

MARINE RESERVES: TIME FOR A GLOBAL PERSPECTIVE

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Abstract

Research on marine reserves, be it field research, management evaluations or modeling, has primarily focused on local or regional scales. This is illustrated with reference to published work during the 1990s at Lizard Island, Great Barrier Reef, on patterns of movement of commercial fishes in relation to marine reserves using visual census, tagging, freeze branding and ultrasonic telemetry. It is now time, however, to address overfishing of ecosystems on the scale at which it is happening in our globalized society, that is on a global scale. There is broad consensus that the world has to deal with massive fisheries overcapacity, fuelled by direct and indirect subsidies, and enhanced by technology creep. The results are globally declining catches and biomass, 'fishing down marine food webs', and ecosystem destruction. Increasingly, studies are demonstrating that marine reserves can play a successful role in fisheries management, but clearly their use needs to go hand in hand with serious and sustained efforts to reduce the overcapacity of all fishing fleets. This effort reduction, however, has to be accompanied by the creation of 'insurance policies', in the form of areas that will be permanently closed to extractive uses, i.e. marine reserves. Ultimately, this needs to be addressed on a global scale, and requires us to reconsider our currently unsustainable approach to marine resources and their use.

Keywords: common pool resources, global perspective, overcapacity, overfishing, subsidies

INTRODUCTION

Marine Reserves (MRs), also referred to by a variety of names such as Marine Protected Areas, Fisheries Closures or No-take Zones, are here defined as 'areas permanently removed from all extractive uses', and are in contrast to Marine Parks, such as Australia's Great Barrier Reef Marine Park, which uses multiple-use zoning as well as marine reserves. The issue of MRs has been reviewed repeatedly (Roberts and Polunin 1991, Dugan and Davis 1993, Halpern and Warner 2002, Russ 2002). Traditionally, much of the global MR research was heavily focused on local (Russ and Alcala 1996a, 1996b, 1998a, b, Zeller and Russ 1998, McClanahan and Mangi 2000) or, at the most regional scales of investigation (Mapstone *et al.* 1996a), focused on fundamental, empirical research topics such as abundance patterns, size distributions, or the essential questions of spillover or recruitment effects of target species. A small component of studies used modelling approaches to investigate the effects of marine reserves (De Martini 1993, Russ *et al.* 1993, Attwood and Bennett 1995, Man *et al.* 1995, Walters *et al.* 1999) or to evaluate reserve management (Alder *et al.* 2002). Few investigations have considered marine-reserve

issues on larger or global scales (Russ and Alcala 1999, Roberts *et al.* 2001, Pauly *et al.* 2002).

MARINE RESERVE EXAMPLE

Research that I have been associated with during the 1990s may serve as a typical example of this localized focus, as would the work of many others (see review by Russ 2002). My work focused on coral reef fishes of significance to fisheries in the Indo-Pacific, mainly serranids and lutjanids. The focal species were the common coral trout (*Plectropomus leopardus*, Serranidae), which forms the main target species of the Great Barrier Reef commercial line fisheries (Mapstone *et al.* 1996b), small serranids such as *Cephalopholis cyanostigma*, and small lutjanids such as *Lutjanus carponotatus*. The main topics of investigation related to home ranges and basic patterns of movement and activity (Zeller 1997, 2002), population size estimation (Zeller and Russ 2000), spawning aggregations (Zeller 1998) and patterns of adult fish movements in relation to established marine reserves (Zeller 1996, Zeller and Russ 1998). The field component of this research was carried out at Lizard Island, northern Great Barrier Reef, and the primary methods consisted of a range of marking techniques, including standard external tags, Passive Induced Transponder tags, and

freeze branding, combined with capture-recapture tools such as fish traps, hook and line fishing and underwater visual census (Zeller 1996, Zeller and Russ 1998, 2000, Zeller *et al.* 2003). In addition to the more traditional techniques, these studies were the first to successfully use ultrasonic telemetry, a remote-tracking technique, on the Great Barrier Reef (Zeller 1996, 1999), including the application of an automated, remote-tracking system (O'Dor *et al.* 2001).

These studies showed that the non-pelagic reef fishes investigated have relatively small home ranges (e.g. *P. leopardus*, ~10,000–18,000 m² Zeller 1997) and limited ranges of movement and activity (Zeller 1997, 2002), with the exception of spawning aggregation activities (Zeller 1998). A related study found no differences in large-scale movements of coral trout inside and outside marine reserves (Zeller and Russ 1998). These results influenced a subsequent investigation of the potential and likely scale of adult spillover across MR boundaries, under conditions of experimentally induced density gradients, and using a range of mark-recapture techniques similar to those used in the previous studies (Zeller and Russ, unpublished data). More than 1300 fish from the three main target families of commercial and recreational fisheries (Serranidae, Lutjanidae and Lethrinidae) were tagged, with recapture rates of 25% over the three-year study period. Preliminary examination of the resulting data indicated that approximately 60% of all recaptures were from the same small spatial area of initial captures (spatial resolution of 50 x 30 m), indicating that the distances moved between recaptures were very limited. Very few fish seemed to move more than 100 m from their area of capture (Zeller *et al.* 2003). These results confirm experimentally what has been becoming increasingly evident (Russ 2002), and that is that many reef fishes have a limited range of activity and movement as adults (here I specifically exclude spawning activities from this generalization).

This, of course, has implications for MRs on coral reefs (and likely elsewhere), with regard to both the scale of their perceived effectiveness as fisheries management tools (if one ignores the potential significance of the recruitment effect (Russ 2002)), as well as the scale of much of the research that is being conducted, because adult spillover on coral reefs is limited in the spatial extent at which it can influence local fisheries.

GLOBAL PROBLEM

Why then is there a need for scientists, resource managers, and especially policy makers, to consider a shift in focus from local or regional pre-occupation to a more global standpoint on MRs?

Few studies have attempted to step back and take the bigger picture into consideration (Russ and Alcala 1999, Roberts *et al.* 2001, Pauly *et al.* 2002). I feel that in many cases the level of focus of research has influenced the level of focus of policy and decision making, limiting policy 'vision' to too small a scale. Although this might be understandable in developing countries with their often huge underlying social, economic and political problems, it does not address humanity's larger problem. Fundamentally, the reasons why scientists, managers, and policy makers should be concerned with the global picture are simple, and are outlined below.

In general, fisheries are known to be in trouble around the world (North Atlantic cod, bluefin tuna, Patagonian toothfish, North-eastern Pacific rockfish stocks etc.), but often are still not perceived by the general public as having strong, or even any, impacts on the structure of underlying ecosystems. One reason for the relatively 'benign' perception of fisheries is that their impacts (e.g. declining landings or even individual stock collapses) are usually seen as local issues or problems, and rarely is the complete ecosystem picture considered. Yet, fisheries are a global industry, with fish products forming one of the world's most globalized commodities (Sumaila 1999). This industry works, deals, trades, and reacts at the global scale. Thus, the way scientists, managers and advisors to policy makers have to think and act is at the global level.

The Food and Agricultural Organization of the United Nations (FAO) maintains the only global database of fisheries landings (data reported by member countries). Based on this data the consensus was that global fisheries catches reached a plateau during the 1990s at around 80 million tonnes. These data ignore uncertainties regarding levels of discarding and 'IUU' catches (illegal, unreported and unregulated) (Alverson *et al.* 1994, Agnew 2000). However, a recent study, correcting for massive over-reporting of catches by the People's Republic of China, showed that the reported world fisheries catches have actually been declining slowly since the late 1980s (Watson and Pauly 2001). That study alone should dramatically change our perspective of the status of global fisheries, and should drastically alter our policy position as well as investment decisions by industry and lending institutions. As long as global catches seemed to be growing, or at least stable, and thus managing to meet global human demand, there seemed to be little public concern, much less national or international intervention. However, if, as that study shows, there is a general decline in global catches, then we have to act.

But not only are we seeing declines in catches, but we are also witnessing changes in the composition of catches that are of great concern, most clearly illustrated by what is now known as 'fishing down marine food webs' (Pauly et al. 1998). This exemplifies itself through declining mean trophic levels of catches, indicating that fisheries, after reducing top-level trophic species, are increasingly targeting fish further down the food web. A good example of this trend is the North Atlantic where it has been shown that the biomass of predatory fishes has declined by approximately two-thirds over the past 50 years (Christensen et al. 2002).

Yet, despite the declining trends in catches and lowering of trophic levels of landings, the global fishing-fleet capacity had grown by over 400% between 1970 and the late 1980s, while at the same time the landing rate had declined from over 6 tonnes to 2 tonnes per registered vessel tonne (Garcia and Newton 1997). According to the FAO, the growth in capacity has slowed during the 1990s, although continuous technological improvements are resulting in ongoing increases in effective catching power (Garcia and Moreno 2001). Thus, it is now generally agreed that a characteristic of many fisheries today is the existence of significant overcapacity in the range of 30–50% of current capacity (Garcia and Newton 1997, Garcia and Moreno 2001).

Thus, we are faced with declining catches and a shift in catch composition to increasingly lower trophic levels, while at the same time we are not succeeding in halting and reversing the growth in effective fishing power. How are we going to address this problem?

GLOBAL SOLUTION

Simplified, the driving forces behind global over-fishing developments are threefold:

1. Fisheries function under the underlying historical concept that marine resources are common pool property (Gordon 1954, Clark 1990);
2. Fisheries are heavily influenced by direct and indirect subsidies to essentially all fishing sectors and fleets around the world (Milazzo 1998, Munro and Sumaila 2002); and
3. There is a continuous technology creep, which increases the effective catching power of fishing fleets (Garcia and Newton 1997, Pauly et al. 2002).

How are we going to deal with these global problems? In a review, Pauly et al. (2002) suggest two key mechanisms to help us stop the destructive downward spiral of over-exploitation with associated fisheries failures and ecosystem

degradation (Christensen et al. 2002). Both mechanisms will cause pain in the short term, but seem the only logical solution in the long term. Interestingly, both mechanisms have also been recently acknowledged as key issues during the 2002 Global Summit on Sustainable Development in Johannesburg.

The first mechanism is a massive reduction of subsidies to the fishing sector, to enable market forces to better control unsustainable over-capacity of existing fleets. The required reductions in fishing effort will involve effective decommissioning of a large fraction of the world's fishing fleets, going hand in hand with implementation of fisheries regulations that apply a strong form of the precautionary principle. Although the conceptual elements for this are in place, e.g. in the FAO Code of Conduct for Responsible Fisheries (Anonymous 1995, Edeson 1996), the political will to act has so far been lacking (reflected in the growing number of fisheries collapses throughout the world). Whether the recent agreement calling for placing global fisheries on a sustainable basis by 2015 and eliminating subsidies, arrived at during the 2002 Global Summit on Sustainability in Johannesburg, will provide better impetus for action remains to be seen. However, it is clearly a useful step forward.

The second mechanism is the creation of large-scale marine reserves based on zoning of the entire ocean areas. This would remove large areas of fishing grounds from exploitation, to permit stock and ecosystem rebuilding by effectively setting an upper limit to fishing mortality. This is where I return to the Theme of this Congress. MRs essentially fulfil the function of 'insurance policy', a role that, historically, was performed by natural refuges unavailable owing to distance or to technologically more limited fishing gears (Roberts 2002). This role of natural refuge has been eliminated through technological and capacity expansion of the world's fishing fleets. To undertake this endeavour at the scale ultimately required (ocean-basin scale and globally) will require humanity to contemplate a change in the historically entrenched notion of marine resources as common pool and essentially open access, towards a more applied and enforced notion of long-term global heritage, and to implicitly re-consider the long-held notion of *Mare Liberum* (Russ and Zeller 2003). This approach, if implemented and enforced thoroughly, will permit our societies to finally develop sustainable fisheries with catches likely in excess of present levels, based on resources that are embedded in functional and diverse ecosystems.

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