Fisheries Management: What Chance on Coral Reefs?

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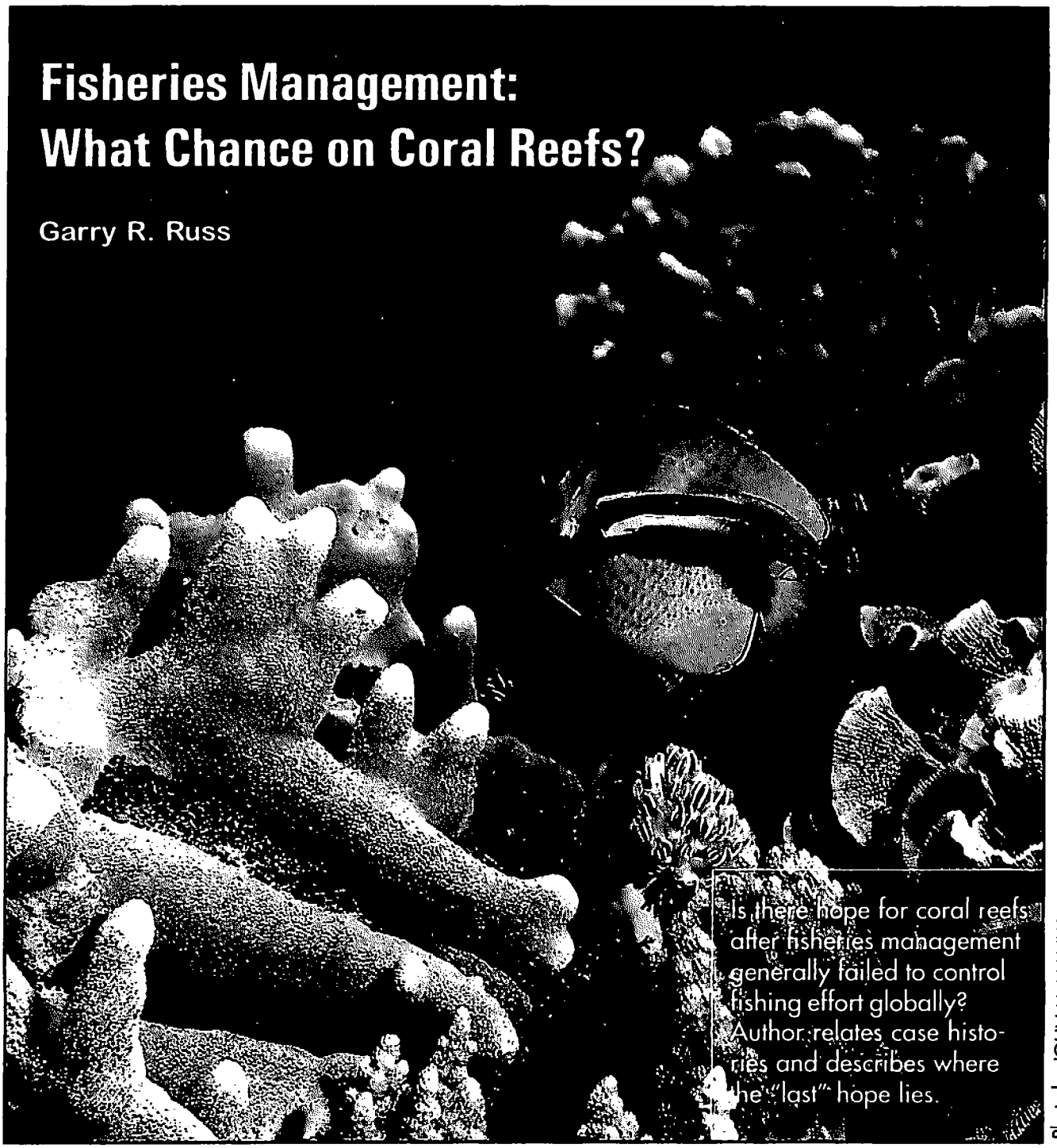


Is there hope for coral reefs after fisheries management generally failed to control fishing effort globally? Author relates case histories and describes where the "last" hope lies.

Photo by JOHN McMANUS

Fisheries Management in the 1990s

A predictable retort these days to the question posed above would probably be - what chance anywhere? Fisheries management has generally failed to control fishing effort globally. A disturbingly high number of fisheries all over the world are overfished (FAO 1994). Just as much, if not more, catch and money could be obtained with far less fishing effort. Greed and economic mismanagement (creation of fleet sizes incommensurate with long-term sustainable yields, overcapitalization) lead to overfishing. The track record of fisheries management has become so bad that subtle arguments about biological, economic or social gains have often been replaced with arguments of stock viability.

Some would counter that all this will change once fisheries gets away from the old open access systems ("freedom of the seas") and moves to systems of ownership (e.g., individual transferable quotas, or ITQs) and thus greater individual responsibility (e.g., Rosenberg et. al 1993). The abalone fisheries of southern Australia have had such ITQs for many years now and are currently embroiled in almost gunboat tactics to try to stamp out poachers. Even attempting to conserve a resource and then allocating a share of it fairly to a limited number of very wealthy users in a developed nation has its problems.

The failures of traditional fisheries management were again brought into sharp contrast in 1992 with the collapse of one of the world's oldest and richest fisheries, the northern or Grand Banks Cod, in a nation with one of the best reputations for high quality fisheries science and management — Canada. A fishery which had maintained a catch of around 200 000 t per year for 200 years was closed in June 1992 when the scientists realized there were virtually no cod left which were old enough to spawn. The problems began when huge "factory freezer" stern trawlers from Europe began fishing the spawning and pre-spawning aggregations of cod in the 1960s. Taking control of the Grand Banks under their Exclusive Economic Zone in 1977, the Canadians embarked on a rebuilding of the stock, deliberately "underfishing" at $F_{0.1}$ or 80% of $F_{0.1}$ during the late 1970s and early 1980s. However, Canadian scientists overestimated stock size by incorrectly assuming that commercial catch rates in the 1980s reflected abundance of the stock in the same way as they had reflected abundance in the 1960s. As recently as the late 1980s, the scientists were aiming at an annual harvest rate of 16% of the stock when in fact the real figures were 40-50%! By 1989, when the scientists realized their mistake and argued for vastly reduced quotas, the politicians refused to slash catch. When the collapse came in 1992 it was considered by many in Canada to be sudden, drastic and unexpected. But as Hutchings and Myers (1994) have argued, it was a stock on an inexorable downward slide for three decades. Any student of basic ecology would not be surprised by the collapse of a population whose intrinsic rate of natural increase was strongly negative for 25 of the past 30 years. In the words of Debora MacKenzie in a recent article in *New Scientist* (September 1995), "How could the massed experts of an advanced nation like Canada allow one of the world's richest fisheries go to the wall?".

Williams (1994) highlighted the debate on the contribution of science to effective fisheries management. On one hand Ludwig et al. (1993) argue that the prospects for achieving scientific consensus over sustainable levels of fishing are not good and that even if consensus is achieved, it may still be ignored. Rosenberg et al. (1993) argue that sustainable use of renewable resources is achievable but choose some rather unfortunate examples to support their case. Rosenberg et al. (1993) state "There are important examples of relatively new fisheries in which access and fishing effort have been controlled from the start and in which scientific advice and management policy have been integrated to achieve sustainable harvesting".

The examples they chose were the Falkland Islands squid fishery and the Australian demersal fisheries.

Photo by MARK PREIN

Anchor damage to Staghorn coral at south end of Tubbataha reef.

Muro-ami method of fishing, that of scaring fish out of coral reefs, has remained uncontrolled in Philippine fisheries.

Photos by JOHN McMANUS

In 1995 there has been serious concern that the *Illex* fishery (a squid with an annual life cycle) is in deep trouble, perhaps due to recent large catches of juvenile *Illex* on the Argentine coast, before the animals migrate to the Falklands (Anon. 1996). The two major Australian demersal fisheries are the Northern Prawn Fishery (which until recently had twice as many boats as required to maximize economic yield) and the South East Fishery (SEF). The SEF has seen the collapse of the gemfish stock in 1990 and its current major target, orange roughy, is in danger of the same fate. Orange roughy have a maximum potential longevity of around 100 years and an age to first reproduction of greater than 20 years. The fishery basically began in 1989. The management objective is to ensure the spawning stock biomass is not reduced below 30% of the original, unfished biomass. However, the most recent assessment concludes that the stock may be at 24% already. Management policy appears to have shifted from "stock reduction" to "promote rebuilding" in just 7 years. A performance to make even the Canadians green with envy! Some scientists have likened the exploitation of orange roughy in southeastern Australia as more akin to mining than fishing. The two common threads in the debate described by Williams (1994) are that there is invariably considerable uncertainty in scientific estimates of stock states and rates and that the track record of traditional fisheries management is not good. Should we be more conservative?

The sequence of "development" of fisheries has been depressingly similar almost since fishing began. The most valuable fish closest to the home port are exploited first. As catch rates and average sizes of fish decline fishers travel further from home to maintain catch rates. As stocks of valuable species become depleted, the fishery often switches to "less desirable" species. The common theme, except in the early stages of fishery development, is too many fishers and not enough fish.

If Management is So Bad, How Do Fisheries Persist?

There is no doubt that traditional input and output controls are essential for the long-term persistence of most fisheries. However, in many fisheries, management controls are either absent or inadequate. I believe that many fisheries, particularly in the developing world, probably persist in the face of excessive fishing effort due to the existence of natural spatial refuges which supply recruits to the fishery. Refugia from fishing mortality exist and have existed in virtually all fisheries. A uniform fishing mortality throughout a stock is the exception rather than the rule. Traditionally, temporal refugia such as weather conditions and spatial refugia such as habitats not accessible to fishing gears have ensured non-uniform distribution of fishing mortality. As technology improves and fishing pressure increases, the natural refuges are gradually found and depleted. An example where this phenomenon accelerates or occurs in "spurts" is the discovery of the location of spawning aggregations of a stock. It was such discoveries followed by almost uncontrolled expansion of fishing effort which put stocks like northern cod and gemfish on the long and almost unstoppable slide to collapse. As the natural spatial and temporal refuges disappear, the supply of larvae and recruits from them decline and fisheries are in danger of collapse even when management schemes (the traditional input and output controls) remain as they had been for the previous years or even the previous decades.

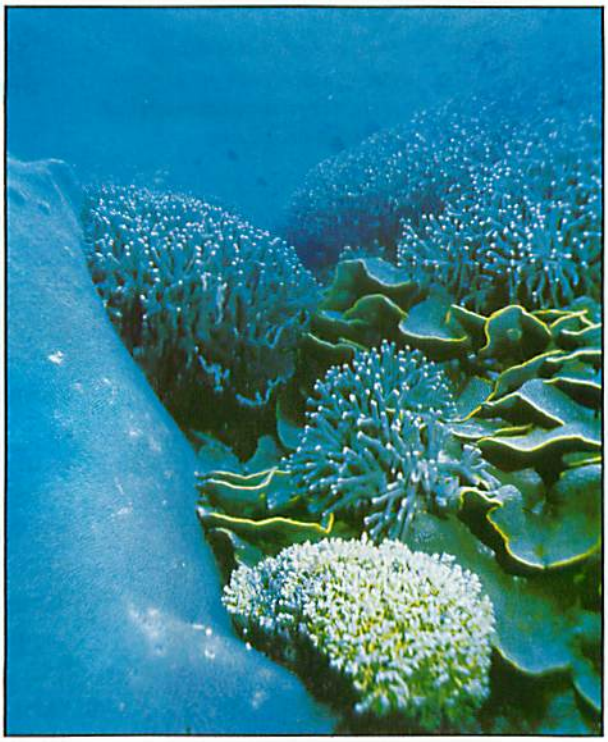


Photo by MARK PREIN

Marine reserves may be the only management option left to maintain a healthy fishery stock.

When the "reserves" are depleted, the resilience of the stock is undermined. The irony is that managers often manage in ignorance of the refuges. Managers set quotas or effort levels. Yields and catch rates seem to stay high as the fishery expands to exploit the last remaining refuges. The presence of pockets of spawning stock in unknown refuges gives the managers the impression that the controls they have administered are actually working!

Management of Coral Reef Fisheries

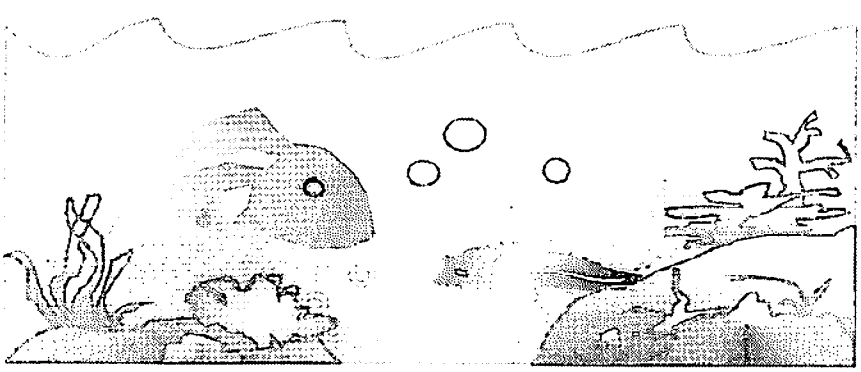
If the Canadians cannot get it right with their most valuable fishery, what hope for fisheries on coral reefs? A number of complex characteristics of fisheries on coral reefs make administering conventional fisheries management programs difficult. The fisheries are almost invariably multispecific with fishing effort spread among a wide variety of gears. Effort is often unevenly distributed spatially and there is frequently a large number of municipal (= artisanal and subsistence) fishers landing their catch at a large number of sites spread over a wide area. Thus difficulties exist with the collection of even the most basic information such as catch and effort. Furthermore, management agencies often view coral reefs to be not important enough economically to warrant spending money on detailed research. Finally and significantly, the importance of coral reef fisheries on a world scale may not be so much in terms of their absolute yield (approximately 0.5 million t per year) as in their contribution to the catch of fishers on low incomes and with few alternative opportunities for employment. Many coral reef fisheries occur in developing nations with rapid human population growth rates and chronic poverty. These characteristics of coral reef fisheries make conventional controls on catch difficult to justify socially and conventional controls on effort (e.g., gear restrictions, size limits) difficult to administer.

I believe that it is time that fisheries scientists learned from past mistakes and took a far more conservative view of the manner in which we manage the exploitation of fishery resources. Given the additional difficulties outlined above of managing coral reef fisheries, we should be even more conservative in our approach to these fisheries. Maybe we simply have to acknowledge that the only safe thing to do in many fisheries is set aside permanent spatial reserves of 10-20% of the stock in the hope that (as Jim Bohnsack put it in 1990) they will act as "an insurance policy against fishery collapse", that is, an insurance against management failure. Needless to say, we also need to manage the fished portion of the stock as best we can.

Use of Marine Reserves in Management of Coral Reef Fisheries

The major objectives (among others) of marine reserves in the management of fisheries is protection of a minimum spawning stock biomass to ensure recruitment supply to fished areas (the "recruitment" effect) and possible maintenance of local yields to areas adjacent to reserves by adult movements (the "spillover" effect). To achieve the first objective, my colleague Angel Alcala and I have spoken of the concept of a network of marine reserves throughout the Philippines as a strategy for protecting a minimum spawning stock biomass in the face of almost overwhelming increases in fishing effort on coral reefs in that country (e.g., Alcala and Russ 1990; Russ and Alcala 1996, in press). This approach argues for a knowledge of the major "sources" and "sinks" of larvae, detailed knowledge of the dispersal paths, larval durations and settlement requirements of larvae and protection (as marine reserves) of important sources of larvae and recruits to the fisheries. These are tall orders but eventually they are problems that must be solved for networks of marine reserves to be best used in maintaining fisheries. Our lack of such knowledge for most (all?) reef systems in the world has sometimes been cited as a reason not to use such a "novel" approach to fisheries management until we are sure it will work and until we can make the reserves of optimum size and in exactly the correct positions to be of maximum benefit. I would argue that in most reef fisheries we simply do not have time to wait for scientists to design the perfect marine reserve let alone the perfect network of reserves to ensure maintenance of reef fisheries. We simply have to accept that setting aside some of the spawning stock in locations which are our best guesses at larval "sources" will be some guard against fishery collapse. I am convinced that we may have to accept sub-optimal placement of reserves rather than no reserves at all. We have to act quickly in many cases since some situations are becoming critical and the amount of time needed to establish properly marine reserves in the developing world is painfully slow. Establishment of marine reserves almost invariably requires the strong support of the local people. Often, "stockwide" (i.e., recruitment) rather than local (i.e., "spillover") benefits appear rather nebulous to local people. This presents a challenge to community-based management.

I argue that, given the critical levels of overexploitation of many coral reefs, marine reserves may be the only management option available to maintain levels of spawning stock biomass necessary to sustain reef fisheries. Consider that in the coral reef fisheries of the Philippines, apart from reserves, there are only three management controls in place: it is illegal to use bombs, cyanide and a drive net system which is destructive to the coral. No other effort or catch controls exist. And unlike Canada, they do not have a mass of experts to stop their fisheries going to the wall. Given the current way we manage fisheries, would it make any difference?



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