PERFORMANCE OF MARINE RESERVES: PERCEPTIONS AND REALITIES

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Perceptions about the environment:

1. There is no problem

   - The historical record reveals pervasive human influence on the sea

2. There is no hope

   - Contrary to the terrestrial situation, most of the large creatures of the sea are not extinct
Perceptions about fisheries management:

1. Traditional management is sufficient, and stocks are rebounding

- For some species, this appears true, but many others are severely depleted. Multispecies fisheries are limited by the “weak links”.

![Cowcod biomass graph](image)
Perceptions about fisheries management:

1. Traditional management is sufficient, and stocks are rebounding

   - For some species, this appears true, but many others are severely depleted

2. Recreational fishing has little impact

   - The overall percentage taken by sportfishers is small. However, in the nearshore environment where most reserves are proposed, many species are taken solely, or in high proportion, by recreational fishers
Total Commercial vs. Recreational Take

Source: NMFS, Fisheries of the US 2000
Nearshore Breakdown, East Coast

Source: NMFS, Fisheries of the US 2000
Florida Landings

![Chart showing Florida Landings with 33.50% commercial and 31.60% recreational landings in 1998 and 1999.]

California Nearshore Fish Landings

![Chart showing the proportion of total landings from 1980 to 2000 with a significant decline in the 1990s.]

Schroeder and Love, 2002
Perceptions about constituencies:

1. Marine reserves are fishery management tools, so it is imperative that reserves address the needs of fishers first.

   - There is widespread support for the idea of marine wilderness areas, and economic analyses suggest that many of these other stakeholders would benefit from the establishment of protected areas.

   - Properly designed reserves are a relatively simple way to manage and protect multiple species of concern
Perceptions about constituencies:

2. Fishery and biodiversity goals for marine reserves are incompatible, so one constituency or another will suffer.

Marine reserve networks can be designed for both fisheries and biodiversity goals
Perceptions about marine reserve function:

1. Reserves don’t work because fish will just swim outside the boundaries and get caught.

There is some loss at the edges of reserves, but there is also much evidence for dramatic and persistent increases of life inside of reserves. For example, biomass (and productive capacity) is four times higher inside of reserves on average.
MARINE RESERVE DATA BASE

81 studies, 102 measurements

Halpern 2003; Micheli et al. 2004; Palumbi 2004
Reserves have higher average values in abundance, biomass, size, and diversity relative to reference areas.
Perceptions about marine reserve function:

2. Because the ecosystem is protected, reserves provide benefit to all species.

Some species decline in abundance after reserve establishment. Previously exploited species increase, and their prey often decrease.
Responses can depend on place in the food web: e.g., Anacapa Marine Reserve, Channel Islands National Park, California
Increase in lobsters results in decreases in purple urchins, and increases in kelp.
Responses to Reserve Protection

- Average density, biomass, size & diversity increase
- Strongest response from exploited species, especially those that do not move much as adults
- Some species will decline as a result of reserve establishment
- For some species, responses can be quick, but slower-growing species may take much longer. Effects can persist for decades.
Perceptions about marine reserve function:

3. There is no evidence of fishery benefits of reserves

- Many studies show that export of adults across reserve boundaries has provided a net benefit to smaller-scale commercial and recreational fishers
Adult spillover: Recreational fishing boats line the corner of a marine reserve in the Florida Keys National Marine Sanctuary.

(Photo by David McClellan, NMFS)
Even larger-scale commercial fisheries show evidence of “fishing the line”

Link et al., 2003

Haddock
CPUE
Lbs./hour fishing

0 lbs.
0.1–500 lbs.
501–1000 lbs
1001–3000 lbs.
3001–7500 lbs/hr

Closed Area I

fisheries show evidence of fisheries show evidence of
There have been a disproportionately high number of world-record fish taken near the Merritt Island (Cape Canaveral) marine reserve.
Perceptions about marine reserve function:

3. There is no evidence of fishery benefits of reserves

- Enhancement of fisheries through larval export out of a reserve has less documentation, because established reserves are too small relative to the area they are expected to service. When a reserve is large enough, enhancement of recruitment should be substantial.
LARGER FISH PRODUCE MANY MORE EGGS

example: red snapper

Length: 60 cm 40 cm
Weight: 12.5 kg 1.1 kg
Number: 1 212

9,300,000 eggs
Marine Reserves on the Georges Bank: closed to bottom trawling in 1994
Larval seeding:
Scallop larval settlement is predicted to be concentrated near and downstream from existing reserves in the Georges Bank.
Larvae versus Adults

NMFS Scallop Survey - Summer 1998
Perceptions about marine reserve function:

4. Marine reserves will allow areas to return to pristine condition.

- Many factors have contributed to historical changes in marine ecosystems. Reserves will only reverse some of those factors (i.e., human-induced mortality and habitat destruction).

Marine reserves cannot control pollution, avoid catastrophes, or prevent exotic species introductions.
Reserves are not a panacea
Perceptions about marine reserve implementation:

1. The only reasonable approach to implementation is to start small and see if they work.

   - If too small, the export function of reserves can’t work. This is also true if reserves are too large.
Too much loss out of reserve, not self-sustainable, low total export

Reserve self-sustainable for many species, adequate total export

Reserve self-sustainable, low total export, no place to fish
RESERVE SIZE

RESERVES OF MODERATE SIZES CAN WORK FOR BOTH CONSERVATION AND FISHERIES
Perceptions about marine reserve implementation:

3. To meet biodiversity goals, only very large reserves will be able to contain self-sustaining populations of marine organisms.

- Networks of smaller reserves can sustain each other, while providing more edges for adult spillover and sufficient total set-aside for larval export.
Too much loss out of reserve, not self-sustainable, low total export

Reserves self-sustainable for some species, reserves seed each other, good total export

Reserve self-sustainable, low total export, no place to fish
Networks of reserves can help to overcome problems of longer-distance dispersal, they can increase export, and they reduce the risk of catastrophic loss.
Reserve Network Proposed for the Northern Channel Islands

Objectives: reserves that can seed each other, provide spillover to fisheries, and avoid the costs of single large reserves.
4. Because larvae disperse enormous distances, any effects of larval export will be too diluted to matter.

Most marine animals and plants have a pelagic (open-water) larval form.
Larvae may be moving less far than we thought.

What does this mean for the fate of production from marine reserves?

Data from Kinlan and Gaines, 2003
Perceptions about marine reserve implementation:

4. Because larvae disperse enormous distances, any effects of larval export will be too diluted to matter.

- Evidence is mounting that dispersal distances may be considerably less than marine scientists had expected. Thus the export functions of reserves may have their greatest effect over a limited regional area.
Local Fishing Fleets
Local enhancement reduced, distant enhancement increased, small improvements overall.
Larval dispersal distances may be considerably less than marine scientists had expected. Thus the same parties that give up areas to set up reserves (e.g., local fishers) should also be the beneficiaries.
5. There is no consensus about what habitats need to be included in marine reserves.

- The criteria for marine reserve siting are well developed. The most critical feature is to include a diversity of habitats in close proximity to one another, so that marine species can complete their life cycles.
Reserves need to encompass diverse marine habitats, because many marine species use different habitats over the course of their lives.
Perceptions about process:

1. Government is imposing reserves without consultation

2. Scientists are ignoring valuable information from consumptive users

3. Reserves are just the first step in a plan to shut down all extractive activity

- This should be a major topic today...how can we improve process to address these perceptions?
CONCLUSIONS

- Most constituents could be served by a common design for a system of marine reserves intended to enhance biodiversity and improve fishing.

- Marine reserves are only one tool in marine management – perhaps the best tool we have for ecosystem preservation and habitat protection. However, they cannot prevent many threats, and they cannot completely replace traditional fisheries management.