hogfish and Bermuda chub.

The shift from a catch dominated by grouper and snapper to one where herbivorous reef fish, such as parrotfish and surgeonfish, formed the mainstay of the fishery as a result of a severe decline in the preferred target species (groupers) rings many alarm bells for the fishery manager.

MANAGEMENT

In Bermuda, laws protecting species and restricting the use of fishing gear types have been variously enacted over the centuries since marine turtles were first protected in 1620. During the 1700s, there were fourteen individual Acts passed to regulate the use of nets in certain areas, and, in 1791, ban the use of

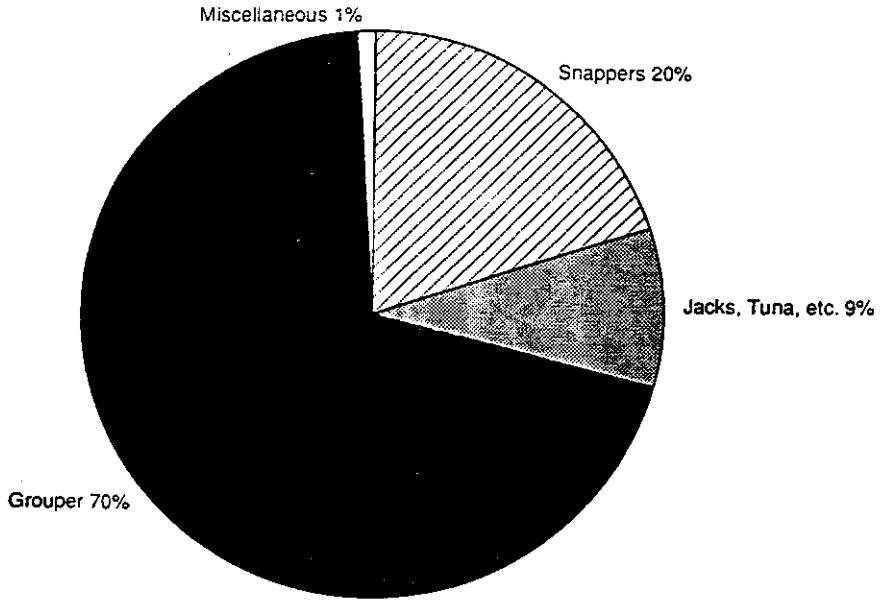


Figure 2. Composition of foodfish landings circa 1950.

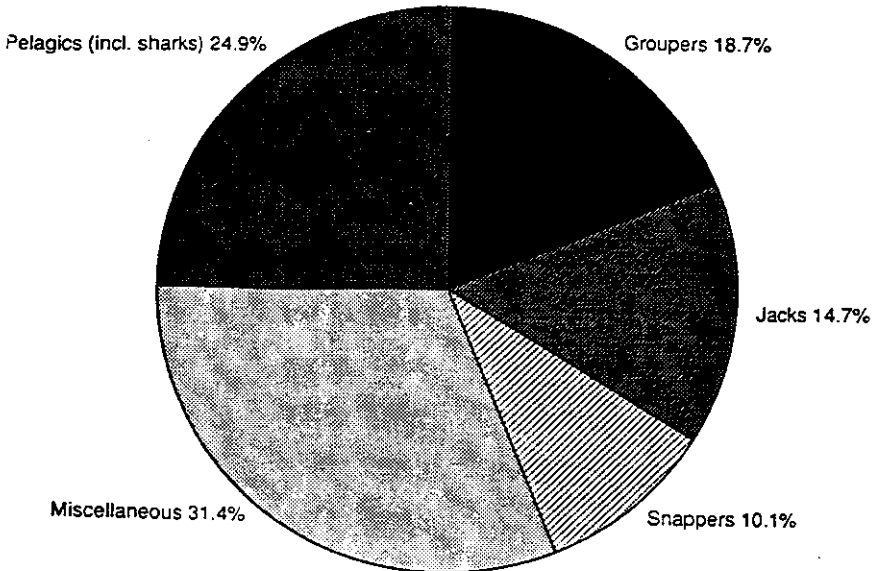


Figure 3. Composition of foodfish landings circa 1989.

fish pots. During the nineteenth century, only one Act was passed to restrict the use of fishing nets.

In 1911 the Harrington Sound Fishing Act was passed to establish a nursery area within that enclosed body of water. In 1921, the Board of Trade Act was passed and fisheries matters were delegated to this Government Board. Under the Board of Trade Act, the Fisheries By-Laws were passed in 1925. These established minimum mesh sizes for nets and the wire mesh sizes that could be used on fish pots.

In the early 1950s, responsibilities for fisheries management were transferred to the Trade Development Board, now Ministry of Tourism, and in 1952 a comprehensive set of Fisheries Regulations were passed which specified the minimum sizes of fish and lobster that could be taken and established protected areas where fish pots could not be used.

In 1961 responsibility for fisheries transferred to the Board of Agriculture and the Department of Agriculture became the Department of Agriculture and Fisheries. In 1963 another new set of principle regulations was made which defined various types of fishing nets, specified additional areas where pots could not be used, restricted the use of spears to one nautical mile from the shoreline; prohibited the use of aqualungs or any other type of breathing apparatus for taking fish of any kind and all persons who fished commercially were required to register with the Department of Agriculture and Fisheries.

In 1972 Parliament passed the Fisheries Act and in the same year extended the jurisdiction over fisheries to a distance of 12 miles from the baseline of the territorial sea. The Fisheries Act provided for control of foreign fishing and made provision for orders to be made to protect selected species and areas of the exclusive fishing zone. The Act provided wider powers of enforcement, controlled the importation and exportation of fish, and gave powers to the Minister to make regulations to control the fishing industry and to protect Bermuda's marine resources. The Regulations made at this time included requirements for commercial fishermen to license and for the compulsory reporting of catch and effort statistics by licensed commercial fishermen.

Since 1972, the economic fishing zone has been extended to 200 nautical miles (370 km) and the Fisheries Act and Regulations have been amended on numerous occasions. Major changes occurred in 1980, when the Government instituted a restricted entry into the commercial fishery. In 1985, a limited entry pot fishery was instituted and the numbers and size of fish pots were greatly restricted. These numbers were further reduced each year on a sliding scale so that the fishermen with the greatest numbers of pots bore the brunt of the reductions. In 1990, some 200 years after first being done, the use of fish pots in Bermuda was banned.

Since the Second World War, there have been numerous attempts to encourage the industry to diversify. In the 1950s and early 1960s, research was

conducted on flyingfish and a net was developed that was effective at catching flyingfish. Similarly, a relatively short longline was developed which was suitable for catching tuna near the edge of the Bermuda platform drop-off. Unfortunately, markets for these fish were at that time limited as consumer preference was for white meat fish, such as grouper and snapper.

In the 1970s, restrictions were placed on the use of fish pots (use by commercial fishermen only), and a processing and marketing project was initiated to develop markets for tuna, wahoo, shark and Bermuda chub. The project was successful in developing and marketing products, such as smoked marlin and tuna as well as dry sally shark and chub, but was unfortunately, not successful in converting the traditional pot fishermen to catching these other species.

Instead of directing effort at tuna, the pot fishermen were able to develop market acceptance of reef fishes presented in the form of "Bermuda fish fillet" regardless of species. This made it economically possible for fishermen to continue to harvest snapper and grouper with pots well beyond sustainable levels. Hence, when grouper became commercially extinct, the "supplemental" reef fishes became the species of choice and because pots are relatively unselective, the already depleted grouper species continued as a "by catch" of the reef fish pot fishery.

Attempts to reduce fishing effort from pots to prevent the reef fish stocks from collapsing in the same way as the groupers had, were made in 1980 by limiting the number of fishermen and the pots they could use. The 1980 programme did not have the desired effect and by 1985 it was obvious that fishing effort needed to be further reduced. A limited entry fishery was instituted at this time, and in this programme the numbers of pots that each fishermen could legally use were regulated. Between 1985 and 1990, the numbers of pots used by the fishermen were reduced on an annual basis and according to a sliding scale from a total of 3, 200 pots to 1, 600 pots.

This limited entry programme did not result in decreased catches of groupers, snappers or reef fishes generally because pot number reductions were largely on a paper-only basis. Fishermen regularly used in excess of their allotted number of pots. In addition, pots were found to have a far greater efficiency than originally estimated because of fish movement and conspecific behaviour of fishes in relation to pots (Luckhurst and Ward, 1987).

Attempts at enforcement of pot numbers were not effective because: 1) on the platform they could be set without surface floats; 2) it is difficult and time consuming to collect evidence of illegal use that will stand up in a court of law; 3) penalties handed down by the courts had generally not been severe enough compared with the profits that are realised each time an illegal pot is hauled to dissuade fishermen from setting too many pots.

It is common maxim that in any fishery where the cost (in terms of effort and dollars) of fishing a depleted small stock is low, while the value of the fish landed is high, profits can be made until the "last fish" of that stock is caught. In the Bermuda equation, over-employment has allowed many fishermen to engage in other forms of work (on a regular or occasional basis), thus, in effect, supporting their fishing activities for these highly marketable resources.

The 1984 Management Plan recognized the historical participation and commitment to the industry of individual fishermen. Part-time fishermen were barred from the pot fishery, and the allotting of pots to full-time fishermen was based on their previous usage. The 1984 Management Plan did not attempt to reduce the number of full-time fishermen allowed to continue to use pots (although, of course, part-time fishermen were eliminated), but rather the strategy to reduce individual allotments of pots.

Prior to the introduction of the 1984 Management Plan, the largest allotment was 100 pots. By 1990, it was 30. Such a large reduction seriously reduced the larger operators' potential to generate revenue. Many of the fishermen whose operations were tailored to the servicing of large numbers of pots, have stated that the reductions caused serious economic hardships. Indeed, it was not uncommon for fishermen to point out that their reduced allotments were so small they had to cheat to make a living.

There were numerous reports of widespread abuses of the regulations governing the use of fish pots, particularly with regard to exceeding allotments, unlawful failure to use surface buoys (to avoid detection) and the use of unidentified pots (to avoid the potential of prosecution). The most distressing illegal activities within the pot fishery were the theft of pots or their catch and the use of pots identified with another fisherman's numbers. Those fishermen who complied with the conditions complained of being unable to compete with illegal operators.

The trend in landings as reported by the industry show there was a steady decline in grouper catch from 1975 through 1981. Although the grouper landings displayed a modest recovery in the period between 1982 and 1989 (Figure 4), examination of these landings by species (Figure 5) shows that this rise is attributable to three species: black grouper, *Mycteroperca bonaci*; coney, *Epinephelus fulvus*; and barber or creole fish, *Paranthias furcifer*. Red Hind, *E. guttatus*, landings remained virtually unchanged during this period. Rather than indicating a recovery, Figure 5 demonstrates that several previously important grouper species are now essentially commercially extinct and that the Bermuda fishery now catches only four grouper species with regularity.

Of those species which have been displayed increased landings, only the black grouper has always been considered a choice fish, whilst the smaller coneys and barbers were previously discarded as unmarketable. Comparison of the species composition of the grouper landings of 1975 with that of 1989

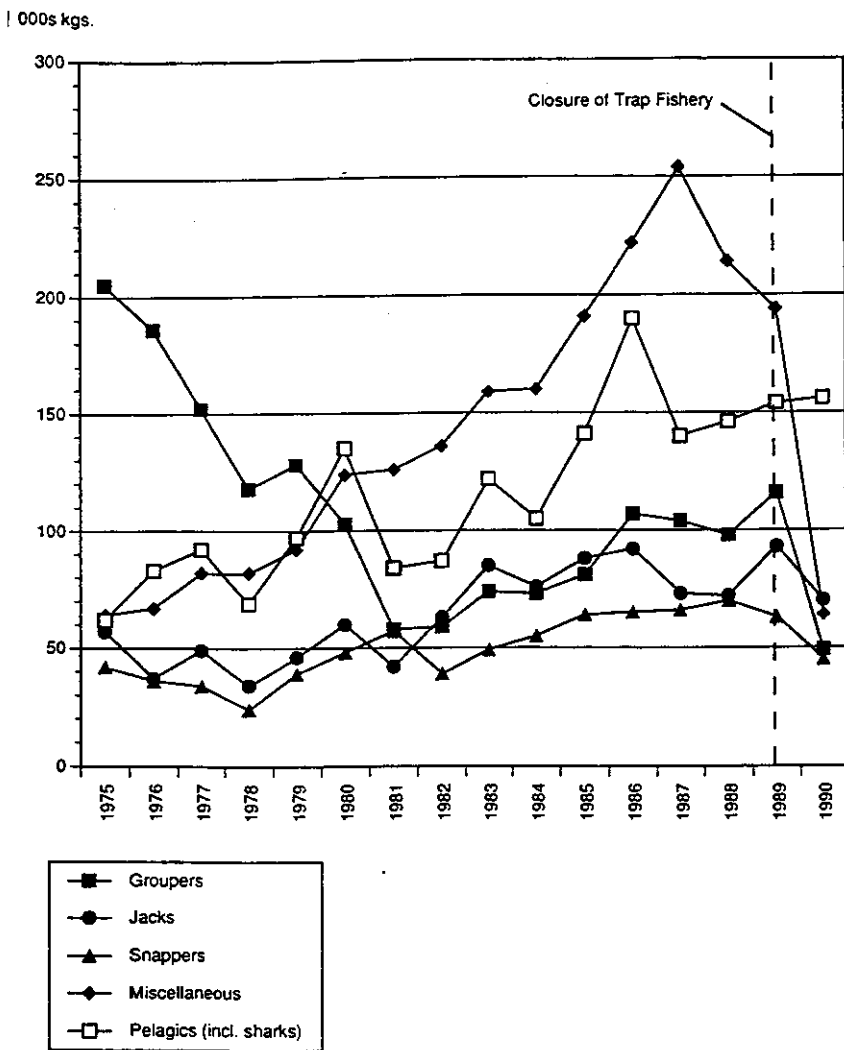


Figure 4. Commercial landings by species group.

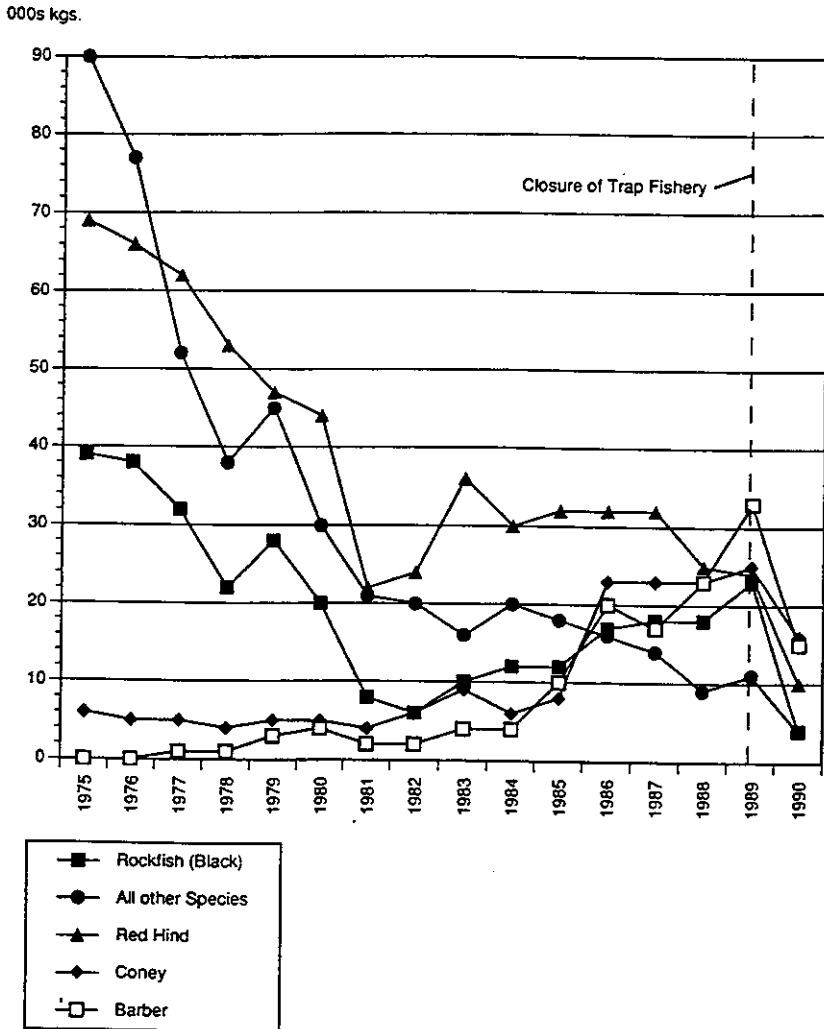


Figure 5. Commercial grouper landings by species.

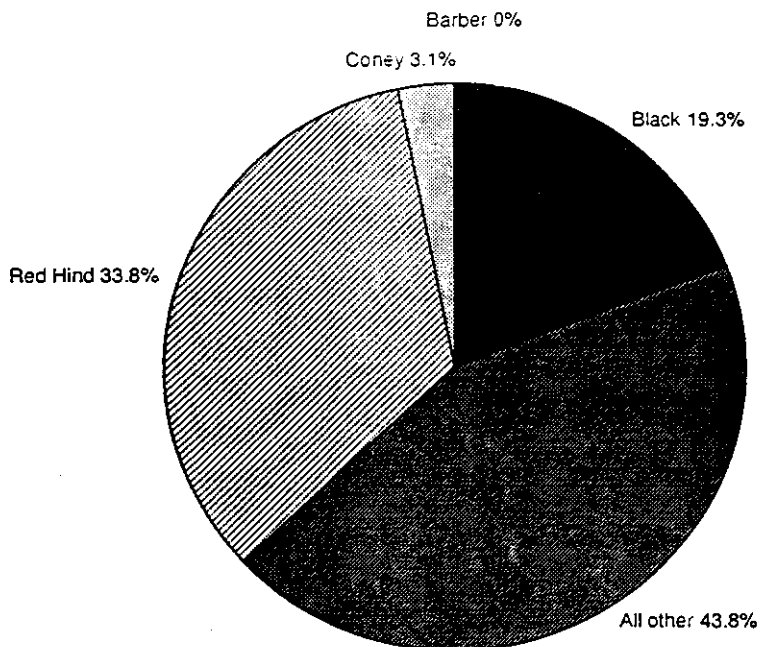


Figure 6. Composition of grouper landings 1975.

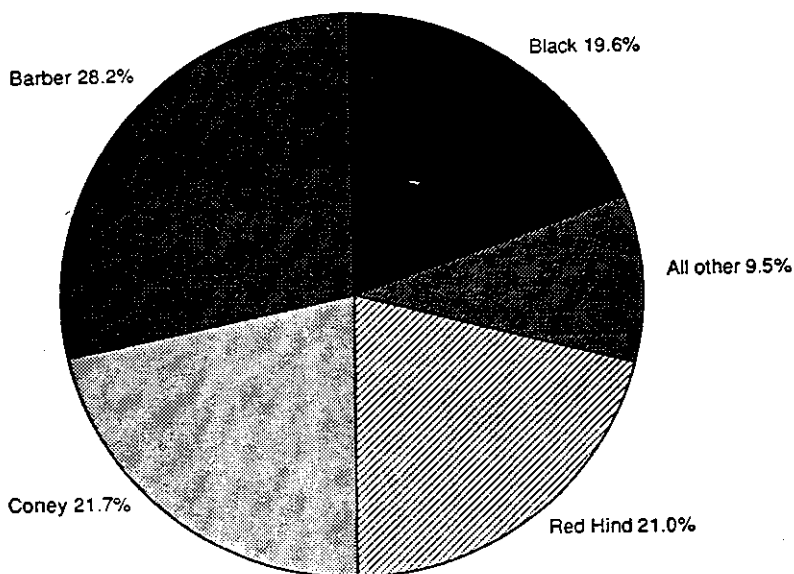


Figure 7. Composition of grouper landings 1989.

(Figures 6 and 7) emphasizes the extent to which the make-up has changed. It should be further noted that the total grouper landings in 1989 were 57% of those reported in 1975.

Not only were key species of fishes being depleted but the ecological effects of reduced numbers of predators on invertebrates was becoming obvious. McClanahan and Shafir, (1990), summarize accounts of the effects of consumer succession from herbivorous fish to invertebrates (sea urchins) when over-fishing occurs. During the past two years, this phenomenon has occurred in Bermuda, especially in harbours and bays where population explosions of sea urchins have denuded the algal substrates.

Based on the evidence from catch and effort statistics that was gathered after the 1984 programme was initiated, it appears likely that even if the necessary level of control over the pot fishery had been obtained, this fisheries management programme would not have been sufficiently effective in protecting the stocks to allow for full recovery. Indeed, it appeared that if the Government had allowed the continued use of even small numbers of pots, it would have enabled the industry to catch the "last fish" in a very real sense. The risk of failure of the 1984 Management Plan and the resulting cost to Bermuda was too great to be acceptable because there were no other under-utilised reef fish species groups remaining and there was concern for the total collapse of the reef fishery and its attendant effect on the complex reef ecosystem. This would not only have an impact on the future of the fishing industry, but also Bermuda's tourism industry, quality of life for residents and the very fabric of the island itself.

THE 1990 BAN ON USE OF FISH POTS

In Bermuda commercial fishing is not carried out at a subsistence level but is, in fact, a business. In other words, the production of food is not so important to the fishermen and to the community as operating a business and making money to be able to support fishermen and their families. Marine resources in Bermuda must provide raw materials for these businesses, but they must also provide raw materials for a range of other competing businesses related to the tourism industry and recreation of residents. While the capture fishery (including lobster and offshore pelagic fishing for tuna, etc.) generates annual gross earnings of some 3, 000, 000, the tourist-related industries of snorkelling, diving, glass bottom boat tours and sport fishing grossed more than 9, 000, 000 (Couper, 1989). Most of this latter income is in the form of foreign currency which helps the island balance its trade deficit.

The Bermuda Government recognized that it was important to strike a balance between various industries competing for the finite reef fish resource and that it was essential that the species and populations which make up the resource were sustained. It was important to ensure that sustainable levels of

harvest were not exceeded, and it was also important to ensure that the habitats and the environment generally were not compromised to the point where populations could no longer sustain themselves.

It is believed that the pot fishing industry had already been restricted to the point that any further reduction in individual pot allotments would lead to undue hardship and economic failure for many fishermen. In others, further restrictions would have pressured fishermen into additional illegal activities with, no doubt, increased ingenuity.

This policy of management of marine resources for multi-user purposes (capture fishing, sport fishing, snorkelling, diving, glass bottom boats, etc.) is a departure from what has gone on historically in Bermuda. Indeed, this change in policy direction, from one of providing protectionism for a small group (71) of commercial fishermen who effectively had a monopoly on the harvest of many fish species and spiny lobsters, to the management of resources for both recreation and harvest, was difficult for the traditional pot fishermen to accept.

For a closure of the pot fishery to be somewhat palatable to the industry and acceptable to the community in Bermuda at large, it was recognised that some form of recompense for the displaced fishermen was essential. It should be recognised that the cost of exit from the industry was prohibitively high to most pot fishermen due to both a general overcapitalization in the pot fishing sector and to the negligible salvage value of their operations (vessels, gear and licenses). Many fishermen were operating at a marginal level due to the high cost of operations maintaining their capital investment (interest). The previous policy of phased reductions in pot allotments had condemned overcapitalized operations to a slow death as pot numbers were decreased annually. Compensation for banned gear (fish pots) was, therefore, considered to be appropriate based on the history of the fishery.

Given the state of the fishery and the vulnerability of depleted stocks, the Government felt that it would be unwise to phase the closure of the pot fishery. As a consequence, the Government decided to offer ex-gratia payments ranging from 10, 000 to 75, 000; depending on the catch of fish and effort with pots that the fishermen had reported making over the three-year period leading up to the closure. This assistance was offered to those fishermen licensed to use pots in 1989/1990, providing the fishermen were in good standing with their licenses. They were also compensated for pots handed in according to size and condition of the pot. If fishermen chose to surrender a winch, this too was compensated for at a fixed rate. Compensation and ex-gratia payments were made only to those fishermen who surrendered the pots that they were licensed to use. In order to prevent speculation on a future fishery and to eliminate any pressures on Government to reopen any form of pot fishery, it was stressed that the closure of the pot fishery was permanent.

Although elegant in its simplicity, a closure of the pot fishery raised two major areas of concern; a) spillover of displaced fishing effort into other established fisheries (longline fishing, charter fishing, net fishing); and b) the development and control of alternate fishing activities that would enable displaced fishermen to continue to harvest the reef fish resources, including grouper.

Spillover

Concern had been expressed by those fishermen who had not been licensed to use pots that the displaced pot fishermen would greatly increase their use of nets, longlines and handlines and compete with them in the harvest of limited resources in their traditional fisheries. Unlike the pot fishery which is able to target all types of reef fishes, commercial line fishing only takes carnivorous fishes, such as grouper, snapper, hogfish, jacks, tuna and wahoo. This fishery is, therefore, self-limiting and requires healthy stocks of these fishes to be viable.

Since April 1990, some of the former pot fishermen have moved into other industries, some are presently fishing on a part-time basis, and others continue to fish full-time using lines and nets. So far, however, there has been no evidence of problems with spillover resulting in increased competition between the "pot fishermen" and the "line fishermen". The contrary has tended the case. With the abolition of fish pots, the "line fishermen" are now able to target a larger proportion of stocks.

This has been most evident in the fishery for lane snapper, *Lutjanus synagris*, on the Bermuda Platform. This species was previously harvested by hook and line (mainly at night) as well as with so-called "channel pots". These wire arrowhead pots, in recent years, were large, being some 2.5 meters on a side and 1.5 meters high. They had a volume of 3.2 cubic meters and were extremely effective at capturing snappers, grunts, chubs and jacks. With all fishermen being forced to use hook and line, the traditional line fishermen have been able to "outfish" many of the pot fishermen and have, in any case, had available a greater share of the snapper stocks.

It should be noted that although the overall fish landings reported in 1990 declined significantly from those reported in 1989 as a result of the closure of the pot fishery, certain species, notably jacks and snappers, became the target of many fishermen. This resulted in the reduction in the reported landings for these species being less marked than for those species previously taken almost exclusively in fish pots.

The establishment of a number of fish aggregating devices near the edge of the platform in about 60-90 meters depth has also helped increase catches by hook and line. Both "ex-pot" and "line" fishermen have used these FADS

extensively and have made good catches. For the traditional line fishermen, it has meant an increase in catch per unit effort and, in most cases, an increase in total catch.

Alternative Fisheries

Although offshore longlining for pelagic species (tuna, wahoo, shark, etc.) and deep water trapping for crabs and prawns both hold promise for the future of Bermuda's diurnal fisheries, none of these activities can yet be considered as viable options for the former pot fishermen. Government has provided support for research and development of these industries, as well as for research on mariculture, but there is insufficient information available on which to advise that any of these pursuits would be financially viable propositions.

Notwithstanding this, a number of fishermen are experimenting with deep water (1000 meters) red crab and shrimp pots and relatively short (1-10 kilometers) longlines. Work with red crab trapping has previously been reported by Luckhurst (1986) and a longline research project by the Bermuda Fisheries Division is concluding this year. In addition, Government has developed a lobster-specific pot which is now being tested in a seasonal, experimental fishery with the cooperation of some fifteen fishermen who work the gear and market the catch.

One of the concerns of management was that the fishermen would adopt other novel, destructive fishing practices in order to offset their loss of fish pots. Regulations were put in place to control longlines, that is, those lines with an aggregate of more than fifteen hooks, to prevent the use of set or trot lines on the shallow platform where they would target the depleted reef fish stocks. Indeed, these Regulations control the use of all stationary gear, including trot lines, weirs, traps and snares.

The use of fishing nets on the shallow reef were also of concern. Although the use of all gill nets, trammels, drift nets and other entangling nets have been banned within Bermuda's exclusive fishing zone for ten years, there was concern that modified beach seines could be used to effectively harvest reef fishes in shallow water. Rather than ban the use of seines, it has been specified that they can only be used to catch pelagic-type species, such as jacks, yellowtail snappers, little tunny and flying fish.

ADDITIONAL MANAGEMENT MEASURES

In order to enhance recovery of fish stocks, the three areas previously used to protect red hind spawning stocks were greatly enlarged and put off limits to all fishing from the 1st of May to the end of September each year. Two of these areas extend from the shore to the 200 meter depth contour and a third is smaller, extending from the breaking reef to the 200 meter depth contour.

In order to help prevent poaching in these protected areas that are designed

primarily to protect spawning groupers, a seasonal bag limit of ten fish per boat per day has been placed on the capture of red hinds. Additionally, a year-round bag limit of two fish per boat per day is in effect for the capture of seven other medium to large grouper species (Nassua grouper, *Epinephelus striatus*; Red grouper, *E. morio*; Mutton hamlet, *E. afer*; Yellowfin rockfish, *Mycteroperca venenosa*; Salmon rockfish, *M. interstitialis*; Black grouper, *M. bonaci*; Finescale rockfish, (gag), *M. microlepis*; Tiger rockfish, *M. tigris*). This two fish per day limit allows an incidental catch of these groupers but prevents directed fishing for them.

REACTION OF INDUSTRY TO THE POT BAN

The reaction to the ban on the use of fish pots varied tremendously, depending on the interest of the individual users.

Line and net fishermen, commercial and sport divers and glass bottom boat operators endorsed the scheme and generally said it was long overdue. Not surprisingly, most commercial pot fishermen were opposed to the scheme, although a minority agreed it was inevitable but, nevertheless, would have liked to have used pots for a few more years. A group of pot fishermen (about one-third the total) were so incensed by the ban that they formed a Fishermen's Division of the main Trades Union on the island. Backed by the Union, the fishermen demonstrated in front of the Ministry Headquarters and at Parliament. The Union eventually threatened a general strike unless an inquiry were held into the banning of pots. This was backed by the Opposition Party, but a compromise was eventually struck to hold an inquiry into the future of the fishing industry and the future protection of the marine environment.

A three-man Commission convened in Beruda in November 1990, reviewed written submissions, conducted both in public and private hearings and presented their findings in February 1991 (Towle *et al.*, 1991).

The Commission made a total of twenty-three individual recommendations, including one that the ban on the use of fish pots should remain in place indefinitely. They also recommended that Government should formally recognise the multi-user nature of marine natural resources (fish, shellfish, corals, sea fans, etc.) and that a conservative approach to management of these resources be instituted. The Commission also recommended that the public be more involved in the process of impleting new regulations through wider consultation and a system of public hearings.

Most fishermen have now accepted that the fish pots will no longer be used and have directed their fishing efforts to line fishing and selective netting for jacks and little tunny. A few have left the fishery, sold their vessels and licenses and are pursuing careers in construction, home maintenance and boat repair and maintainance. But a handful still feel the banning of fish pots was unnecessary and that pots should be given back to the industry. These individuals are vocal

and have managed to keep fisheries a topic of news locally for the past eighteen months.

DISCUSSION

Before passing legislation to ban the use of fish pots, Government weighed many factors. It took a look at past management policies and the reasons for their failure. For example, the establishment of seasonal refuges failed to prevent the decline of red hind stocks. It is believed that this measure was compromised by an inability to adequately enforce the closure and the continued high level of ambient fishing pressures (Barnes, Ward, and Burnett-Herkes, in press).

The Bermuda Division of Fisheries currently has one Head Warden and four Fisheries Wardens who are charged with the enforcement of the Fisheries Act and all the Regulations made under the Act. Although there are sufficient vessels to allow for coverage of the protected areas, scheduling of manpower on a 24-hour basis is difficult and it is really only at peak times that complete coverage can be given to the protected areas.

In 1984 a Fisheries Management Plan was put into effect that established limited entry into the fishery and phased a reduction in fish trap allotments in an attempt to redress the symptoms of overfishing. By all indications, there continued to be widespread abuses of trap allotments as well as an increase in the efficiency of the use of traps by fishermen.

The continuing decline in the reported landings of groupers in conjunction with a marked increase in the landings of species in the miscellaneous category (parrotfish and other reef species) and increasing concern over the adverse effects of commercial fishing on the aesthetic value of the marine resources indicated that something drastic had to be done. It was obvious that effective enforcement of a scheme prescribing specific numbers of pots each fishermen could use was virtually unenforceable.

Looking back on the record of the past fifty years, it is obvious that the steps taken to manage the resources had been invariably a case of "too little, too late". The reason for this was a desire not to pass laws that would adversely impact on the fishermen and, as a consequence, the regulations did not have the desired impact on the management of the stocks.

Given Bermuda's remote position in relation to foreign larval sources, the tenuous predicament of local stocks and the great value of the marine resource to recreation and eco-tourism, Government decided to adopt a very conservative management approach involving the complete closure of the trap fishery complemented with enlarged protected areas and bag limits for grouper species. This giant step which, in the words of the fishermen, has "killed" the pot fishery, is a very real attempt by Government to beat the "too little, too late" syndrome

and realistically manage the resources for the benefit of the entire Bermudian community.

This account of the management of Bermuda's reef fish resources is directly applicable throughout the region. Bermuda, as a microcosm, illustrates what happens when for a variety of reasons, management measures do not go far enough.

Bermuda differs from the Caribbean in two significant ways: having cooler seasonal water temperatures resulting in slower growth rates of fish and invertebrates and, more importantly, by being geographically isolated.

As a result of being isolated, recruitment is largely from local stocks, but supplemented by larvae carried in eddy currents thrown off at random by the Gulf Stream. As fishing effort throughout the region increases to levels that are being applied in such areas as Florida, Jamaica, Puerto Rico and the Virgin Islands, the Caribbean will experience the same type of recruitment problems as those facing Bermuda.

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