

NOAA Coral Reef Conservation Program Fishing Impacts Working Group

Threat Based Priority Strategic Goals and Objectives

Coral reefs and associated habitats provide important commercial, recreational and subsistence fishery resources in the United States. Fishing plays a central social and cultural role in many island communities and can represent a critical source of protein. But coral reef fisheries, though often relatively small in scale, may have disproportionately large impacts on the ecosystem if conducted unsustainably. Rapid human population growth, demand for fishery resources, use of more efficient fishery technologies, and inadequate management and enforcement have led to the depletion of key reef species and habitat damage in many locations. Specific impacts of fishing on reefs generally include one or more of the following: 1) direct overexploitation of fish, invertebrates, and algae for food and the aquarium trade; 2) removal of a species or group of species impacting multiple trophic levels; 3) by-catch and mortality of non-target species; and 4) physical impacts to reef environments associated with fishing techniques, fishing gear, and anchoring of fishing vessels (Waddell 2005). Such threats are exacerbated when coupled with other coral reef stressors such as climate change and land-based sources of pollution.

Assessments such as the region-wide efforts in the U.S. Pacific have demonstrated declines in reef fish abundance and correlations between reduced fish biomass and proximity to human population centers (Schroeder et al., in press). In addition, socioeconomic studies have documented fishers' perceptions that fish are less abundant and coral reef health has declined (e.g. Griffith et al., 2007). Work in U.S. coral reef jurisdictions has shown; however, that appropriate management actions can reverse these trends. For instance, 'no-take' areas in the Florida Keys (Bartholomew et al., 2007) and marine preserves in Guam (Taylor, in press) have resulted in increased numbers and size of economically and ecologically important reef fish. Management actions focused on key coral reef species, such as the Fish Replenishment Areas in West Hawai'i, have also demonstrated success in protecting reproductive stock and maintaining the fishery for important aquarium trade species (Williams et al., 2009).

Minimizing negative fishing impacts throughout coral reef ecosystems is critical to revitalizing and protecting coral reef resources for current and future generations. Given the many entities with jurisdiction or expertise over U.S. coral reef resources, cooperation among partners is essential. The CRCP aims to support collaboration among federal, state, territory, commonwealth, and local governments; academic institutions; and nongovernmental organizations to achieve the goals and objectives outlined below. These goals and objectives include:

- Increase the abundance and average size of key coral reef fishery species to protect trophic structure and biodiversity and improve coral reef ecosystem condition;
- Support effective implementation and management of marine protected areas (MPAs) and ecological networks of MPAs that protect key coral reef ecosystem components and functions;
- Increase stakeholder engagement and capacity to improve local compliance with and enforcement of fisheries management regulations that further coral reef ecosystem conservation; and
- Utilize locally relevant education and communication strategies to increase public and policy

maker understanding of fishing impacts in coral reef ecosystems and support for effective management options.

Fishing Impacts Goal 1

Increase the abundance and average size of key¹ coral reef fishery species to protect trophic structure and biodiversity and improve coral reef ecosystem condition.

Excessive fishing may reduce fish size and abundance and change species composition throughout coral reef ecosystems. This can be severe enough to compromise the natural ecological balance of the system (Bellwood et al. 2004). Studies suggest that when key functional reef species, such as herbivorous fishes, are overfished, associated phase-shifts from high-diversity coral-dominated systems to low-productivity algal-dominated communities can occur (Hughes 1994). Shifts in community structure may cause reefs to be less resilient to other hazardous events including coral bleaching and disease (Westmacott et al. 2000). Management, research and monitoring of fishing impacts is challenging due to the diversity of coral reef ecosystem species, the variety of methods used to extract them, and the paucity of basic information on fishing effort and ecology. Thus the intent of Goal 1 is to focus sound science and ecosystem-based management on key species or functional groups.

In addition, Goal 1 seeks to balance the desire for short-term fishery yield with the need for long-term fishery sustainability and coral reef persistence. Reducing impacts from fishing can enhance coral reef integrity, stability and aesthetics by increasing the abundance and average size of targeted species, restoring biodiversity, and maintaining coral reef ecosystem function. When fishing impacts are sufficiently reduced, coral reef ecosystems have the capacity to deliver ecological services while ensuring long-term reef productivity and persistence.

NOAA traditionally undertakes fisheries management under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The following goals and objectives are consistent with MSFCMA and are not meant to supersede it nor any state and territorial fisheries management requirements. The intent of these goals and objectives are to improve and conserve coral reefs as intact, fully functioning ecosystems.

Objective 1.1: Support the creation or improvement of coral reef fisheries management plans that address ecological, social, and economic considerations.

Objective 1.2: Prioritize key coral reef associated species or functional groups (e.g. herbivores, apex predators, etc.) on which to focus management, research and monitoring activities for each jurisdiction or managed area.

Objective 1.3: Obtain essential life history and ecological information on key species or functional groups to support management actions.

¹ Key coral reef species (or functional groups) should be identified by each jurisdiction or managed area, and are defined as the composite of species essential to effective ecosystem-based function. Key species/groups may be those most affected by extractive activities, those that serve as indicator or keystone species, or other criteria.

Objective 1.4: Obtain necessary information on fishing effort in U.S. coral reef ecosystems by measuring fishing intensity, fishing mortality, frequency, area coverage, community dependence, etc. to inform management activities.

Objective 1.5: Predict appropriate levels of extraction for key species or groups by developing and utilizing valid, precise, place-based and realistic ecosystem dynamics models.

Objective 1.6: Conduct applied biological, social, and economic research and monitoring to evaluate effectiveness of coral reef ecosystem management actions on key species or groups.

Fishing Impacts Goal 2

Support effective implementation and management of marine protected areas² (MPAs) and ecological networks³ of MPAs that protect key coral reef ecosystem components and functions.

Marine protected areas (MPAs) are valuable marine management tools for protecting and fostering the recovery of populations, habitats and ecosystems that have been depleted or degraded by excessive exploitation. A large body of scientific research supports the role of marine reserves⁴ ('fully-protected' or 'no-take' MPAs) in increasing the abundance, size and productivity of exploited marine fish, and increasing the biodiversity of fish communities within the protected areas - the so-called 'reserve effect' (Halpern 2003). Because of the importance of dispersal in the marine environment, well designed ecological networks of MPAs are needed to effectively protect biodiversity, habitats and ecosystem functions.

Concerns over economic and social impacts have sometimes led to selective, rather than complete, closure to extractive activities. Although ecosystem benefits from partial closures may accrue, theory and practice suggest that 'no-take' marine reserves are more effective for the protection and recovery of coral reef ecosystems affected by fishing. In order to maximize effectiveness it is also critical to utilize appropriate land and watershed-use provisions (see Land-Based Sources of Pollution section) and implement MPAs within the context of other coral reef fisheries management tools.

As with any management action, societal support and compliance are key elements to ensuring MPA effectiveness. In implementing MPAs and MPA networks, ecological and societal outcomes must be weighed, and the local management context must be considered. The CRCP remains committed to strengthening the effectiveness of existing MPAs, as well as supporting the establishment of new MPAs, reserves, and networks where determined to be locally appropriate.

² Marine Protected Area (MPA): An area of the marine environment that has been designated by law or regulation to provide lasting protection for part or all of the resources therein.

³ Ecological Network: A set of MPAs that are connected through ecological processes and that share complementary purposes and synergistic protections.

⁴ Marine Reserve: A type of MPA within which extractive uses are prohibited (often referred to as a "no-take" area or 'fully-protected' MPA).

Objective 2.1: Identify, characterize and rank priority areas for protection within each jurisdiction, including (but not limited to):

- spawning sites, nursery habitats, or other areas critical to particular life-history stages
- biodiversity hotspots
- areas with greatest resilience or potential for restoring resilience
- areas facing greatest threats

Objective 2.2: Synthesize research on the performance of MPAs that protect key coral reef ecosystem components and functions.

Objective 2.3: Using outputs of Objective 2.1 and 2.2, appropriate models, and socioeconomic considerations, identify MPAs that require increased protections or improved management, and areas to be considered for siting of new MPAs that protect key coral reef ecosystem components and functions.

Objective 2.4: Work with relevant agencies, offices, and communities to create, implement, and improve the management of MPAs that protect key coral reef ecosystem components and functions.

Objective 2.5: Conduct biological and socioeconomic research and monitoring to assess the performance of MPAs with respect to protection and restoration of key coral reef ecosystem components and functions.

Fishing Impacts Goal 3

Increase stakeholder engagement and capacity to improve local compliance with and enforcement of fisheries management regulations that further coral reef ecosystem conservation.

The success of management actions targeted at reducing the impacts of fishing on coral reef ecosystems will be largely dependent on voluntary compliance with or necessary enforcement of regulations, managed areas or best management practices. Increasing community involvement in planning, implementation, and enforcement activities will increase local capacity, collaboration, and communication, all of which are essential to protect key species/functional groups and ensure that marine protected areas are effective. Improved stakeholder participation can also provide local and traditional knowledge critical to tailoring management activities to specific geographic areas. Additionally, compliance may be improved by identifying locally appropriate economic alternatives to unsustainable fishing. Monitoring the outcomes of programs designed to increase community participation, compliance, and enforcement will provide important information for adaptive management of coral reef ecosystems.

Objective 3.1: Increase participation of stakeholder or citizen groups in fisheries management planning, decision-making, and monitoring activities that improve conservation of coral reef ecosystems.

Objective 3.2: Strengthen local agency and community capacity for effective and consistent enforcement of regulations or behaviors that reduce impacts of fishing on coral reef ecosystems.

Objective 3.3: Work with partners to identify economic alternatives that reduce effects of non-traditional extractive livelihoods on coral reef ecosystems and provide options for communities impacted by coral reef fisheries management actions.

Objective 3.4: Conduct biological and socioeconomic research and monitoring necessary to assess the effectiveness of compliance and enforcement activities, understand community concerns, flag roadblocks to implementation, and incorporate into management efforts.

Fishing Impacts Goal 4

Utilize locally relevant education and communication strategies to increase public and policy-maker understanding of fishing impacts in coral reef ecosystems and support for effective management options.

Effective education and outreach mechanisms are critical to communicating basic coral reef ecosystem information and the nuances inherent in research, monitoring and management of these complex ecosystems. Coral reef species are highly inter-dependent and face a variety of threats that may cause both individual and synergistic effects. Thus, management actions may not demonstrate an immediate cause/effect impact on the ecosystem. Effective implementation of long-term policies that will reduce the impacts of fishing on coral reef ecosystems requires improved communication of the goals, values and benefits of management activities leading to broader public support and understanding of their impacts and timelines. The scope of this goal is activities relevant for each jurisdiction or local manager. National education and outreach strategies will be developed by the CRCP Education and Outreach Working Group.

Objective 4.1: Develop curricula incorporating locally relevant lessons plans about coral reef ecosystems and fisheries management that meet current state and national standards.

Objective 4.2: Develop and implement effective strategies and tools to improve communication between scientists, managers and policy makers on best management practices to protect key coral reef ecosystem species and functional groups.

Objective 4.3: Develop targeted, locally-relevant outreach and communication strategies to increase community understanding and support for regulations to protect key coral reef ecosystem species/functional groups and expanded use of marine protected areas.

Objective 4.4: Obtain socioeconomic and human dimension data to inform jurisdiction-specific education and communication strategies and initiatives and monitor program outcomes.

References

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Appendix I: Suggested Activities for Implementing CRCP Fishing Impacts Goals and Objectives

This supplementary information is submitted with the Goals and Objectives by the Fishing Impacts Working Group. The activities below are a compilation of discussions from our workshop, activities listed in earlier drafts of the Goals and Objectives, and comments received. **Areas in bold highlight key statements, and are not the original emphasis of commenter.**

Goal 1

Objective 1.1:

- Suggested plan for implementation:
 1. Conduct gap analyses
 2. Create timeline-driven plans to address gaps
 3. Implement plans
 4. Refine regulatory frameworks
- Begin process by asking managers what they feel fishing issues are, existing management strategies, and what measures are being used to measure their effectiveness, and whether management strategies have been found ineffective in order to determine whether and what changes need to be made.

Objective 1.2:

- A potential activity should at minimum, include a **review and synthesis of historical fisheries information** to determine key coral reef species on which to focus management. Species or species groups which have experienced significant declines in catch and/or catch per unit effort over past 10-20 years may be candidate species to consider. Similarly, species or species groups which catch continually ranks in the top 5 over the past 10-20 years could also be considered.
- Since most jurisdictions do not have sustainable fishery management plans, the AIC recommends the CRCP provide assistance to jurisdictions to help them **complete their plan, before establishing priorities.**

Objective 1.3:

- Suggested plan for implementation:
 1. Identify gaps in knowledge of key coral reef ecosystem species/groups;
 2. Identify sources of existing information;
 3. Develop a research plan for filling critical gaps;
 4. Implement research plan;
 5. Provide information to managers
- As noted in the Goal 1 statement, management, research and monitoring of fishing impacts is challenging due to the diversity of coral reef ecosystem species, the variety of methods used to extract them, and the paucity of basic information on fishing effort and ecology. One of the fundamental needs to help local jurisdictions (as well as NOAA) better understand and address the impacts of fishing on coral reef ecosystems is the **development of more rigorous and statistically reliable data collection programs for estimating coral reef fishery catch and effort.**

- Life history studies for the same species are being conducted on many islands. How much variation is truly present between jurisdictions? **Can jurisdictions promote sharing of species-size-reproduction curves with a good degree of confidence?** This should be considered, repetitive studies of the same species are very expensive and time consuming, and there should be an effort to understand the need and share appropriate information.

Objective 1.4:

- Synthesize recreational and commercial fishing effort data from coral reef ecosystems where it exists
- Determine recreational and commercial effort on key species or functional groups to fill gaps;
- Characterize reef fisheries to understand community dependence and total fishing effort
- 1.3 is a high priority. This is important and necessary. However, in order to achieve this, NOAA Fisheries needs to change the way they collect fishery data. Currently, coral reefs are not separate entities for which data is collected, and they need to be. For federal waters, NOAA and the FMC's need to **identify coral reefs within their jurisdictions and set them up as separate areas for which information is obtained.**
- Need commercial, recreational, and subsistence fishing information in order to get an accurate picture of fishing effort and impacts to habitat, including through fishing species that have not been well studied such as octopus as this fishing involves trampling on reef and catching even juvenile animals. **Should work with fishers to obtain realistic estimates of fishery species** (see Objective 3.1) similar to work being done by Dr. Richard Nemeth in USVI.

Objective 1.5:

- Obtain or determine historical abundance levels and population structure to use as reference targets.
- Need for development and transferability of multispecies stock assessment tools and spatial ecosystem models. Hopefully these will greatly extend and make more reliable the capabilities of models like ECOPATH.
- It is imperative that state managers participate in the development of, or the selection of, the ecosystem dynamics models. This is crucial for state buy-in to the process.

Objective 1.6:

- Compare fished with un-fished reefs and measure spatial and temporal responses to changes and differences in fishing effort and gear types;
- Increase NOAA and local capacity to collect and analyze socioeconomic and human dimensions information relevant to assessing the impacts of fishing and management activities on coral reef ecosystems
- Need to **include metrics on biodiversity in key functional groups** across major taxa (fish, corals, invertebrates, algae). Otherwise you will not be able to evaluate the effectiveness of the goal to conserve or restore biodiversity.
- FYI - EPA's Ecosystem Services Research Program in Coral Reefs is conducting research on this topic and uses a DPSIR organizing framework to link the biological, social, and economic research components. This is a prime opportunity for collaboration!

Goal 2:

Objective 2.1:

- Identify ontogenic linkages of key coral reef species/functional groups among habitats
- Determine population connectivity of key species/groups for recruitment and population replenishment
- Develop a reef resilience index to guide siting and management of MPAs

Objective 2.3:

- Develop a management needs and effectiveness index for existing MPA sites.
- Research, analysis, and modeling for network development should be taking place simultaneously as capacity building for existing individual sites.

Objective 2.6:

- Compare MPA site with non-MPA site or pre-establishment data with post-establishment data to measure impacts on key species or functional groups
- Potential activities for Objective 2.1 should include a **comparison of biological data between existing MPA sites with similar biogeographical characteristics**. Comparing two protected areas with similar biogeographical characteristics may provide more useful information on the performance of an MPA than comparing an MPA site with a non-MPA site.
- Utilize no-take areas as experimental controls for understanding the impacts of fishing on coral reef communities.

Goal 3:

Objective 3.1: Note – care must be taken that these activities serve to advance coral reef ecosystem conservation, not just increase participation.

- Support the creation and/or strengthening of stakeholder/citizen groups to participate in fisheries management, planning, and monitoring to improve public input into and buy-in for decision making.
- Establish a body and/or positions within existing management agencies to liaise with fishers, other affected stakeholder groups, and indigenous communities;
- Support incorporation of locally appropriate mechanisms (including the use of traditional knowledge) for public participation in management action/priority setting initiatives
- Support implementation of community-based coral reef ecosystem fishery management plans (see Objective 1.1)
- Work with existing or new community-based programs to **include the public in resource or socioeconomic monitoring** activities (see Objectives 1.6, 2.5, 3.4 and 4.4)
- Ensure that local needs, concerns, and **issues of equity** are considered in fisheries regulations

Objective 3.2:

- Increase capacity (e.g. personnel, training, equipment, retention systems, outreach) of local agencies
- Support **local community monitoring and patrolling** through trainings, enabling legislation or other capacity building

- Support (as appropriate) **traditional methods of enforcement**
- Measure **cost-effectiveness** of different enforcement technologies, capacity to react to remote-sensed info
- Identify long-term funding sources to strengthen local capacity
- Under this goal, it may be useful to **assess existing resource rules, statutes, etc. at state, local, and federal levels and assess how the various authorities "mesh."** There may be circumstances under which the state has insufficient authority or for which the federal government has insufficient enforcement capabilities. From this exercise, information can be gained to describe the changes necessary to existing rules, regulations, statutes, etc. to make enforcement more effective.
- Additionally, an **assessment of what resources are necessary to enforce existing and proposed rules** could be carried out. It is evident in southeastern Florida that there are insufficient enforcement resources, but it is not known exactly what changes are necessary to make it sufficient.
- Investigation into the **feasibility of new technologies for surveillance** could be an additional activity, particularly for remote areas such as the PRIA and Hawaiian Islands.
- Priority enforcement effort should be deployment of **Vessel Monitoring Systems**.
- This objective should include first **identifying what exists, whether it works, how what exists might need to be changed**, etc. Also should identify who would be in charge of the groups in an oversight capacity and **whether the capacity for oversight currently exists** or would be created as part of this objective.
- Perhaps include 'cross-training' of enforcement officers into known, successful programs.
- As part of enforcement efforts, need to include technology development for **continuous near real-time surveillance** (including remote webcams, RADAR, Ecological Acoustic Recorders, etc.)
- Make sure management and enforcement actions don't simply give funds to enforcement agencies, but develop partnerships between agencies and communities.

Objective 3.3:

- Facilitate regional and/or local discussions on development and implementation of ecotourism opportunities, appropriate aquaculture development, or other non-extractive sources of income
- Educate users on the importance of reducing or optimizing fishing pressure to achieve long-term sustainability of fishery;
- Understand and balance coral reef fisheries with non-extractive activities

Objective 3.4:

- There is a need for research to **understand values and motivations driving individual fisheries and components**. This is particularly important in management design where a stock or area is targeted by a number of groups with significantly different motivational drivers, or constraints on effort - subsistence, local market/extended family, commercial market income generation, global market big red fish.

Goal 4:

Objective 4.2:

- Improve dissemination of research, monitoring, and management results in a way that is easily accessible and understood by policy makers and the public.
- This objective should include efforts by scientists to translate results for management and education. **Don't start from scratch** in creating tools to improve dissemination of results--work with partners like Fishery Management Councils, NOAA Education and COSEE centers.

Objective 4.3:

- Develop multi-leveled approach (resource users, community leaders, policy makers, future generations, etc.)
- Utilize social marketing approaches
- Help jurisdictions deal with liability issues (school children, public in-water programs, etc)
- Link to needs of local coral reef fisheries management plans.
- Many people go to the Keys to dive, however many have little understanding of coral ecosystems. The dive operators have a vested interest in the ecosystem and should be encouraged to **incorporate reef education into their dive classes and trips**. Most of the dive sites are offshore so transit time would provide opportunity to educate. This is a good practice to instill, even in those areas where tourism is not a currently causing significant damage.