White Paper

A comparison of advantages and disadvantages of fisheries management and marine reserves for reef protection along the Gold and Treasure Coasts of southeastern Florida

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Introduction

Coastal reefs in the four counties of southeastern Florida's Gold and Treasure Coasts (G&TC) are ecologically and economically important features that provide many goods and services. Reefs protect coasts from storms and reduce sand erosion, but are most valued for their support of fishing, tourism, education, SCUBA diving, and other recreation. Compared to the rest of the Florida reef tract, however, G&TC reefs have received relatively little protection. Florida's resident population was 5 million people in 1960 and in 50 years has grown to about 20 million people. In 2014 the resident populations of Florida's G&TC alone was over 5.9 million people, about 30.5% of Florida's population and larger than the population of 30 U.S. States (Bureau of Economic and Business Research, 2014). The management challenge is that people and their impacts are concentrated at a density of 47,411 residents/mile of coast along 125 miles or 8% of the Florida coast. This density is 12 times higher than 4,024/ mile for the remaining 92% of Florida's coast (13.5 million people/3375 mi). In response to this problem, considerable public interest and support has developed for establishing marine protected area (MPAs) or no-take marine reserves to protect reefs. There is also considerable resistance by some fishing interests who want to allow fishing in all marine areas. This paper compares advantages and disadvantages of marine reserves and fishery management. For simplicity, only marine reserves that prohibit all fishing and extraction are examined because they show greater benefits and significantly higher densities of organisms within their boundaries than MPAs partially protected from fishing (Lester and Halpern 2008). Results show that both approaches are necessary and complementary; that neither is sufficient to resolve problems; and that there is no inherent tradeoff between achieving conservation and fishery goals.

Traditional Fisheries Management –Advantages and Disadvantages

Definitions : Fishery management allocates catch among users, determines allowable fishing gear, establishes retention sizes, determines the amount of fish that can be safely removed, and limits fishing effort and mortality to maintain long-term fishery productivity and sustainability. Tools commonly used to regulate fisheries included gear restrictions, size and daily bag and trip limits, quotas, limited entry, seasonal and spatial closures, and permanent closures.

> **Sustainability** - requires that present levels of fishing mortality will allow fishery production to continue forever. Declining landings trends are not sustainable.
>
> **Overfishing** – the annual rate of catch is too high. **Overfished** – the population size is too small. The difference? **Overfishing** is a direct result of fishing activities, but an **overfished** stock can be the result of many factors including overfishing, habitat degradation, and disease.

Advantages of fishery management

- Some fisheries can be successfully managed by size and effort limitations.
- There is consensus that coral reefs fisheries can be successfully managed by fishing regulations in combination with MPAs (Bohnsack 1998; MacNeil et al. 2015).
- Single species management (SSM) seeks to maximize yield and prevent overfishing and depletion for the most valuable and abundant managed species.
- In Florida, single species, stock-wide assessments are used to manage fisheries.
- Southern Florida is one of the most intensively studied marine areas in the world.
- Florida collects extensive fishery dependent and fishery independent data.
- Uniform state wide fishing regulations are applied inside and outside of MPAs.

Disadvantages and Limitations: Traditional Single Species Fishery Management

- Single species management (SSM) discounts ecological function, trophic interactions between species, changes in ecosystem productivity, and interactions between fisheries, unlike holistic ecosystem-based management approaches.
- Single species assessments and management are not adjusted for geographic differences in ecology or fishing effort. Uniform statewide fishing regulations are a disadvantage for the Florida Gold and Treasure Coasts because they lead to local overfishing and depletion.
- Coral reef ecosystems are extremely sensitive to fishing pressure and difficult to manage by size limits and effort controls alone. Reef fishes are especially prone to overfishing because of their ecology, life history, longevity, large size, high economic value, limited habitat, predictable location in space and time, vulnerability to fishing gear, and high release mortality (Davis 1977; Coleman et al. 2000; 2004; Ault et al. 2001, 2002Alcala et al 2005; Bartholomew and Bohnsack 2005; Stallings 2009; Williams et al. 2015).
- Few reef species have adequate data for fishery stock assessments.
- Single species fishery management does not allocate for esthetic and non-extractive activities.
- SE Florida has no marine areas protected from fishing. Other activities must suffice with diminished resources.
- SSM fishery management is data-intensive and requires continuous, quality data to be effective.
- SSM is on trial and error strategy of 'one size fits all' and is reactive to problems once they become manifest. In comparison, proactive adaptive management seeks to anticipate problems

and applies adaptive management that applies different simultaneous interventions to determine which treatment works best.

- Numbers of recreational anglers are unlimited; effort is regulated by statewide regulations.
- Gamefish abundances and sizes were no different inside or outside of Florida MPAs managed by uniform fishing regulations. Larger sizes and densities were detected for MPAs that had additional fishery regulations (Bohnsack 2011).
- Many reef species in southern Florida are not regulated (e.g. great barracuda, jolthead Porgy).
- Individuals of the most reef species targeted by fisheries rarely reach reproductive size in SE Florida even though juveniles are often common (red grouper, barracuda, hogfish (Ferro et al 2005; Kilfoyle et al 2014).
- Reef fishery declines are well documented in southeastern Florida for great barracuda, hogfish, mutton snapper, jolthead porgy, Nassau grouper, yellowtail, snapper (Harper et al. 2000; Coleman et al 2004, Ault and Franklin 2011; Cooper et al 2014; Kilfoyle et al. 2014).
- Important fishery species in the SE Fla are undergoing overfishing or are overfished, including snowy grouper, speckled hind, hogfish, red snapper, red porgy, Warsaw grouper. A formerly common species, Nassau grouper, is being considered for endangered species listing. All species recognized as overfished or experiencing overfishing in SEUS by federal agencies are reef fishes: amberjack, red snapper, red porgy, speckled Hind, snowy and Warsaw grouper, hogfish and blueline tilefish . http://www.nmfs.noaa.gov/sfa/news/2015/status_of_stocks_2014.html
- Fishing regulations are difficult to enforce and require high release survival.

Myths:

Myth 1. Protection of distant reef stocks in the Tortugas or Florida Keys are sufficient to resupply fisheries in SE Florida. Research indicates that both local and distant spawning are necessary and important to resupply fisheries. Population depletion in SE Florida impedes spawning and resupply of juvenile recruits. Although distant spawning is important for genetic connectivity, most fish populations are resupplied by local sources (Cowan et al. 2006; Bohnsack 2011).

Myth 2. Fishing does not change genetic characteristics of exploited populations such as large size, rapid growth, and behavior. It is well established that fisheries are adversely selective for growth, longetivity, fecundity and behavior in a manner opposite of animal husbandry (i.e. the most valuable individuals are removed and the least desirable individuals breed). Marine reserves can maintain genetic diversity, especially for species with sedentary adults (Conover & Munch 2002 Trexler & Travis 2000).

Myth 3. Opening all areas to fishing has no adverse economic impacts. Healthy reefs with undiminished fish populations are non-existent in SE Florida, but are required for many forms of recreation, education, tourism, research, and conservation. For example, many major universities are located along the G&T Coast with marine educational and research programs, yet there are no places locally to take students to study or experience reefs unconfounded by fishing.

Myth 4. Marine reserves do not work for fishery management. Reserves are well documented to protect fish populations, promote healthy fisheries, are widely used in Florida, and have been shown to complement traditional fishery management (Rosenberg 2003; Ault et al. 2006). Florida coastal reserves have helped maintain recreational trophy fisheries and boosted total recreational compared to having all areas managed by the same fishing regulations (Roberts et al. 2001, Bohnsack 2011).

Myth 5. Marine Reserves are a last resort in fishery management. Actually, the last resort is closing a fishery entirely. Florida fishery closures now include goliath and Nassau grouper (1990), queen conch (1975 commercial; 1985 recreational), stony corals, and sea turtles. In 2014, hogfish was determined to be overfished and experiencing overfishing with" high confidence" in southern Florida (FWC SEDAR 37). Some fishermen proposed closing the fishery for great barracuda at a 2015 public FWC meeting. Marine reserves are best used for precautionary management and are not well designed for single species recovery or for solving fishery management problems (Ballantine 2014).

Myth 6. Coral decline and recovery are unrelated to reef fish presence. In fact, coral growth is enhanced by nutrient supplied by fish presence (Meyers et al. 1983; Huntington et al. in prep). Besides disease, top sources of coral mortality are from damselfish and coral grazing snails. Predators that feed on damselfish and snails are vulnerable to fishing, including grouper, hogfish, and spiny lobster. Although Toth et al. (2014) found no improvements in coral abundance in MPAs in the Florida Keys after 15 years, that is not a long time for corals. Florida gamefish took between 15 and 30 years to recover in Florida MPAs and was correlated with the generation time of each species (Roberts et al 2001, Bohnsack 2011). The prevailing consensus for lack of coral recovery in Florida is that coral population densities are so low that successful coral reproduction is rare and limits recovery (Hunt et al 2014).

Myth 7. Marine reserves infringe on the "right" to fish. Fishing is a privilege. Reserves do not prevent anybody from fishing although not everywhere. While some may view marine reserves as an infringement of "rights", others welcome it as a way to protect their "rights" and ensure orderly and sustainable use of resources, including an ability to see and experience an healthy reef with minimal human disturbance (Crosby et al 2000). Zoning is widely used and accepted on land to allow users the freedom to pursue conflicting activities without harming others, but only recently has zoning been widely applied to marine environments, in part because of mistaken beliefs that marine resources were plentiful and inexhaustible. Although marking boundaries on the water was often not practical in the past, that problem has been solved by technology.

Myth 8. Current Florida fishing regulations prevent overfishing. Landings declines and significant reductions in average size are well documented for many species in SE Florida, including barracuda, mutton snapper, yellowtail, and others (Johnson et al 2007; Ault and Franklin 2011). Some populations have less than minimum 30% spawning potential ratio (SPR) required by international standards for sustainability; and populations at less than 1% of their historical abundance (Ault et al. 1998, 2005, 2006, 2014; Cooper et al. 2014). In Biscayne National Park, Nassau grouper and jolthead porgy crashed in the 1970s, major population shifts have occurred and more than 99.9% of recreational fishing trips taken fail to catch grouper (Harper et al. 2000; Ault et al. 2001, Bohnsack 2003, Kellison et al. 2012). (2007, 2009; Bohnsack et al. 2003).

Myth 9. Pollution is the problem; not fishing. Density of exploited reef fish species in small marine reserves in the Florida Keys increased rapidly and significantly when fishing was stopped which shows fishing is an important factor. Yellowtail snapper, for example, increased 4 fold, gray snapper 10 fold, black grouper 27 fold, and red grouper by 50 fold (Bohnsack et al. 2006, 2010). Corals are surviving and expanding in many areas in SE Florida under ambient water quality conditions where protected from burial by sediments. Fishing is the simplest explanation for why adults of only exploited species seem to be missing in SE Florida (Ferro et al. 2004, Kilfoyle et al. 2014). Often plenty of juveniles can be found and juveniles usually are more sensitive to poor water quality than adults. Where pollution is a problem, or when environmental changes reduce the productivity of the resource, the appropriate policy implications are the same: reduce fishing pressure (Rosenberg 2003).

Marine Reserve MPAs –Advantages and Disadvantages

Definitions :

Marine Protected Area (MPAs) are widely used for conservation and management in the United States. Over 100 legal authorities have established about 1,700 MPAs, each with its own purpose (USDOC 2014). Presidential Executive Order 13158 of May 26, 2000 called for the development of a National System of Marine Protected Areas (MPAs) and defined an MPA as: "*Any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein*." **Under this definition, an MPA must have legally defined geographical boundaries, be established and managed under a U.S. jurisdiction, and be subject to federal, state, local, or tribal law or regulation.** 'Marine' includes ocean and coastal waters; bays, sounds, and estuaries; and intertidal areas. 'Lasting protection' is the stated intent to provide permanent protection beyond any general protections that apply outside the MPA.

Marine reserves (MRs) are no-take MPAs closed to all fishing and other extractive uses except for limited exceptions for research and education by permit. A growing scientific, conservation, and management interest in MRs has occurred because MRs offer an objective, high level of resource protection using a precautionary approach to protect resources and maintain marine ecosystem structure and function (Bohnsack 2000, IUCN 2004). Successful MRs follow five rules: (1) no fishing of any kind; (2) no removal of material, living, dead or mineral; (3) no dredging, dumping, construction of any other activities that would disturb natural processes; (4) subject to the above rules, people are encourage to view, appreciate, study, and publicize the results of this protection; and (5) these rules and the reserves are permanent (Ballantine 2014).

Advantages of marine reserves

- Are a habitat and ecosystem-based management tool, based on preventive, precautionary approaches to management (Bohnsack 1999, 2003, Ballantine 2014);
- Increase user satisfaction by separating incompatible activities and reduce user conflicts between fishing and non-extractive activities involving diving, conservation, education, science, and tourism (Bohnsack et al. 2004). As a diver operator stated, the average tourist diver only gets to see lobster on a menu.
- Provide an objective, high degree of protection for sensitive areas and potential to protect ecosystem structure and function (PDT 1990, Bohnsack 2000, Bohnsack et al 2004);
- Promote non-extractive economic activities including diving, tourism, and education (Bohnsack et al. 2004).
- Can increase total production when overfishing occurs (Buxton et al. 2014, Edgar et al. 2014);
- Are well-documented to benefit coral reefs and sedentary species (Halpern and Warner 2002; Russ and Alcala 2010, Ault et al 2014);
- Protect all species in reserves without having complete or precise knowledge for each species;
- Can operate without requiring continuous data collection;
- Complement traditional fishery management by increasing average size and reducing total fishing mortality without loss of yield (Hastings and Botsford 1999);
- Provide the easiest regulation to enforce on the water, the no fishing rule (PDT 1990);
- Provide science-based controls, baselines, and reference sites to assess fishery impacts and effectiveness of fishery management interventions (Bohnsack et al. 2004);
- Make overfishing more difficult by providing a population refuge and insurance against management failures outside of reserves;

- Reverse the burden of proof and are designed to prevent problems based on adaptive management instead of only responding to problems after they become manifest;
- Promote coral growth by providing healthy reef fish populations that provide nutrients (Meyer et al. 1983; Huntington et al. *in prep*);
- Reduce coral mortality from coral predation because fish and lobster populations in reserves help control coral grazing snails and damselfish; and
- Provides the only fishery management tool that protects population genetics from adverse fishery selection (PDT 1990, Trexler and Travis 2000).

Disadvantages, Obstacles, and Limitations:

- Marine reserves are not a substitute for fishery management since they don't allocate yield; change size regulations; or alter total effort, catch, and bag limits.
- Marine reserves are not a panacea for environmental and overfishing problems.
    - They do not stop pollution, sedimentation, diseases, coral bleaching, or ocean acidification, for example.
    - They are not well suited for single species management or sufficient to solve fishery problems (Ballantine 2014).
    - They work best in conjunction with traditional fishery management to manage fishing outside of reserves (Ault et al 2006).
    - They are least likely to benefit highly mobile or migratory species.
- Resistance is anticipated by those who consider marine reserves a violation of their "rights", while others consider marine reserves necessary to protect their "rights" (Crosby et al. 2000).
- No shallow reef marine reserves exist along the SE Florida Gold and Treasure Coasts although southern Florida is one of the most intensively studied marine areas in the world and no-take marine reserves are widely used for reef management in Florida and globally.
- Obstacles to establishment include making decisions on MPA site location, size, total area, and what habitats to include.
- Conservation success increases significantly in response to 5 key factors: no take, well enforced, established > 10 yr, > 100 km^2, and isolation by sand or deep water (Edgar et al. 2014).
- Public education and outreach help build public understanding, compliance, and acceptance.

Myths:

Myth 1. Marine reserves are a panacea for solving fishing and environmental problems. They do many things, but are not a panacea (see second bullet above). Fishery management is necessary.

Myth 2. Marine reserves interfere with fishery management. The roles of fishery management are to allocate catch among users; determine the amount of fish that can be safely removed while maintaining long-term fishery productivity and sustainability; determine allowable fishing gear; and control total fishing effort and mortality with limited entry, quotas, size and bag limits; closed seasons, and closures. Marine reserves do not do any of these things to conflict with fishery management and are not a substitute for fishery management. Reserves can complement fishery goals by increasing average size and reducing total mortality without loss of yield (Hastings and Botsford 1999).

Myth 3. Marine reserves are the last resort in fishery management. Actually, the last resort is closure which has happened in Florida for Nassau and goliath grouper, queen conch, coral, and sea turtles. It does not make sense to establish reserves after everything is depleted. Like national parks, it is best to protected areas before they are destroyed. Successful reserve networks are established in the Great Barrier Reef, Australia (Emslie et al. 2015), California (CDFG 2008), and Florida (Bohnsack et al. 2010, Ault et al. 2014).

Myth 4. All areas should be open to fishing. There is no biological, economic or social theory to support having all areas fished. Unexploited protected areas receive a high level of public support on land and the principles are the same in water. For example, duck hunters saved duck hunting by establishing wildlife refuges where hunting was not allowed. Marine reserves provide a similar benefit for fishes (Bohnsack 2003). Likewise tourists go to national parks with expectation of seeing wild bison and bears; not what was left over after hunting.

Myth 5. Marine reserves "shut down" reefs and prevent people from fishing. Nobody is prohibited from fishing. Fishers are prevented from fishing in closed reserves areas, but they can move and fish in open areas covering most reef habitat. Shifting fishing locations can be an inconvenience, most anglers consider this a reasonable accommodation to support conservation. In the same way that highway lanes are closed (i.e. shut down) so that they can be repaired, marine reserves allow some reefs to heal and recover from fishing depletion and damage. While protected, marine reserves continue to produce fish and resupply surrounding fishing grounds.

Myth 6. Marine reserves just force fishers into other areas increasing pressure and impacts on those places. Displacement is not an issue unless large proportions of habitat are included in reserves (Bohnsack 2000, Emslie et al 2015). In the G&T coast, 75% of total fishing is for offshore or coastal migratory species that will not impacted by reef reserves. Reef fisheries comprise 25% of total fisheries. Anticipated recommendations by Our Florida Reefs working groups would include 20% (or less) of reef area, representing a maximum potential impact of 5% of total fish production if displaced fishers did not move to reef areas open for fishing. The actual total impact will be much less because lost catch from closed areas can be compensated for by either moving to other areas or by increased time fishing. Also, spillover from closed areas will soon benefit surrounding fisheries.

Myth 7. Marine reserves are too difficult and costly to enforce. No fishing is the easiest regulation to monitor and enforce on the water. Compliance tends to increase over time with experience and by self-enforcement by users who take ownership. As resources recover there is more incentive for poaching.

Myth 8. Marine reserves restrict public access to resources. Public benefits and access can increase for non-extractive users (divers and tourists) and aesthetic fisheries (e.g. fish counters), while fisheries still have access to resources in areas open to fishing. Nobody is prevented from fishing. Small areas lost to fishing can be more than compensated by greater total production and access to fish in open areas. Well- designed marine reserve networks can have win-win benefits for conservation, non-extractive activities, and fisheries.

Myth 9. Marine reserves are an experiment. From a science perspective marine reserves are the controls or reference areas but not experiments (Ballantine 2015). It is well accepted that fish protected from fishing mortality in reserves will grow and reproduce. The real experiment is determining how many organisms can be removed, and how much habitat can be altered, and still maintain productive and sustainable fisheries and persistent ecosystems to provide goods and services for people (Bohnsack 2004, Ballantine 2014).

Myth 10. There is an inherent tradeoff between achieving conservation and fishery goals. This perception is not supported by data. Analyses of size, spacing, location and configuration have been developed to provide guidelines for designing MPA networks to simultaneously enhance biological conservation and reduce fishery costs, and even increase fishery yields and profits (Gaines et al. 2010, Emslie et al 2015). Combined fishery management and marine reserve networks can improve resource allocation, long-term fishery sustainability, and conservation (Halpern et al. 2009).

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