

VI. Closing the Coral Commons to Support Reef Restoration in Florida



Reed Watson and Brett Howell
PERC

Despite their ecological and economic importance, Florida's coral reefs are teetering on the verge of collapse. Scientific studies point to the impact of effluent discharges from municipal storm and wastewater treatment facilities along the coast. Other reports document the physical destruction caused by boat groundings, fishing equipment, and recreational divers. Policy makers seeking to reverse the coral decline are contemplating additional regulations on coastal point sources, increased fines for boat collisions, and extended Endangered Species Act protections. All regulatory in nature, these policies are aimed at equating the private and social costs of reef deterioration.

This report explores the viability of an alternative framework for managing Florida's coral reefs, one based on clearly defined, secure, and transferable property rights. Rather than relying on the political

process to determine the optimal level of reef protection, such property rights would allow voluntary trades to occur between competing reef users, namely divers, anglers, boat captains, conservation organizations, and coastal communities. Already, conservation entrepreneurs have developed methods for growing imperiled coral species in nurseries and replanting them on reefs. A market-based management approach that rewards this kind of innovative stewardship—and creates accountability for reef deterioration—has greater potential to enhance Florida's coral resources than the command-and-control policies currently under consideration.

Florida's Coral Reefs: A Resource in Decline

Coral reefs are valuable ecologically, economically, and socially. They provide habitat for many commercial

fish stocks; offer recreational opportunities for divers, snorkelers and fishermen; help protect coasts from storm damage; and are biodiversity hotspots. Though coral reefs make up about one-tenth of one percent of Earth's surface, covering only 1.2 percent of the world's continental shelves, they provide habitat for roughly a quarter of the known marine species.¹ Scientists now believe that somewhere between one million and ten million distinct marine species live in coral reefs around the world.² Reefs are also a vital component of the global economy, with an estimated 500 million people worldwide dependent on reefs for food, coastal protection, and livelihoods.³

More than 80 percent of the domestic coral reefs are found off the South Florida coast.⁴ Approximately 6,000 marine species depend on these reefs during some portion of their life. The economic importance of these reefs is difficult to overstate. According to a 2001 study, coral reefs, both natural and artificial (e.g., shipwreck) generated more than \$5.7 billion in total reef-related expenditures in southeast Florida.⁵

After years of degradation from coastal development, effluent discharge, overfishing, eutrophication,⁶ and boat collisions, the Florida Keys National Marine Sanctuary (FKNMS) was established in 1990 to protect what remained of South Florida's reefs. The Sanctuary covers 2,896 square nautical miles, 60 percent of which is state controlled and 40 percent federal.⁷ The Sanctuary is a marine protected area (MPA), technically defined as an area "where natural and cultural resources are given greater protection than the surrounding waters."⁸ In zones throughout the Sanctuary, regulatory restrictions limit what activities are permissible. The regulations permit minimal fishing in some zones, while others are strict no-take zones.

Despite their economic importance and the creation of the Florida Keys National Marine Sanctuary, the health of Florida's coral reefs continues to decline. The Florida Department of Environmental Protection reports that the state's coral cover declined 44 percent between 1996 and 2005.⁹ The coverage of elkhorn (*Acropora*

palmata) and staghorn (*Acropora cervicornis*) corals, the two primary reef-building corals in the Caribbean, has declined by upwards of 90 percent since the 1970s.¹⁰ On average, southeast Florida reefs contain 2 to 3 percent live hard coral cover, with typically higher coral cover and habitat diversity found in the southern compared to northern sections of the reef.¹¹ The remaining reefs are referred to by some as "remnant" or "zombie" reefs because they support very little marine life.¹² Having suffered severe declines in Florida, both corals were listed as threatened under the U.S. Endangered Species Act in 2006.¹³

As described by the report "Coral Reef Restoration and Mitigation Options in Southeast Florida," the threats to coral reef are numerous and varied. Global stressors such as climate change and ocean acidification, as well as local impacts from coastal development, overfishing, eutrophication and direct physical impacts, threaten the coral reef ecosystems and the benefits that they provide.¹⁴ Numerous local influences have been identified as having the potential to seriously adversely impact the reef environment of southeast Florida, many of which are a result of the dense coastal human population (> 6 million). "These threats include, but are not limited to, the introduction of large volumes of freshwater, partially treated wastewater, nutrients, and/or agricultural chemicals into the marine ecosystem, boating, fishing, and diving activities, high volume of ship traffic including large container vessels, the presence of numerous utility cables laid across the coral reef environment, coastal armoring, beach nourishments, and port expansions."¹⁵

While the rate of coral decline is slower in the marine protected areas of the Florida Keys National Marine Sanctuary than in unprotected areas,¹⁶ the 2011 FKNMS Condition Report found an overall decline in the status of habitats and organisms in protected waters.¹⁷ This persistent decline is not surprising given the inability of Sanctuary managers to influence forces outside the Sanctuary, such as effluent discharge from

coastal development, that hinder the ability of these habitats to maintain a healthy status.¹⁸

Advances in Reef Restoration

Because the designation of protected areas has failed to restore reefs in the Florida Keys National Marine Sanctuary, non-government restoration efforts have been under way since the early 2000s. One method involves growing pieces of coral in underwater nurseries. The techniques used in Florida were predominately developed by Ken Nedimyer of Coral Restoration Foundation (CRF), with support from the Nature Conservancy (TNC).¹⁹ The technique relies on asexual fragmentation (essentially creating a copy of the same coral as opposed to sexual spawning). Since *Acropora* corals, such as staghorn and elkhorn, rely heavily on asexual reproduction, there is little genetic diversity among new colonies, limiting the expansion of the population. However, propagation of genetically diverse, nursery-grown parents planted in high numbers in close proximity is expected to lead to higher success rates of species recovery.²⁰

Based on early successes with the technique, in 2009, grants from the National Oceanic and Atmospheric Administration (NOAA) funded through the American Recovery and Reinvestment Act (ARRA) and administered by TNC provided \$3.3 million to support the development of nurseries for corals in Florida and the U.S. Virgin Islands. Coral nursery partners, in addition to TNC and CRF, include Nova Southeastern University with Broward County Natural Resources Planning and Management Division, University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, the Florida Fish and Wildlife Conservation Commission, Mote Marine Lab, and the University of the Virgin Islands.²¹

Coral nurseries established through the ARRA grant have proven to be highly successful at creating colonies of threatened coral species. For example, as of the end of June 2012, CRF alone had over 25,000 colonies in their nurseries, even after outplanting approximately 1,500.²² However, 2012 NOAA

budget cuts significantly reduced funding for all but essential services (e.g., weather satellites). If the coral restoration efforts are to continue, alternative funding sources must be secured.

Harnessing Markets to Recover Florida's Reefs

The challenge of restoring Florida's coral reefs is twofold: limiting access and securing funding. Regarding access, the various factors contributing to the coral decline persist because there is no clear ownership of the resource and, consequently, no meaningful limit on access. As an open-access commons, there is little incentive for reef users to invest in stewardship or to limit present use for future gains.²³ Moreover, those who visit coral reefs and those whose livelihood depends on reef visitors have no claim against parties whose actions deteriorate the resource.

Regarding funding, the Coral Restoration Foundation estimates that to grow, plant, and monitor a coral (staghorn and elkhorn) twice a year costs between \$75 to \$135 (with elkhorn being more expensive since there are fewer fragments in production).²⁴ Fragmented pieces 2 to 3 inches in length take, at minimum, 8 months to grow into small colonies measuring 6 to 8 inches.²⁵ Consequently, reef restoration at the ecosystem level would require several millions of dollars, far more than federal grants or charitable donations are likely to provide.

Restoration efforts to date have primarily relied on federal regulations and funding. With the continued deterioration of Florida's reefs and the 2012 expiration of ARRA funding, reef users, environmental organizations, and restoration practitioners are searching for new restoration strategies and funding sources. By establishing property rights or at the very least limited access privileges to the coral reefs, policy makers could overcome both the access and funding issues and convert Florida's reef resources from an open access commons to an economic asset worth conserving.

Linking Producers and Consumers

Markets for environmental goods and services are premised on the notion that “those who benefit from environmental services (such as the users of clean water) should pay for them, and those who contribute to generating these services (such as upstream land users) should be compensated for providing them.”²⁶ By financially linking the consumers and producers of an environmental resource, markets rely on self-interest and incentives—rather than regulations—to engender resource stewardship.

As noted above, potential producers of reef restoration include nonprofit organizations like the Coral Restoration Foundation that grow staghorn and elkhorn coral in ocean-based aquaculture nurseries and transplant them to wild reefs. To date, CRF has developed the largest offshore coral nursery in the United States and transplanted more than 3,000 corals at 22 different reef locations in the Upper Florida Keys. This approach to active reef management has the potential to increase the resilience and biodiversity of the reefs.

Other potential sellers of reef restoration include those whose actions currently degrade reef health, such as wastewater dischargers, commercial fishing boats, and cruise line operators. Although some might object to the concept of paying an emitter to emit less, an angler to fish less, or a cruise captain to divert off course less, such objections fail to recognize the reciprocal nature of costs and the practical effectiveness of forbearance contracts. Because coral growth is measured in inches per year, and because a single boat anchor can quickly destroy an acre, limiting the harmful activities is just as important, if not more so, than transplanting new coral.

The list of reef restoration consumers is eclectic. The most obvious beneficiaries of a healthy coral ecosystem are the local dive shop operators, charter boat captains, hotel owners, restaurateurs, and tourism agencies who profit from the reef visitors. These groups may be willing to invest in reef restoration not

only for the business insurance it provides against the potential total collapse of the natural asset, but also for the reputation premium these businesses might collect as restoration supporters.

Of course, the willingness of local businesses to invest in reef restoration ultimately depends on the demands of divers and snorkelers for a healthy reef ecosystem. The evidence from the Gili Islands in Indonesia suggests that this demand is sufficiently high to support meaningful restoration efforts. There, first-time divers pay 50,000 Rp (\$5.50) and sometimes more into the Gili Eco Trust, which funds an extensive reef restoration program and compensates fishermen who agree to forego harmful fishing practices, such as using dynamite or cyanide.²⁷ More than 20 local hotels and restaurants also donate between 1 and 2 percent of monthly profits into the Trust, reflecting their recognition that a healthy tourism industry depends upon healthy reefs.

A less obvious but potentially significant source of restoration funders are the “existence” consumers—those who may or may not plan to visit the reefs but who nonetheless are willing to pay some amount to know that it exists and that they contributed to restoration. Defenders of Wildlife demonstrated the effectiveness of targeting this consumer group by raising the wolf compensation trust fund with sales of posters depicting gray wolves reintroduced to Yellowstone National Park.²⁸

The most obvious question is whether the buyers’ willingness to pay exceeds the sellers’ costs of production, that is, whether the margins are sufficient. Next is the all-important question of transaction costs. Monitoring, measuring, and enforcing performance of contractual obligations will not be cheap, be they affirmative obligations to plant coral or forbearance obligations to not destroy them. If these transaction costs overwhelm the margin, then access to the resource will remain open. Conversely, if the producers and consumers of reef restoration can strike mutually beneficial deals, a market for coral

restoration has the potential to expand the number and size of viable reefs and allow the reefs to recover some of the lost biodiversity that is so critical to their ecological function.

The Property Rights Prerequisite

For markets to enhance environmental assets, two conditions must be met. First, there must be “clear and recognized property rights and resource tenure so that there is a legitimate seller of ecosystem services.”²⁹ Second, the value of or benefit from the ecosystem service must be transferable from the current owner to a willing buyer, who could be geographically or temporally distant from the resource. Without such clearly defined, enforceable, and transferable property rights, the consumers of an environmental resource (such as scuba divers on a reef) will not take into account the full cost of their consumption, and the producers or stewards of the resource (such as the Coral Restoration Foundation) will not be rewarded for investing in restoration.

Defining property rights and establishing resource tenure in the marine environment poses new, but not insurmountable, challenges. While terrestrial property laws address such issues as boundary disputes and trespass, the definition and enforcement of similar rights in the marine environment is less robust. Technologies such as marine GIS and underwater cameras reduce the costs of creating and monitoring a virtual fence around underwater resources. However, the legal institutions that govern these marine resources pose significant challenges to market-based reef restoration.

Property rights and markets have promoted the conservation of such resources as commercial fisheries, stream flows, and endangered species, to name a few. However, this application of property rights to the coral reefs off Florida’s coast raises unique questions regarding the initial allocation of rights, the logistics and legality of excluding non-paying users, and the potential for transaction costs to

frustrate conservation agreements. The next section examines these and other issues specific to Florida’s deteriorating reefs.

Institutional Barriers and Opportunities

Market-based strategies have the potential to generate the stable and long-term funding needed for sustaining ecosystem scale coral reef restoration, but only if the legal institutions governing coral reefs allow the producers of reef restoration to charge the consumers of reef restoration. The open-access nature of the Florida Keys National Marine Sanctuary currently limits opportunities for private investment in reef restoration. Environmental entrepreneurs must overcome these institutional barriers to develop and harness a market for reef restoration.

The Public Trust Doctrine

Under the public trust doctrine of the United States, the public, rather than private individuals, retains ownership of certain resources.³⁰ The doctrine establishes a trustee relationship of government to hold and manage wildlife, fish, and waterways for the benefit of the resources and the public. Fundamental to the concept is the notion that natural resources are deemed universally important in the lives of people, and that the public should have an opportunity to access these resources for purposes that traditionally include fishing, hunting, trapping, and travel routes (e.g., the use of rivers for navigation and commerce).³¹ While generally important to environmental law, the public trust doctrine is especially prominent in the marine environment because marine resources and the rights of fishing and navigation have historically been considered part of the public trust.³²

Private land rights cease at the mean high water mark to protect the right of navigability. The federal government has jurisdictional control over the exploration and use of marine resources beyond state coastal waters and up to 200 nautical miles from the coast, including the right to

lease assets for revenue (e.g., oil and gas leases), known as the Economic Exclusive Zone (EEZ), established by the Law of the Sea.³³

The public trust doctrine is largely defined by state ownership of submerged lands.³⁴ In *Illinois Central Railroad v. Illinois*, and later in *Phillips Petroleum Co. v. Mississippi*, the Supreme Court recognized state ownership of tidal lands within their borders.³⁵ In 1953, the United States formally granted title to the states of submerged lands within three miles of the shoreline and “the natural resources within such lands and waters.”³⁶ However, the federal government retained a navigational servitude even over state waters.³⁷

The Constitution of the State of Florida affirms that the state maintains title to “lands under navigable waters, within the boundaries of the state [and] which have not been alienated . . . in trust for all the people.”³⁸ The Florida Constitution also allows for the sale of submerged lands “when in the public interest”³⁹; however, Florida has statutorily banned future sales and conveyances of submerged lands that remain in the public trust.⁴⁰

The doctrine in Florida also protects certain rights. “The public has the right to use navigable waters for navigation, commerce, fishing, and bathing and ‘other easements allowed by law.’”⁴¹ The public’s right to fishing in Florida has also been protected by statute: “No water bottoms owned by the state shall ever be sold, transferred, dedicated, or otherwise conveyed without reserving in the people the absolute right to fish thereon, excepted as otherwise provided in these statutes.”⁴²

Although the public trust doctrine and the state constitutional provisions noted above explicitly proscribe full divestment of coral reefs to private parties, limitations on public access to coral reefs are completely legal if the purpose of such limitations is to benefit the resource and the public. The following discussions of ocean zoning and aquaculture leases highlight possible strategies for overcoming this institutional constraint and creating quasi-ownership rights.

Ocean Zoning

On July 19, 2010, President Obama signed Executive Order 13547 directing federal agencies to implement a new National Ocean Policy by developing plans to, in effect, zone the oceans within U.S. territorial waters and also to include control over key inland waterways and rivers that reach hundreds of miles upstream, a plan somewhat similar to the way local governments zone land.⁴³ The idea is that identifying areas suitable for various economic, industrial, or conservation uses in advance can help reduce conflicts and facilitate compatible uses. Comprehensive Ocean Zoning was defined as “a strategic allocation of uses based on a determination of an area’s suitability for those uses, and reduction of user conflicts by separating incompatible activities.”⁴⁴

The Florida Keys National Marine Sanctuary currently uses a form of marine zoning to regulate fishing and other activities.⁴⁵ Expanding on the current zoning efforts to include restoration zones, allocating the management authority for each zone to conservation groups or other restoration producers, and allowing that group to charge an access fee would create quasi-ownership rights to the reef. It would also create an incentive for restoration zone managers to steward the resource and attract the most visitors.

Florida Aquaculture Leases

Though full divestment of submerged lands in Florida is not possible, the state does lease submerged lands for aquaculture, mainly for growing hard clams, oysters, and live rock.⁴⁶ Lessees enjoy exclusive use of the bottom and water column as required by the licensed aquaculture activity. Though *Acropora* corals are not a commercial product, restoration producers could secure exclusive access rights and charge an access fee using the state’s aquaculture leasing program.

Under such a proposal, a private entity could apply for a submerged lands lease with the intention of promoting coral restoration. Such a lease could cover a pre-existing reef or an area where the lessee intends

to culture a new reef. Lessees would be able to limit physical and ecological damage to the reef by being able to exclude other users who might damage the ecosystem by dragging anchors on reefs or harvesting important species living on the reef, which reduces the ecosystem's resilience.

Charging a Sanctuary-Wide Access Fee

Assuming exclusive access rights cannot be created in the Florida Keys National Marine Sanctuary—through zoning, leasing, or some other method—the federal government could charge a sanctuary-wide access fee and invest the funds in reef restoration. Charging an access fee to the Florida Keys National Marine Sanctuary and allowing Sanctuary managers to retain and invest collected fees in the Sanctuary could create a significant and sustainable funding source for coral restoration. According to Scott Saunders, owner of Fury Water Adventures, “user fees could be placed in an environmental trust fund with proceeds going toward coral restoration and other environmental projects.”⁴⁷

Though such a fee would not be a true market approach to restoration, it would align the incentives of Sanctuary managers with the demands of visitors. If designed like the federal public lands fee demonstration program, a majority of the funds collected would remain under the control of Sanctuary staff.⁴⁸

Because such fees were deemed illegal in 1990 as part of an agreement between NOAA and Florida to create the Sanctuary,⁴⁹ congressional action authorizing user fees would be required. NOAA has not officially expressed any interest in pursuing this option or in studying the level of funds that could be raised through a user fee structure.⁵⁰ NOAA's opposition to user fees stands in stark contrast to the National Park Service (NPS), which charges a \$5 weekly access fee to the Dry Tortugas National Park, approximately 70 miles west of Key West.⁵¹ Total fees collected by all categories in Dry Tortugas National Park were \$183,591 in 2009 and \$694,514 in 2010 (there was a large Commercial Use Authorization payment

of \$501,888 in 2010, significantly increasing fee revenue).⁵² In January 2012, the Obama administration proposed that NOAA, presently part of the Department of Commerce, be placed under the Department of the Interior, which includes the National Park Service, Bureau of Land Management, and Fish and Wildlife Service, all of which apply user fees in numerous locations.⁵³ If this change were to occur, the agency could become more receptive to charging access fees.

Several other countries are using fees successfully to support reef restoration and management. For example, Bonaire has charged mandatory fees to access its marine parks since the 1990s and had great success with paying for active management of national parks.⁵⁴ In 2005, the legislation covering marine park usage fees was changed with the inauguration of the “Nature Fee.” Scuba divers are charged \$25 for a year pass or \$10 for a day pass and all other users of the marine park must pay \$10 for an annual pass. Tag receipts go directly to STINAPA Bonaire National Parks Foundation and are used entirely for the management of Bonaire's National Parks.⁵⁵ The Coral Restoration Foundation recently began a coral nursery program in Bonaire with funding provided in part through a voluntary \$1/night donation from guests at a local dive hotel, Buddy Dive Resort, and a grant from the Alex C. Walker Foundation.⁵⁶ STINAPA is at the early stages of considering direct payments, or other budget support (e.g., materials), to NGO groups like the Coral Restoration Foundation to assist with coral restoration in Bonaire.⁵⁷

Proposed Reforms

To be successful, market-based options require a minimum level of tenure security, exclusive access to sites (allowing fees to be charged), and enforcement. Since state and federal policies currently preclude such fees, financing options are limited to philanthropic capital and conservation finance categories (e.g., donations and grants). To raise the amount of revenue to support large-scale coral reef restoration, more viable market-based solutions are required.

The Florida Keys National Marine Sanctuary is presently conducting a three-year public review process of the regulations that will shape Florida Keys marine conservation for the next 20 years.⁵⁸ On June 29, 2012, on behalf of the Alex C. Walker Foundation, Georgia Aquarium, the Property and Environment Research Center (PERC), 18 endorsing organizations, and 8 individuals, the authors submitted a public comment recommending the following changes to the Florida Keys National Marine Sanctuary's regulatory and zoning schemes.

Permitted Damage Fee

NOAA has federal regulatory authority to charge companies or individuals that receive construction permits in the FKNMS a fee (technically a donation) to mitigate for corals affected by activities that cannot be avoided or minimized.⁵⁹ This fee, set in 2006, is presently \$1.06 per square centimeter of affected coral and provides funds for maintaining existing coral nursery structures, such as the Key West rescue nursery co-located at NOAA's docks. NOAA uses what it believes to be the best information available on the costs to raise corals in a nursery environment to set the mitigation fee, which is typically added to construction permits through a legally binding letter of authorization.

The program has gained some acceptance from the local community as a reasonable way to protect coral that would otherwise be lost, yet there are several ways the coral mitigation program could be improved to better reflect the cost of restoration and, consequently, enhance restoration efforts. The first is to update the mitigation fee charged by NOAA. Costs are estimated based on how long a coral is going to be in nursery, which is typically 6 months. But the \$1.06 per square centimeter calculation was based on coral production costs in 2006 and does not account for subsequently developed efficiencies in coral nursery operations, which would likely reduce the cost, or increasing scarcity values for threatened corals which would likely increase the cost.⁶⁰

NOAA should update these production cost values and include some factor to account for the less-than-100 percent survivorship of outplanted coral colonies. Each square centimeter of affected coral should be replaced by a higher amount of coral in the nursery in order to achieve the targeted square centimeter coverage area of successful outplant to the reef. Extensive cost data is available from ARRA-funded nursery operators to assist with updating the mitigation fee. For example, NOAA's own rescue nursery reports quarterly on work, maintenance, cleaning and data collection associated with the coral nursery.

The mitigation fee charged should also include the costs of outplanting the corals and monitoring their survival, not just time in nursery. NOAA staff biologists or independent contractors should conduct pre- and post-construction assessments, the additional cost for which should be added to the annual operating budget or to the mitigation fee calculation. The post-construction surveys are irregularly completed, yet these are essential to analyze the effect on the corals in construction buffer zones and ensure that work was completed as permitted.

Limited Access Reef Restoration Zones

Whether entirely new restoration zones or existing zones converted to restoration areas, NOAA should cordon off special restoration sites and allow only permitted or certified restoration practitioners and water usage industry organizations, such as dive and snorkel shops, recreational and commercial fishing groups, to access the sites. Restoration practitioners and water usage industry organizations could then charge visitation fees for these sites in return for their investment in the restoration efforts. Such an approach would allow NOAA to facilitate restoration of the reef ecosystem, including coral nurseries, coral outplanting, *Diadema* urchin and fish reintroduction, removal of invasive species and marine debris and other activities that may increase the success of restoration and overall health of the area, while allowing participants to observe and be a part of reef restoration.

This strategy likely would be consistent the National Marine Sanctuaries Act and the resolution prohibiting Sanctuary fees for allowed public uses because neither NOAA nor the State of Florida would be administering the fees. In the past, FKNMS-based dive shops and the Tourism Development Council have been able to circumvent this prohibition by creating voluntary fees to access sites, as in the case of the *USS Spiegel Grove*, a vessel sunk as a scuba site near Key Largo, Florida in 2002.

To address concerns by the public about loss of access to previously unpriced reef resources, such restoration zones could be temporary in nature, reverting back to previous level of access, that is, the original zoning designation with no access fee, after the site achieves certain ecological success criteria measured against baseline pre-project monitoring. Possible criteria include species diversity, population size and genetic diversity of select species, live stony coral cover, metrics of three-dimensional structure or benthic complexity, and resilience to natural disturbances, such as storms and very warm or very cold conditions. Note that a minimum period of time of exclusive access should be guaranteed to the organization completing the restoration activities so that it has the opportunity to offset its costs of investing in the project. An additional consideration may be that the organization(s) that complete the restoration work be granted a percentage of the long-term income derived from the restored site.

Reversion coupled with carefully crafted monitoring may help increase understanding of the contribution of various anthropogenic stresses to the restored natural resources. Post-restoration reversion could be entire or partial. Entire reversion may result in reestablishment of regulations according to the current FKNMS zoning plan, matching regulations in the restoration area to analogous areas.

To offset NOAA management costs associated with the new zones, NOAA could auction access rights to restoration zones by category, such as certified

restoration practitioners/coral nursery operators and water usage industry organizations, or NOAA Blue Star-recognized dive shops. The auction should be open to NGOs and for-profit entities alike. NGOs could be competitive with for-profit entities by using their tax deductible donation status to partner with corporations interested in their cause to cover auction costs, to jointly bid, etc.

Absent significant regulatory reform, the auction must function and be characterized in a way that does not violate the current user fee prohibition. The access right could be categorized as a special product or service, since NOAA's policy is to recover the full cost of providing a special product or service when, for example a movie is filmed in FKNMS.⁶¹ If this is not feasible, one alternative would be to have the practitioner assume the management activities under NOAA's supervision. Another option is to have the practitioners manage the auction activity and limit auction participants to water usage industry organizations.

Market-Enabling Regulatory Reforms

Currently, only NGOs are permitted for coral nurseries and coral outplanting efforts, and the Sanctuary has been hesitant to consider issuing additional permits because it is uncomfortable with the number of potential market entrants. To achieve the scale of activity required for ecosystem restoration, NOAA must expand the number of participants in the marine ecosystem restoration space.

The Administration could maintain quality control by developing a certification program for restoration practitioners. The criteria should be developed by working with CRF, TNC and other ARRA-partner NGOs who pioneered the practice of coral restoration. Dive certification agencies, such as PADI, Scuba Schools International [SSI], or the National Association of Underwater Instructors [NAUI], would be good candidates to operate the programs since they have experience in many aspects of curriculum development and insurance considerations. For example, CRF has

worked with PADI on a coral restoration specialty that could be expanded to certify professional restoration practitioners. Certification should be achievement-based, not experiential.

The Nature Conservancy and the Coral Restoration Foundation both went to great lengths to receive permission to outplant corals grown in nurseries. Now that the various federal, state and local regulating agencies have become comfortable with the concept of active coral propagation and outplanting, the permitting process can be simplified and shortened using a programmatic Environmental Impact Statement (EIS) and related streamlining frameworks. The permitting process is far slower than the exponential growth rate of coral now demonstrated in nursery environments and corals can be grown faster than permits can be obtained to place them on reefs.

In addition to increasing the number of potential conservation organizations, NOAA should increase the number of coral nursery permits beyond those held by current participants. Other individuals or organizations with a conservation focus, regardless of entity type and tax status, should be able to participate. For-profit and developing hybrid organizations such as Low-Profit Limited Liability Companies (L3Cs) and B-Corporations should be allowed to participate in restoration activities along with NGOs through full management of their own, permitted, coral nurseries.

Perhaps most importantly, NOAA should allow nursery and outplanting permits to be tradable between holders of such permits. Like the NOAA-backed catch share fishing program, such an approach would create a tradable incentive for nursery operators. Permit trading would allow different operators to buy or sell nursery permits based on current funding levels, operational efficiencies, etc. Additionally, if a new group wanted to enter the market, it could purchase a permit from an existing participant, lowering its startup costs while recognizing, via cash payment, the efforts of the seller in restoring coral reefs in FKNMS.

The coral nursery permit market could be modeled on the existing trade of Marine Life Endorsements that accompany a Saltwater Product License issued through the Florida Fish and Wildlife Conservation Commission. Marine aquarium trade collectors operating in FKNMS currently trade these endorsements. As part of the design of the tradable permits, measures should be taken to prevent monopolization where only one organization holds all permits. The intent is to prevent individuals/entities from being priced out of the market due to a situation such as market speculators acquiring all permits without the intent of participating in ecosystem restoration.

Open the Coral Trade

As ARRA partnership NGOs have demonstrated, large amounts of coral tissue can easily be grown once nurseries have been established. Current understanding is that all corals grown in Sanctuary-permitted nurseries belong to FKNMS because broodstock corals were collected under a FKNMS permit after the Endangered Species Act (ESA) listing in 2006. Corals can be given away for free with the appropriate permitting, but a sale between a nursery operator and a private third party such as a hotel, cruise line, port, or dive shop cannot legally occur.

Allowing the trade of corals is a first step in establishing third-party coral mitigation banks, a developing market-based solution being considered by NOAA and the U.S. Coral Reef Task Force. The evidence from other threatened and endangered resources around the world suggests that prohibitions on trading actually exacerbate illegal poaching and increase the risk of extinction, but when resource stewards can profit from effective stewardship, recovery becomes a realistic outcome.⁶² The same could prove true for Florida's corals.

While these four proposed strategies are entirely new approaches in the marine environment, achieving the goal of restoring and conserving the FKNMS

ecosystem requires at least the consideration of new approaches that have the potential to achieve a scale that the status quo, regulation-based management regime has failed to achieve.

Conclusion

Since no one owns the coral reefs off Florida's coast, no one group has taken ownership of the problem of reef degradation. The issue is one of property rights. Because Florida's coral reefs are an open-access commons, there is neither an incentive nor a mechanism for private reef stewardship. Those who recreate by coral reefs and those who depend on reef

recreationists for their livelihood currently have no claim against those whose actions deteriorate the resource.

Defining and enforcing property rights to the reefs will require institutional reform and entrepreneurial vision. But doing so has the potential to close the coral commons and generate stable funding for reef restoration. Though full divestment of the reef resources is not likely, given the institutional constraints noted above, restoration zoning and aquaculture leases are two options for defining and enforcing quasi-ownership rights that would align the incentives of reef users with the long-term health of the resource.

About the Authors

Reed Watson, Research Fellow and Applied Programs Director, Property and Environment Research Center (PERC). Please direct inquiries to reed@perc.org.

Brett Howell, 2011 PERC Enviropreneur.

Notes

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