



## 3 *Reduce Adverse Impacts of Fishing on Coral Reef Ecosystems*

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### *Introduction*

Coral reefs and associated habitats provide important commercial, recreational, and subsistence fishery resources in the U.S. and around the world, and represent a critical source of food for many developing countries. Fishing plays a central social and cultural role in many island communities. The rich biodiversity of reefs also supports a valuable marine aquarium industry and promises rich genetic resource for pharmaceuticals or other natural products. However, human population growth, the emergence of export fisheries, the use of more efficient fishing equipment, and lack of effective management responses have led to overfishing<sup>1</sup> and fishing-related impacts on habitats and ecosystems. Increasing evidence shows overfishing significantly alters the ecological balance and contributes to the degradation of coral reef ecosystems.

Overfishing of coral reef resources is the most widespread direct anthropogenic threat to coral reefs around the world.<sup>2</sup> Fishing has been identified as a high threat in every populated U.S. jurisdiction except the Commonwealth of the Mariana Islands (CNMI), where it is categorized as a moderate threat.<sup>3</sup> Fishing was also identified in 2002 by the States, Territories, and Federal members of the U.S. Coral Reef Task Force as one of five key threats to address through local action strategies.

The CRCP approach to reducing the adverse impacts of fishing was informed by a series of CRCP-sponsored workshops under the auspices of the U.S. Coral Reef Task Force. These workshops brought together fishers, local managers, environmental non-governmental organizations (NGOs) and academic scientists in 2002 in Puerto Rico (for the U.S. Caribbean), 2003 in Guam (for Guam and CNMI), Hawai'i (including a series of pre-meetings on different islands), and 2005 in American Samoa. They revealed both a variety of needs and approaches, as well as certain common challenges:

- Overfishing has occurred on all near-shore reefs, but detailed data needed to assess the degree of overfishing or support traditional management measures is generally lacking.
- Large predatory fishes have been depleted, and aside from Florida, there has been increased fishing on, and depletion of, herbivores, raising concerns about effects of the removal of key functional groups of reef species on reef ecosystems.

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<sup>1</sup> The term "overfishing" in this document refers to significant depletion of reef species by commercial, recreational, or artisanal fisheries. It does not necessarily imply that a status of overfishing or overfished as defined by the Magnuson-Stevens Fisheries Conservation and Management Act has been determined.

<sup>2</sup> Reefs at Risk, 1998. *Note: Reefs at Risk did not address climate change risks.*

<sup>3</sup> State of the Coral Reef Ecosystems of the United States 2005





- Most fisheries are small-scale, multispecies and artisanal in nature; recreational fisheries, a growing component, may exceed commercial catch.
- Collection of fishes and invertebrates for the aquarium trade has increased where this is allowed.
- There is weak enforcement of existing fishing regulations.
- Certain fishing gear types are of particular concern either because of habitat impacts and bycatch (e.g., large gill nets and fish traps), or because of their contribution to overfishing specific groups (e.g., scuba spearfishing).
- Coastal development and land-based pollution are perceived as a significant factor affecting fish habitats.

NOAA has particular expertise and management responsibilities in addressing this objective. NOAA's Fisheries Service has been delegated authority under the Magnuson-Stevens Fisheries Conservation and Management Act to sustainably manage coral reef fisheries in Federal waters, principally through fishery management plans developed by four regional Fishery Management Councils (South Atlantic, Caribbean, Gulf of Mexico, Western Pacific). The agency also has responsibility for ensuring the identification, conservation, and enhancement of essential fish habitat (EFH), including consultations with other Federal agencies on their activities that may adversely affect such habitat in either state or Federal waters. In some cases, NOAA has direct management responsibilities for fisheries within National Marine Sanctuaries, often in collaboration with either the state management agency or the regional fishery management council. NOAA's scientists have a significant history of research in areas related to fisheries management on coral reefs, especially in Florida.

However, in the U.S., most shallow coral reefs occur within state, territory or commonwealth jurisdiction waters and fisheries management is primarily the responsibility of these government entities. In these cases, NOAA's CRCP can provide relevant science and capacity-building or direct support for state, territory, commonwealth, and local management approaches through the CRCP grants program. A foundation of the CRCP is its "ecosystem approach" to science and management. Coral reefs represent complex ecosystems. As such, adequate understanding of their structure and function requires multidisciplinary analysis of major interacting biotic and abiotic components, together with environmental forcing factors, including those from adjacent systems irrespective of agency-jurisdictional boundaries (e.g., terrestrial water-shed, deep-water). Accordingly, cooperation among partner agencies is essential to monitor and manage living resources across their entire geographic range and to implement the most effective management regime to prevent and mitigate impacts of overfishing on coral reefs.

NOAA's CRCP is working with partners to reduce the adverse impacts of fishing and increase the sustainable management of coral reef fisheries through improved scientific information, coordination, enforcement, targeted management approaches, education, and capacity building. Given NOAA's mandates, expertise, and the broad importance of this problem, this has been a major area of investment for the CRCP. To address this goal, the CRCP has focused efforts on addressing the following objectives:





- Understand Connectivity, Habitat Utilization, and Essential Fish Habitats
- Conduct Socioeconomic Studies
- Identify and Protect Spawning Aggregations
- Address Impacts of Overfishing and Gear on Reefs
- Enhance Fisheries Management Implementation
- Address Fisheries Enforcement and Outreach

The activities under this goal area are directly supported by the objective *Assess and Characterize U.S. Coral Reefs*, which provides much of the baseline information on the status of reef fishes and their habitats. Additionally, marine protected areas, particularly no-take reserves and other spatial restrictions on fishing, are recognized as having a particular value in the management of fishing impacts and are also addressed under the objective of *Improve Use and Effectiveness of MPAs*.

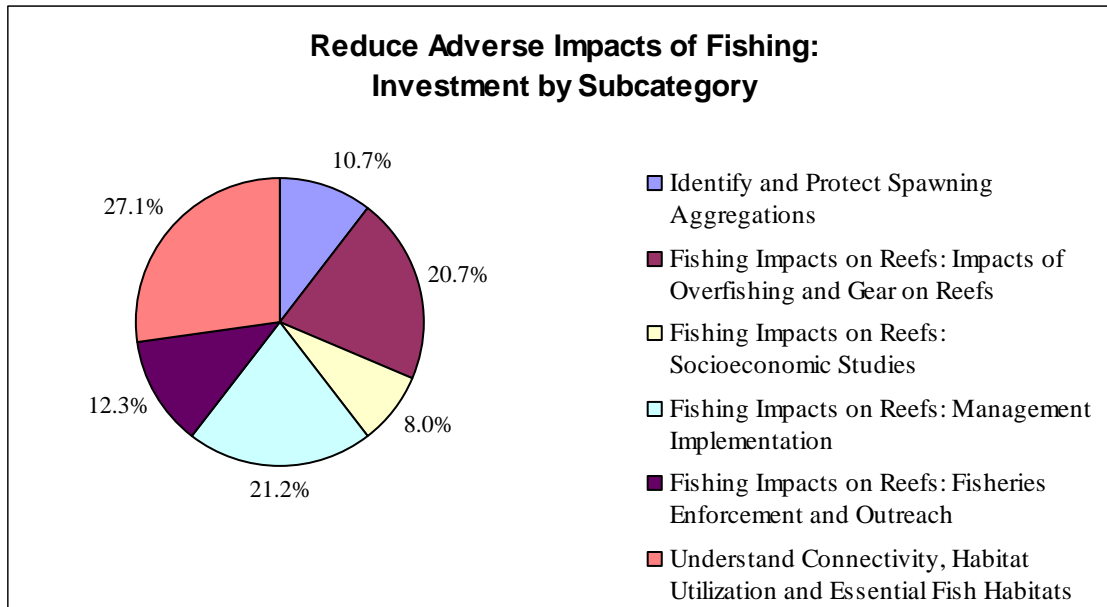
Between 2002 and 2006, the CRCP provided \$14.3M to support 238 projects in this category, which accounted for 11% of the overall CRCP funding and 18% of the overall number of projects (Exhibit III-3-1a).

<b>Exhibit III-3-1a Investments to Reduce Adverse Impacts of Fishing on Coral Reef Ecosystems 2002-2006</b>						
Spend Plan Category	Number of Projects	% Category Projects	% Total Projects	Funding	% Category Projects	% Total Projects
<b>Reduce Adverse Impacts of Fishing</b>	<b>238</b>	<b>18.3</b>	<b>18.3</b>	<b>\$14,306,986</b>	<b>11.1</b>	<b>11.1</b>
Understand Connectivity, Habitat Utilization and Essential Fish Habitats	56	23.5	4.3	\$3,875,239	27.1	3.0
Fishing Impacts on Reefs: Socioeconomic Studies	26	10.9	2.0	\$1,142,136	8.0	0.9
Identify and Protect Spawning Aggregations	25	10.5	1.9	\$1,524,425	10.7	1.2
Fishing Impacts on Reefs: Impacts of Overfishing and Gear on Reefs	41	17.2	3.2	\$2,967,352	20.7	2.3
Fishing Impacts on Reefs: Management Implementation	46	19.3	3.5	\$3,034,992	21.2	2.3
Fishing Impacts on Reefs: Fisheries Enforcement and Outreach	44	18.5	3.4	\$1,762,842	12.3	1.4





Exhibit III-3-1b shows the distribution of investments in each of these subcategories during 2002-2006.



**Exhibit III-3-1b.** Distribution of Investments by Subcategory, 2002-2006

### *Performance Goals*

The CRCP has not set quantitative performance goals for this objective. The principal NOAA-wide (Government Performance and Results Act) performance measure for fisheries is to increase the number of fish stocks managed at sustainable levels. In most cases, however, the coral reef fish stocks are primarily in state waters, and traditional fishery dependent data sources are inadequate to measure progress in small-scale, multispecies reef fisheries. Two alternative performance goal approaches are being explored:

- Using NOAA and partner fishery-independent monitoring to track the status of multiple target reef species and gauge their recovery. This approach has been pioneered with success by NOAA in the Florida Keys, and is being explored for the Pacific Islands. A pilot study was conducted in the U.S. Caribbean, but consistent monitoring data are generally lacking in that region.
- The U.S. Coral Reef Task Force has set an overall goal for no-take reserves that, if implemented, will significantly improve the management of reef fish and their habitats. This reflects an appreciation that networks of no-take reserves to protect representative and connected ecosystem components and functions can form the core of an ecosystem





approach to fisheries and reef management. Interim milestones for this goal have only been met in Guam and the Northwestern Hawaiian Islands.

*USCRTF No-Take Reserve Goal: Establish additional no-take ecological reserves to provide needed protection to a balanced suite of representative U.S. coral reefs and associated habitats, with a goal to protect at least 5% of all coral reefs and associated habitat types in each major island group and Florida by 2002; at least 10% by 2005; and at least 20% by 2010. Toward this end, immediately move forward to establish no-take reserves in the highest priority reef habitats.*

## **Subcategory: Understand Connectivity, Habitat Utilization, and Essential Fish Habitat**

### ***a. Introduction to Subcategory***

The productivity and sustainability of coral reef fisheries and ecosystems depends on the ability of local populations of reef organisms to replenish themselves. Population growth depends upon both local reproductive potential and connectivity through larval recruitment and post-recruitment migration. Management of coral reefs for conservation and sustainable fisheries requires information on the processes that control where larvae originate, where they settle, and how they move to different habitats during their lifetimes. Design and management of MPAs, in particular, can benefit from knowledge of the life history and connectivity relationships of the local populations of targeted species, both by determining key habitats that need protection and by predicting the population effects of protecting specific areas. These efforts also provide a link between fisheries objectives and other land and reef management efforts (see objectives for *Reduce Impacts of Coastal Uses* and *Reduce Impacts of Pollution and Coral Disease*).

The CRCP has addressed this issue primarily through studies that improve the scientific understanding in the following areas:

- How larvae are dispersed by currents from spawning sites. This work includes both biological and physical oceanographic studies in both the Atlantic and Pacific.
- Where larvae settle and what nursery habitats (e.g., mangrove and seagrass habitats) are used, and how they are used, by important reef fishery species.
- Assessing the habitat requirements of different life history stages and how, where, and when fishes migrate to reef habitats.

Between 2002 and 2006, the CRCP provided \$3.9 million (M) to support 56 projects in this subcategory. This subcategory accounted for 27% of funding within the *Reduce Adverse Impacts of Fishing* category and 3% of overall CRCP funding; and 24% of projects in the category and 4% of overall CRCP projects from 2002-2006 (see Exhibit III-3-1). The regional breakdown for the Understand Connectivity, Habitat Utilization, and Essential Fish Habitat subcategory was as



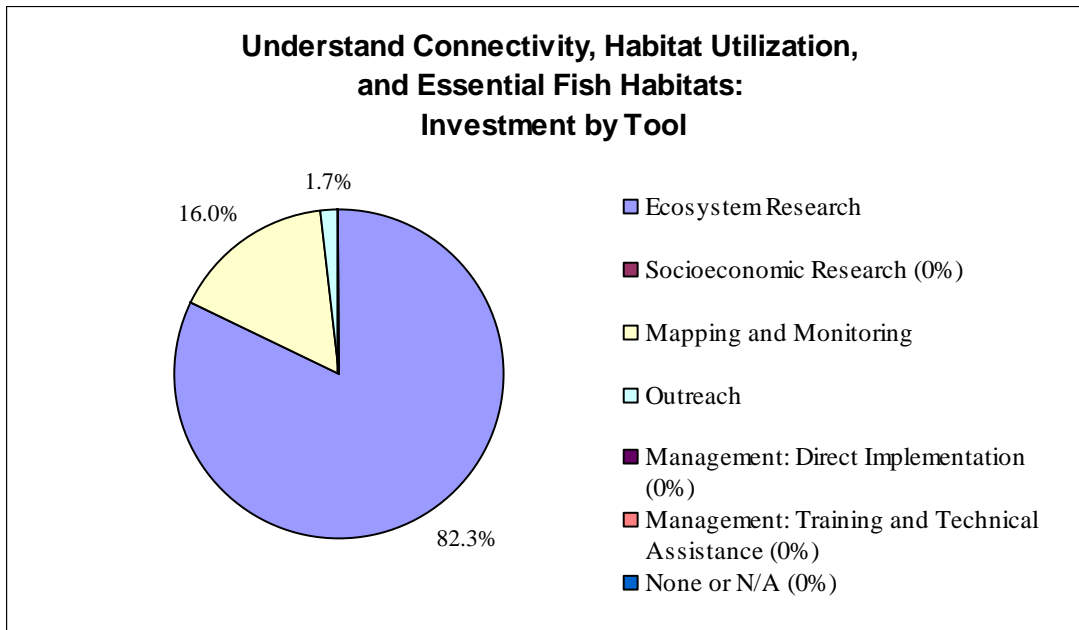


follows: 65% for Atlantic activities, 27% for the Pacific, 2% for the Freely Associated States and 7% for International. The distribution of funds and effort by tool for this subcategory is shown in Exhibits III-3-2a and -2b.

<b>Exhibit III-3-2a</b> <b>Understand Connectivity, Habitat Utilization and Essential Fish Habitats</b> <b>Investments by Tool</b>														
Tool	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
	2002	2003	2004	2005	2006	TOTALS 2002-2006								
Ecosystem Research	8	\$730,000	8	\$645,000	10	\$664,377	8	\$603,106	8	\$546,715	42	75	\$3,189,198	82.3
Socioeconomic Research	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Mapping and Monitoring	1	\$10,000	2	\$45,843	4	\$303,000	4	\$193,164	1	\$69,034	12	21.4	\$621,041	16
Outreach	0	\$0	0	\$0	1	\$20,000	1	\$45,000	0	\$0	2	3.6	\$65,000	1.7
Management: Direct Implementation	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Management: Training/Technical Assistance	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
None or N/A	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
<b>TOTAL</b>	<b>9</b>	<b>\$740,000</b>	<b>10</b>	<b>\$690,843</b>	<b>15</b>	<b>\$987,377</b>	<b>13</b>	<b>\$841,270</b>	<b>9</b>	<b>\$615,749</b>	<b>56</b>	<b>100</b>	<b>\$3,875,239</b>	<b>100</b>

Exhibit III-3-2b shows the distribution of investments by tool for this subcategory during 2002-2006.





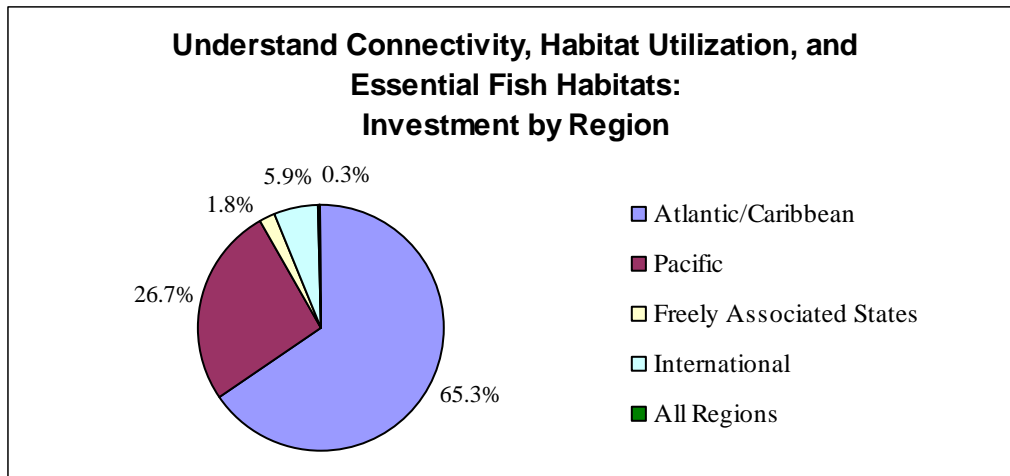
**Exhibit III-3-2b.** Distribution of Investments by Tool, 2002-2006

Exhibits III-3-3a and -3b show the investments by region for this subcategory during 2002-2006.

### Exhibit III-3-3a Understand Connectivity, Habitat Utilization and Essential Fish Habitats Investments by Region

Region	2002		2003		2004		2005		2006		TOTALS 2002-2006			
	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
Atlantic/Caribbean	7	\$615,000	7	\$390,935	10	\$720,750	6	\$428,000	5	\$377,715	35	57.4	\$2,532,400	65.3
Pacific	2	\$125,000	2	\$220,000	2	\$154,390	5	\$333,164	3	\$201,545	14	23	\$1,034,099	26.7
Freely Associated States	0	\$0	1	\$39,908	1	\$31,000	0	\$0	0	\$0	2	3.3	\$70,908	1.8
International	0	\$0	1	\$40,000	4	\$81,237	3	\$80,106	1	\$26,627	9	14.8	\$227,970	5.9
All Regions	0	\$0	0	\$0	0	\$0	0	\$0	1	\$9,862	1	1.6	\$9,862	0.3
<b>TOTAL</b>	<b>9</b>	<b>\$740,000</b>	<b>11</b>	<b>\$690,843</b>	<b>17</b>	<b>\$987,377</b>	<b>14</b>	<b>\$841,270</b>	<b>10</b>	<b>\$615,749</b>	<b>61</b>	<b>100</b>	<b>\$3,875,239</b>	<b>100</b>





**Exhibit III-3-3b.** Distribution of Investments by Region, 2002-2006

***b. Activities***

***Larval Dispersal Studies*** – Several research activities examined the connectivity of reef species between regional reef systems (e.g., between the Mexican Caribbean and Florida, and within the Hawaiian Archipelago) using a variety of technologies, including trace elemental analysis of otoliths, DNA markers, surveys of fish larvae, and ocean circulation measurements/modeling (see Program Highlight, p.III-3-13).

***Nursery Habitat Studies*** – CRCP studies of nursery habitats were conducted primarily in the Atlantic, including studies of reef fish use of coral and mangrove habitats at night and/or under turbid conditions. The CRCP also supported two workshops and symposium volumes on “Backreef Habitats” and the First International Symposium on Mangroves as Fish Habitat, which provided major syntheses of the current knowledge of these important habitats.

***Reef Habitat Studies*** – The majority of habitat studies were conducted in the Atlantic. These studies, using a variety of methods, focus on acquiring basic information about the habitat utilization of important reef fish species – where they spawn, what habitats they use during different life stages, how abundant they are in different habitats, etc. Other areas of concentration are mapping and characterizing essential fish habitat (EFH) to inform management decisions, and measuring habitat utilization in existing protected areas.

***c. Funding Recipients and Partners***

Exhibit III-3-4 provides examples of CRCP partners and grant recipients under this subcategory.







**Exhibit III-3-4  
Funding Recipients and Partners  
Understand Connectivity, Habitat Utilization,  
and Essential Fish Habitats**

NOAA Offices	States and Territories	Fisheries Management Councils	Academic Institutions	Non-Governmental Organizations
<ul style="list-style-type: none"> <li>• NMFS - Pacific Fisheries Science Center</li> <li>• NMFS - Southeast Fisheries Science Center</li> <li>• NMFS - Pacific Islands Regional Office</li> <li>• NMFS - Southeast Regional Office</li> <li>• NOS - National Centers for Coastal Ocean Science</li> <li>• OAR - National Undersea Research Program</li> </ul>	<ul style="list-style-type: none"> <li>• Hawai'i Gulf of Mexico</li> <li>• South Atlantic</li> <li>• Western Pacific</li> </ul>	<ul style="list-style-type: none"> <li>• Gulf of Mexico</li> <li>• South Atlantic</li> <li>• Western Pacific</li> </ul>	<ul style="list-style-type: none"> <li>• Florida State University</li> <li>• Hawai'i Undersea Research Laboratory (NURP Center)</li> <li>• San Diego State University</li> <li>• University of Guam</li> <li>• University of Hawai'i</li> <li>• University of Miami</li> <li>• University of New Hampshire</li> <li>• University of Puerto Rico</li> <li>• University of the Virgin Islands</li> </ul>	<ul style="list-style-type: none"> <li>• Perry Institute for Marine Science (NURP Center)</li> </ul>

Projects also depended on a wide variety of partnerships with other NOAA offices, other Federal agencies, state/territory governments and agencies, and NGOs.

**d. Outputs**

***Larval Dispersal Studies***

- Spawning aggregations, larval distributions, and oceanic currents were mapped in the Mexican Caribbean to determine potential coral reef population connections with Florida





reefs. Light trap collections off Mexico yielded an unprecedented diversity of fish larvae, including tuna, bonefish, and groupers that could all be populating Florida ecosystems. Seven previously unreported species were also discovered. Floating drifters released in the Yucatan headed north towards Florida, indicating that fish larvae could easily travel along the same path. Outreach activities included meetings with local fishing groups and local schools.

- DNA markers were isolated from mutton snapper to examine genetic connectivity between the Mesoamerican Barrier Reef and the Tortugas. Initial results show no concrete genetic distinction between the populations sampled.
- Larval fish transport work in the Pacific: otolith microchemistry is being used to determine source waters and stock structure, including differences between NWHI and the Main Hawaiian Islands (MHI) and different environments within each island group. The use of drifters and Acoustic Doppler Current Profilers help elucidate larval transport to and from the MHI and NWHI.
- Monitored and collected reef fish larvae, particularly red hind and several snapper species, along the southwest coast of Puerto Rico in areas of known spawning aggregations and areas subject to seasonal closures. Researchers collected information on benthic habitats in the area.

### *Nursery Habitat Studies*

- First study to use rare earth elements as tracer signatures in otoliths (see Program Highlight, p. III-3-16).
- Completed a successful captive tagging-survivorship pilot study of 140 juvenile gray snappers in Florida. Established companion outreach/education project: "*The Connectivity Project: Love Your Reefs? -- Know Your Mangroves*" partnering with local schools, natural resources managers, and community groups.
- Monitoring of grey snapper in Florida Bay via visual surveys revealed significant differences between mangrove shoreline habitats in terms of fish species habitat use. Archival tags showed strong diel patterns of vertical movement and acoustic tags demonstrated a strong association with mangrove canopy.
- Fieldwork and data analysis were conducted for the calibration of a state-of-the-art acoustic technology (DIDSON) for estimating fish abundance and size structure in coral reef and mangrove habitats under low light/turbid conditions.
- The First International Symposium on Mangroves as Fish Habitat was the first forum of its kind for assessing the state-of-the-science of mangrove-fish research and charting a course for sound science and management of mangroves as fish habitats. Proceedings were published in the peer-reviewed *Bulletin of Marine Science*.
- Deployed acoustic and environmental sensor packages near an Integrated Coral Observing Network-Coral Reef Early Warning System (ICON-CREWS) station in USVI to continuously measure and record the abundance and size distribution of organisms. These sensor packages had never before been used in a coral reef context.





- Conducted a suite of interrelated studies in USVI to quantify habitat usage patterns, including comparisons of density estimates and species richness for fishes and invertebrates in multiple habitats. GIS maps highlighting fine-scale habitat characteristics and densities of fishery species were also created.

### ***Reef Habitat Studies***

- Spawning behavior of yellowfin grouper and cubera snapper was observed at Grammanik Bank (St. Thomas), a known, multispecies spawning aggregation site. Extensive habitat descriptions of the area were conducted.
- Micro-scale habitat tracking of 46 hogfish occurred in the Florida Keys National Marine Sanctuary to determine home ranges and habitat use. Confirmation of spawning activity and description of spawning behavior was conducted. There is concern about the disruption of reproductive output of hogfish harems following the removal of large individuals by fishing.
- Determined reliability of an acoustic mapping classification scheme (Quester Tangent Corporation (QTC)) in Florida and Navassa for generating habitat maps in waters too deep for mapping with conventional methods. Off Carysfort Reef, discovered new deep reef promontories offshore from a previously (1998) located aggregation of black grouper.
- Successfully mapped approximately 75% of the deep water (100-400m) Hawaiian bottomfish habitat using multibeam data grids and GIS data layers. Products derived from this information include slope, rugosity, depth contours, and 3-dimensional GIS layers. Fish surveys, commercial catch data, and data from submersible dives were used to further validate the information compiled in the GIS.

### ***e. Outcomes***

- Long-term studies of currents and larval dispersal in Hawai'i and the NWHI revealed that while some transport occurs in both directions, the NWHI alone are unlikely to be capable of replenishing resources in the MHI. This means that recovery of depleted stocks in the MHI cannot rely on conservation efforts in the NWHI. The findings also outline potential larval pathways from the MHI to Johnston Atoll to the NWHI.
- A guide to the identification of the early stages of western central North Atlantic fishes was published. This treatise provides complete information on all characteristics needed to identify eggs, larvae, and juveniles – foundational information that is critical to understanding the complex biology and ecology of coral reef fishes.
- Demonstration that juvenile snapper can be separated by distinct nursery regions based on variability in the elemental constituents of their otoliths.
- Grey snapper habitat monitoring provided information about the importance of juvenile to adult habitats and serves as a “baseline” against which to assess the impacts of the changes to freshwater flow that are planned as part of the Everglades Restoration effort.





- EFH mapping in the main Hawaiian Islands guided the State of Hawai'i and NMFS in creating a revised plan for Restricted Fishing Areas for bottomfish, which was implemented in 2006.
- Zoning studies in Puerto Rico reserves led to management recommendations for their conservation. At Guanica Biosphere Reserve, mooring buoys and navigation markers have been installed and red mangrove habitats are being restored with seedlings raised from previous CRCP-funded efforts.

#### *f. Challenges*

- Pacific drifter and current studies were conducted during cruises, whose timing did not necessarily match the timing of fish spawning. Therefore, observed dispersal by currents may not match that actually experienced by fish larvae.
- Working with the inherent difficulties in gathering robust data via visual surveys in structurally complex back-reef ecosystems, such as mangroves.
- Maintaining effective working relationships between NOAA, state and territory resource agencies, and contractors, in order to translate research results into management action.

#### *g. Future Directions*

- Further integration of ecosystem based research concepts to develop a more holistic approach to connectivity throughout major regional systems, such as the Caribbean Basin, Gulf of Mexico and South Atlantic, or the Hawaiian archipelago and the Marianas Archipelago.
- Increased efforts to map benthic habitat and the identification of pathways taken by larvae to ensure protection of these areas, as well as areas where later stages settle and grow to juveniles.
- Continue basic research to quantify reproductive output, fish movements, and habitat quality associated with marine reserves. This information can be used to address concerns of fishing effects on the disruption of reproduction and help managers determine the appropriate size MPA to protect and manage important reef fish species.
- Recent evidence points to a greater degree of self-replenishment of reef fish populations than had previously been suspected. New techniques of marking larvae should be incorporated with current efforts using DNA and other markers to better understand this process.





### *Program Highlight: Identifying Reef Fish Nursery Habitats Through Otolith Microchemistry*

The CRCP is funding groundbreaking otolith microchemistry experiments, conducted by scientists at the Southeast Fisheries Science Center, using chemical signatures from individual bodies of water to naturally “tag” fishes and determine habitat use from early juvenile stages to adulthood. Ecosystem-based coral reef and fishery management, including the use of place-based management tools (e.g., MPAs), requires an understanding of the origins of fish larvae, their movements, and ultimate habitat needs.

This study was the first to use rare earth elements as tracer signatures in otoliths to determine nursery grounds of juvenile gray snappers in Florida Bay, the Dry Tortugas, and other estuarine nursery areas. Differences could be detected among populations separated by as little as 10 km. Concurrent isotope analysis enhances chemical signatures and maps out the bodies of water each fish passes through. Biologists are now examining two additional species of snapper (schoolmaster and lane snapper) and have determined species-specific otolith trace element signatures and similar distribution patterns to gray snapper.

The next phase of work, which is ongoing, is building on techniques to differentially extract the juvenile “core” from adult otoliths to determine from which juvenile habitat the adults originated. This will assess the relative importance of specific juvenile habitats (such as Florida Bay, for example) to adult snapper populations on the Florida reef tract – important information for protecting nursery habitats and migratory corridors for migrating reef fish and for determining stock structure of reef fish populations.



## **Subcategory: Fishing Impacts on Reefs: Socioeconomic Studies**

### ***a. Introduction to Subcategory***

Coral reef fisheries provide economic and cultural benefits to coastal communities. Improved management of these fisheries requires improved understanding of these communities, the way they use reef resources, and the social and economic factors that contribute to overexploitation.

General economic valuation studies of U.S. coral reefs, conducted in each jurisdiction by the CRCP, place fisheries in context with other competing reef values. On a more targeted level, CRCP is supporting several projects in the U.S. Caribbean and South Florida to gain an understanding of the human dimensions of fishing activities and how management measures impact communities supported by commercial and recreational fishing activities. Work in this area also enables analysts to evaluate the ability/capacity of fishers to adapt to changes brought



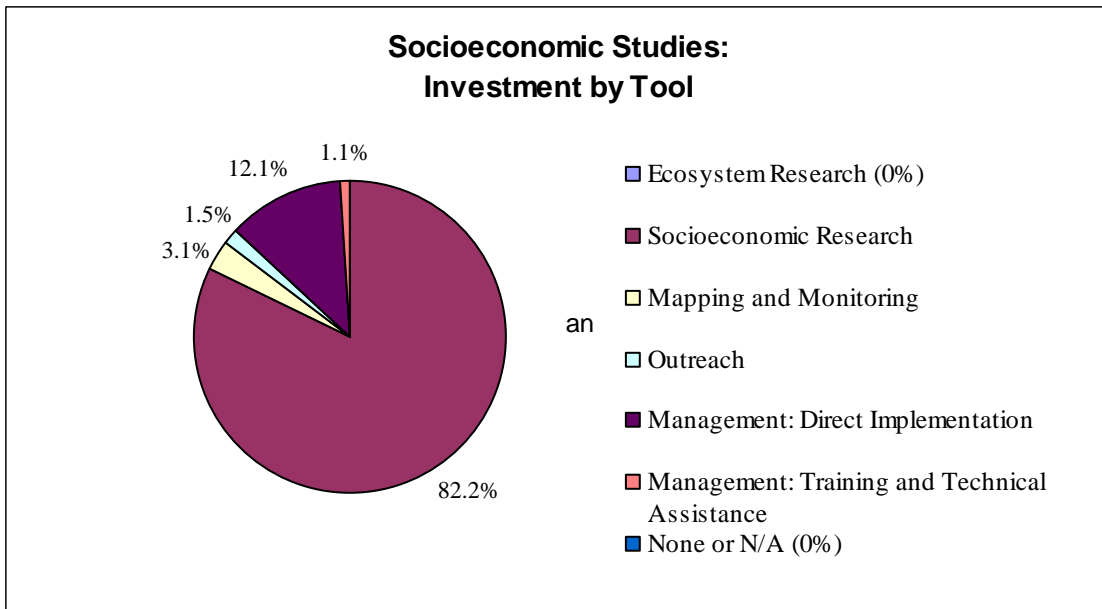


about by implementation of management measures. The information collected assists the Fishery Management Councils in meeting their mandates under the Magnuson Stevens Act, particularly under Standard 8, and the Coral Reef Conservation Act. Additionally, this work helps managers interject human dimensions into comprehensive coral reef ecosystem management.

Between 2002 and 2006, the CRCP provided \$1.1M to support 26 projects in this subcategory. This subcategory accounted for 8% of funding within the Reduce Adverse Impacts of Fishing category and 1% of overall CRCP funding; and 11% of projects in the category and 2% of overall CRCP projects between 2002-2006 (see Exhibit III-3-1). The regional breakdown for the Socioeconomic Studies subcategory was as follows: 71% for Atlantic activities and 29% for the Pacific. CRCP funds support ongoing socioeconomic projects in the Atlantic, while the Pacific is still building capacity in this area. The distribution of funds and effort by tool for this subcategory is shown in Exhibits III-3-5a and -5b.

Exhibit III-3-5a Fishing Impacts on Reefs: Socioeconomic Studies Investments by Tool														
Tool	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
	2002	2003	2004	2005	2006	TOTALS 2002-2006								
Ecosystem Research	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Socioeconomic Research	2	\$110,000	2	\$75,042	4	\$365,500	5	\$187,374	3	\$201,354	16	61.5	\$939,270	82.2
Mapping and Monitoring	0	\$0	0	\$0	0	\$0	1	\$10,000	1	\$25,000	2	7.7	\$35,000	3.1
Outreach	0	\$0	0	\$0	0	\$0	0	\$0	2	\$17,440	2	7.7	\$17,440	1.5
Management: Direct Implementation	0	\$0	1	\$30,000	1	\$6,000	2	\$71,885	1	\$30,000	5	19.2	\$137,885	12.1
Management: Training/Technical Assistance	0	\$0	0	\$0	1	\$12,541	0	\$0	0	\$0	1	3.8	\$12,541	1.1
None or N/A	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
<b>TOTAL</b>	<b>2</b>	<b>\$110,000</b>	<b>3</b>	<b>\$105,042</b>	<b>6</b>	<b>\$384,041</b>	<b>8</b>	<b>\$269,259</b>	<b>7</b>	<b>\$273,794</b>	<b>26</b>	<b>100</b>	<b>\$1,142,136</b>	<b>100</b>



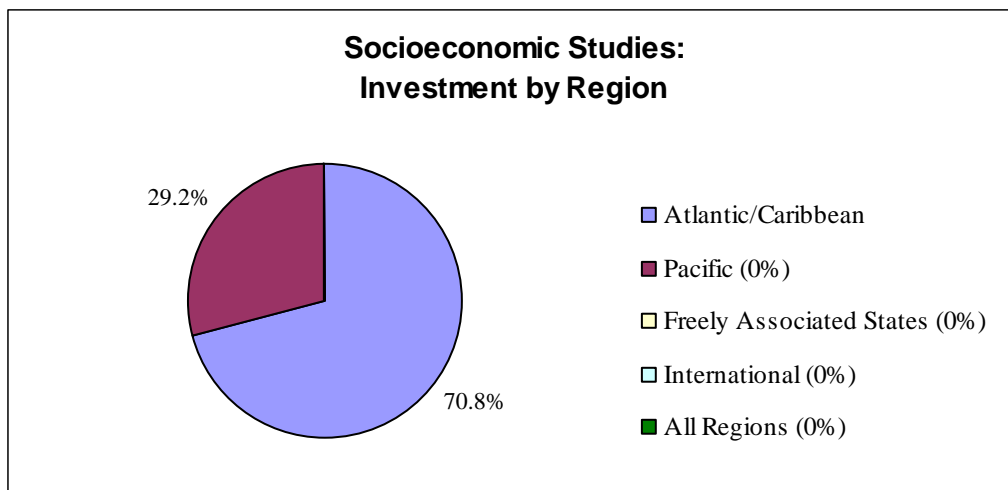


**Exhibit III-3-5b.** Distribution of Investments by Tool, 2002-2006

Exhibits III-3-6a and -6b show the investments by region for this subcategory for 2002-2006.

<b>Exhibit III-3-6a Fishing Impacts on Reefs: Socioeconomic Studies Investments by Region</b>														
Region	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
	2002		2003		2004		2005		2006		TOTALS 2002-2006			
Atlantic/Caribbean	2	\$110,000	1	\$25,042	2	\$297,000	4	\$175,136	3	\$201,354	12	46.2	\$808,532	70.8
Pacific	0	\$0	2	\$80,000	4	\$87,041	4	\$94,123	4	\$72,440	14	53.8	\$333,604	29.2
Freely Associated States	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
International	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
All Regions	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
<b>TOTAL</b>	<b>2</b>	<b>\$110,000</b>	<b>3</b>	<b>\$105,042</b>	<b>6</b>	<b>\$384,041</b>	<b>8</b>	<b>\$269,259</b>	<b>7</b>	<b>\$273,794</b>	<b>26</b>	<b>100</b>	<b>\$1,142,136</b>	<b>100</b>





**Exhibit III-3-6b.** Distribution of Investments by Region, 2002-2006

***b. Activities***

In the S. Atlantic and Caribbean region, the Southeast Fisheries Science Center’s social scientists are conducting socioeconomic and cultural assessments of fishing communities to obtain broad, region-wide overviews of fishing activities, and to characterize the economic and sociocultural importance of reef resources in this jurisdiction. Tools such as oral histories, focus groups, in-depth key informant interviews, and cultural mapping have been used. Sample projects include:

- Assessment of social dimensions (i.e., perception of performance) of MPAs in the USVI and Puerto Rico.
- Study of socioeconomic profiles of fishing communities in Puerto Rico and the USVI (St. Thomas, St. Croix, and St. John) and development and implementation of fishers’ community profile workshops and outreach in Puerto Rico and the USVI.
- Comprehensive census of the marine commercial fishery in the USVI.
- Development of a South Florida Sportfishing Geodatabase for spatial and socioeconomic analysis of recreational fishing (South Florida Recreational Fisheries).
- Socioeconomic research and monitoring program (commercial fishing panels) for the Florida Keys National Marine Sanctuary (FKNMS).

***c. Funding Recipients and Partners***

Exhibit III-3-7 provides examples of CRCP partners and grant recipients under this subcategory.







**Exhibit III-3-7  
Fishing Impacts on Reefs: Socioeconomic Studies  
Funding Recipients and Partners**

NOAA Offices	States and Territories	Fisheries Management Councils	Academic Institutions	Non-Governmental Organizations
<ul style="list-style-type: none"> <li>• NMFS - Southeast Fisheries Science Center</li> <li>• NOS - Special Projects Office</li> </ul>	<ul style="list-style-type: none"> <li>• Hawai'i</li> <li>• American Samoa</li> <li>• CNMI</li> <li>• Florida</li> <li>• Puerto Rico</li> <li>• U.S. Virgin Islands</li> <li>• Texas</li> </ul>	<ul style="list-style-type: none"> <li>• Caribbean</li> <li>• South Atlantic</li> <li>• Western Pacific</li> </ul>	<ul style="list-style-type: none"> <li>• East Carolina University</li> <li>• University of Arizona</li> <li>• University of Georgia</li> <li>• University of Miami</li> <li>• University of Puerto Rico</li> <li>• Whittiker College</li> </ul>	<ul style="list-style-type: none"> <li>• Aquirre International</li> <li>• Impact Assessment, Inc.</li> <li>• Thomas Murray and Associates</li> </ul>

Projects also depended on a wide variety of partnerships with other NOAA offices, other Federal agencies, state/territory governments and agencies, and NGOs.

**d. Outputs**

- Major activities over the last few years have characterized the fishing communities in Puerto Rico and the U.S. Virgin Islands (See Program Highlight, p. III-3-19).
- The South Florida Sportfishing Geodatabase maps the annual distribution of sportfishing effort in ten-mile-square areas off Palm Beach, Broward, Dade, and Monroe counties. The database incorporates 2001-2003 NMFS Marine Recreational Fishing Statistics Survey, the NMFS Headboat Survey, the SEFSC Aerial Survey, the Biscayne National Park Recreational Creel Survey, and the U.S. Census Bureau. The database, available online to managers, provides information on monthly counts of for-hire and private sportfishing vessels, bathymetry, and the distribution of coral reef habitat.
- CRCP funds supported continuation of a program, initiated in 1998, that surveys Florida Keys commercial fishers to monitor socioeconomic impacts of displacement from no-take areas. Researchers collect information on catch, catch distribution, and financial performance (net earnings). This information helps assess both the short and long-term impacts of "no-take" reserves on the commercial fisheries.
- During the census of commercial fishers of the USVI, the majority of all licensed commercial fishers were interviewed (323 interviews). This information is crucial for





characterizing commercial fisheries in the U.S. Caribbean and informs a survey (initiated in 1998 and ongoing) of socioeconomic impacts on commercial fishers from MPAs.

#### *e. Outcomes*

- Increased understanding of the fishing communities in Puerto Rico and the USVI is providing insights into the human dimensions, and outlook for success, of future reef fish management measures (See Program Highlight, p. III-3-19).
- Results from the commercial fisher surveys will contribute to assessments of the effectiveness of "no-take" reserves as a management tool and build the necessary record to justify whether compensation or assistance is required. In addition, results were used by a National Marine Fisheries grant project for a pre- and post-assessment of the socioeconomic impacts of Tortugas Ecological Reserve on commercial fishers, and are being included in the National Centers for Coastal Ocean Science's assessment of the performance of the Tortugas Ecological Reserve.
- The web-based user interface for the South Florida Sportfishing Geodatabase allows managers direct access (via the Coral Reef Information System, or CoRIS) to recreational fishing statistics for southeast Florida. Resource managers will be able to use the tool to evaluate the concentration of recreational fishing near coral reef resources and identify the relative amounts of inshore and offshore fishing effort.

#### *f. Challenges*

- Conducting socioeconomic surveys of fishers or fishing communities requires approval by the Office of Management and Budget, which is a lengthy process and can delay project progress.
- In-person interviews are time-consuming and expensive.
- It is difficult to prioritize our research agenda, given long-term research ecosystem management needs and short-term fishery management support activities.





*Program Highlight:  
Socioeconomics of Fishing Communities in the U.S. Caribbean*

Major activities have centered on characterization of fishing communities in Puerto Rico and the USVI to provide a baseline for future ecosystem and management changes, help evaluate performance of management and how regulations are perceived by fishers, and provide guidance on how to mitigate regulatory impacts on fishing communities. Studies on impacts of Marine Protected Areas have particular relevance to research and management activities in areas outside the U.S. Caribbean.

Information yielded by this program is critical for NOAA (along with the Caribbean Fishery Management Council) and state and territory managers to effectively manage fishery resources and the communities that depend on them. This multi-faceted work is ongoing since 2002 and has resulted in a better understanding of fishing communities and behaviors in the region – essential information for effective fishery management. For example, studies have found that, on average, USVI fishers are more dependent on fishing for their income than their Puerto Rican counterparts (64.5% of income versus 40-45%), with a higher level of income diversification seen in Puerto Rico.

In terms of cultural importance, fish sharing, festivals, and religious celebrations play an important role in maintaining connections to the sea. Fishermen seem to agree that coral reefs are in decline and gave various reasons for their perceptions. Many perceive MPAs and seasonal and area closures as relevant for sustainable management of reef resources, but the lack of participatory processes by resource managers appear to limit their acceptance of these tools. Other information collected included baseline data on age, income, education, ethnicity, investment in fisheries, fishing effort, fishing gear, and landings/sale of fishery resources. Researchers held a series of 12 public workshops to present the findings of their work – validating results and building rapport with stakeholders.

Socioeconomic research is time consuming and most fisher surveys and interviews require OMB approval. To get a comprehensive snapshot of the fishing communities in the region requires extensive resources for project development, implementation, feedback and evaluation. CRCP has made a significant investment in this work, ensuring meaningful outcomes, standard methods, and defensible results.

Time	Dead/ Absent	Nearly dead	More or less healthy	Pretty healthy	Healthy	Don't Know
10 years ago	1.8	1.8	9.3	19.8	63.9	3.5
5 years ago	2.2	11.1	29.2	31.4	21.7	4.4
Today	19.3	30.5	20.6	16.6	9.0	4.0
5 years from now	44.1	14.7	12.3	8.5	10.0	10.4

Commercial fishers' perception of coral reef health

**g. Future Directions**

- Ensure ongoing CRCP-supported projects continue to assess social impacts of future/current management decisions and regulations on fishing communities. One





project that should yield interesting results is the replication of a study conducted ten years ago about the impacts and perceptions of the Florida Keys National Marine Sanctuary.

- Expand tools such as the South Florida Sportfishing Geodatabase to cover additional years and greater geographic coverage, and expand training for managers in using such tools.
- Develop conceptual framework (social science modules) to meet ecosystem management
- 
- eds.
- Integrate social sciences into ecosystem research, management, and monitoring frameworks. In this respect, integrating lessons learned internationally through the Global Socioeconomic Monitoring Initiative (SocMon) project (see *Reduce the Threats to International Coral Reefs*) should be valuable.

### ***Subcategory: Identify and Protect Spawning Aggregations***

#### ***a. Introduction to Subcategory***

Spawning aggregations occur when fish gather at a particular time and place to simultaneously reproduce en masse. A number of reef fish species, especially snappers and groupers, are well known for this behavior and fishers have learned over time when and where to expect and exploit these massive aggregations. This effort has decimated the populations of many reef fish, and many spawning aggregations have disappeared. NOAA researchers are studying spawning aggregations to learn more about how and why fish aggregate to spawn, and how their populations respond once the aggregations are effectively fished out. Protecting spawning aggregations is important to ensure the reproductive success of these important resources and to ensure larvae have the opportunity to sustain reef fish populations.

The majority of NOAA's work on spawning aggregations has been conducted in Florida and the Caribbean. These regions were once home to huge spawning aggregations of Nassau and other groupers. Major spawning aggregations in this region have been targeted by fishers, a practice that has been identified as a major contributor to depletion of several stocks. CRCP activities have supported four spawning aggregation projects in Florida and the U.S. Caribbean (with one year of work in the Cayman Islands) all with the goal of understanding how and why fish aggregate to spawn; the habitat and oceanographic conditions necessary to facilitate spawning; and the potential for reef fish aggregations to re-form once they have been effectively fished out. Hawai'i is depauperate in shallow-water snappers and groupers, and there have been few studies of spawning aggregations elsewhere in the U.S. Pacific.

Protecting spawning aggregation sites is important to ensure the reproductive success of these important resources and to ensure the larvae have the opportunity to travel throughout the Caribbean and southeastern U.S. to sustain reef fish populations. Caribbean countries outside the





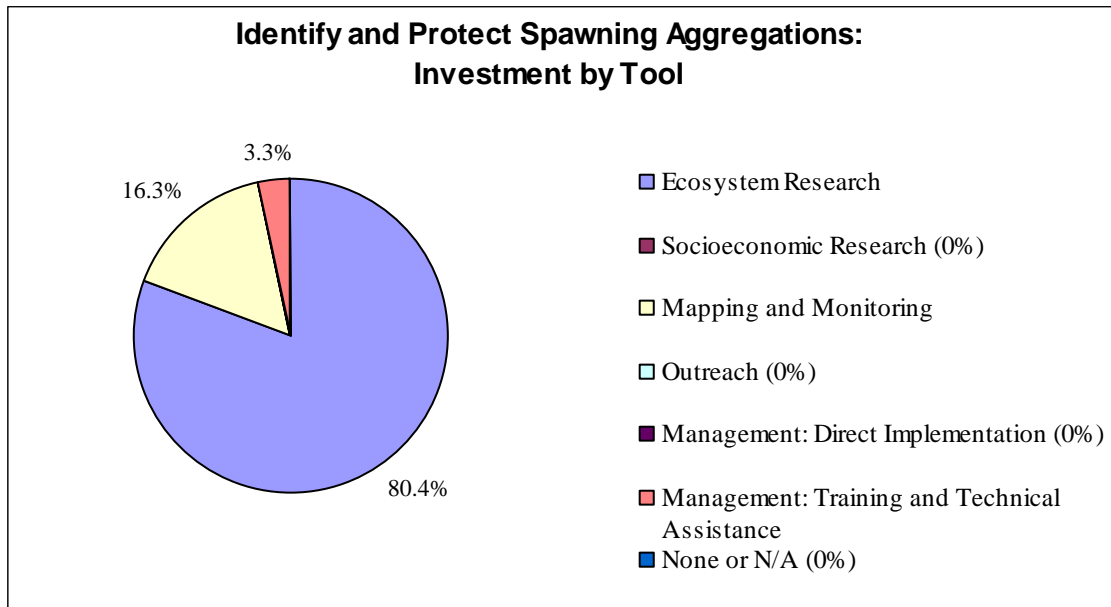
U.S. contain some of the last known spawning aggregations of commercially and ecologically important reef fish in the region. Working with international partners is essential for conserving and recovering these essential resources and learning how to recover spawning aggregations in U.S. waters. Surprisingly little published data exists, particularly on grouper habitat characteristics or aggregation behavior in continental U.S. waters.

Between 2002 and 2006, the CRCP provided \$1.5M to support 25 projects in this subcategory. This subcategory accounted for 11% of funding within the Reduce Adverse Impacts of Fishing category and 1% of overall CRCP funding; and 11% of projects in the category and 2% of overall CRCP projects between 2002-2006 (see Exhibit III-3-1). The regional breakdown for the Identify and Protect Spawning Aggregations subcategory was as follows: 75% for Atlantic activities, 6% for Freely Associated States, 11% for International and 9% for the Pacific. The distribution of funds and effort by tool for this subcategory is shown in Exhibits III-3-8a and -8b.

**Exhibit III-3-8a  
Identify and Protect Spawning Aggregations  
Investments by Tool**

Tool	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
	2002		2003		2004		2005		2006		TOTALS 2002-2006			
Ecosystem Research	2	\$170,000	4	\$350,000	4	\$211,000	5	\$297,000	3	\$198,226	18	72	\$1,226,226	80.4
Socioeconomic Research	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Mapping and Monitoring	0	\$0	0	\$0	2	\$91,017	2	\$64,302	2	\$92,880	6	24	\$248,199	16.3
Outreach	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Management: Direct Implementation	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Management: Training/Technical Assistance	1	\$50,000	0	\$0	0	\$0	0	\$0	0	\$0	1	4	\$50,000	3.3
None or N/A	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
<b>TOTAL</b>	<b>3</b>	<b>\$220,000</b>	<b>4</b>	<b>\$350,000</b>	<b>6</b>	<b>\$302,017</b>	<b>7</b>	<b>\$361,302</b>	<b>5</b>	<b>\$291,106</b>	<b>25</b>	<b>100</b>	<b>\$1,524,425</b>	<b>100</b>



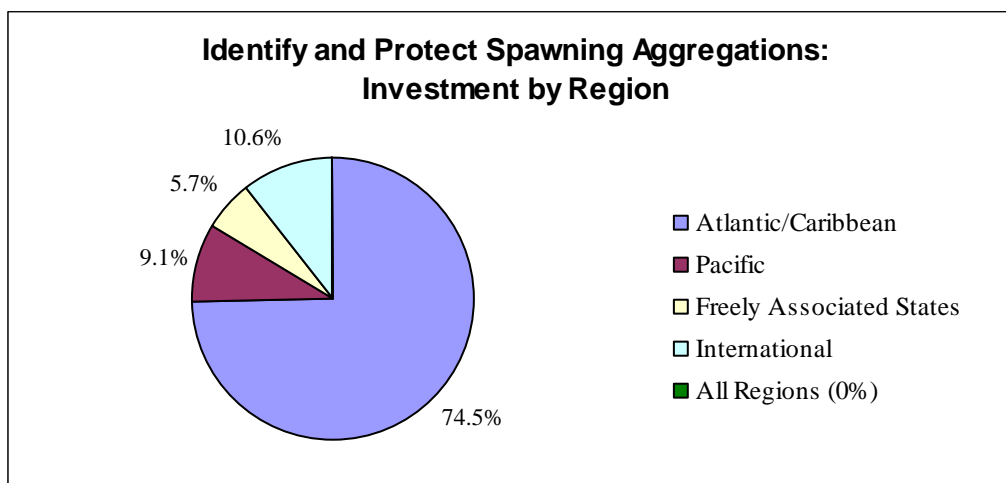


**Exhibit III-3-8b.** Distribution of Investments by Tool, 2002-2006

The distribution of funds and effort by region for this subcategory is shown in Exhibits III-3-9a and -9b.

<b>Exhibit III-3-9a Identify and Protect Spawning Aggregations Investments by Region</b>														
Region	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
	2002	2003	2004	2005	2006	TOTALS 2002-2006								
Atlantic/Caribbean	3	\$220,000	3	\$205,000	4	\$236,267	5	\$276,827	3	\$198,226	18	69.2	\$1,136,320	74.5
Pacific	0	\$0	0	\$0	0	\$0	1	\$46,000	2	\$92,880	3	11.5	\$138,880	9.1
Freely Associated States	0	\$0	0	\$0	1	\$48,750	1	\$38,475	0	\$0	2	7.7	\$87,225	5.7
International	0	\$0	2	\$145,000	1	\$17,000	0	\$0	0	\$0	3	11.5	\$162,000	10.6
All Regions	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
<b>TOTAL</b>	<b>3</b>	<b>\$220,000</b>	<b>5</b>	<b>\$350,000</b>	<b>6</b>	<b>\$302,017</b>	<b>7</b>	<b>\$361,302</b>	<b>5</b>	<b>\$291,106</b>	<b>26</b>	<b>100</b>	<b>\$1,524,425</b>	<b>100</b>





**Exhibit III-3-9b.** Distribution of Investments by Region, 2002-2006

***b. Activities***

- Biological characterization of Riley’s Hump and Tortugas Bank to assess the effects of MPA establishment on exploited fish communities in the Tortugas Ecological Reserve, including monitoring of mutton snapper spawning aggregation recovery.
- Use of hydroacoustics to monitor and assess spawning aggregation activity (Red Hind) in Puerto Rico and the USVI.
- Monitoring of shallow water grouper behavior, habitat utilization and seasonal movements in South Florida waters using a combination of visual surveys, acoustic and visual habitat mapping, and acoustic tagging technology.
- Monitoring of Nassau grouper demographics at historical spawning aggregations in the Cayman Islands and Grammanik Bank, USVI to study the possible recovery of exploited aggregations.
- Other projects include enhancing MPA and fisheries management effectiveness in Pohnpei, Micronesia and comparative investigations of red hind aggregations under different management strategies in the USVI.

Other types of activities supporting the identification and protection of spawning aggregations include a workshop with scientists, conservationists, government agencies, and fishermen from various Caribbean islands to discuss fish spawning aggregations and marine protected areas; classroom sessions on fish biology and size estimation; and identification of potential sites for hind/grouper spawning sites in the USVI.





**c. Funding Recipients and Partners**

Exhibit III-3-10 provides examples of CRCP partners and grant recipients under this subcategory.

<b>Exhibit III-3-10                      Identify and Protect Spawning Aggregations                      Funding Recipients and Partners</b>				
NOAA Offices	States and Territories	Fisheries Management Councils	Academic Institutions	Non-Governmental Organizations
<ul style="list-style-type: none"> <li>• NMFS - Southeast Fisheries Science Center</li> </ul>	<ul style="list-style-type: none"> <li>• Florida</li> <li>• Puerto Rico</li> <li>• U.S. Virgin Islands</li> <li>• Cayman Islands (Department of Natural Resources )</li> </ul>	<ul style="list-style-type: none"> <li>• Western Pacific</li> </ul>	<ul style="list-style-type: none"> <li>• NOAA National Undersea Research Center at UNC Wilmington</li> <li>• University of the Virgin Islands</li> <li>• University of Puerto Rico</li> <li>• University of Miami - RSMAS</li> </ul>	<ul style="list-style-type: none"> <li>• Reef Environmental Education Foundation (REEF)</li> <li>• The Nature Conservancy</li> <li>• Pflieger Institute for Ecological Research (PIER)</li> </ul>

**d. Outputs**

These activities in Florida and the U.S. Caribbean developed and utilized groundbreaking technologies for studying spawning aggregations, including hydroacoustics, acoustic tagging and tracking, deep diving, ultrasound, drop cameras, and remotely operated vehicles (ROVs). They resulted in new information on spawning sites and the development of a long-term collaboration between scientists and fishermen. Highlights include:

- Qualitative and quantitative characterization of the habitat and hydrographic conditions at spawning sites in the Tortugas Ecological Reserves. The study documented the preliminary recovery of mutton snapper populations after decades of heavy fishing and subsequent protection.
- Hydroacoustic surveys and groundtruthing of known and potential spawning habitats in Puerto Rico and the USVI.
- Establishment of an array of 25 acoustic receivers at Conch Reef in the Florida Keys National Marine Sanctuary and subsequent tagging of 16 black groupers to assess behavior, movement patterns and site fidelity.







- Assessments of spawning groupers and snappers at Grammanik Bank (see Program Highlight, p. III-3-27).

#### **e. Outcomes**

- NOAA-supported research provided key information and management recommendations that resulted in new protections for Nassau and yellowfin groupers during the spawning season in Puerto Rico and USVI.
- Grammanik Bank was closed to fishing during critical spawning periods to protect grouper spawning aggregations (see Program Highlight, p. III-3-27).
- The Puerto Rico Department of Natural Resources (PRDNR) recently published regulations prohibiting all fishing of red hind (*Epinephelus guttatus*) during their spawning season (December 1st to February 28th) around the entire shelf in Puerto Rico jurisdictional waters. This management action, intended to reduce overfishing, was the direct result of SEFSC's and the Puerto Rico Dept. of Natural Resources' hydroacoustic research on fish spawning aggregations showing their re-appearance in specific locations in the Puerto Rico shelf. Closures apply to commercial and recreational fishing under Puerto Rico Fishing Regulations.

#### **f. Challenges**

- Extremely time-sensitive work requires researchers to be in the water at certain places at certain times, which reduces the ability to cover large geographic areas and makes timely receipt of funding a priority. Previous projects, such as the Cayman Islands work on Nassau grouper, had to be canceled because funding was not arriving until spring, when spawning activities were taking place in the winter.
- Many spawning aggregations (e.g., Nassau grouper sites) within U.S. waters have already been over-exploited. Research in other countries where spawning aggregation sites still exist offers the opportunity to better understand behavioral and ecological aspects of such sites and their role as sources of larvae on a regional scale. The CRCP's domestic focus has made it difficult to generate support for such international projects.
- Spawning aggregations are particularly vulnerable to exploitation. Lag times between scientific documentation of the aggregation site and management action can result in destruction of the resource.
- Work on spawning aggregations in the Pacific has been limited compared to that in the Atlantic. Hawai'i does not have major shallow-water grouper and snapper populations. Most NOAA-led efforts elsewhere in the Pacific have been constrained by available ship time, which does not necessarily match spawning periods.





***g. Future Directions***

- There is a need to monitor recovery of protected spawning aggregations and track fish behavior and migration unimpeded by fishing activities in order to assess the impact of management strategies.
- Many studies to date have been opportunistic, taking advantage of known or suspected spawning sites. The hydroacoustic work in Puerto Rico showed the value of the technology for broader surveys of spawning aggregations. There is now a need to utilize these technologies to achieve better geographic coverage.
- Develop new partnerships that will increase the ability to work in the U.S. Pacific and in the jurisdictions of other countries where this will complement existing efforts and enhance an ecosystem approach.
- Provide a funding mechanism so money can be available during spawning season (generally winter/spring for many important grouper/snapper species).
- Incorporate socioeconomic data to understand fishing patterns and fisher perceptions of grouper abundance and behavior, in order to better align fishing and conservation objectives and understand the economic and social implications of different management strategies.
- Better employ acoustic methods and other remote technologies to reduce personnel and travel requirements.
- Where management measures are in place, there is a need to support adequate enforcement, especially during the spawning season.





### *Program Highlight: Protection of Grammanik Bank Spawning Site*

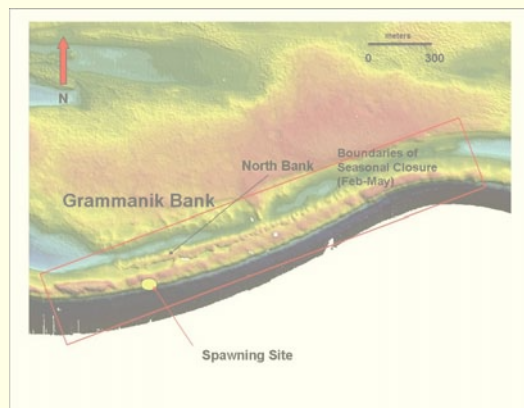
The Grammanik Bank, located 9 miles south of St. Thomas in the U.S. Virgin Islands, is a charismatic, multi-species spawning aggregation site. The Coral Reef Conservation Program, via direct funding and CRCP grants programs, has provided funding for research on the resources of the Bank. Program research has directly impacted management of this site, resulting in an annual, seasonal closure of the Bank during the spawning season. The University of the Virgin Islands, with support from NOAA, administers this project.

The bank supports aggregations of 35,000 – 84,000 fish annually; including yellowfin, yellowmouth, and tiger grouper; and cubera and dog snapper. CRCP activities led to the discovery of these previously undocumented snapper aggregations. Anecdotal reports reference historical Nassau grouper spawning at the Bank as well, but this aggregation was likely fished to commercial extinction. Although Nassau grouper are present at the Bank, numbers have not returned to the critical mass needed to reform the spawning aggregation.

The primary research goals of research at Grammanik Bank are to 1) monitor, document, and describe spawning activities on the Bank, 2) determine the size distribution and sex ratio of grouper using groundbreaking ultrasound techniques, 3) tag and release Nassau and yellowfin grouper for migration and population size estimates, and 4) locate and assess other historic spawning areas for Nassau grouper. Mapping activities by the NOAA R/V Nancy Foster (NOS/NCCOS/Biogeography) created essential, extensive habitat maps for the entire bank and surrounding region – significantly aiding and directing research activities.

This research directly informed the decision by the Caribbean Fishery Management Council to institute a seasonal closure of the bank to protect spawning aggregation sites in 2005. This closure, in addition to protecting fish populations, allows researchers to monitor and study spawning aggregations unimpeded by fishing activities. This is especially critical for Nassau grouper, which appear to be returning in large numbers to the bank. They are returning presumably to spawn (spawning coloration and behavior are present), but actual spawning has yet to be observed.

Monitoring of Grammanik Bank continues, collecting information on grouper and snapper distribution, abundance and behaviors. A new facet of this project includes an extensive acoustic component to help passively monitor movements of fish to and from the area. A professional spawning aggregation educational video was also created with funds leveraged by this project.





**Subcategory: Impacts of Overfishing and Gear on Reefs**

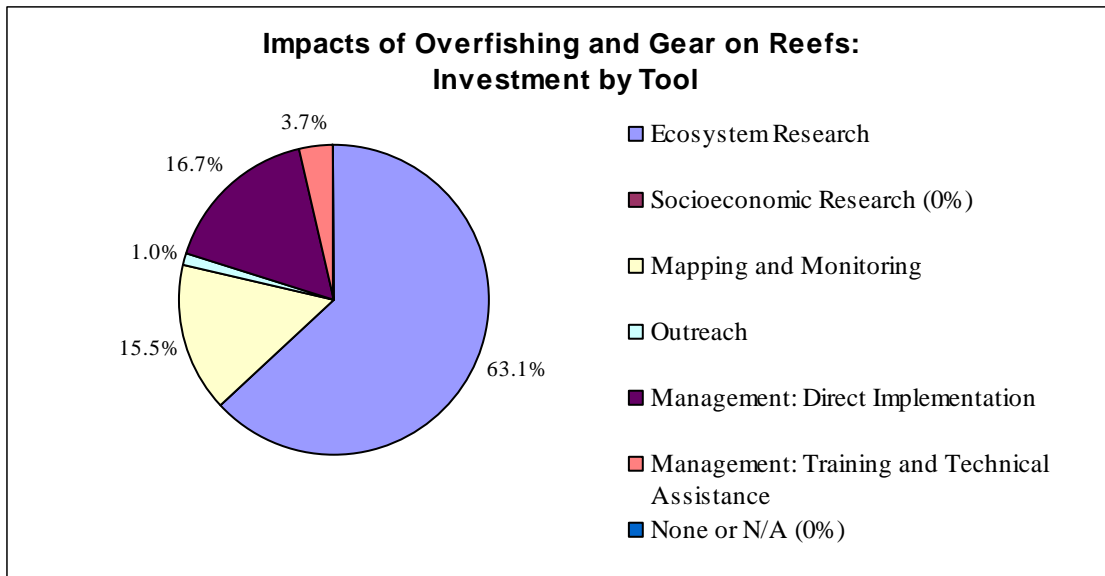
**a. Introduction to Subcategory**

The two principal adverse effects of fishing in coral reef ecosystems are overfishing (i.e., removal of too many target or non-target species) and habitat impacts or bycatch from inappropriate gear types. The CRCP has addressed these problems by improving the scientific information available to managers on the status of stocks and the impacts of gear, and by providing assistance and capacity building to managers in their efforts to address these problems.

Between 2002 and 2006, the CRCP provided \$3M to support 41 projects in this subcategory. This subcategory accounted for 21% of funding within the Reduce Adverse Impacts of Fishing category and 2% of overall CRCP funding; and 17% of projects in the category and 3% of overall CRCP projects between 2002-2006 (see Exhibit III-3-1). The distribution of funds and effort by tool for this subcategory is shown in Exhibits III-3-11a and -11b.

Exhibit III-3-11a Impacts of Overfishing and Gear on Reefs Investments by Tool														
Tool	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
	2002		2003		2004		2005		2006		TOTALS 2002-2006			
Ecosystem Research	3	\$445,000	3	\$360,000	5	\$462,215	5	\$406,715	3	\$197,240	19	46.3	\$1,871,170	63.1
Socioeconomic Research	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Mapping and Monitoring	0	\$0	0	\$0	4	\$168,752	3	\$258,800	1	\$33,865	8	19.5	\$461,417	15.5
Outreach	0	\$0	1	\$30,000	0	\$0	0	\$0	0	\$0	1	2.4	\$30,000	1
Management: Direct Implementation	1	\$33,900	3	\$150,000	2	\$119,500	1	\$37,500	3	\$155,000	10	24.4	\$495,900	16.7
Management: Training and Technical Assistance	1	\$50,000	0	\$0	0	\$0	1	\$33,865	1	\$25,000	3	7.3	\$108,865	3.7
None or N/A	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
<b>TOTAL</b>	<b>5</b>	<b>\$528,900</b>	<b>7</b>	<b>\$540,000</b>	<b>11</b>	<b>\$750,467</b>	<b>10</b>	<b>\$736,880</b>	<b>8</b>	<b>\$411,105</b>	<b>41</b>	<b>100</b>	<b>\$2,967,352</b>	<b>100</b>





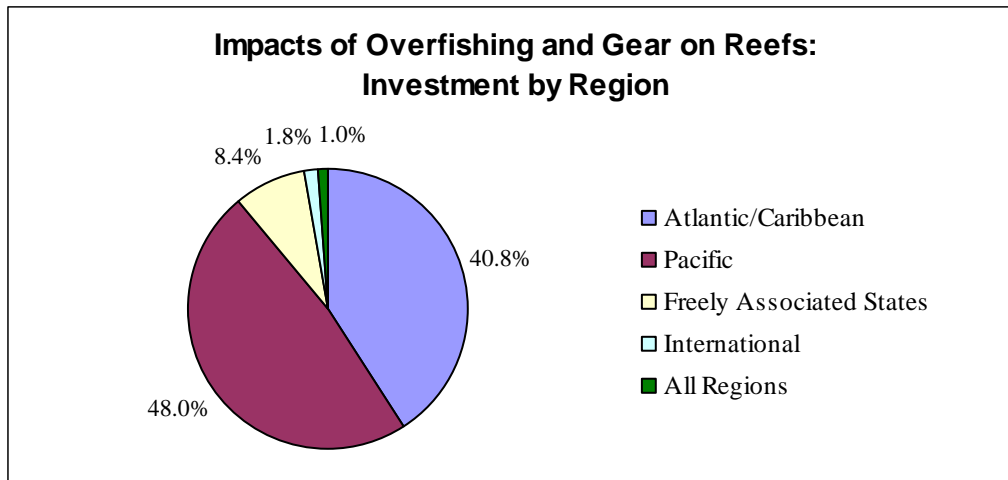
**Exhibit III-3-11b.** Distribution of Investments by Tool, 2002-2006

The regional breakdown for the Impacts of Overfishing and Gear on Reefs subcategory was as follows: 48% went to Pacific activities, 41% to Atlantic, 8% to the Freely Associated States, 2% to International, and 1% to projects that applied to all regions. The distribution of funds and effort by region for this subcategory is shown in Exhibits III-3-12a and -12b.

### Exhibit III-3-12a. Fishing Impacts on Reefs: Impacts of Overfishing and Gear on Reefs Investments by Region

Region	2002		2003		2004		2005		2006		TOTALS 2002-2006			
	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
Atlantic/Caribbean	1	\$245,000	2	\$185,000	5	\$369,063	3	\$277,500	3	\$133,344	14	32.6	\$1,209,907	40.8
Pacific	3	\$233,900	4	\$325,000	4	\$275,769	5	\$346,990	4	\$243,896	20	46.5	\$1,425,555	48
Freely Associated States	1	\$50,000	0	\$0	2	\$78,920	2	\$85,675	1	\$33,865	6	14	\$248,460	8.4
International	0	\$0	0	\$0	1	\$26,715	1	\$26,715	0	\$0	2	4.7	\$53,430	1.8
All Regions	0	\$0	1	\$30,000	0	\$0	0	\$0	0	\$0	1	2.3	\$30,000	1.0
<b>TOTAL</b>	<b>5</b>	<b>\$528,900</b>	<b>7</b>	<b>\$540,000</b>	<b>12</b>	<b>\$750,467</b>	<b>11</b>	<b>\$736,880</b>	<b>8</b>	<b>\$411,105</b>	<b>43</b>	<b>100</b>	<b>\$2,967,352</b>	<b>100</b>





**Exhibit III-3-12b.** Distribution of Investments by Region, 2002-2006

### *b. Activities*

Major areas addressed by CRCP include:

- Development of new technologies or approaches to assess reef fish abundances in support of management, including camera bait stations to study Pacific bottomfish populations (see Program Highlight, p. III-3-34) and acoustic tracking of conch populations in the USVI.
- Regional assessments of possible overfishing and impacts to reefs
- Assessing the interaction of specific gear types (e.g., fish traps in the Caribbean and lobster traps in the Hawaiian archipelago and Florida) with coral habitats using standardized methods.
- Assistance to fishers and management agencies to phase out problem gear types or fishing methods (e.g., trammel nets in St. Croix or live fish food trade in the Marshall Islands).
- Provision of outreach and educational materials addressing overfishing and gear impacts.

### *c. Funding Recipients and Partners*

Exhibit III-3-13 provides examples of CRCP partners and grant recipients under this subcategory.





Exhibit III-3-13 Impacts of Overfishing and Gear on Reefs Funding Recipients and Partners				
NOAA Offices	States and Territories	Fisheries Management Councils	Academic Institutions	Non-Governmental Organizations
<ul style="list-style-type: none"> <li>• NMFS - Pacific Islands Science Center</li> <li>• NMFS - Southeast Fisheries Science Center</li> <li>• NMFS - Southeast Regional Office</li> </ul>	<ul style="list-style-type: none"> <li>• American Samoa</li> </ul>	<ul style="list-style-type: none"> <li>• Western Pacific</li> </ul>	<ul style="list-style-type: none"> <li>• University of California Santa Barbara</li> <li>• University of Rhode Island</li> </ul>	<ul style="list-style-type: none"> <li>• International Marine Life Alliance</li> </ul>
<ul style="list-style-type: none"> <li>• NMFS - Office of Habitat Conservation</li> </ul>	<ul style="list-style-type: none"> <li>• CNMI</li> </ul>			<ul style="list-style-type: none"> <li>• Marine Aquarium Council</li> </ul>
<ul style="list-style-type: none"> <li>• OAR - National Undersea Research Program (NURP)</li> </ul>	<ul style="list-style-type: none"> <li>• Florida</li> </ul>			<ul style="list-style-type: none"> <li>• Environment, Inc</li> </ul>
	<ul style="list-style-type: none"> <li>• Hawai'i</li> </ul>			<ul style="list-style-type: none"> <li>• Perry Institute for Marine Science (NURP Center)</li> </ul>

In addition to the PIs listed above, projects depended on a wide variety of partnerships with other NOAA offices, other Federal agencies, state/territory governments and agencies, academic institutions, and NGOs.

#### *d. Outputs*

- The USVI queen conch mark-and-recapture studies tagged over 1,600 individuals, including 57 with acoustic tags. Population data from mark-recapture studies and visual surveys show that study locations contain higher abundances of queen conch than initially indicated from surveys using different techniques. The study also quantified fishing activities, providing evidence of previously underestimated poaching pressure.
- Rapid ecological assessments of reef ecosystems in the U.S. Pacific (part of CREIOS RAMP cruises) resulted in a variety of accomplishments. Data summaries of overfishing/fishing impacts were prepared for each jurisdiction (main Hawaiian Islands, Northwestern Hawaiian Islands, American Samoa, Guam, CNMI, U.S. Phoenix Islands, U.S. Line Islands, Johnston Atoll, and Wake Atoll). Other outputs included reports and recommendations to management agencies, and the development of GIS tools for habitat and fish survey data. Preliminary results include:
  - The population status of targeted reef fish species is strongly correlated with local human densities. Highest fish biomass is found around the uninhabited, or sparsely populated, isolated islands and atolls of the central Pacific. Conversely, lowest





- fish densities are found around heavily populated islands, such as Oahu (Hawai'i) and Guam.
- Coral reef fish biomass around the more remote and uninhabited islands is dominated by large apex predators, such as sharks, while biomass on reefs suspected to be heavily fished is primarily comprised of herbivorous fish.
  - At Rose Atoll (American Samoa), ecosystem effects of a longline-vessel grounding have now persisted for more than 12 years at the site of impact, where turf-algae/cyanobacteria and herbivorous fishes are significantly greater than at neighboring sites.
- Trap fishing studies in the Caribbean near Florida, Puerto Rico, and the USVI assessed the impacts of the region's most ubiquitous fishing gear found in coral reef habitats. It used a combination of fishers' input into the practices and current status of their fisheries, boat surveys of trap locations, and diver assessments of damage and recovery. Initial findings are that damage to corals from traps is less than anticipated; however, regional declines in coral cover mean there is less coral present to be impacted by the traps. The project also found that catch rates in more resilient habitats, such as algal plains, sand, or seagrass beds, make those habitats more economically viable to fishers as well as more sustainable or less prone to damage.

#### *e. Outcomes*

- Queen conch population data from this and prior sampling programs were the main inputs used to assess current stock status in the U.S. Caribbean for the Caribbean Fishery Management Council. Information about poaching has been provided to the USVI Division of Fish and Wildlife on St. Thomas, and the USVI National Park Service office located on St. John for enforcement monitoring.
- Initial results from fishery independent methodologies to assess overfishing in the U.S. Pacific are being used by partner resource management agencies (e.g., Hawai'i, American Samoa, CNMI/Guam). For example, the Government of American Samoa is considering the development of a protected area surrounding an area of unusually large coral heads on the east side of Tau Island which were surveyed and highlighted using the Towed-Diver methods.
- In 2006, the State of Hawai'i revealed a Revised Plan for Bottomfish Restricted Fishing Areas around the MHI. The State has committed to use the BotCam system for at least a five-year monitoring effort of these new deep-water MPAs.
- Prior to CRCP research, fish traps were banned in the Florida Keys, but were a major fishing method in the U.S. Caribbean. Results of the research on Caribbean trap fishing were reported to the Caribbean Fishery Management Council and incorporated into their Sustainable Fisheries Act Amendment required by the Magnuson-Stevens Act. Results were crucial to plans for improved management of the trap fisheries in Puerto Rico and the USVI, and additional restrictions of traps in shallow nearshore waters are being discussed in USVI.







## *f. Challenges*

- Data maintenance and quality control for large projects (e.g., multi-year data from approximately 55 islands/banks in the Pacific collected with a diverse array of methods) are complex and time-intensive processes. This presents challenges for timely dissemination of results to managers and stakeholders.
- Large geographic scale and limited sampling periods result in low sample numbers, making fine-scale and inter-annual comparisons statistically problematic.
- Logistical challenges include coordination with regional partners, severe weather, and adapting to changes in what is being studied. For example, during the trap study, the fishery changed markedly due to new techniques (fishers switching from surface floats to GPS coordinates) and massive trap losses from hurricane damage.

### *Management challenges*

- While NOAA can provide sound scientific data and management recommendations, in many cases the authority and responsibility for using these products does not fall within NOAA's purview.
- Regardless of the amount of research data collected, the decision as to "how much damage is too much" is a management question that will not be easy to address.

## *g. Future Directions*

- Pilot activities have shown that fishery independent visual assessments of reef fishes can supplement traditional fishery dependent stock assessment efforts. There is a need to begin to mesh these two approaches.
- Long-term datasets of sufficient scope are necessary to determine overfishing and fishing impacts, as well as to determine the effectiveness of management measures in restoring such stocks and habitats (e.g., stock recovery in response to fishing effort restrictions; fish density increases within and outside no-take MPAs; habitat recovery from fishing impacts).
- Continued study of gear impacts, with emphasis on understanding the full suite of effects and addressing new impacts due to advances in gear technology and changing methods.
- Continue to improve survey methods, develop innovative ways to expand the scope of monitoring, and support increased enforcement to bring overfished populations back to sustainable levels.



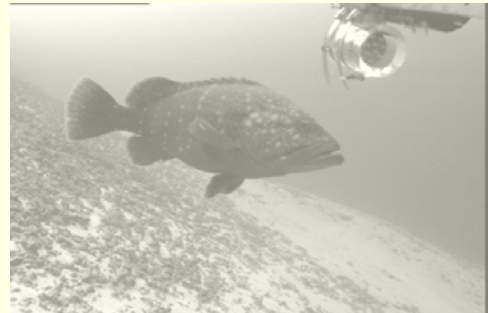


### *Program Highlight: Bottomfish Camera Bait Station (BotCam)*

The Pacific deepwater bottomfish fishery targets species of snappers, groupers, and jacks. These species are long-lived, slow growing, and have low reproductive capacity, rendering them especially susceptible to overfishing. It is important to monitor these stocks to evaluate the effectiveness of regulatory measures, such as spatial (e.g., no-take MPAs) or temporal (e.g., seasonal) fishing closures, or to monitor recovery rates. BotCam provides a non-extractive fishery-independent ("sightings-per-unit-effort") alternative for long-term monitoring of deepwater (typically >100 m) bottomfish and collecting of pertinent habitat information in the U.S. Pacific Islands. Such techniques augment fishery-dependent monitoring surveys.

The BotCam system includes two visually synchronized (stereophotogrammetry), low-light, digital-video cameras, and a bait container, automatically released at a preset time. Once the unit is deployed to selected site and depth, the bait is released and recording of fish feeding commences (for up to 60 min). An acoustically triggered release then allows the tethered unit to float to surface for recovery by tender vessel. CRCP funds supported the development, testing, and deployment of BotCam prototypes by the Pacific Islands Fisheries Science Center and Hawaii Undersea Research Laboratory.

Since early 2004, BotCam has been successfully deployed and recovered over 200 times in the Marianas Archipelago, Wake Atoll, the Northwestern Hawaiian Islands, and in the Main Hawaiian Islands, and has already produced some stunning results. Three systems are currently in operation. The State of Hawai'i is currently using BotCam for a 5-year monitoring survey of its bottomfish restricted fishing areas, where NOAA has determined that overfishing is occurring. BotCam has proven to be a valuable tool to accurately identify, estimate relative abundance, and measure the sizes of deepwater fish in their habitat. CRCP provided the initial funding for development and proof of concept for the deep-water BotCam system. CRCP funding ended after the development phase, however there is interest by several agencies, most notably the State of Hawai'i in utilizing BotCam for field surveys.



## ***Subcategory: Fisheries Management Implementation***

### ***a. Introduction to Subcategory***

Addressing the impacts of fishing on coral reefs requires increased capacity to manage these resources. Central to these efforts has been CRCP support for state and territory Local Action Strategies (LAS) to address fishing impacts to reefs. This assistance has included providing information and personnel to help develop and implement the LAS, on-the-ground fisheries liaisons in most jurisdictions, and direct grant support for LAS projects and personnel. NOAA has also provided additional capacity to the Regional Fishery Management Councils and jurisdictions to develop fishery management plans in Federal waters and to partner with local agencies in management of shared fishery resources.

Between 2002 and 2006, the CRCP provided \$3M to support 46 projects in this subcategory. This subcategory accounted for 21% of funding within the Reduce Adverse Impacts of Fishing category and 2% of overall CRCP funding; and 19% of projects in the category and 4% of overall CRCP projects between 2002 and 2006 (see Exhibit III-3-1). The regional breakdown for

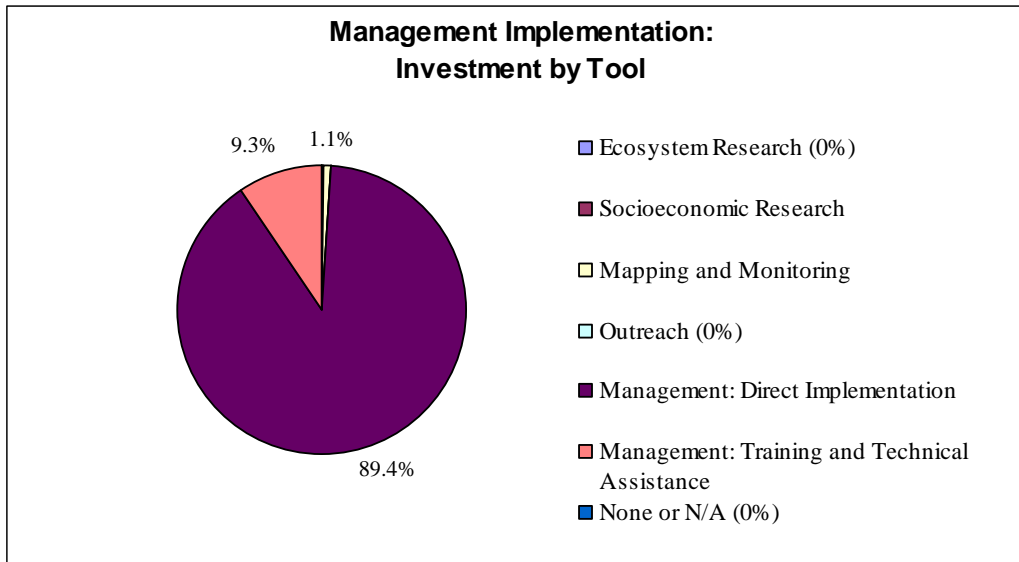




the Management Implementation subcategory was as follows: 67% for Pacific activities and 33% for the Atlantic. The distribution of funds and effort by tool for this subcategory is shown in Exhibits III-3-14a and -14b.

<b>Exhibit III-3-14a.</b> <b>Fishing Impacts on Reefs: Management Implementation</b> <b>Investments by Tool</b>														
Tool	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
	2002		2003		2004		2005		2006		TOTALS 2002-2006			
Ecosystem Research	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Socioeconomic Research	0	\$0	0	\$0	0	\$0	1	\$5,000	0	\$0	1	2.2	\$5,000	0.2
Mapping and Monitoring	0	\$0	0	\$0	0	\$0	0	\$0	1	\$32,500	1	2.2	\$32,500	1.1
Outreach	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Management: Direct Implementation	4	\$620,650	5	\$425,575	10	\$495,087	7	\$460,855	9	\$712,450	35	76.1	\$2,714,617	89.4
Management: Training/Technical Assistance	3	\$145,000	0	\$0	2	\$53,500	3	\$44,375	1	\$40,000	9	19.6	\$282,875	9.3
None or N/A	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
<b>TOTAL</b>	<b>7</b>	<b>\$765,650</b>	<b>5</b>	<b>\$425,575</b>	<b>12</b>	<b>\$548,587</b>	<b>11</b>	<b>\$510,230</b>	<b>11</b>	<b>\$784,950</b>	<b>46</b>	<b>100</b>	<b>\$3,034,992</b>	<b>100</b>





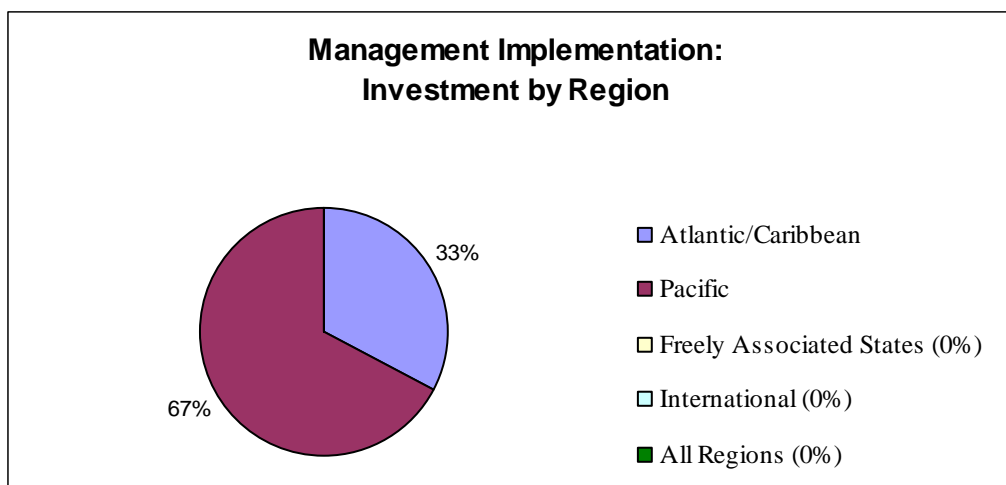
**Exhibit III-3-14b.** Distribution of Investments by Tool, 2002-2006

The distribution of funds and effort by region for this subcategory is shown in Exhibits III-3-15a and -15b.

### Exhibit III-3-15a. Fishing Impacts on Reefs: Management Implementation Investments by Region

Region	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
	2002	2003	2004	2005	2006	TOTALS 2002-2006								
Atlantic/Caribbean	3	\$147,650	3	\$161,575	2	\$56,087	6	\$277,500	5	\$349,635	19	41.3	\$992,447	32.7
Pacific	4	\$618,000	2	\$264,000	10	\$492,500	5	\$232,730	6	\$435,315	27	58.7	\$2,042,545	67.3
Freely Associated States	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
International	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
All Regions	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
<b>TOTAL</b>	<b>7</b>	<b>\$765,650</b>	<b>5</b>	<b>\$425,575</b>	<b>12</b>	<b>\$548,587</b>	<b>11</b>	<b>\$510,230</b>	<b>11</b>	<b>\$784,950</b>	<b>46</b>	<b>100</b>	<b>\$3,034,992</b>	<b>100</b>





**Exhibit III-3-15b.** Distribution of Investments by Region, 2002-2006

### *b. Activities*

The bulk of funds in the Management subcategory went to cooperative agreements with the Western Pacific, South Atlantic, Gulf of Mexico and Caribbean Fishery Management Councils for program administration, workshops, GIS related projects, hiring of various personnel, management plan development, data review and management, advisory meetings, and recreational fishery management plan development. Other projects strengthened management capacity in Puerto Rico, the U.S. Virgin Islands (USVI), the Commonwealth of the Northern Mariana Islands (CNMI), American Samoa, Hawai'i, Guam, and Florida including Local Action Strategy support, community based management training, marine conservation program for indigenous fishers and supporting inshore fishing surveys. Several of the projects relate to priorities identified in the sections of the Local Action Strategies (developed by each of the seven local jurisdictions) related to Overfishing.

A major priority has been to establish CRCP liaisons in Puerto Rico, American Samoa, Guam and CNMI. This has allowed NOAA to better provide on-the-ground capacity-building to local management agencies, develop island-specific outreach materials and support Local Action Strategy implementation. Key activities include:

- Development and initial implementation of an inshore creel survey in CNMI to monitor fishery dependent trends in food fish abundance and biomass and complement an on-going offshore creel survey
- Creation of a Marine Conservation Program for Indigenous Fishermen of the CNMI through collaboration with the fishing community and various resources agencies to disseminate information regarding the positive benefits of resource conservation and management





- Promotion of environmental stewardship in American Samoa through workshops with local agencies and community workshops resulting in the drafting of village marine management plans
- Revision and implementation of Hawai'i's overfishing LAS

**c. Funding Recipients and Partners**

Exhibit III-3-16 provides examples of CRCP partners and grant recipients under this subcategory.

<b>Exhibit III-3-16 Management Implementation Funding Recipients and Partners</b>		
<b>NOAA Offices</b>	<b>States and Territories</b>	<b>Fisheries Management Councils</b>
<ul style="list-style-type: none"> <li>• NMFS - Pacific Regional Office</li> <li>• NMFS - Southeast Regional Office</li> <li>• NOS - Office of Marine Sanctuaries</li> </ul>	<ul style="list-style-type: none"> <li>• American Samoa</li> <li>• CNMI</li> <li>• Florida</li> <li>• Guam</li> <li>• Puerto Rico</li> <li>• U.S. Virgin Islands</li> </ul>	<ul style="list-style-type: none"> <li>• Western Pacific</li> <li>• Caribbean</li> <li>• South Atlantic</li> </ul>

In addition to the Principal Investigators listed above, projects depended on a wide variety of partnerships with other NOAA offices, other Federal agencies, state/territory governments and agencies, community organizations, academic institutions, and NGOs.

**d. Outputs**

Key accomplishments and outputs from Fisheries Management Implementation projects include:

- Revising, finalizing and implementing the Hawai'i Fisheries Local Action Strategy. The entire LAS was revised to change it from a list of projects to a plan with objectives, goals, performance criteria, and implementation milestones.
- Outputs from the CNMI Indigenous Fisher program included design and printing of coral reef fishery outreach material (calendars, posters), fishing regulations, fisher interviews, fisher forums, training workshops, school presentations, and radio shows on coral-related topics.
- The CNMI inshore creel survey conducted interviews with fishers to obtain catch data, implemented an observer program with fishers, and collected demographic data to determine the ethnic makeup of survey participants.





- Draft marine management plans for four villages in American Samoa developed in coordination with PIRO, American Samoa Marine and Wildlife staff, village elders, and community members.
- Workshops were held with commercial and recreational fishers from around Puerto Rico and commercial fishers from all three of the USVI. In Puerto Rico, the workshops were used to present local and Federal fishing regulations, including the new Puerto Rico Fishing Regulations, and discuss the importance of fishery statistics. In USVI, the workshops were used to present the role of the various local and Federal agencies involved in fishery and marine resource management and discuss ideas for new commercial and recreational fishing regulations.

#### *e. Outcomes*

- NOAA assistance to state and territory partners has directly contributed to the development of new fishing regulations in Puerto Rico, USVI, and Hawai'i, and has fostered a positive working relationship with the fishing community and the various resource agencies.
- New fishing regulations in Hawai'i include the gill net fishing ban in certain locations on Oahu and for the entire island of Maui.
- Use of creel data to assess the status of the fishery and make informed management decisions, and the development and/or strengthening of fisheries regulations and enforcement.
- Through workshops for USVI fishers, the Department of Planning and Natural Resources Division of Fish and Wildlife was able to begin outlining a strategy for the creation of recreational fishing regulations and the revision of existing commercial fishing regulations.
- Via fisher workshops in Puerto Rico, recreational fishers were made aware of the new requirements for recreational fishing, which was previously unregulated. All fishers were provided a forum to comment on the effectiveness of the new Puerto Rico Fishing Regulations and their comments were considered in the completion of recent amendments to the fishing regulations, such as changing catch restrictions for a deep water snapper species from a minimum size limit to a spawning season closure for more effective management and protection of the species.
- Results of fisher surveys and forums in CNMI are being used to better manage fisheries. Positive feedback from outreach efforts indicates that local fishers and other resource users are anxious to learn about the positive benefits of resource conservation and management.
- Participatory learning and action training workshops with villagers in American Samoa have empowered local communities to manage the marine resources in their area.
- Establishment of NOAA Pacific Island Regional Coral Coordinators has encouraged positive working relationships with various Federal and territorial resource agencies and led to the formation of key partnerships.





### *f. Challenges*

- One key challenge in island countries was the lack of efficient mechanisms at the local government level for managing coral reef funds and coordinating with partners and within their own agency. In the Pacific, the creation of Regional Coral Coordinators should help to address this problem.
- Other key challenges are securing funding and planning multi-year projects that can acquire/assimilate more data and therefore strengthen project outcomes.
- Difficulty in quantifying the effectiveness of work dominated by education and outreach efforts.
- The revision, finalization, and implementation of LAS faced challenges in both the Pacific and Atlantic, particularly challenges of ensuring participation of important stakeholders and developing and implementing projects that improve fisheries management.
- The participation of community members in education and outreach projects such as workshops and other interactive efforts often proved to be a key challenge.
- Some key challenges in the jurisdictions are long-term support for government program staff, compensation for fishers involved in the conservation process, and adequate enforcement of marine conservation statutes.

### *g. Future Directions*

- Capacity building in local agencies to improve management of coral reef resources and assist in building partnerships and strengthening relationships with local communities is needed.
- Support for efforts begun under the LAS initiatives to address overfishing needs to continue in order to increase education and awareness about fishing regulations, fish biology, and enforcement.
- Continue work to develop and implement new ecosystem-based fishery management plans for coral reef species.
- In the Southeast, NOAA should continue to strengthen communication efforts between offices and agencies, such as through an additional coral coordinator positions for USVI, to complement the office in Puerto Rico. The positions in place in each Pacific jurisdiction have greatly increased coordination.

## ***Subcategory: Fisheries Enforcement and Outreach***

### *a. Introduction to Subcategory*

In every jurisdiction, inadequate enforcement of, and compliance with, existing fishing regulations has been identified as a major constraint to addressing the impacts of fisheries on







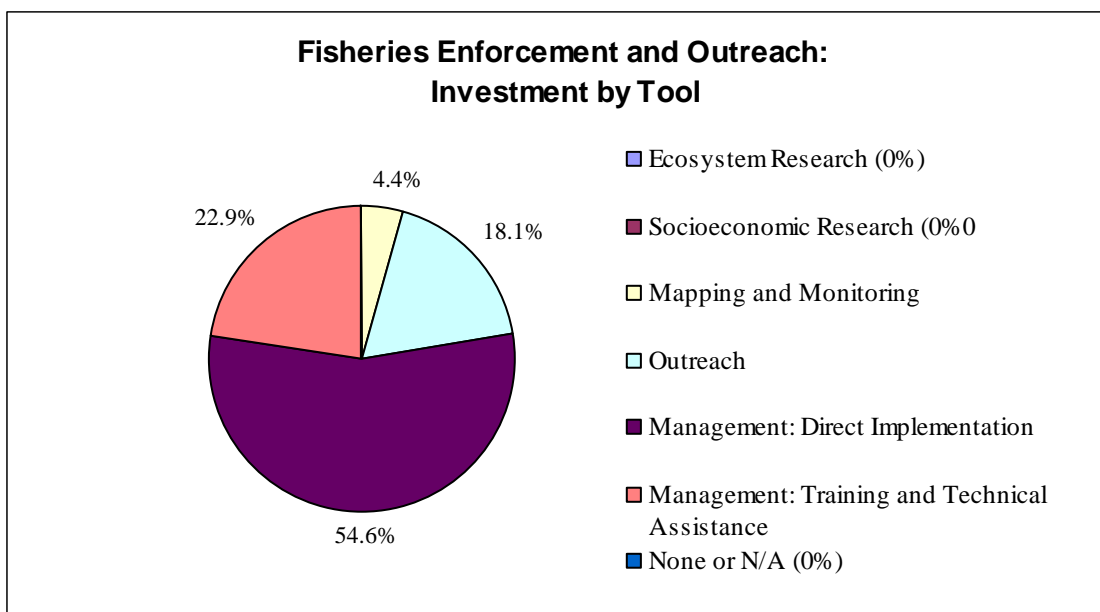
reefs. Additionally, a major key to success is improved understanding by fishers and the public of the life history of coral reef fishes, the impacts of fishing, existing regulations, and possible alternatives to overfishing. The CRCP has directly supported additional enforcement personnel in the territories, provided needed training, held workshops with local fishers, and developed extensive outreach materials. The overall goal of these activities is to strengthen enforcement capacity and to increase community involvement – make fishers partners in all aspects of management.

Between 2002 and 2006, the CRCP provided \$1.8M to support 44 projects in this subcategory. This subcategory accounted for 12% of funding within the Reduce Adverse Impacts of Fishing category and 1% of overall CRCP funding; and 18% of projects in the category and 3% of overall CRCP projects between 2002-2006 (see Exhibit III-3-1). The regional breakdown for the Fisheries Enforcement and Outreach subcategory was as follows: 62% for Pacific activities and 38% for the Atlantic.

The distribution of funds and effort by tool for this subcategory is shown in Exhibits III-3-17a and -17b.

Exhibit III-3-17a Fisheries Enforcement and Outreach Investments by Tool														
Tool	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
	2002		2003		2004		2005		2006		TOTALS 2002-2006			
Ecosystem Research	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Socioeconomic Research	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
Mapping and Monitoring	0	\$0	0	\$0	2	\$77,500	0	\$0	0	\$0	2	4.5	\$77,500	4.4
Outreach	2	\$68,000	0	\$0	3	\$88,500	4	\$73,900	4	\$88,364	13	29.5	\$318,764	18.1
Management: Direct Implementation	3	\$234,000	5	\$243,840	3	\$238,500	2	\$102,500	3	\$143,965	16	36.4	\$962,805	54.6
Management: Training and Technical Assistance	1	\$38,000	4	\$82,463	5	\$139,000	2	\$95,000	1	\$49,310	13	29.5	\$403,773	22.9
None or N/A	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
<b>TOTAL</b>	<b>6</b>	<b>\$340,000</b>	<b>9</b>	<b>\$326,303</b>	<b>13</b>	<b>\$543,500</b>	<b>8</b>	<b>\$271,400</b>	<b>8</b>	<b>\$281,639</b>	<b>44</b>	<b>100</b>	<b>\$1,762,842</b>	<b>100</b>



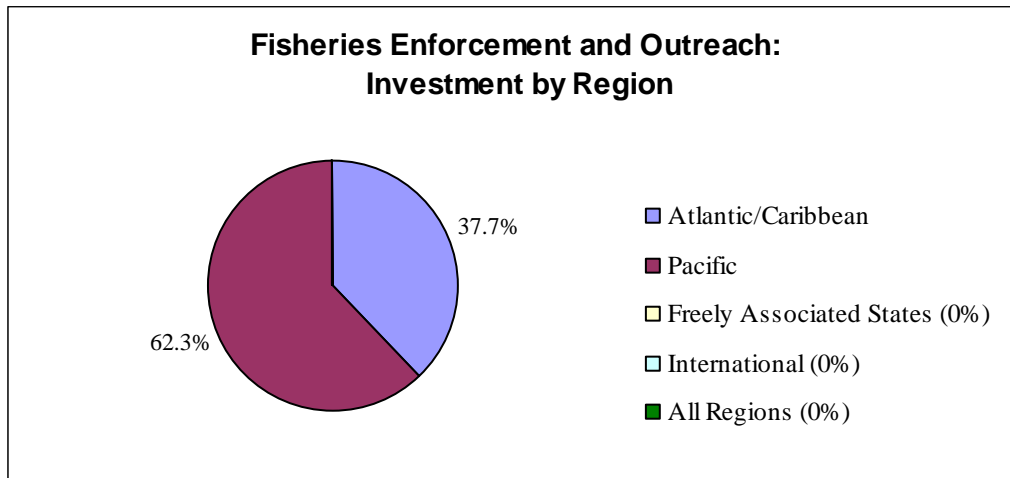


**Exhibit III-3-17b.** Distribution of Investments by Tool, 2002-2006

The distribution of funds and effort by region for this subcategory is shown in Exhibits III-3-18a and -18b.

<b>Exhibit III-3-18a Fisheries Enforcement and Outreach Investments by Region</b>														
Region	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	Funding	Number of Projects	% of Total Subcategory Projects	Funding	% of Total Subcategory Funding
	2002		2003		2004		2005		2006		TOTALS 2002-2006			
Atlantic/Caribbean	3	\$218,000	4	\$98,263	5	\$170,000	4	\$109,900	3	\$68,778	19	43.2	\$664,941	37.7
Pacific	3	\$122,000	5	\$228,040	8	\$373,500	4	\$161,500	5	\$212,861	25	56.8	\$1,097,901	62.3
Freely Associated States	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
International	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
All Regions	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	0	\$0	0
<b>TOTAL</b>	<b>6</b>	<b>\$340,000</b>	<b>9</b>	<b>\$326,303</b>	<b>13</b>	<b>\$543,500</b>	<b>8</b>	<b>\$271,400</b>	<b>8</b>	<b>\$281,639</b>	<b>44</b>	<b>100</b>	<b>\$1,762,842</b>	<b>100</b>





**Exhibit III-3-18b.** Distribution of Investments by Region, 2002-2006

***b. Activities***

The Fisheries Enforcement and Outreach subcategory includes projects to address enforcement needs, including personnel, training, equipment, and strengthening of enforcement presence in protected areas in Puerto Rico, the Commonwealth of the Northern Mariana Islands (CNMI), American Samoa, Hawai’i, Guam, and Florida. Other projects focus on outreach, including workshops, personnel, and the creation and distribution of educational materials related to fishing regulations and marine conservation. Several of the projects relate to priorities identified in the sections of the LAS for each jurisdiction related to overfishing. Key activities include:

- Hiring of a Fisheries Extension Agent in Hawai’i
- Creation of a conservation officer reserve program in Guam, whereby off-duty law enforcement officers partner with conservation officers to increase patrolling capacity
- Workshops and trainings in the U.S. Caribbean on fishing regulations and coral reef ecology, and U.S. Coral Reef Task Force enforcement training in both U.S. Pacific and Caribbean island jurisdictions
- Design, construction, and installation of a RADAR network covering much of the Florida Keys National Marine Sanctuaries
- “Deep water coral reefs are coral reefs too” outreach project on the unique deep reef habitats of Southeast Florida’s Oculina Banks

***c. Funding Recipients and Partners***

Exhibit III-3-19 provides examples of CRCP partners and grant recipients under this subcategory.





**Exhibit III-3-19  
Fisheries Enforcement and Outreach  
Funding Recipients and Partners**

NOAA Offices	States and Territories	Fisheries Management Councils
<ul style="list-style-type: none"> <li>• NMFS - Pacific Regional Office</li> </ul>	<ul style="list-style-type: none"> <li>• American Samoa</li> </ul>	<ul style="list-style-type: none"> <li>• Western Pacific</li> </ul>
<ul style="list-style-type: none"> <li>• NMFS - Southeast Regional Office</li> </ul>	<ul style="list-style-type: none"> <li>• CNMI</li> </ul>	
<ul style="list-style-type: none"> <li>• NMFS - Southeast Enforcement Office</li> </ul>	<ul style="list-style-type: none"> <li>• Florida</li> </ul>	
<ul style="list-style-type: none"> <li>• NMFS - Office for Law Enforcement</li> </ul>	<ul style="list-style-type: none"> <li>• Guam</li> </ul>	
<ul style="list-style-type: none"> <li>• NOS - International Programs Office</li> </ul>	<ul style="list-style-type: none"> <li>• Puerto Rico</li> </ul>	
<ul style="list-style-type: none"> <li>• NOS - Office of Response and Restoration</li> </ul>	<ul style="list-style-type: none"> <li>• U.S. Virgin Islands</li> </ul>	
	<ul style="list-style-type: none"> <li>• Hawai'i</li> </ul>	

In addition to the Principal Investigators listed above, projects depended on a wide variety of partnerships with other NOAA offices, other Federal agencies, state/territory governments and agencies, academic institutions, and NGOs.

***d. Outputs***

Key accomplishments and outputs from the fisheries enforcement and outreach efforts include the completion of workshops with specific user groups in the Pacific and the Atlantic; training activities for law enforcement personnel, hiring of enforcement personnel, and hiring of extension agents and other personnel related to fisheries education and management in the Pacific and the Atlantic; and the production of outreach materials to inform the general public and/or key user groups about fisheries regulations, marine protected areas and associated regulations, and environmental stewardship in the Pacific and the Atlantic. Examples include:

- Installed a working radar network on USCG Aids to Navigation Towers for the Dry Tortugas Coral Reefs. Authorized users could access the network through the internet to track suspicious vessels and monitor usage of the protected area real time.
- Hired a fisheries extension agent in Hawai'i who has:
  - Conducted outreach activities with 166 recreational shoreline fishermen and women regarding fishing regulations, conservation biology, and coral reef management efforts by NOAA and the state.
  - Established important relationships with state managers and enforcement officers.





- Established a Collaborative Ciguatera Research Program through which spear fishers supply researchers with reef fish commonly associated with ciguatera.
- Developed a shoreline access guide with maps.
- Developed a Fish Measurement Guide with information about state regulations and fish biology.
- Conducted an educational outreach activity with 60 elementary students.
- Trained members of the Maritime Unit of the Puerto Rico Ranger Corps of the Department of Natural and Environmental Resources through various collaborative efforts focusing on the importance of the coral reef ecosystem, identification of management species, intervention procedures, and regulations related to marine resource conservation.
- Completed educational activities to promote conservation ethics and promote self-policing to strengthen enforcement as part of a Florida Local Action Strategy fishing impact priority project.
- Increased awareness of and involvement with deep water coral resources of the Southeast region by producing a teacher workshop, daily web-logs during an *Oculina* research and monitoring cruise, a port day for students and teachers, multi-media resources for media and educators, posters and rack cards, and web-based resources.

### *e. Outcomes*

Key outcomes of fisheries enforcement and outreach efforts include increased community participation in the development of management plans, fishery regulations, and fishery research, improvements in management strategies by local resource agencies and the development and/or strengthening of fisheries regulations and enforcement. Grants to several jurisdictions (e.g., American Samoa and CNMI) have allowed them to increase their enforcement personnel devoted to coral reef fisheries. Examples include:

- Real time interception of vessels in Dry Tortugas Coral Reefs, FL, through use of radar network enabled implementation of new enforcement strategies.
- Through the work of a Fisheries Extension Agent in Hawai'i, the fishing community is assisting with enforcement, supplying fish to researchers studying ciguatera, and has become more aware of the importance of reefs and conservation.
- Through training activities with personnel from the Ranger Corps of the Puerto Rico DNER, enforcement of fisheries regulations related to catch of undersized lobster and queen conch and threatened and endangered sea turtles increased.

### *f. Challenges*

- As for other subcategories, key challenges for the implementation of fisheries enforcement and outreach projects include the lack of efficient mechanisms at the local government level in island countries for managing coral reef funds and coordinating with





partners and within their own agency, and the revision, finalization and implementation of LAS that improve fisheries enforcement.

- The CRCP has limited capabilities and authority to meet the full suite of local needs for increased enforcement.
- Enforcement personnel often have no background in resource conservation and basic biology. Thus, a key challenge is developing tools to familiarize enforcement personnel with the resources they are responsible for protecting and the biological reasons for legal protection of marine resources, such as the establishment of legal size limits and closed seasons for fishing.
- Building trust among various agencies and partners and keeping the lines of communication open to ensure that projects address local priorities and have adequate participation to make them effective and successful.
- CRCP funding was able to demonstrate the feasibility of using radar as a surveillance tool in the Dry Tortugas. However, project funding mechanisms were not able to ensure long-term funding for maintenance and replacement when installations were damaged by hurricanes and other extreme weather events.

### ***g. Future Directions***

Key future directions include:

- Capacity building in local agencies.
- Support for efforts begun under the LAS initiatives.
- Promoting environmental stewardship at the community level.
- Designing and implementing and/or restructuring of existing training for enforcement personnel to ensure understanding of marine resource regulations for more effective enforcement.
- Implementation of innovative strategies for enforcement within protected areas to compensate for the lack of sufficient enforcement personnel.





## Appendix III-3 Publications and Presentations Resulting from CRCP Funding

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