

Reducing the Adverse Impacts of Fishing



GOAL: Reduce the adverse impacts of fishing and other extractive uses to protect coral reef ecosystems and ensure sustainable fisheries.

Rationale for Action

More than 4,000 species of fish (25 percent of all marine fish) inhabit coral reefs and associated habitats

(Spaulding et al. 2001). These habitats support important commercial, artisanal, recreational, and subsistence fisheries in the United States and around the world. Coral reef fisheries

OBJECTIVES

OBJECTIVE 1: Identify, monitor, and protect critically important U.S. coral reef fisheries habitats and spawning populations through an expanded network of no-take ecological reserves; ensure effective enforcement of existing no-take fishery reserves; monitor reef fish stocks in no-take marine reserves and reference sites to evaluate the effectiveness of reserves; and identify and protect new areas necessary to ensure the integrity of fisheries and ecosystems.

OBJECTIVE 2: Reduce overfishing by monitoring coral reef fisheries, assessing the adequacy of current fishing regulations, revising regulations as needed (using existing statutory processes in the case of federal regulations), and providing enhanced enforcement and education.

OBJECTIVE 3: Enhance coordination on coral reef fishery issues with the U.S. territories in the Caribbean and Western Pacific.


OBJECTIVE 4: Reduce adverse environmental impacts of fishing by assessing essential fish habitat; identifying the effects of fishing and fishing gear; implementing actions or additional gear and fishing vessel anchoring restrictions to reduce habitat damage; eliminating destructive fishing practices; assessing and mapping deeper coral reefs, banks, and beds; and developing strategies to conserve these deeper ecosystems.

OBJECTIVE 5: Incorporate ecosystem-scale considerations into coral reef fishery management by performing targeted research, including the development of models, to understand the ecosystem effects of fishing and the socioeconomic impacts of fishery management.

OBJECTIVE 6: Reduce the overexploitation of reef organisms for the aquarium trade by banning the domestic commercial collection of coral and “live rock” and monitoring the collection of other species, developing new management measures or ecologically sound alternatives to wild collection, evaluating the effectiveness of existing legal authorities and policies governing the collection and importation of coral and other reef-dwelling species, and addressing inconsistencies among federal and state/territory regulations on collection and trade of ornamental coral reef species.

OBJECTIVE 7: Develop a process to evaluate issues and possibly develop guidance related to coral reef aquaculture in conjunction with stakeholders and relevant interagency groups, including the Aquatic Nuisance Species Task Force and the Invasive Species Council.





provide food and income and play a central social and cultural role in many island communities; however, human population growth, the emergence of export fisheries, and the use of more efficient fishing equipment have led to overfishing and degradation of the habitats upon which these fish depend.

Overfishing of high-value species has been documented on nearly all U.S. inshore reefs and contributes to localized depletions of key species. Increasing evidence shows overfishing significantly alters the ecological balance and contributes to the degradation of coral reef ecosystems. In particular, overfishing of herbivorous fish has been linked to phase shifts from high-diversity, coral-dominated systems to low-productivity, algal-dominated communities (Bellwood et al. 2004). Also, some fishing gear can damage reef habitats, and fishing pressure on predatory fish may accelerate bio-erosion of corals by their invertebrate prey. Overfishing has been identified as a major concern in all U.S. states and territories with coral reefs, and it was chosen in 2002 by the USCRTF as one of six priority areas for the development of local action strategies (LASs) to reduce this threat.

Summary of Implementation

USCRTF members and their partners are working together to implement programs that increase knowledge about coral reef fisheries and reduce the adverse impacts of fishing. Because most coral reef fisheries are located within state and territory waters, many programs are collaborative efforts among NOAA, the U.S. Department of the Interior (DOI), state and territory government agencies, fishery management councils, and nongovernmental and university partners. Since 2002, USCRTF agencies supported more than 57 federal management and research programs to understand and address coral reef fisheries. The programs emphasize efforts to:

- Assess the effectiveness of established marine protected areas (MPAs) in promoting the recovery of overfished stocks;

- Identify spawning aggregation sites and monitor the health of these aggregations and associated fishery resources;
- Understand habitat use patterns and linkages to identify key habitats that should be included within MPA networks; and
- Evaluate fishing efforts and the impacts of fishing gear on coral reef ecosystems.

This information is being provided to local, state, and territory resource agencies and regional fishery management councils to support ongoing evaluations of current regulations and the development of new regulations to enhance the sustainability of coral reef fisheries.

Successful efforts to reduce the impacts of fishing must include an integrated effort to protect, understand, and rebuild important coral reef fish populations. Assessments of fishery stocks are lacking for the majority of coral reef species (see table 6), hindering the establishment of a balance between resource protection and exploitation through ecosystem-based management approaches. To address this gap, NOAA and its partners have worked together to conduct detailed assessments of fish size, abundance, and diversity of selected coral reef fish populations throughout U.S. waters. These assessments help researchers evaluate the health of ecologically and economically important species and understand species interactions and the effect fishing has on these associations.

For example, comparative studies in the Hawaiian Island Archipelago found a large number of apex predators (primarily large jacks and reef sharks) throughout the entire Northwestern Hawaiian Islands (NWHI) chain. This is a stark contrast to the near absence of apex predators in the Main Hawaiian Islands. The difference in apex predator populations is likely a result of greater fishing pressure in the Main Hawaiian Islands, which emphasizes the need for better regulations to manage fishing and recover depleted populations (Friedlander and DeMartini 2002). In addition, the USCRTF and

Table 6. Overview of Coral Reef Species Stock Information Listed Under Fishery Management Plans for Federal Waters

Fishery management council/ jurisdiction	Fishery management plan	Number of stocks	Number of stocks overfished (biomass is below threshold)	Number of stocks not overfished (biomass is above threshold)	Number of stocks where fishing is closed in the EEZ	Stocks with no information about overfishing
South Atlantic	South Atlantic snapper-grouper	60	8	11	2	41
	South Atlantic spiny lobster	2	–	1	0	1
	Coral, coral reefs, and live/hard bottom habitats in the South Atlantic region	5	–	–	5	5
Caribbean	Puerto Rico and U.S. Virgin Islands reef fishery	140	2	–	2	138
	Puerto Rico and U.S. Virgin Islands spiny lobster fishery	1	0	1	0	0
	Puerto Rico and U.S. Virgin Islands queen conch resources	13	1	–	0	12
	Puerto Rico and U.S. Virgin Islands coral and reef associated invertebrates	25	–	–	6	25
Gulf of Mexico	Gulf of Mexico reef fish resources	42	5	3	2	34
	Gulf of Mexico spiny lobster	2	–	1	0	1
	Gulf of Mexico corals and coral reefs	5	–	–	5	5
Western Pacific	Western Pacific bottom fish and seamount groundfish	10	–	–	0	10
	Western Pacific coral reef ecosystem fishery management plan	146 ^a	–	–	0	146
	Western Pacific crustacean	6	–	–	5 ^b	6
	Western Pacific region precious corals fishery	12	–	–	12 ^b	12
Highly migratory species ^c	Highly migratory species	3 ^d	3	0	0	0

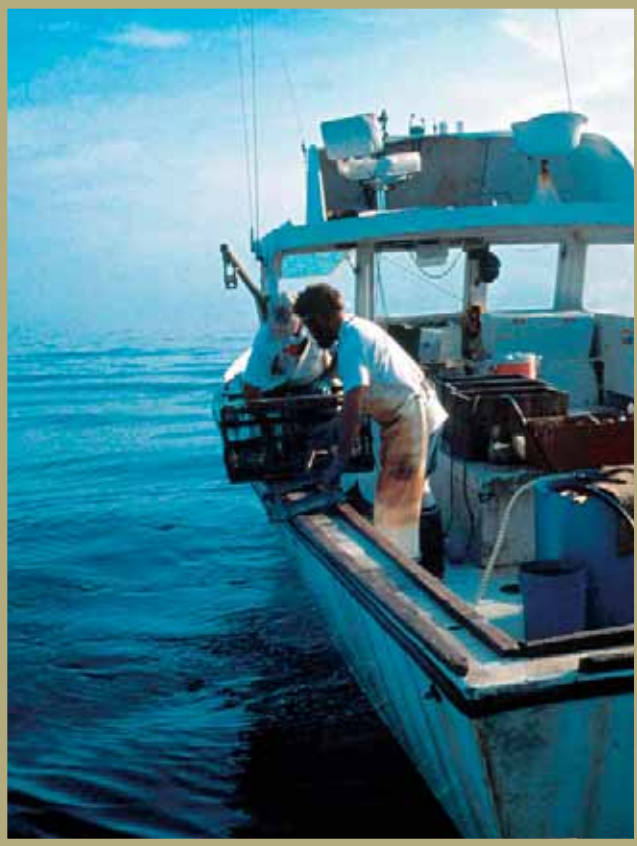
Information for this table was derived from the 2003 Status of U.S. Fisheries report, <http://www.nmfs.noaa.gov/sfa/reports.html>. The table includes only those coral reef-associated species that are listed on fishery management plans and does not reflect all known coral reef species.

^a This figure was taken directly from the Western Pacific Coral Reef Ecosystem Fishery Management Plan, <http://www.wpcouncil.org/coralreef.htm>, and includes only those species listed as currently harvested coral reef taxa.

^b The fishery is closed in the Northwestern Hawaiian Islands.

^c Highly migratory species are not under the jurisdiction of any one Fishery Management Council.

^d The three shark species include the Caribbean reef shark, tiger shark, and nurse shark.



its partners are identifying spawning aggregations, assessing temporal and spatial behaviors of groupers and snappers associated with these aggregations, and devising strategies to protect these aggregations in the Atlantic and Caribbean. Many of these commercially important species are slow growing and long lived, forming seasonal spawning aggregations that are easy for fishers to find and target, but that can be decimated within a few years by heavy fishing. Research illustrates that aggregations are vital to ensuring the successful reproduction and recruitment of these fish and their protection is critical to reef ecosystem health.

NOAA, DOI, state and territory agencies, and others are evaluating the effectiveness of established MPAs and developing new protected areas to enhance fishery resources. Effectiveness studies have centered on assessing changes in fish populations within established protected areas, relative to non-protected areas, and on determining if these protected areas act as sources or sinks for larvae and/or adults. For example, studies in Florida demonstrated the average size and density of exploitable (prey) species increased in no-take reserves and some spillover appeared to occur from reserves into the surrounding fished areas. Riley's Hump in the Tortugas South Ecological Reserve has shown significant increases in density of several snapper and grouper species since additional protections were implemented in 2001 (Burton et al. 2004), and scientists have observed an increase in spawning aggregations within coral reef reserves in Guam and other areas.

No-take ecological reserves (reserves) are increasingly important tools for coral reef fishery management (see also chapter 5). NOAA and its partners have initiated efforts to help local resource managers understand the importance of marine reserves and science-based decision-making processes in the effective design of MPAs. These efforts include:

- Workshops in Puerto Rico and the USVI for key stakeholders to improve their understanding of ecosystem impacts associated with overfishing and destructive fishing and the benefits of marine reserves in conserving biodiversity and enhancing fisheries;
- Socioeconomic evaluations to determine fishermen's perceptions and preferences about MPAs in the Caribbean;

- Development of models evaluating the effect of different management regimes on trophic dynamics (i.e., different levels of organization within the food chain), which can predict the rate of changes within a reserve, and assess its performance based on the types of habitats selected, patterns of use within these habitats, and fishing effort; and
- Research on connectivity and recruitment linkages between American marine reserves in Meso-American reef areas, the Dry Tortugas, and the Florida Keys.

Key elements for reducing the impacts of fishing include improved regulations, enhanced enforcement, and outreach and education efforts to inform stakeholders of new procedures and how to help sustain reef resources. Since 2002, five jurisdictions have instituted new or revised fishery regulations. In March 2004, Puerto Rico implemented comprehensive new fishing regulations, including ones compatible with federal regulations that established recreational and commercial fishing licenses by species.

For federal waters, final rules were published to implement the Fishery Management Plan for Coral Reef Ecosystems of the Western Pacific Region. This plan establishes a coral reef ecosystem regulatory area and complements four other fishery management plans to regulate fishing. Additional management measures were implemented in federal waters of the Gulf of Mexico and South Atlantic to help reduce overfishing and rebuild reef fish stocks. In Biscayne Bay, the National Park Service (NPS) established regulations related to lobster take. Beginning in 2003, USCRTF members initiated efforts to train local resource personnel in relevant laws, regulations, and related enforcement approaches. The USCRTF will continue to provide additional assistance in the area of enforcement.

Highlights of Task Force Member Activities

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Gag Grouper MPAs Extended

Two MPAs were established in the northeastern Gulf of Mexico in 2000 to protect gag grouper (*Mycteroperca microlepis*) spawning grounds at the edge of the continental shelf in an effort to increase the stock biomass and, specifically, the percentage of males while protecting other species. NOAA supported efforts to map, characterize habitats, and evaluate changes in fish assemblages in the MPAs and an adjacent area of similar depth and habitat that is open to fishing. Efforts targeted the Madison-Swanson and Steamboat Lumps MPAs and the Twin Ridges control area. In all sites, reef fish abundance and distribution increased between 2001 and 2002, but declined by 2003. The recent decline may represent natural fluctuations; however, continued fishing activity in the MPAs aggravated the separation of natural and fishing mortality. In 2003, the Gulf of Mexico Fishery Management Council used the resulting data to extend the initial 4-year closure for an additional 6 years. NOAA proposed continued studies during the 10-year closure to evaluate the efficacy of area closures in the management of gag grouper resources.

More Effective Implementation of Marine Preserves in Guam

In 2002, Guam developed its Coral Reef Fisheries Management Local Action Strategy to increase and better assess the effectiveness of its five marine preserves at restoring reef fish stocks. The strategy focuses on increased law enforcement and prosecution, assessment of connectivity and spillover effects using larval tracking and reef fish assessments, and coordinated educational outreach, including program briefings to policymakers and the Guam legislature. Compared with data from the control sites, preliminary survey data show significant increases in fish density and species diversity within the preserves.

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Enhanced Fishery Management in Biscayne National Park

A 2002 study of fish populations at Biscayne National Park conducted by the University of Miami and NOAA concluded that approximately 70 percent of commercial and recreational target species are overfished by federal standards and the number and size of key species are critically low. These findings led NPS to begin development of a groundbreaking Fisheries Management Plan (FMP) with the Florida Fish and Wildlife Conservation Commission (FWC). The joint FMP is a model effort to produce a management strategy transcending jurisdictions and boundaries to sustain fish stocks across their full range in and around Biscayne National Park. Scheduled for completion in late 2004, the FMP will be based on quantifiable,

desired future conditions for size and abundance of fishery populations to be met by reducing fishing gear impacts on habitat and bycatch, among other issues. NPS and FWC are incorporating input from the public and key stakeholders, including commercial and recreational fishers, divers, scientists, and conservationists, through the Florida Keys National Marine Sanctuary (FKNMS) Advisory Council to increase the effectiveness and facilitate implementation of the plan.

Training for Law Enforcement Officers

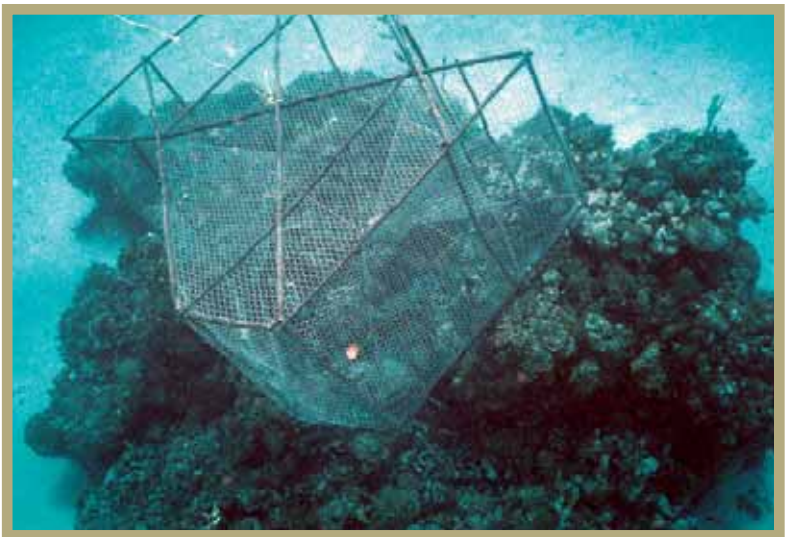
In 2003, the Puerto Rico Department of Natural and Environmental Resources selected eight rangers from six different regions to serve as members of a new Coral Reef Ranger Team in an effort to boost enforcement of coral reef and fisheries regulations. NOAA sponsored a training workshop for the rangers on the biology and identification of coral reef species, followed by a 2-week law enforcement training at FKNMS that emphasized topics in law enforcement, damage assessment, and coral and seagrass restoration.

OBJECTIVE 3: Enhance coordination on coral reef fishery issues with the U.S. territories in the Caribbean and Western Pacific.

LAS Implementation for Overfishing

In 2002, under the auspices of the USCRTE, state and territory partners began drafting LASs to address overfishing (or coral reef fishery management). These plans highlight ongoing conservation and management activities, identify gaps in local coral reef fishery management, and prioritize research and management needs for the next 3 years. Beginning in 2004, NOAA initiated support for new activities identified within the fishery management LASs, with an emphasis on supporting enforcement personnel and equipment.

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Antillean Z-trap dropped onto live coral in the Caribbean.

Understanding Trap Impacts

Certain types of fishing gear may damage coral reefs and seagrass beds. Managers need to understand the impacts of certain gear and the viable alternatives to those that are damaging. For example, fishers in the Atlantic, Caribbean, and Pacific commonly use traps to catch lobsters and fish, which have often been perceived as detrimental to coral reefs. Therefore, NOAA initiated an interdisciplinary effort in 2001 to analyze the placement and seasonality differences of trap usage, quantify damage to coral habitats, and examine the recovery rate of damaged organisms. Preliminary results from studies in Puerto Rico, the USVI, and Florida indicate that trap damage is not as high as anticipated because most fishers do not directly target hard coral areas.

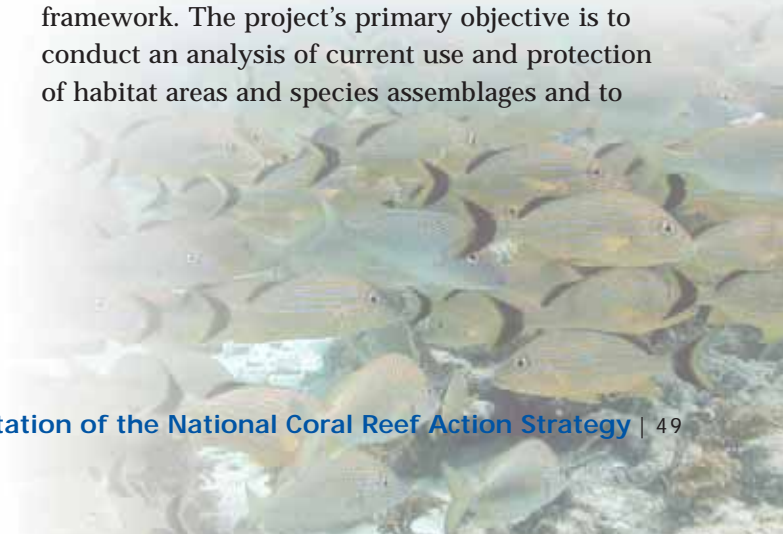
OBJECTIVE 5: Incorporate ecosystem-scale considerations into coral reef fishery management by performing targeted research, including the development of models, to understand the ecosystem effects of fishing and the socioeconomic impacts of fishery management.


Western Pacific Coral Reef Ecosystem Fishery Management Plan

Early in 2004, NOAA published the final rule to implement the Western Pacific Region Fishery Management Council’s Coral Reef Ecosystem Fishery Management Plan—the first U.S. coral reef ecosystem-based management plan. The rule establishes a coral reef ecosystem regulatory area, MPAs, no-anchor zones, gear registrations, permitting and reporting requirements, and a framework for the regulatory process.

Hawai’i Marine Gap Program

The Hawai’i Marine Gap Program was established by the State of Hawai’i with support from NOAA to integrate available data on Hawaiian nearshore waters into a spatial database to provide a comprehensive ecosystem conservation and planning framework. The project’s primary objective is to conduct an analysis of current use and protection of habitat areas and species assemblages and to





help identify representative habitat types that should be considered for additional protection. To facilitate this work, a comprehensive database and geographic information system have been developed to better manage and visualize the vast amounts of data gathered in support of Hawaii's marine resources. The program is a central component of The Nature Conservancy of Hawaii's marine program.

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Closure of Live Rock Harvest in Western Pacific

One of the most significant actions within the Coral Reef Ecosystem Fishery Management Plan prohibited the harvest of live rock in federal waters. The plan defines live rock as "any natural, hard substrate, including dead coral and rock, to which is attached or which supports any living marine life-form associated with coral reefs." Along with American Samoa's ban on live rock collection in 2000, this prohibition closed the last loophole allowing the destructive collection of live rock in U.S. waters.

Managing Aquarium Collection in West Hawai'i

The Hawai'i Coral Reef Initiative Research Program has funded annual monitoring of the West Hawai'i

coastline. The 6-year program sought to investigate the status of aquarium fish populations along the west coast of Hawai'i and determine the effectiveness of the region's nine fisheries replenishment areas (FRAs). Although specific FRAs varied in their degree of effectiveness, overall study results demonstrate that MPAs can effectively promote the recovery of fish stocks depleted by fishing pressures in Hawai'i, at least for heavily exploited species. Overall, FRAs have successfully reduced conflicts between collectors and other resource users, promoted a sustainable fishery, and enhanced aquarium fish populations. The success of FRAs in West Hawai'i is likely to increase as aquarium fish grow and mature within these protected areas and further replenish nearshore reefs.

OBJECTIVE 7: Develop a process to evaluate issues and possibly develop guidance related to coral reef aquaculture in conjunction with stakeholders and relevant interagency groups, including the Aquatic Nuisance Species Task Force and the Invasive Species Council.

Aquaculture in waters adjacent to reefs has increased, and environmental issues have been dealt with on a case-by-case basis. USCRTF agencies have not yet developed national guidance specific to coral reefs and aquaculture.

Increase in the Number of Aquaculture Farms in the Hawaiian Islands

In 2002 and 2003, NOAA, through the University of Hawai'i Sea Grant College Program, has contributed to the founding and/or operation of 47 aquaculture farms in the Hawaiian Islands. This includes significant contributions to 8 pearl farms, 4 demonstration and training pearl hatcheries, 15 giant clam farms (including the largest commercial giant clam aquaculture venture in the Pacific), and 20 sponge farms. Overall, NOAA and its partners have helped

increase the number of aquaculture enterprises in the Hawaiian Islands to 126 farms valued at \$25.2 million and supplying approximately 630 jobs.

Offshore Aquaculture Technology Tested for Efficacy

NOAA and its partners have tested offshore aquaculture technology in such tropical locations as Hawai'i and Puerto Rico that have demonstrated the potential of this technology for coral reef fisheries management. This offshore aquaculture technology allows for the production of commercial reef fishes without depleting the natural population in coral reef ecosystems. For example, in Puerto Rico the cobia offshore pen produced 15 tons of marketable product in an 8-month period without depleting natural populations. Changes in benthic communities as a result of nutrient inputs in the surrounding area were found to be negligible.

Future Challenges

States, territories, and their federal partners have taken multiple steps to address the impacts of fishing on coral reefs; however, resource extraction still exceeds the limits of sustainability on most reefs near populated coastlines. Further progress will require a combination of enforcing existing regulations and exploring new alternatives for managing coral reef fisheries.

Enhance enforcement capabilities of state and territory agencies. The USCRF's state and territory members have identified lack of adequate enforcement as one of the major constraints to effectively



Example of traditional community fishing efforts using a non-selective seine net.

managing reef fisheries. In addition to environmental laws, officers in these regions are increasingly called on to enforce a variety of regulations, including customs efforts, drug interdiction, and immigration. These regions often do not have enough manpower, boats, or support to adequately enforce environmental laws and prosecute environmental crimes committed on their coral reefs. To address their pressing enforcement needs, DOI, the U.S. Department of Justice (DOJ), the U.S. Environmental Protection Agency (EPA), and NOAA have initiated a series of enforcement workshops to help support the individual needs of each jurisdiction and begin to provide additional training for both enforcement officers and legal personnel.

Increasingly, states and territories are experimenting with community-based approaches and enhanced education and outreach to improve coral reef fisheries compliance. These novel approaches, building on diverse models such as those pioneered in West Hawai'i and American Samoa, are among the most promising additions to the fisheries management toolkit.



Nassau Grouper is a candidate species for listing under the Endangered Species Act.

Continue support for implementing LASs. The USCRTF's state and territory partners have developed 3-year plans to address overfishing and coral reef fishery management issues in their jurisdictions. Additional support is needed from federal agencies and other partners to support the priority actions listed within these LASs.

Continue developing networks of no-take reserves. Combined with traditional fishery management efforts, no-take reserves can be effective tools for recovering and sustaining overfished species and protecting the habitats that sustain them. The USCRTF will continue to work with key stakeholder groups, including resource managers, recreational and commercial user groups, nongovernmental

organizations, and the public, in all phases of the design, implementation, and evaluation of MPAs. These efforts need to consider appropriate legislative and regulatory authorities; traditional, community-based, and subsistence uses; and the best available scientific data on the natural history of coral reef species, species associations, and habitat considerations.

Research coral reef fisheries. Research is needed in the area of ecosystem-level, multispecies stock assessments with an emphasis on nontraditional, poorly known species of increasing commercial importance (e.g., ornamentals, invertebrates, herbivorous fishes). Future research needs to examine the natural history of representative species from different trophic groups, including species interactions and the cascading effects of overfishing on target and associated nontarget species.

Characterize and protect essential fish habitats. Efforts need to focus on understanding the habitat requirements of commercially and ecologically important fish and invertebrates and the effects of habitat degradation on these species. Understanding the connectivity and linkages between adjacent habitats and their role as essential fish habitats (EFHs); the factors affecting recruitment, migration, and movement within and among habitats; and how to ensure appropriate habitats are delineated and protected as EFHs is also important.