

Protecting the Spawning and Nursery Habitats of Fish: The Use of MPAs to Safeguard Critical Life-History Stages for Marine Life

Marine protected areas are often designated to protect sites of high biodiversity or scenic character, like coral reefs. But many fish species that inhabit such places as adults have rarely spent their entire lifetimes there. “Nursery grounds” such as seagrass beds or mangroves provide protective habitat for juvenile-stage fish before they migrate to their adult habitat. And sites where adult fish gather on a seasonal basis to spawn can be located elsewhere as well. Such habitats encompass critical life-history stages for marine life, and their protection from harvesting or other pressures can help ensure the maintenance of broodstock and sustainability of populations.

As such, these habitats can form a crucial part of MPA networks. This month, *MPA News* discusses the use of MPAs to protect spawning and nursery habitats with several experts, each working to raise awareness of these habitats’ importance to marine systems.

Spawning aggregation sites

Many commercially important fish species reproduce in spawning aggregations that range in size from tens to tens-of-thousands of individuals. Such periodic gatherings can be lucrative for fishermen: they yield large catches, and are often easy to locate again and again. Overfishing can occur rapidly as a result, as has happened for several reef-based species worldwide.

Biologist Yvonne Sadovy is director of the Society for the Conservation of Reef Fish Aggregations (SCRFA), an international NGO that works to protect such aggregations and raise awareness of the problems of aggregation fishing. “In the context of fisheries management, communities and managers alike typically view spawning aggregations as fishing income opportunities, rather than as a life-history feature that is vulnerable, needs management, and supports the fishery of a particular species,” says Sadovy. SCRFA, conceived in 2000 and funded mainly by the David and Lucile Packard Foundation, has undertaken an array of education and outreach programs to spread its message on spawning aggregations, including pamphlets and posters in multiple languages for local stakeholders, an educational DVD, a handbook for NGOs and conservation/fishery officers, and a detailed manual for managers and researchers. It has also pushed to include

spawning aggregation protection on the international agenda through statements of concern at major forums, including the 2003 International Tropical Marine Ecosystems Management Symposium and the 2004 IUCN World Conservation Congress.

SCRFA considers fishery closures — whether seasonal or permanent — to be an appropriate tool for managing aggregations for certain species and circumstances. “From a biological perspective, closures at the spawning site are particularly important when spawning habitat of a species is limited to specific areas, and in cases where a particular species forms very few, but very concentrated, aggregations with very large numbers of fish,” says Sadovy. Closures are also important, she says, in cases where spawning animals may be easily disturbed or their behavior disrupted by fishing activities. For species like grouper and emperor, which mature first as females then can become male later in life, conventional harvest of older, larger individuals may result in imbalance of sex ratios and potential limitation of available sperm at spawning time. (Sex changes in these species are informed by social information, including the ratio of males to females during aggregations. The change by females to males is not fast enough, however, to compensate the loss of large males during an aggregation event — the change occurs between reproductive seasons.)

SCRFA maintains an online, GIS-capable database (<http://www.scrfa.org>) of known reef-fish aggregations worldwide, based on information from published and unpublished literature, personal communications, and interviews with fishers. From that database, Sadovy estimates there are roughly 20 spawning aggregation sites that receive some protection in the Caribbean and tropical western Atlantic, and a similar number with such protection in the Indo-Pacific; in many places, the protection is seasonal rather than year-round. These figures amount to a small fraction of exploited reef-fish aggregation sites worldwide (the database lists more than 500), but the number of protected sites is increasing, says Sadovy.

“A few years ago, a review of MPAs in the Caribbean and tropical western Atlantic showed that only 5% of MPAs had specifically incorporated spawning aggregations in their design,” she says. “Since that time, there

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has been much more awareness of the need to consider aggregations. Major successes include 11 aggregation sites protected year-round in Belize recently, following a demonstration that the sites were spawning areas for many different species. Also, the Cayman Islands have closed several sites during spawning season as part of an

eight-year pilot program.” In the Indo-Pacific region, the Association of Southeast Asian Nations this year released guidelines for its member states on the protection of spawning aggregations (see news brief, p. 6). In 2003, Australia’s Great Barrier Reef Marine Park Authority incorporated five spawning aggregation sites in no-take zones as part of its major rezoning initiative.

Sadovy notes that closures are not always the best management option for aggregations. In an interview in June 2004 (*MPA News* 5:11), she said that low levels of subsistence fishing on spawning aggregations can probably be sustained, and not all aggregating species are equally vulnerable to fishing. In cases where protection is necessary, the appropriate measures depend on the biology of the species, nature of the

fishery, and local management and social contexts. Seasonal sales bans on certain species, coinciding with their known aggregation times, can work well in some situations, whereas quotas or other conventional management tools may be more appropriate in others. Also, for species whose aggregation locations shift from year to year, spatially fixed closures — unless very large — would do little good.

Nonetheless, says Sadovy, seasonal and/or spatial closures can be invaluable under the right conditions. For resource managers around the world who are in the process of selecting sites for MPAs — particularly where protection of spawning biomass is a major goal — she encourages them to consider spawning aggregations. “We would like to see this important and vulnerable

life-history phase considered, routinely, as a factor in MPA planning,” she says.

Nursery sites: seagrass beds, mangrove forests

Seagrasses are underwater flowering plants that can occur in extensive beds or meadows, generally in shallow coastal waters. A vital part of the marine ecosystem, seagrasses provide food and habitat for numerous vertebrate and invertebrate species, from fish and crustaceans to sea turtles and dugongs. In the case of juvenile fish, the three-dimensional structure provided by seagrass meadows provides an ideal environment for concealment from predators, and serves as a buffer against strong currents.

Seagrasses are declining, and even disappearing, around the world, impacted by human actions. Sensitive to changes in water quality, seagrasses have become an indicator of the overall health of coastal ecosystems. “Stretches of coastline in North America, Europe, and Japan that are highly developed have lost much of their seagrass,” says Fred Short, a biologist at the University of New Hampshire (US) and director of SeagrassNet, a global monitoring program (<http://www.seagrassnet.org>). “In the developing world, deforestation with concomitant erosion and mangrove removal has also resulted in seagrass declines.” Of the 48 sites being monitored by SeagrassNet and partner institutions around the world, the majority are experiencing some degree of decline, almost always due to direct or indirect human impacts, he says.

In his book *World Atlas of Seagrasses* (University of California Press, 2003), Short estimates there are at least 250 MPAs worldwide that include seagrass habitat. Yet few of these, he says, were established with protection of seagrass in mind. “In fact, in the majority of MPAs with seagrass habitat, seagrasses are not acknowledged by management or directly protected,” he says. SeagrassNet is working to become established in MPAs and to have seagrass monitoring become an integral part of long-term MPA monitoring programs. Currently SeagrassNet has 20 monitoring sites located in MPAs, ranging from small community-based protected areas to large World Heritage sites.

“The biggest challenge in protecting seagrass is making people aware, first, of its presence, and second, of its importance,” says Short. “Once the role of seagrass habitat in coastal ecology, coral health, and fisheries is made clear, leaders and citizens are easily convinced of the need for monitoring and protection.” Protection can come in the form of restrictions on various human activities, such as aquaculture, fishing, mangrove removal, or nearby coastal development. “In several of our monitoring locations, protection measures or public awareness initiatives have been instituted as a direct result of SeagrassNet involvement and advocacy,” says Short.

Global coverage of various habitats in MPAs

It is difficult to determine exactly how many MPAs worldwide contain the types of fish nursery habitats described in this article. The majority of the world’s oceans are unclassified at the level of habitat detail necessary to generate such figures, and global databases on MPAs do not contain habitat information for many sites. Louisa Wood, who heads the MPA Global database project at the University of British Columbia (Canada), estimated to *MPA News* in September 2004 that 354 MPAs contain seagrass, and 237 contain mangroves (*MPA News* 6:3), but she cautioned this was a very rough determination. The database is available at <http://www.mpaglobal.org>.

The count of coral reef MPAs may be more accurate, if perhaps because there are more researchers engaged with such habitats and because MPAs are often designated for the particular purpose of coral reef protection. Camilo Mora of Dalhousie University (Canada) published a paper in the 23 June 2006 edition of *Science* journal that measured the percentage of tropical coral reefs worldwide that were within MPAs in general (18.7%), and the percentage that were specifically within no-take areas (less than 2%). The data were generated through a global survey of 1000 managers and researchers. Mora’s team has called for a major increase in the number of no-take coral reef MPAs. The paper and supplementary materials, including regional assessments of coral reef coverage in MPAs, are available online at <http://www.fmap.ca>. Click on “Publications”.

Ecologist Peter Mumby at the University of Exeter (UK) says marine conservation strategies need to protect connected corridors of habitat and facilitate the natural migration of species between habitats over time. In a study published in *Nature* journal in February 2004, Mumby determined that the availability of mangrove habitat — used as a nursery by juveniles of many coral reef fish species — had a pronounced impact on community structure and biomass of reef fish in their adult, coral reef habitat. (The paper is available at <http://www.projects.ex.ac.uk/msel/papers/mumbyetal2004.pdf>.) Biomass of several reef species in the Caribbean more than doubled when reefs were connected to rich mangrove sources — ones with at least 70 km of fringing mangrove within a region of 200 km². Mumby later used this finding to develop algorithms for use in natural resource planning, including the identification of mangrove sites with unusually large importance to reefs, and priority sites for reforestation projects. These algorithms appear in a follow-up paper he published this year in the journal *Biological Conservation* (Vol. 128, pp. 215-222), reprints of which are available from the author.

For MPA planners seeking to maximize reef fisheries production, Mumby suggests that protection of nearby sea-fringing mangroves should be a priority. “The mangrove fringe is usually dominated by *Rhizophora mangle* in the Caribbean, and its prop roots provide excellent nursery habitat,” says Mumby. “Ultimately, it is the perimeter of this habitat that is important for reef fish rather than its area.”

Along the same line, his findings hold implications for the planning of coral reef MPAs. In cases where planners must choose from among several reefs to protect, Mumby recommends that reefs near the largest-perimeter mangrove forests receive priority protection — particularly in cases of heavy fishing pressure. “Protecting a reef near a large-perimeter mangrove would maximize the chance of achieving a persistent reserve population if neighboring areas were intensively exploited,” he says. “This should also offer the greatest chance of achieving a high local population of fish, which could then benefit neighboring areas through spillover.” However, he adds, if the fishery were carefully managed and enforced, there would be a case for fishing the reef near the large-perimeter mangrove and protecting other reefs instead: the reason being that the reef near the large-perimeter mangrove would theoretically be able to sustain higher levels of extraction.

Protecting nursery grounds: a manager's viewpoint


In the US state of Florida, more than one million people engage in recreational fishing each year, generating an economic impact of US \$1.4 billion. Of the species fished, at least 70% of them spend part of their lifecycle in seagrass communities or other coastal nursery habitats.

In St. Lucie County, bordering on the coastal Indian River Lagoon on the Atlantic side of Florida, Jim Oppenborn is county marine resource coordinator. He says an offshore MPA designated nearby by federal managers — to protect the Oculina Banks deepwater coral reefs — has alienated local fishing groups, as it was among the few hard-bottom areas available for them to fish. Any effort by managers to designate a second offshore MPA would likely meet great opposition. But efforts to protect coastal juvenile habitat for fished species are another matter, he says.

“Of the snapper-grouper complex that uses our offshore reefs in St. Lucie County, 21 of the 45 species also use the Indian River Lagoon at some point in their life histories,” says Oppenborn. “Because of the dependence of our offshore fisheries on the Indian River Lagoon, creating special management zones in the lagoon makes sense to anglers.” (Due to the non-regulatory nature of his position, Oppenborn would be required to propose the creation of such zones to state-level government.) These zones, which have been instituted elsewhere in Florida, could include gear restrictions — such as bans on netting for bait, which impacts juvenile sportfish as bycatch. In some cases, the taking of oysters on restored oyster beds would be banned. Restrictions would most likely be instituted in areas that (a) feature newly restored habitat where harvest had not occurred for years, and (b) are close to public areas so that officials, like harbor masters or bridge tenders, could supervise them easily.

These factors contribute to enforceability, a concept that Oppenborn says is appreciated by fishermen. “Many of them agree that some amount of restrictions are needed to protect our fisheries resources, and without enforcement the rules will affect only law-abiding, conservation-minded anglers,” he says.

The zones would have little negative effect on fishermen, since they would be instituted in areas where little fishing has occurred in recent years. Fishing activity, in fact, does not pose a great threat to the fish nursery habitats of St. Lucie County. With a human population that has grown by more than 25% since 2000, the larger impacts on coastal resources are pollution, sedimentation, coastal development, habitat alteration, and other stressors. The effective protection of nursery habitats, even in these special management zones, is a challenge.

Education is key, says Oppenborn. “Most of the local decision makers do not have a background in natural resources, but many understand the importance of preserving natural communities once the concept is presented to them,” he says. “It would be unrealistic to pretend that effective protection could be afforded to the resources overnight. This does not mean that protection should not be attempted.” 

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MPA Perspective Anatomy of an Advocacy Campaign

By Joshua Reichert

There are few ocean areas under US jurisdiction established as no-take marine reserves, and fewer still of large enough size to be ecologically meaningful. The

Northwestern Hawaiian Islands (NWHI) offered a unique and unparalleled opportunity to establish an ecosystem-scale reserve, one in which extractive activities could be prohibited and natural biological processes could progress unaltered by direct human interference.

From the late 1990s, prior to the Trusts' involvement, local conservation groups in Hawai'i engaged in important work to protect the NWHI. They devoted significant resources to help develop and promote actions by former US President Bill Clinton to designate a large "coral reef ecosystem reserve" over much of the NWHI [*MPA News* 2:6], and nursed the site through the initial stages of a multi-year management planning process. They also successfully convinced the Governor of Hawai'i to close state waters (0–3 nm around all emergent lands) in the NWHI to all commercial activities, a significant achievement. If not for their technical expertise, strong grassroots

organizing, and dogged determination, the concept of establishing a monument fully protected from commercial and recreational fishing would not have existed.

This being said, as the result of an internal analysis conducted in early 2005, staff of the Pew Charitable Trusts concluded that the NWHI-related efforts of these organizations were not likely to be sufficient in themselves to accomplish the goal of ending commercial fishing in this area. While at least six organizations had staff focused on the NWHI, no one worked on it full time. No person was exclusively devoted to the task of

developing and overseeing a winning strategy adaptable to changing political conditions, and capable of overcoming obstacles and taking advantage of opportunities. The individuals most familiar with the issue all had multiple projects on which they were working, causing them to split their time, attention, and available resources devoted to this effort.

The Trusts determined that various activities were needed to increase the prospects of achieving the goal of a no-take marine reserve for the NWHI. From January 2005, the Trusts took the following steps:

- Hired an experienced conservation advocate/biologist to become the Trusts' NWHI director; he was also a former senior member of the Trusts' environment division. His mission was to help coordinate and focus existing environmental efforts to ensure that federal agencies adopted the most protective and conservation-oriented management measures possible, including an end to commercial fishing in the NWHI. In addition, the Trusts expressed a willingness to lead an effort, currently underway, at crafting a buyout package to facilitate the permanent retirement of existing commercial fishing permits in the NWHI.
- Provided two full-time professionals to assist Hawaiian organizations in demonstrating to state political leaders the extent of support in Hawai'i for NWHI protection. One individual focused primarily on grassroots development, while the other conducted media outreach.
- Hired a respected communications/media firm in Hawai'i to reach out to businesses and organizations not typically sympathetic to conservation concerns.
- Hired a media consultant to assist conservation groups in their efforts to create an "NWHI Network" of organizations in support of protection (<http://www.nwhinetwork.net>), and to prepare and disseminate press releases and conduct other outreach to media.
- Launched an effort to engage Hawaiian chefs, who represent an economically significant sector of the island economy, in support of fully protecting the NWHI archipelago.
- Encouraged a study at the University of Hawai'i looking at the economic impact of a fishery closure on the Hawaiian economy, restaurants, and consumers. This study was designed to assess the likely economic impacts of ending commercial fishing in the NWHI and to disseminate this information to political leaders and the public.
- Engaged a prominent retired judge to lead a professional team to begin outreach and buyout negotiations with the eight bottomfish permit holders.

Editor's note

The effort to secure strong protective measures for the Northwestern Hawaiian Islands (NWHI) in US waters, culminating in President George W. Bush's proclamation of the 362,000-km² NWHI Marine National Monument (*MPA News* 8:1), involved many organizations, politicians, scientists, resource users, and others. The substantial support in favor of no-take regulations from Hawaiian residents and organizations was instrumental in influencing the direction of state-level planning for NWHI waters (*MPA News* 6:11), and was cited by President Bush in his federal-level decision.

Among these proponents of protection, one organization took a comprehensive approach to advancing the issue. The Pew Charitable Trusts, a non-profit organization (formerly a foundation), launched an 18-month multifaceted campaign to build local and national support for NWHI protection, with assistance from other philanthropies (the Lenfest Foundation and the Sandler Family Supporting Foundation). Joshua Reichert, director of the environment division for the "Trusts", agreed to outline some of the activities encompassed by the organization's NWHI initiative to *MPA News*.

Reichert's essay here provides an illustration for all stakeholders, no matter their stance on MPAs, of an unusually wide-ranging and aggressive advocacy campaign, the style of which is not often seen in the MPA field. *MPA News* hopes in future issues to feature the perspectives of others involved in the NWHI designation process — or in other MPA processes worldwide — to show how multiple styles and scales of support can be effective in informing policy actions.

For more information


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- Contracted with several legal experts to investigate specific fisheries-related issues including information on the NWHI fishing permits, agency actions, and NWHI fisheries regulations.

- Worked with a number of members of the Hawaiian legislature to help educate other political leaders.

- Worked with Washington, DC-based conservation partners to ensure that recreational fishing organizations were fully briefed on the NWHI issue and that their

questions and answers were fully addressed in advance of the President's decision.

Again, without years of organizing by local conservation groups and the development of broad-based political support in Hawai'i, this action by the President never would have happened. The Trusts were pleased to be able to work together with these organizations in helping create a positive political climate that greatly facilitated the decision by the President to protect this spectacular place. 

MPA News Reader Poll: Which MPA is the "World's Largest"?

For decades, the 344,400-km² Great Barrier Reef Marine Park in Australia was widely cited as "the world's largest MPA". Then, in June 2006, the US designated the Northwestern Hawaiian Islands (NWHI) Marine National Monument, covering 362,000 km² of marine area. So that means the NWHI site is now the world's largest MPA...right?

It might not be that simple. There are marine areas under conservation management that are much larger in size than either the Great Barrier Reef or NWHI. The question is, do they qualify as MPAs? *MPA News* has always taken an expansive view on what constitutes a marine protected area. The following poll seeks *your* view.

MPA News Poll: Which of the six candidates below is the world's largest MPA, and why?

Cast your vote — and tell us the reason behind your choice — at <http://www.mpanews.org>. We will print the results in a future issue.

As a reminder, the IUCN definition for *marine protected area* is: "An area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment." (IUCN, 1992) The six categories of protected area management, as defined by IUCN, are at http://www.unep-wcmc.org/protected_areas/categories/index.html.

A. Northwestern Hawaiian Islands Marine National Monument (US)

- Size: 362,000 km²
- Designated in June 2006 by presidential proclamation (*MPA News* 8:1);
- Commercial fishing within the site will be phased out within five years, and recreational fishing is prohibited;
- Traditional Native Hawaiian cultural practices will be allowed by permit under certain conditions;
- Protection is permanent.

B. Aleutian Islands Habitat Conservation Area (US)

- Size: 957,000 km²
- Designated in July 2006 by National Marine Fisheries Service;
- Consists of a permanent network of gear closures in US waters to protect seafloor habitat for deepwater corals and other sensitive features (the press release is available at <http://www.noaanews.noaa.gov/stories2006/s2673.htm>);
- Nearly all of the site (96%) is closed to bottom trawling;
- Additionally, six areas with particularly high-density coral and sponge habitat are closed to all bottom-contact fishing gear, including longlines and pots;
- Use of other fishing gears is allowed with regulations.

C. Mediterranean/Black Seas bottom trawl closure

- Size: 1.63 million km²
- Designated in 2005 by the General Fisheries Commission for the Mediterranean (GFCM);
- Permanently bans bottom-trawl fishing in waters deeper than 1000 meters in the Mediterranean and Black Seas for the purpose of protecting deep-sea biodiversity (*MPA News* 6:9);
- Enforcement is the responsibility of the 24 member states of the GFCM;
- Most of the closure is outside of national waters, which could make enforcement in these high-seas areas a challenge when vessels from non-GFCM nations are involved;
- Use of other fishing gears is allowed with regulations.


D. Marine area covered under the Convention on the Conservation of Antarctic Living Marine Resources (CCAMLR)

- Size: 35.7 million km²
- Entered into force in 1982 as part of the Antarctic Treaty System;
- Managed primarily for conservation under the Convention's articles, using precautionary and ecosystem approaches (<http://www.ccamlr.org>);
- Creation and enforcement of conservation measures, including fishing restrictions, is the responsibility of 31 CCAMLR member states;
- Non-member states are not subject to CCAMLR measures.

E. IWC Indian Ocean Whale Sanctuary

- Size: approximately 70 million km²
- Established in 1979 by the International Whaling Commission (IWC) to protect cetacean species from commercial harvest (<http://www.iwcoffice.org>);
- Must be reviewed and reconsidered every 10 years;
- A second IWC whale sanctuary, in the Southern Ocean, is roughly 30 million km².

F. The high seas

- Size: 218 million km²
- Waters outside of any national jurisdiction are subject to the United Nations moratorium on large-scale pelagic driftnet fishing, which took effect in December 1992. 

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MPA News is published monthly by Marine Affairs Research and Education (MARE), a 501(c)(3) not-for-profit corporation, in association with the School of Marine Affairs, Univ. of Washington.

All content has been written by the MPA News editorial staff unless otherwise attributed.

Financial support for MPA News is provided in part by grants from:

- David and Lucile Packard Foundation; and
- Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration (NOAA), Silver Spring, MD (USA), under the Federal Coastal Zone Management Act.

The views expressed herein are those of the author(s) and should not be interpreted as representing the opinions or policies of the Packard Foundation, NOAA, or NOAA's sub-agencies.

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Notes & News

New website for Mediterranean MPA managers

MedPAN, an EU-funded initiative to network MPA managers in the Mediterranean, has launched a website, at <http://www.medpan.org>. The website, available in English and French, features a directory of Mediterranean MPAs by country, MPA-related documents, a gallery of Mediterranean MPA photos, and the project newsletter (*MedPAN Bulletin*), as well as an "extranet" resource center that is accessible to Mediterranean MPA managers upon request (e-mail cpiante@wwf.fr to request access). The extranet offers management tools, working documents, presentations from MedPAN workshops, and an updated directory of Mediterranean MPA managers, among other materials. The aim of MedPAN is to improve management effectiveness of Mediterranean MPAs, including through exchange of information and experience among MPA managers in the region.

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UNESCO World Heritage adds new marine sites

On 12 July 2006, two sites with marine components were added to the World Heritage List, overseen by the United Nations Educational, Scientific and Cultural Organization (UNESCO):

- Malpelo Flora and Fauna Sanctuary, Colombia (8571 km² of marine area) — Located 500 km off the Pacific coast of Colombia, this MPA includes Malpelo island and the surrounding marine environment, filled with abundant populations of sharks, giant grouper, and billfish; this is reportedly the largest no-take zone in the Eastern Tropical Pacific.
- Kvarken Archipelago, Finland (roughly 1650 km² of marine area) — Including 5600 islands and islets, this archipelago is continuously rising from the sea, owing to moraines formed by the melting of the continental ice sheet; as a consequence, islands appear and unite over time, peninsulas expand, and lakes evolve from bays.

The World Heritage Convention (<http://whc.unesco.org>) seeks to protect the world's most important natural and cultural heritage. In designating 830 locales so far as World Heritage sites — from the Great Wall of China to the Belize Barrier Reef Reserve System — the 182 state parties to the convention have indicated their desire that these places be preserved. A press release on the newly listed MPAs is at http://www.iucn.org/en/news/archive/2006/07/12_pr_world_heritage.htm.

Guidelines released for responsible fishing in SE Asia, including the use of fisheries refugia

Governments in Southeast Asia are promoting the use of "fisheries refugia" as one of several tools for making fisheries in the region more sustainable. In a new set of guidelines released by the intergovernmental Southeast Asian Fisheries Development Center (SEAFDEC) and the Association of Southeast Asian Nations (ASEAN), resource managers are encouraged to designate such refugia particularly in areas critical to the life history of fished species, such as spawning aggregation sites, nursery grounds, and migratory routes. The guidelines specify that the term "fisheries refugia" does not mean "no-take zones" in this case; rather, these are areas in which various gear-based, seasonal, or other restrictions on fishing effort are applied, while allowing other fishing activity to continue. "States should focus on establishing fisheries refugia with a very clear fisheries agenda and based on the concept of sustainable use," say the guidelines. The recommendations cover several refugia-related topics, including establishment of sites, anticipated management challenges, and complementary management initiatives.

SEAFDEC member countries are Brunei Darussalam, Cambodia, Indonesia, Japan, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The publication, *Supplementary Guidelines on Co-Management Using Group User Rights, Fishery Statistics, Indicators and Fisheries Refugia*, is available online at http://fish.seafdec.org/GL/4_GL.pdf.

Monitoring expedition for Sudanese MPAs profiled online

Available online are day-by-day accounts and photos from a July 2006 expedition to assess biodiversity at two MPAs in Sudan: 22-km² Sanganab Atoll Marine National Park, and 3000-km² Dungonab Bay-Mukkawar Island Marine Protected Area. This online coverage (<http://www.africanparks-conservation.com/sudan-expedition.php>) is intended to raise awareness of the existence of the parks, which have coral reefs in excellent condition and low tourism levels (2000-2500 visitors per year). The expedition itself established baseline biodiversity data for management of the parks and laid out 23 permanent monitoring sites. The African Parks Foundation, an NGO that manages the two MPAs in cooperation with Sudanese wildlife authorities, is responsible for funding the parks and is working with local communities to guide conservation and sustainable development of the area. The organization manages eight national parks in six African nations.

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