TESTIMONY OF ROBERT R. WARNER
PROFESSOR OF MARINE ECOLOGY
UNIVERSITY OF CALIFORNIA, SANTA BARBARA
BEFORE THE
SUBCOMMITTEE ON FISHERIES, CONSERVATION, WILDLIFE, AND OCEANS
COMMITTEE ON RESOURCES
UNITED STATES HOUSE OF REPRESENTATIVES
MAY 23, 2002

Good morning, and thank you Mr. Chairman and the members of the committee for inviting me to testify today. My name is Robert Warner, and I am a Professor of Marine Ecology at the University of California, Santa Barbara, and have served as Chair of the Department of Ecology, Evolution, and Marine Biology. I served on the Science Advisory Panel to the Marine Reserves Working Group for the Channel Islands National Marine Sanctuary, and currently serve on the Sanctuary Advisory Council as the Research Chair. Over the past three years I have been a member of three working groups at the National Center for Ecological Analysis and Synthesis, all of which were concerned with coastal marine ecosystems. One of these working groups concentrated on the science of marine reserves, and today I'd like to outline some of our findings regarding the use of marine reserves as a tool for ecosystem-based management. In addition, I'd like to place into the record a paper just about to appear in one of the premier peer-reviewed journals of our field, sponsored by the Ecological Society of America. The paper contains a summary of the working group's findings.

Mr. Chairman –

We depend on ocean life in many ways, far beyond the 80 million metric tons of food that we draw from the sea each year. The ecologist Stuart Pimm recently estimated that marine ecosystem services have a value of $20 trillion, with most of that being provided from coastal ecosystems. Yet these ecosystems have been altered dramatically over the past decades – in some places, they have essentially collapsed. Many of the fisheries of the world are depleted, and the species we catch are getting smaller and further down the food chain. The problems of habitat alteration, pollution, aquaculture, exotic species, and climate change all converge on the species that make up ecosystems, and effects on one species can severely affect others. For example, in Hawaii, nutrient pollution fuels algal growth, and fishing removes the fishes that eat the algae, and corals die underneath the encroaching seaweeds. In every marine ecosystem that one of the NCEAS working groups investigated, there was clear evidence of fundamental change and loss of resources, and these losses are accelerating. Ecosystem health is often measured in terms of productivity and species diversity, and it is precisely these measures that are declining in many coastal habitats.

Entire marine ecosystems are affected by threats at many levels, and evaluating and responding to these threats in an integrated fashion is the challenge we currently face. Let me make this clear: there is a real need to shift our attention to ecosystems-based management of the marine environment, away from the confusing and often conflicting mass of single-species management plans. On the West coast, there are 88 species that generate more than $1 million a year in fisheries revenue. In New England, there are 41 such species, and in both areas invertebrates like urchins, squid, and lobsters are the most valuable resources. Multiple overlapping single-species management plans can become cumbersome and difficult. A complementary approach to this problem is a scheme of ecosystem-based management.

Marine reserves, areas of the ocean completely protected from all extractive activities, can be a useful tool

for ecosystem-based management. They cannot solve all of the problems of the coastal ocean, but they can stop habitat alteration and allow the recovery of depleted populations of several species at a time. Reserves are a place- and habitat-based approach to management, distinctly different from single-species management.

Because much of the sea is hidden from our view, and because the ocean is so vast, we have not been as aware of changes in marine ecosystems as we are of terrestrial changes. On land, many of the larger animals went extinct soon after humans arrived on the scene, and commercial hunting disappeared at the turn of the last century. In the sea, many of the large animals are rare but still present, and harvesting of wild animals continues at high levels. There is hope in this fact – it may be possible to restore marine ecosystems in some places to conditions approaching their former glory, because most of the key players are still present. This is a chance to do more than build a small monument to what existed before. We have a much more rewarding goal: rebuilding coastal ecosystems *and* recharging coastal fisheries. This is one of the few instances where we can combine benefit to both the extractive users and to the conservation community. It can be done.

The simplest question to ask is what happens when reserves are established. That is, can we document the effect of reserves on coastal ecosystems?

Documented responses of animals and plants to protection inside reserves

The overall coastal area currently under full protection in marine reserves is less than a fraction of one per cent. Although reserves are rare in the US, several have been the subject of careful study. The NCEAS working group summarized these studies and scores of other peer-reviewed reports of the responses of animals and plants to reserve protection around the world. The results were striking. Regardless of whether the reserve was in the tropics or in temperate waters, there was strong evidence that reserves function to increase the abundance and size of many species within their borders. On average, population sizes of animals nearly double, and the animals themselves average about 30% larger. This means that the biomass (or capacity for production) of these species showed a dramatic increase, at least doubling regardless of the location of the reserves.

Not surprisingly, it is exploited species that show the strongest positive response to protection, including species thought to be too mobile to benefit from reserve protection. But I want to stress that the changes seen inside reserves are ecosystem-level changes – not just the recovery of exploited species. For example, when reserves were established in New Zealand, the increase in lobsters resulted in a major decrease in sea urchins, the lobster's prey. This, in turn allowed kelp beds to flourish (because urchins eat kelp), and the overall productivity of the area has increased.

When year-round area closures were instituted on the Georges Bank to aid in the recovery of cod and other finfish, it was scallops that responded the most quickly, becoming unbelievably abundant inside the closed areas. Thus many species can be simultaneously affected by any particular closure.

Responses occurred in reserves of all sizes, and they appear rather quickly – reserves only two to four years old showed increased levels of animal abundance and size equivalent to reserves that had been established for decades.

As I mentioned previously, not all species increase inside reserves, but the great majority show a strong positive response. Neither will all species show a rapid response, especially those that are long-lived and

slow-growing. However, the overwhelming result from over 20 years of studies is that species recover within reserve borders, becoming more numerous and larger. Although local conditions may affect the exact result in any particular place, the value of reserves in generating broad changes within their boundaries has been demonstrated in scores of well-documented studies in virtually all settings. This is good news for ecosystem-based management.

While reserves cannot stop pollution, prevent catastrophes, or slow the arrival of exotic invaders into marine ecosystems, they can help to withstand these threats simply because they contain larger populations and more species. Many studies have shown that healthy ecosystems are more resilient to chronic or acute threats, and species-rich ecosystems are more resistant to invasion.

Effects outside of reserve borders

While the major role envisioned for reserves is the protection of habitats and ecosystems, there is added benefit if they export some of their population to surrounding areas. This function is particularly important when reserves are viewed as a fishery management tool, because this export could be used to replenish species subject to harvest in non-reserve areas.

The large variety of life histories, movement patterns, and time spent as a planktonic, drifting larva means that spillover will occur differently for different species. There are so few reserves established, and most of them are so small, that there have been relatively few studies done on spillover. Nevertheless, the evidence is compelling that reserves can recharge nearby areas.

Spillover can take two forms. The first is simple movement of adult animals out of reserves. Several studies have shown that numbers and sizes of species are greater in areas near reserve boundaries, and other studies have shown that the catches of fishers near reserves are higher than in other areas. Fishermen may not have read these studies, but they often know where the fish are, and this has led to concentrations of recreational and commercial fishing activity along reserve borders, an activity known as “fishing the line”.

The other major potential contribution of marine reserves to fisheries is through larval export. Most marine species produce tiny young that drift in the water for days or weeks. We know that the rate of production of young by animals inside reserves can be tremendous – at the Edmonds Underwater Park in Washington, for example, it is estimated that the large lingcod there produce 20 times as many young than are produced in equivalent areas outside. But do some of these young make their way into the fishery? There has been little documentation of the effects of larval spillover, mostly because reserves are simply too small to have much effect. The Edmonds reserve, for example, is only 25 acres in extent, a tiny fraction of the area over which the larvae produced there could be expected to drift.

In one US example of a marine reserve large enough to have the potential to recharge fisheries through larval export, this apparently has occurred. On the Georges Bank, several large areas were set aside in 1994 to preserve cod and other groundfish, and as I have mentioned the strongest response so far has been in the fast-growing scallops. By 1998 scallops were 14 times more dense in the protected areas than outside, and dense settlement of young was predicted in downcurrent areas near the reserves. These areas are in fact now yielding higher catches than other areas, and overall revenues have increased from $91 Million in 1995 to $123 million in 1999.

Reserve Size and Reserve Networks

A common perception is that conservation and fishery objectives for marine reserves are incompatible, and there will be inevitable conflict between these competing interests. That is certainly what appears to be happening at this point, but models of reserve function suggest that this need not be so. It is true that the larger the reserve, the more species will be able to complete their entire life cycles inside reserves. A reserve too small will not be self-sustaining because most larvae produced in it will be transported elsewhere, and thus a small reserve needs to be seeded from a fished area. Very large reserves, on the other hand, leave little area left to in which to fish.

Most single-species fisheries models of reserves suggest that the most substantial impacts on yields occurs when between 20 and 50% of the area is set aside. The amount of area required in reserves varies, but few models show significant benefit at levels below 10%. The more depleted the fishery is on the outside, the more substantial the benefit from reserves.

Where does this leave conservation interests? To what extent can set-asides at this level work to rebuild ecosystems? Fortunately, the most recent scientific findings have suggested a solution: networks of smaller reserves. While these reserves may individually be too small for self-seeding, they are close enough together so that one reserve can seed another. In addition, networks can provide high amounts of spillover into fished areas because they have extensive borders, and networks can boost regional production of young as long as the aggregate area in reserves is sufficiently large.

Studies also suggest networks of reserves can provide additional protection against catastrophic loss (because we're not putting all of our eggs in one basket), and they may make reserve siting easier and more flexible because there are simply more options available.

Where to put a marine reserve?

Recent scientific work on the criteria for siting marine reserves has emphasized that in any management area, there are many different reserve designs that might fit the biological needs of the protected community. That is, science can suggest a range of options that can then be evaluated for other criteria, like their social, economic, or political impact. This flexibility is good news for the process of establishing marine reserves, because it can include input from many different sectors of the community in forming the final decisions.

The most important criterion for designing reserves is to include representation of all habitat types within an area, preferably adjacent to one another, simply because many species use different habitats over the course of their lives. A common misconception is that reserves should be placed in the areas of best fishing. In fact, reserves should show the best response in areas that were formerly productive but are currently overfished – protection can allow these areas of proven potential to recover.

Conclusions

I realize that much of the regulatory process is constrained by mandated consideration of one species at a time. However, the solution to managing multiple threats to the oceans requires an integrated approach that includes the need to preserve intact marine ecosystems on a regional basis. Single species management is not sufficient for the future, especially since many fisheries already affect many different species through by-catch.

Marine reserves are one of the best tools we have to address management of entire marine ecosystems. While they are not the solution to every problem facing the coastal ocean, they can stem habitat destruction, alleviate the effects of local overfishing, simplify the simultaneous management of multiple species, and restore biodiversity within their borders. The healthier ecosystems inside reserves can be more resistant to threats from the outside, and more resilient in their recovery. A regional network of marine reserves may be the best solution for the broad enhancement of coastal ecosystems, with substantial contributions to biodiversity and recruitment of young both inside and outside their borders. While reserves are ideal tools for habitat protection and ecosystem preservation, they are best used as a complement to traditional fisheries management.

The conclusion of the summary paper that I have included in the record contains the Consensus Statement on Marine Reserves, a remarkable document signed by over 160 Ph.D. level academic scientists from around the world. The full listing of the signatures can be found on the website of the National Center for Ecological Analysis and Synthesis. The document is remarkable first because it's one of the few times I have ever seen 160 marine scientists agree on anything, and second for the force of its recommendations. Much of what it states has already been covered by this testimony, but I'd like to conclude with the last line of the statement: "Existing scientific information justifies the immediate application of fully protected marine reserves as a central management tool."

Thank you again for inviting me to testify here today.