Final Performance (Technical) Report
October 1, 2003 through March 31, 2008

A. Grant Number: NA03NMF4630330

B. Amount of Grant: $14,200

C. Project Title: Coral Reef Conservation through Outreach: Educational Traveling Exhibit, Phase 1 (Starting in Florida)

D. Grantee: Florida State University

E. Award Period: From October 1, 2003 To March 31, 2008

F. Period Covered by this Report: From October 1, 2003 To March 31, 2008

G. Summary of Progress to Date:

PROJECT SUMMARY

This Coral Reef Conservation through Outreach project brought back to life an educational traveling exhibit which first debuted in 1996 at the 8th International Coral Reef Symposium (ICRS) in Panama. The original, a bilingual product of the Smithsonian Tropical Research Institute, was a classic museum exhibit, shipped in large wooden crates, requiring carpenter's tools for assembly. This edition, "Our Reefs: Caribbean Connections," is both a scientific and a technological update, incorporating discussion of the many changes endured by Caribbean reefs in the last 12 years within its new content, while utilizing a compact, lightweight modular system easily transported and displayed in a variety of configurations to suit numerous venues.

Goals

Both exhibits were designed and built with the same goals and purposes in mind:

- Public outreach education (formal and informal) – To expand public knowledge and understanding about the structure, function, and diversity of coral reef ecosystems and, in particular for the wider Caribbean and specifically Florida, their current status, reasons for their declines, and local efforts at sustainable utilization or restoration.
- Stimulating action – To energize the public at large to promote and support coral reef environmental conservation initiatives or, when locally appropriate, attempts at their remediation. To encourage new and publicize existing grass roots conservation and enhancement projects in Florida and the wider Caribbean. To promote volunteer-supported community activism.
- Role model – To serve as a model that, with suitable changes in content and illustrations, is adaptable for outreach education in other regions of the world.

In order to achieve these goals, in addition to finding appropriate photos and diagrams to illustrate the multifaceted story being told, another challenge was to tell it in such a way that all members of the target audiences could understand it. Much care was taken to write all text in a vocabulary and style that makes the story accessible to the public at large, regardless of age, educational level, employment, or societal position.

Target Audiences

Locally recruited docents (see below) are trained to adopt a conversational style appropriate for the age and educational level of their audiences while they help to impart the exhibit's content and meaning to visitors. Hence, our target is deliberately broad and encompasses the full range of the public at large, including:

- Decision makers – *e.g.*, business leaders, financiers, government officials, philanthropists
- General public – *e.g.*, construction workers, farmers, manufacturers, retailers
- Media – *e.g.*, reporters, radio and TV crews
- Resource users – *e.g.*, dive shop owners and staff, fishers, resort managers and staff, tourists
- Students, educators, and researchers – from day care through university

This award, in collaboration with grants from NFWF, Project Aware, and the Raymond Foundation, has enabled the recreation of a highly successful prior project. Time to develop the exhibit, track down and collect needed images of sufficient display quality, and script the new story was donated by the two curators of the original exhibit. Time to design and produce the exhibit was donated by an associate art professor at Florida State University. A fourth volunteer has devoted time to some of the administrative, logistical, and outreach tasks associated with the exhibit. Smithsonian staff suggested the type of panel system used.

Methodology

A distinguished group of scientists, outreach educators, conservationists, and other experts provided input and informal review of the exhibit content. Information updates were solicited via email, as were photographs and other graphic elements for the display.

Formative evaluations were received from colleagues who contributed photographs and information. Each contributor was asked to assess the draft script containing his/her material, and to make corrections or suggest changes. Hundreds of such interactions took place. Frequently an entire panel was sent to someone with particular expertise in the topic covered for scientific judgment on both the content and the presentation. After the design phase was completed, all draft modules were distributed to appropriate advisors for further pre-printing critique.

As in the original exhibit, each topic boasts an arresting visual introduction, a science-grounded description of the relevant problems, and examples of Caribbean peoples working on solutions. Easily identifiable-as-Caribbean locales are used to demonstrate the challenges being faced, without any kind of specific identification. Positive examples showing efforts at solutions are identified as to location, and often as to the group(s) taking leadership roles. This strategy is designed to provide the exhibit's diverse audiences with opportunities for cultural inclusion, social interaction, and a foundation for developing local pride and ownership, often the first step in stimulating the action needed to energize the public to promote and support coral reef conservation.

A key lesson learned in 1996 was that trained docents (local volunteers – *e.g.,* high school or university students, teachers, conservationists, divers, retirees) are invaluable resources in terms of helping to explain and interpret the exhibit's content to many viewers. Sufficient time and materials (including a guide to the significance of the exhibit's content) must be committed to their training at each of its venues. Some docents also receive training in the use of additional education materials, primarily for use with children. As before in other venues (although not at the 11th ICRS because of the more than 100 other exhibitors), exhibit space will be made available for local groups to contribute small displays highlighting local concerns and remedies.

Thanks to the Internet, at least financially speaking, the exhibit's content was far less costly to develop for this exhibit than for the original. As the scientifically sound content of the modules was gradually brought together, the associate professor in the FSU Department of Art began working with them on the design and layout. A series of posters was printed and laminated onto panels in-house in the Department of Art at FSU.

The type of modules used simply stack 1-meter square panels on top of and next to each other using a simple peg connector system, requiring no tools for assembly. Thus the exhibit is 2 meters high, and some multiple of meters wide, depending upon the subject. Some are four panels wide, some are three. By zigzagging the panels in accordion style, the individual panels stand without the need for any exterior support.

Panels were laminated on each side, thereby providing capacity to present twice as many topics on half as many modules as in the original. As of the premiere of the exhibit at the 11th ICRS in Fort Lauderdale in early July 2008, ten of twelve subjects, or five of six modules, were complete. As of this report, work continues on the last two subjects, on one module.

Exhibit Content

Since the original exhibit, reefs of the wider Caribbean have been subjected to, in addition to stresses from overfishing, pollution, climate change, habitat degradation, and massive die off of the herbivorous long-spined sea urchin *(Diadema)* and reef-building staghorn and elkhorn coral populations: repeated episodes of coral bleaching, an onslaught of new diseases and alien species, and added perturbations as a result of several hurricanes. Information about all of these topics has been incorporated into the exhibit.

By the numbers, the exhibit currently includes:

- 388 images, graphs, and tabular information
- 84 additional text boxes generally associated with the graphic art, including various levels of titles and subheads
- 36 square meters (387.5 square feet) of visually displayed content

Subjects covered in the initial ten modules of the exhibit include key scientific and socioeconomic topics relevant to the conservation of Caribbean coral reefs, using easily recognized examples of local problems and some locally derived solutions:

Currents

- Flowing currents link the nations of the wider Caribbean, connecting coral reefs that provide millions with goods, jobs and enjoyment.
- Seawater transports the spores, eggs and larvae of the marine organisms that populate reefs across the wider Caribbean. Some larger animals (like turtles) swim great distances to complete their life cycles.
- Seawater also brings invasive non-native species (lionfish as well as orange cup corals), diseases (the long-spined sea urchin die-off was important because they eat seaweeds which can overgrow corals or prevent coral larvae from settling), and pollutants (like toxic chemicals, plastic, tar) that harm marine animals and accumulate on windward beaches.
- Eventually all reefs are damaged by nature or, increasingly, by human activities. Their survival will depend upon the currents that continue to bring larvae, and upon humans collaborating to help reduce our harmful effects on the oceans. International laws can give endangered species (such as sea turtles) a chance to recover.

Creating a Reef (Geology)

- The stony corals that build reefs have skeletons of calcium carbonate (lime) which is laid down in layers that differ, at the micro scale, between day and night. Seasonal growth differences result in bands of alternating density that you can see with your naked eye (like tree rings). Density bands can be used to estimate the age of stony corals and annual variations in their growth rates.
- The skeletons of corals and coralline sponges (that grow too slowly to form density bands) are useful storehouses of information about past environments and of changes introduced by humans (like oil refining or lead pollution).
- Coral reefs contain the skeletons of dead corals and other reef organisms, plus calcareous sand and silt particles – skeletal fragments created by organisms which attack from inside or externally. Crustose coralline algae and sponges bind coral rubble. Calcareous crystals form in cavities, cementing the skeletons, rubble and sediment into a solid rock which is likely to undergo repeated episodes of boring, binding, infilling with silt or sand, and further cementation.
- Coral communities in fossil Pleistocene reefs (less than 1.8 million years old) were very similar to those on modern reefs. The wider Caribbean's reefs have recovered from natural catastrophes in the past, but their current declines (like that of elkhorn corals from unknown disease in the 1970-80's) are taking place in a world now dominated by a rapidly expanding human population.

Climate Change

- The increase in greenhouse gases from human activities, especially of carbon dioxide (CO_2) from the burning of fossil fuels and trees, is warming Earth and its oceans. Seawater is also becoming more acidic as it absorbs more CO_2 from the atmosphere.
- Warming will affect hurricane activity, and cause more mass bleaching events on coral reefs. Reef corals, and many other reef animals, "bleach" when they lose the tiny symbiotic algae that ordinarily inhabit their tissues, or if the algae remain but have no yellow-brown photosynthetic pigments. Prolonged bleaching kills corals and other reef organisms, or makes them more susceptible to diseases that kill.
- Switching to alternate "renewable" energy sources can reduce further warming. Solar power can be used to heat water, dry crops, desalinate water, cook food or generate DC electricity. Turbines can be powered by wind, water, steam and bagasse to generate electricity. Energy-efficient products (like LED lights or solar-powered refrigerators) consume less electricity or burn less fuel.
- Helping to reduce or offset global warming are countries that engage in "emission reduction" trades, companies (and NGOs) that invest in "carbon offset" programs, communities that plant shade trees to cool buildings, and individuals that minimize their use of powered vehicles or voluntarily contribute to projects that result in reduced warming.

Land and Reef

- Wind and water carry soil, nutrients, and pathogens into the sea. Too much sediment smothers corals and covers up the hard surfaces (dead corals) on which coral larvae need to settle. Nutrients (in sewage and other animal wastes, fertilizer) stimulate the growth of photosynthetic blue-green algae and seaweeds that can harm reef animals. High nutrient levels may also increase the severity of diseases in sea fans and corals, or prevent coral wounds from healing. Human pathogens found in some coastal waters and on nearshore stony corals create health risks for swimmers, seafood consumers, and marine organisms.
- Runoff can be reduced by maintaining, or replanting, vegetation, especially trees, on steep hillsides. Reforestation projects include trees with edible fruits (like mango) or that are used for lumber and charcoal (like cassia). Nutrients can be removed from sewage before it is released into the environment (as in artificial wetlands or low-flow Wastewater Gardens®). Coastal mangrove forests and seagrass meadows (when left intact, as not noted here!) also trap sediments and nutrients, thereby protecting nearby reefs (as also not noted here).
- Reefs benefit from farming practices that retain soil and nutrients on land (contour farming, conservation tillage, mulching or underplanting), reduce the use of chemical fertilizers (with nitrogen-fixing bacteria, or natural fertilizers), and by natural methods of pest control (integrated pest management practices, natural pesticides like neem). Markets for "sustainably" grown foods are growing, and the "added value" allows higher prices to be charged.

Vulnerable Coastlines

- Coastal habitats are degraded by poor development practices such as inappropriate land "reclamation" projects (for runways, housing developments), jetties and seawalls that disrupt natural sediment flow patterns, shipping lanes located near reefs that result in grounded vessels, pollutants in coastal runoff, ship discharges, and oil spills – both chronic and catastrophic.

- Channel dredging, beach nourishment, and road construction projects can all be designed to minimize environmental harm to coastal reefs and related ecosystems. Sandy beaches can be stabilized with dune-adapted plants. Sewage wastes in the holding tanks of small boats can be collected in dockside pump-out facilities (rather than being released into the ocean, as not noted). Trash can be deposited in containers or, when necessary, collected from nearshore areas. "Reduce, reuse, recycle" is part of the solution.
- Governments that outlaw toxins (for example, anti-fouling boat paints), change shipping traffic flow patterns and replant ship-damaged reefs are helping to reduce the damage. Although not yet adopted commercially, certain brake ferns remove arsenic from soils contaminated with lumber that had been treated with CCA (chromated copper arsenic, now banned for residential use in the USA). Opportunities to accomplish even more are likely to occur as efforts like these meet with increasingly visible success.

Paradise for Sale (Tourism)

- Large-scale tourism is important to the economies of the wider Caribbean (including Florida), but has many negative effects on local environments and societies.
- Responsible tourism providers are using renewable sources of energy (solar and wind power), reducing air pollution (like well-maintained, energy-efficient engines on some cruise ships), and using construction practices that reduce or remove the need for air-conditioning, inefficient lighting and toxic chemicals.
- They also reduce water use (with low-flow toilet fixtures or composting toilets, and by encouraging guests to reuse towels), recycle manufactured materials (like aluminum cans and glass), reuse cleansed wastewater (as when growing fruits and ornamental plants or watering lawns), and preserve or restore terrestrial vegetation.
- Tourists and tourism providers are collaborating to protect sea turtle nesting sites, establish artificial reefs and assess reef fish populations.

Depleted Harvests (Overfishing)

- Edible reef fishes and invertebrates (animals without backbones) have been overfished in most of the wider Caribbean, with large predators often having been the first to disappear. Smaller animals are removed in fine-mesh fish traps, and abandoned traps may capture prey for months before disintegrating. Particularly vulnerable to exploitation are animals that change sex as they mature, need more than one habitat to complete their life cycle, aggregate to breed or lay egg, stay in a home "territory" that is easily found, or move slowly.
- As prey become scarce, the ones that remain are smaller, of reduced economic value and harder to catch. Fishing becomes more dangerous and seafood is more costly. Reefs are more likely to be damaged by fishing gear, and animals or seaweeds that kill corals or prevent their larvae from settling are more likely to proliferate.
- Responsible fishing practices are possible when local communities are engaged in management. They include fair distribution of fishing rights, protecting nursery habitats, and restricting fishing during the reproductive season, especially at aggregation/spawning sites, and generally obeying fishery regulations. Higher prices can be charged for live or smoked fishery products.
- Plants (like edible seaweeds which photosynthesize on their own, given light and nutrients) and animals that filter their own food from seawater (like shellfish, although we don't have an example of this in the exhibit) are good candidates for marine culture. Naturally growing

sea plumes (a type of horny gorgonian coral) are being carefully cropped for cosmetics in the Bahamas, and "live rocks" cultivated for aquaria in Florida. Raising shrimps and other animals that need feeding is costly and more likely to result in environmental damage or destruction.

Marine Reserves

- Fishery reserves can help depleted fish stocks to recover naturally, but to be successful, local fishing communities must be full participants in the management process. Moreover, benefits and inconveniences must be spread equally among all groups of affected fishers. Reserves must also encompass all habitats used by the animals that are being protected (for example, nearshore patch reefs and offshore fore reefs for lobsters in the Florida Keys). Having several examples of each habitat type provides "insurance" against catastrophic losses such as may occur during hurricanes.
- Fishers can benefit by "spillover" of large animals that move away and can be caught outside of reserves or when large protected animals reproduce and their larvae are carried by currents to areas that are open for fishing. Other kinds of management actions (such as seasonal or size limits) can also benefit fisheries stocks; moreover, fish larvae are just naturally more successful at settling in some years than others, regardless of whether or not they are fished. However, locally produced larvae may be virtually absent in severely overfished areas, and many years may pass before larvae from elsewhere appear and restock a reserve.
- Fishing families can really only afford to relinquish rights to fish in reserves when other sources of income are available. Successful reserves create jobs (with training if necessary - but that is not stated in the exhibit) within the fishing community for educators, wardens or technicians. Jobs are also available for tour guides, fee collectors and concessionaires when ecotourism is compatible with the reserve, especially if "charismatic" animals (like Goliath groupers, turtles, dolphins, whale sharks) are present.

Reef Repair Experiments

- Rebuilding of fish stocks in protected reserves helps corals when the animals that harm corals are once again controlled by their own predators *(e.g.,* the lobster, grouper and snapper that are often overfished) or if populations of large parrotfishes recover and eat the algae that can kill corals or prevent their larvae from settling. And corals that grow create habitats for many other animals that depend on reefs for shelter, feeding or breeding.
- Grounding sites in seagrass meadows in the Florida Keys are being restored by planting grass plugs and adding stakes that attract birds—their droppings act as a natural fertilizer for the young grasses! Artificially rehabilitating reefs will be much harder. One approach is focused on trying to breed and reintroduce the long-spined sea urchins to remove excess seaweeds. Seafood stocks (like Queen conch) may also need artificial culturing in areas where their larvae are too scarce to naturally repopulate reefs. Preventing the accidental release of pathogens that cause diseases along with the cultured organisms is still a huge challenge.
- Some protected reefs are being restocked with live corals that have been propagated underwater from naturally occurring fragments (especially the staghorn and elkhorn corals that are important reef builders). And there are other attempts to bypass the dangers of larval transport in currents by artificially "seeding" reefs with cultured coral larvae.

The Future?

- Since everyone shares responsibility for what has already happened to coral reefs, everyone is asked to help save and protect what is left of our natural resources.
- Coral reefs have declined from decades of overfishing, sediment and other pollution, ship groundings, diseases and bleaching from global warming, introductions of alien organisms (like lionfishes), etc. When old corals die on a reef that is being overgrown by seaweeds, it has virtually no future.
- Everyone can help repair the damage that has been done. Some solutions are simple, like using trash bins or mooring buoys for dive boats. Some are difficult, like collecting invasive lionfish, or culturing corals to rehabilitate reefs. Preventing loss (as of coastal vegetation or fish spawning aggregation sites) is less costly than restoration. Remedies which are costly at first give long-term benefits (like using solar power, conserving water with composting toilets, establishing public nature trails at wastewater nutrient retention ponds).

Travel Destinations

This exhibit was designed and designated to be a traveling exhibit. The first exhibit was in two languages, and traveled throughout the English-speaking and Spanish-speaking Caribbean. For contemporary news and web coverage at the time, see:

- http://www.sanpedrosun.net/old/98-441.html
- http://stri.org/english/visit_us/bocas/visit.php
- http://www.cep.unep.org/pubs/cepnews/v11n2/ev11n2.html

Content of the new exhibit increased greatly over the first because it is restricted to text in only one language at a time, permitting more surface area to cover more subject matter. This first one is in English, designed to travel around the English-speaking parts of the wider Caribbean. After the English-language exhibit has toured sufficiently to identify any needed changes, a Spanish-language version is planned.

As a result of discussions with 11th ICRS attendees, a cadre of volunteers has pledged its support in helping in the translation of the exhibit into Spanish, as well as to help seek funds for production of the new exhibit. Several venues have been suggested for that version of the exhibit, including Honduras, Guatemala, and several places in Puerto Rico and Mexico. Plans are already in various stages of development to travel this English-language exhibit to:

Various venues in Florida, including Fort Lauderdale, the Florida Keys, Gainesville, Tallahassee, Panama City
Georgia
Louisiana
Various venues in Texas
USVI
Bahamas
Belize
Grenada
St. Vincent
St. Lucia
Dominica
Antigua
St. Kits
Nevis
Montserrat
British Virgin Islands
Anguilla
Barbuda
Tobago
Barbados

Lessons Learned

- By limiting each new edition of the exhibit to one language, almost twice as much material could be accommodated, entailing about twice as much work as for the earlier exhibit. (Definitely a good news/bad news situation!)
- Significant challenges were encountered as a result of this project not being under the umbrella of one central sponsor. Due to the lack of a singularly more vested sponsor, priorities for expenditure and allotment of staff time created significant delays in development of the exhibit.
- Appreciated from the beginning of this endeavor, exhibit content was wholly dependent upon the generosity and cooperation of many scores of people, mostly people who are only indirectly associated with this project, some of whom do not even work in this field. Although it had been anticipated that the internet would make it easier to contact and converse with people, two additional facets were not sufficiently appreciated: (1) people may have the best of intentions when promising assistance, but often get too busy with other priorities to be very responsive with follow through; and (2) although the internet and other imaging technologies have expanded exponentially, this has not necessarily translated into publication-quality images. Digital photography seems to have resulted in a superabundance of images, but very few have exhibit-quality content and resolution.
- Purchase of a laminator greatly reduced production costs and increased productivity of updates and corrections.
- Posting of a limited-access, online image database for the hundreds of digital photos submitted for possible use in the exhibit is necessary for a project of this size, all the more so when project designers and curators operate from different locations. This may also prevent loss of images as suffered when certain designed images from the original exhibit, planned to be used again in this new exhibit, were lost by the original design firm.
- In-process, qualitative evaluations during display at various venues of the first-completed modules can identify weaknesses in design and test possible alternatives early on, well before the entire exhibit has been laid out.
- Despite the ease of electronic communication, nothing beats one-on-one interaction in the design of an exhibit. Differences in meaning and nuance between vocabularies used in art and science created much more difficulty than imagined. Progress increased by about an order of magnitude when a curator and the artist could devote blocks of time (days or a week) to working together in person.

Outcomes

Like the original, this exhibit is intended to act as catalyst for community discussion and action related to Caribbean coral reefs. It may be too soon to draw substantial conclusions based solely upon Phase One, construction of the exhibit. We firmly believe that informed and motivated citizens are more likely to initiate personal and public actions that will be necessary to conserve reef resources while accommodating the socioeconomic needs of coastal populations. Moreover, based on our experiences with

its predecessor, we can attest to the excitement that is generated in nations of the American tropics (including parts of the U.S.A.) by the arrival of a regional traveling exhibition augmented by local displays when, for example, elected officials first understand environmental issues of importance to resource managers and conservationists, marine reserves requested by fishers and the diving tourism industry finally receive official status, when laypersons begin to appreciate the reasons for science-based natural resource management, or when children learn how to talk with their elders about responsible stewardship of marine ecosystems.

We can, however, report a warm reception and much interest from visitors at initial stops in Florida at the 11th ICRS and then at the Alvin Sherman Library, Research, and Information Technology Center.

Our Reefs: Caribbean Connections premiered with a ribbon-cutting ceremony, directly following opening ceremonies of the 11th International Coral Reef Symposium (ICRS) in Ft. Lauderdale, July 7, 2008. The 3,000-square foot exhibit served as the centerpiece of the ICRS Education Center, surrounded by a temporary *Coral Theater* and booths from a dozen education and outreach organizations. The Southeast Florida Coral Reef Initiative's (SEFCRI) Awareness and Appreciation Focus Team recruited volunteers to serve as docents. Docents were provided with a special guide to the exhibit and a half-day of training prior to ICRS.

The Alvin Sherman Library serves both Nova Southeastern University and the citizens of Broward County. It is the largest library building in the state of Florida (<http://www.nova.edu/library/about/events/exhibits.html>http://www.nova.edu/library/about/events/exhibits.html). It has a large room that is designed to host traveling exhibits, and a staff experienced in providing local publicity and overseeing other arrangements for visiting exhibits.

Additional Products

- A poster about the project was displayed at the Feb. 24-25, 2004, US Coral Reef Task Force Meeting at the Dept. of Commerce in Washington, DC.
- Oral presentation about the project ("Museum Displays and Traveling Exhibits") presented as part of the "Tools of the Trade: Case Studies on Communicating Coral Reef Messages" session in the Mini-Symposium "Influencing Perceptions and Behavior: The Role of Outreach Education in Coral Reef Conservation," on February 24, 2004, as part of the Eleventh Meeting of the U.S. Coral Reef Task (USCRTF), conducted at the U.S. Department of Commerce in Washington, DC.
- The prototype of the Land and Reef module was exhibited at the March 21-27, 2004, White Water to Blue Water (WW2BW) Miami Conference. Partnerships were established at the meeting with at least 45 representatives of Caribbean governments, NGOs, industry, and academia for help with content research and who will assist with future travel plans for the completed exhibit. Contacts for several local organizations to possibly host the exhibit and/or to contribute to the changing local module were also made in at least 16 countries. Additionally, this display exercise provided an excellent opportunity for evaluation of the

exhibit layout and design, as well as content of this module. Revisions were made in both format and content, based upon these evaluations.

- Bookmarks promoting the development and funding of future phases of the project were developed and distributed at the WW2BW Miami Conference.
- An oral presentation of "Coral Reef Conservation through Outreach Education" was made at the 10th International Coral Reef Symposium (ICRS) in Okinawa in June 2004, in the session "4-24. Fostering Positive Change for Coral Reefs – Education Resources." This proved to be a wonderful chance to exchange ideas with other outreach education enthusiasts and experts from around the world. The manuscript based on this talk was reviewed and published in the 10th ICRS Proceedings.
- Another talk presenting the exhibit as a model for outreach education about coral reefs was presented at the Census of Marine Life (Coral Reefs) Workshop at the Hawaii Institute of Marine Biology in August 2004.
- In 2006, two completed modules of the exhibit were displayed in late April in an open house at the Florida State University Marine Lab; at the Coral Reef Task Force meeting in Washington, D.C. in early May; and at the Southeast Florida Coral Reef Initiative's Land-Based Sources of Pollution's Technical Advisory Committee meeting at the National Coral Reef Institute in Dania Beach, Florida, in late May.
- Poster-size prints of the nine modules were taken to the March 2007 meeting of the U.S. Task Force in Washington, DC, for evaluation. Detailed critiques from NOAA and NPS staff regarding text legibility were particularly informative.
- An invited presentation about the exhibit was given at the IYOR Launch in Washington, DC, in January 2008.
- A special 11th ICRS edition *Docent's Guide* to *Our Reefs: Caribbean Connections* was published and distributed during docent training prior to the opening at ICRS. Since then, it has been revised for use in the Florida Keys. It is expected that the guide will be continually updated for each region.
- New ideas were implemented about overall floor plan and use of larger structures to help to attract visitors to a central gathering place for docents to meet with them, to guide them through it, and to encourage discussion. A distinctive entry was created with two sets of title banners. Although the original exhibit had a large central "casita" which had provided an ideal space in which groups could have discussions after viewing the exhibit; it was too bulky and heavy for this new exhibit, which has as a top priority its ease of travel and set-up. Fortunately, the technology of light-weight, folding structures has also been developing rapidly, and a sturdy free-standing canopy was found, with sides that could be printed with photos. With underwater photos of a goliath grouper, a whale shark among dog snappers, and corals with a giant barrel sponge printed on three of the canopy's six, 5' by 6' side panels, color-matched to its blue top, an inviting space has been created, evoking the wonders of a Caribbean dive, within which small school classes and other groups can gather for discussions while visiting the exhibit.
- The canopy can also be outfitted with a screen through which slides can be rear-projected from a three-sided tower that has been constructed with the remaining panels and a plywood shelf. The tower serves "double duty" as a platform where visitors can post comments/ask questions and for temporary displays with particular relevance to the local venue. Wire brochure racks are accommodated on small folding tables that, in some locations, will allow

individual use of the CD and DVD-based materials currently being assembled to travel with the exhibit.

- Press and other web coverage mentioning the exhibit may be found at the following links:
  - http://www.nova.edu/cwis/pubaffairs/sharkbytes/2008/aug6/coral_reef.html *
  - http://www.nova.edu/library/about/events/exhibits.html *
  - http://www.oglhaiti.com/coralreefPR.htm *
  - http://www.solutions-site.org/artman/publish/printer_400.shtml *
  - http://www.nova.edu/ncri/11icrs/media/press_release_educenter_062408.pdf *
  - http://www.youtube.com/watch?v=sqbvUJlNXiQ (not very good video, but exhibit is shown about 6 minutes into the 9-minute video of ICRS in Ft. Lauderdale)
  - http://www.oglhaiti.com/
  - http://www.iyor.org/icrs/Summer%20Camp%20Invite_ICRS%20.pdf
  - http://www.reef.org/node/

  * Denotes credit is given within content to NOAA funding of the exhibit.

Plans for Future Work

In order to travel the exhibit in Phase Two, funds are being sought through sponsorships from local and international organizations at each venue and through additional grants. Expenses are expected to compare well with many other traveling exhibits, based, as they will be, primarily on the actual shipping charges for an expected seven pieces of oversized aluminum trunks on wheels and the travel expenses for one member of the team to oversee erection of the exhibit and training of local docents. Costs will necessarily vary, depending on where the exhibit is coming from and going to, and will be certain to be greatly influenced by fluctuating oil prices.

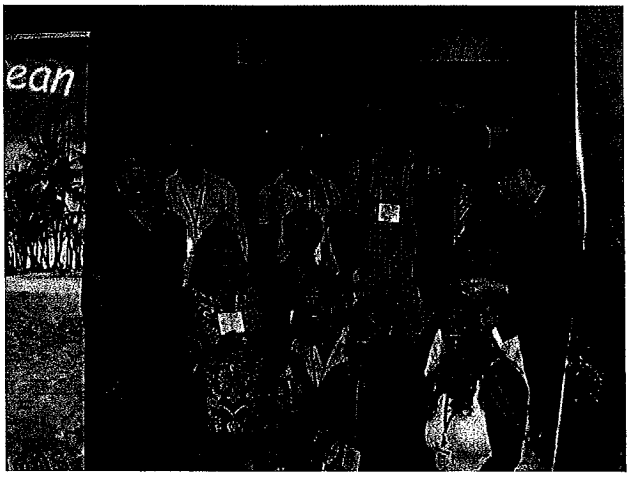
Additionally to the previously mentioned Spanish-language translation version of the exhibit, interest was shown by several people at the 11th ICRS for a French-language version as well. One group expressed great interest in designating a specific scientist to do the translation. At least one other person volunteered as well. With current technology levels, most universities have plotter printers on which they print their own technical posters to take to scientific meetings. Most of these plotters use 1-meter wide paper, thus enabling them to locally produce the panels of the exhibit for their own wall display. Further work by the artist in Fall 2008 will be required before the files will be transferable. There are several requests for these files, including the group doing the French-language translation, a coastal outdoor exhibit site in Florida and the Jamaican National Environment and Planning Agency. Teachers also requested the exhibit content be provided on CD-ROM.

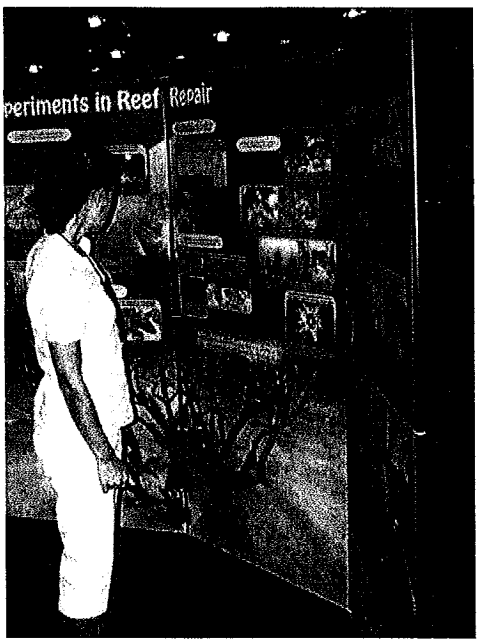
An additional request was made for the exhibit text to be compiled into a booklet.

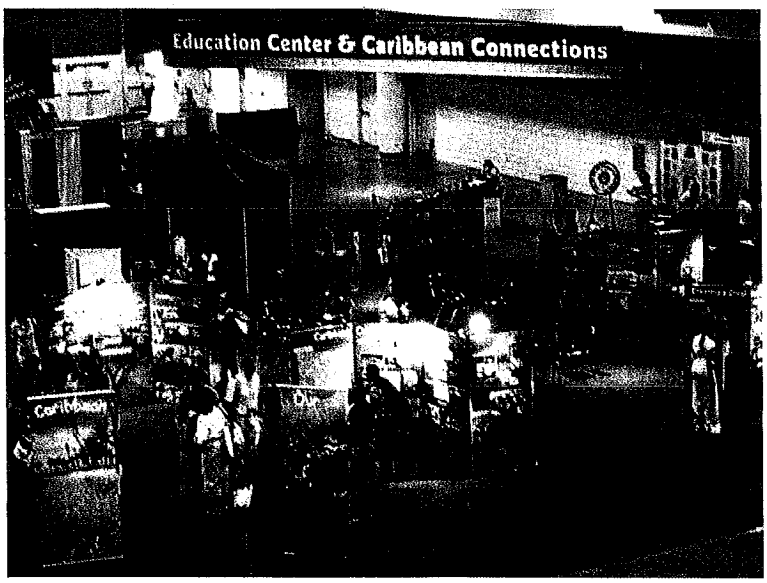
Attachments

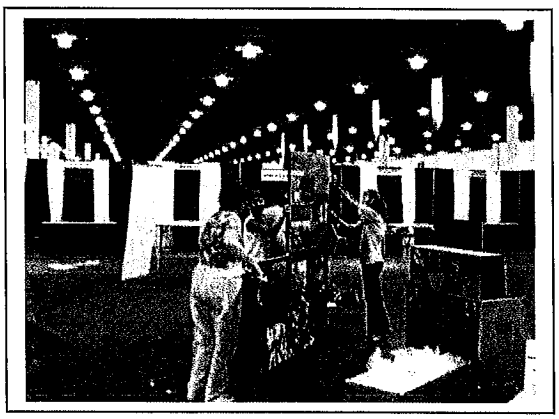
- Photos of the exhibit
- *Docent's Guide*

OUR REEFS: CARIBBEAN CONNECTIONS
11th International Coral Reef Symposium, July 2008









Thank You
for Volunteering to Serve as a Docent!

Our Reefs: Caribbean Connections Traveling Exhibit
WORLD PREMIERE AT 11TH ICRS

Thank you for taking part in making coral reef education history in South Florida!

- The 11th International Coral Reef Symposium (ICRS), the world's biggest coral reef science meeting, is taking place in Fort Lauderdale, July 7-11, at the Greater Fort Lauderdale/Broward County Convention Center. This is the first time this meeting has been held in the continental U.S. for more than 30 years.

- *Our Reefs: Caribbean Connections* traveling exhibit will celebrate its world premiere at the 11th ICRS before embarking upon a several-year sojourn throughout Florida and the wider Caribbean.

Visitors to the 3,000 sq. ft. *Our Reefs: Caribbean Connections* exhibit, centerpiece of the Education Center found in Hall A, will find a lot of information to digest. Coral reef scientists and graduate students will be immersed in the scientific program of the 11th ICRS. Folks with backgrounds in the environment, conservation, marine, and related fields serve as excellent docents for the exhibit. Faculty and upper-level and graduate students of other disciplines, particularly those with scientific, legal, social, policy, economic, and business backgrounds also provide much-needed insight to the exhibit.

Docents help interpret the exhibit to the public, helping each individual identify the personal role s/he can take to help protect our precious coral reef resource, thus becoming inspired and empowered to create the social will necessary for their conservation.

Thank you for taking advantage of this opportunity to become involved!

Volunteer docents will be the very first to see the exhibit assembled and on display. Docents are invited to a special 2-hour training event on Sunday, July 6, from 2 until 4 p.m. It will be an excellent opportunity to become personally enriched by a one-on-one experience with the traveling exhibit's creators and curators, noted coral reef scientists Drs. Judith Lang and Janie Wulff. (They were also the creators and curators of the original Smithsonian Tropical Research Institute's version of the exhibit which debuted in 1996 at the 8th ICRS in Panama.) Docents have been requested to make a minimum commitment of 8 hours (two shifts; each shift is 4 hours) during the week.

As you are aware, there is nothing simple about trying to protect and conserve an ecosystem, particularly an ecosystem with as such a global reach as coral reefs. There are very important scientific aspects that must be explored, researched, and shared with government agencies with responsibilities for these fragile natural resources. There are also entire national economies of sometimes small island states involved here, as well as nutritional and cultural traditions at stake.

"Our Reefs" explores this intricate web as it exists in the wider Caribbean, including discussions of the problems we face as a region, and examples of some of the solutions being tested. We need docents with scientific, legal, social, economic, and business backgrounds to help interpret the exhibit to the public, to help each individual identify the personal role s/he can take to help protect our precious coral reef resource and to become inspired and empowered to create the social will necessary for their conservation.

Interpreting
Our Reefs: Caribbean Connections
A Docent's Guide

INTRODUCTION

As the title of this exhibit explains, all of us who live in the Wider Caribbean are connected by a precious and fragile natural resource, coral reefs. Just as we differ as peoples, cultures, societies, and economies, our coral reefs also differ as to types, health, and species populations. Yet all are entwined and related by the ocean currents of the Wider Caribbean upon which ride the larvae and propagules of many reef organisms that propagate future growth and continuity of our coral reefs, but often the poisons, pathogens, pollution and trash that threaten to halt that continued growth as well. Naturally based threats from hurricanes, disease and thermal bleaching exacerbate the situation. Anthropogenic sources such as overfishing, CO_2 level rise contributing to global warming, overexploitation of organisms for decoration, recreation and potential pharmaceuticals and beauty products, add layer upon layer of stress to the system. Accidental contact, from a diver's casually misplaced flipper or a ship's abrupt grounding across a reef, can kill hundreds to millions of tiny live corals at a time, as well as wipe out centuries of reef structure. Reef structure is created by the layering, shifting and natural cementation of thousands of generations of corals and other reef organisms. Reef structure also provides protection, home and source of food to various types of marine organisms. Everything is related on a coral reef, whether it is as a source of protection or a source of sustenance.

The health of our planet's oceans are said to be measured by the health of its reefs. There are many kinds of reefs. Types of coral reefs are determined by water depth, latitude, currents, and geological and climatic history. Coral reefs themselves are parts of coral reef ecosystems which may be composed of one or more of the following: coral reefs, seagrass meadows, and mangrove forests.

This traveling exhibit is designed to heighten awareness, knowledge, and stewardship of coral reefs among all people of the Wider Caribbean.

HISTORY

This exhibit is a revision of an earlier traveling exhibit which was funded and developed by the Smithsonian Tropical Research Institute and was debuted at the 8th International Coral Reef Symposium in Panama in 1996. Created as a classic museum exhibit, it often required cranes and carpenters to move it from one venue to another. Since 1996, the coral reefs of the Wider Caribbean have been subject to widespread disease, thermal bleaching, and a host of other insults, including a series of stronger-than-usual hurricanes. As the exhibit wore out physically, the basis of its content degraded, as well. Original curators and creators, Drs. Judy Lang and Janie Wulff, have combined their resources and talents again, updating the content of the exhibit, and, utilizing the genius and talent of Florida State University Associate Professor of Art Keith Roberson and modern exhibit technology and flexibility, created a visually exciting and content-packed new exhibit. Instead of traveling the exhibit in huge wooden crates requiring hammer and crowbar to seal then open, this exhibit utilizes easily interlocked panels requiring no tools at all. Panels are transported in wheeled aluminum cases, readily moved from plane to truck to venue. Once arriving at its destination, the exhibit is easily put together, ready for another eager audience. It is important to note that the original exhibit was funded by Smithsonian. Although their encouragement and good wishes have been most appreciated, this effort is primarily a volunteer one. This new version was produced by Florida State University. Funding for material and supplies are gratefully acknowledged from grants from the National Fish and Wildlife Foundation (NFWF), the National Oceanic and Atmospheric Administration (NOAA), the Raymond Foundation, the Local Organizing Committee of the 11th ICRS, the National Coral Reef Institute at Nova Southeastern University, and Project Aware. All time spent in research, collection of images and information, review, design, and production have been volunteered. There is no source of funds to cover any expenses.

Generous sponsorships from agencies, universities, and other organizations and venues of the region determine the travel and display of this exhibit. To each of these, we are deeply indebted and most appreciative.

BACKGROUND

Protecting coral reefs is not as simple a quest as might be initially imagined. Coral reefs found in the Caribbean are restricted to mostly warm waters. Whole national economies of the region are based upon those warm waters and coral reefs which draw millions of tourists and an increasing number of human residents each year. Sustainability becomes the key issue, that is, to protect and conserve the continued use of the local natural resources. People's jobs, sources of food, money for expenses and government services and infrastructure, more often than not, can be traced back to the region's coral reefs. Social issues such as political stability and people's health and welfare are at stake as well. Simply creating a natural preserve for the sake of protecting coral reefs is neither wise nor practical. People whose ways of life and livelihoods are at stake ("stakeholders") can and do come together, however, to establish goals, evaluate other programs, and plan various types of protected (or partially protected) areas. (*Please note:* "marine preserves," "no-take zones," "marine-protected areas," and "marine sanctuaries" are ***not*** synonymous.) Decisions are not easy. Increasing the availability of scientific information and knowledge is challenging at best. Limitations, both fiscal and physical, restrict what is known. Parts of the moon were well mapped decades before similar maps of the coral reefs of South Florida were even started. Dates, times, and triggers of spawning for many coral reef species are still an unlocked secret. Unlike thousands of years of man's observations on land, observations of species and processes underwater are recent and usually limited by the occasion of fair seas for boat safety and the length of dives, themselves dependent upon the amount of air in a diver's tank.

PHILOSOPHY

Our exhibit is not meant to portray all doom and gloom or hopelessness. Good things are happening all over the Caribbean, both big and small. By focusing on a single topic, panels on each side of a module present authentic and readily recognized situations occurring in the Caribbean region today. Some may be indicative of bad practice or declining resource quality, but a conscious effort has been made to also show a variety of positive attempts and success stories, complete with attribution as to their source, so we may congratulate, celebrate, and emulate those as well.

Although at times the task may seem intimidating or overwhelming, the choices we make on a daily basis can and do make a difference. It is up to us as individuals, organizations, governments, and together a region, to decide whether our actions will help or harm our invaluable coral reefs, and eventually our own future.

METHODOLOGY

Depending on the available space for a particular venue, a variety of modules, a canopied discussion area, and a dedicated area to showcase the host sponsors' own coral reef conservation programs can be configured into a display. Currently, these are the modules available for exhibition. Two more are in production.

EXHIBIT HIGHLIGHTS

An overview of the Modules of *Our Reefs: Caribbean Connections* Traveling Exhibit

Currents

- Flowing currents link the nations of the wider Caribbean, connecting coral reefs that provide millions with goods, jobs and enjoyment.
- Seawater transports the spores, eggs and larvae of the marine organisms that populate reefs across the wider Caribbean. Some larger animals (like turtles) swim great distances to complete their life cycles.
- Seawater also brings invasive non-native species (lionfish as well as orange cup corals), diseases (the long-spined sea urchin die-off was important because they eat seaweeds which can overgrow corals or prevent coral larvae from settling), and pollutants (like toxic chemicals, plastic, tar) that harm marine animals and accumulate on windward beaches.
- Eventually all reefs are damaged by nature or, increasingly, by human activities. Their survival will depend upon the currents that continue to bring larvae, and upon humans collaborating to help reduce our harmful effects on the oceans. International laws can give endangered species (such as sea turtles) a chance to recover.

Creating a Reef (Geology)

- The stony corals that build reefs have skeletons of calcium carbonate (lime) which is laid down in layers that differ, at the micro scale, between day and night. Seasonal growth differences result in bands of alternating density that you can see with your naked eye (like tree rings). Density bands can be used to estimate the age of stony corals and annual variations in their growth rates.
- The skeletons of corals and coralline sponges (that grow too slowly to form density bands) are useful storehouses of information about past environments and of changes introduced by humans (like oil refining or lead pollution).
- Coral reefs contain the skeletons of dead corals and other reef organisms, plus calcareous sand and silt particles – skeletal fragments created by organisms which attack from inside or externally. Crustose coralline algae and sponges bind coral rubble. Calcareous crystals form in cavities, cementing the skeletons, rubble and sediment into a solid rock which is likely to undergo repeated episodes of boring, binding, infilling with silt or sand, and further cementation.
- Coral communities in fossil Pleistocene reefs (less than 1.8 million years old) were very similar to those on modern reefs. The wider Caribbean's reefs have recovered from natural catastrophes in the past, but their current declines (like that of elkhorn corals from unknown disease in the 1970-80's) are taking place in a world now dominated by a rapidly expanding human population.

Climate Change

- The increase in greenhouse gases from human activities, especially of carbon dioxide (CO_2) from the burning of fossil fuels and trees, is warming Earth and its oceans. Seawater is also becoming more acidic as it absorbs more CO_2 from the atmosphere.
- Warming will affect hurricane activity, and cause more mass bleaching events on coral reefs. Reef corals, and many other reef animals, "bleach" when they lose the tiny symbiotic algae that ordinarily inhabit their tissues, or if the algae remain but have no yellow-brown photosynthetic pigments. Prolonged bleaching kills corals and other reef organisms, or makes them more susceptible to diseases that kill.
- Switching to alternate "renewable" energy sources can reduce further warming. Solar power can be used to heat water, dry crops, desalinate water, cook food or generate DC electricity. Turbines can be

powered by wind, water, steam and bagasse to generate electricity. Energy-efficient products (like LED lights or solar-powered refrigerators) consume less electricity or burn less fuel.

- Helping to reduce or offset global warming are countries that engage in "emission reduction" trades, companies (and NGOs) that invest in "carbon offset" programs, communities that plant shade trees to cool buildings, and individuals that minimize their use of powered vehicles or voluntarily contribute to projects that result in reduced warming.

Land and Reef

- Wind and water carry soil, nutrients, and pathogens into the sea. Too much sediment smothers corals and covers up the hard surfaces (dead corals) on which coral larvae need to settle. Nutrients (in sewage and other animal wastes, fertilizer) stimulate the growth of photosynthetic blue-green algae and seaweeds that can harm reef animals. High nutrient levels may also increase the severity of diseases in sea fans and corals, or prevent coral wounds from healing. Human pathogens found in some coastal waters and on nearshore stony corals create health risks for swimmers, seafood consumers, and marine organisms.
- Runoff can be reduced by maintaining, or replanting, vegetation, especially trees, on steep hillsides. Reforestation projects include trees with edible fruits (like mango) or that are used for lumber and charcoal (like cassia). Nutrients can be removed from sewage before it is released into the environment (as in artificial wetlands or low-flow Wastewater Gardens®). Coastal mangrove forests and seagrass meadows (when left intact, as not noted here!) also trap sediments and nutrients, thereby protecting nearby reefs (as also not noted here).
- Reefs benefit from farming practices that retain soil and nutrients on land (contour farming, conservation tillage, mulching or underplanting), reduce the use of chemical fertilizers (with nitrogen-fixing bacteria, or natural fertilizers), and by natural methods of pest control (integrated pest management practices, natural pesticides like neem). Markets for "sustainably" grown foods are growing, and the "added value" allows higher prices to be charged.

Vulnerable Coastlines

- Coastal habitats are degraded by poor development practices such as inappropriate land "reclamation" projects (for runways, housing developments), jetties and seawalls that disrupt natural sediment flow patterns, shipping lanes located near reefs that result in grounded vessels, pollutants in coastal runoff, ship discharges, and oil spills – both chronic and catastrophic.
- Channel dredging, beach nourishment, and road construction projects can all be designed to minimize environmental harm to coastal reefs and related ecosystems. Sandy beaches can be stabilized with dune-adapted plants. Sewage wastes in the holding tanks of small boats can be collected in dockside pump-out facilities (rather than being released into the ocean, as not noted). Trash can be deposited in containers or, when necessary, collected from nearshore areas. "Reduce, reuse, recycle" is part of the solution.
- Governments that outlaw toxins (for example, anti-fouling boat paints), change shipping traffic flow patterns and replant ship-damaged reefs are helping to reduce the damage. Although not yet adopted commercially, certain brake ferns remove arsenic from soils contaminated with lumber that had been treated with CCA (chromated copper arsenic, now banned for residential use in the USA). Opportunities to accomplish even more are likely to occur as efforts like these meet with increasingly visible success.

Paradise for Sale (Tourism)

- Large-scale tourism is important to the economies of the wider Caribbean (including Florida), but has many negative effects on local environments and societies.

- Responsible tourism providers are using renewable sources of energy (solar and wind power), reducing air pollution (like well-maintained, energy-efficient engines on some cruise ships), and using construction practices that reduce or remove the need for air-conditioning, inefficient lighting and toxic chemicals.
- They also reduce water use (with low-flow toilet fixtures or composting toilets, and by encouraging guests to reuse towels), recycle manufactured materials (like aluminum cans and glass), reuse cleansed wastewater (as when growing fruits and ornamental plants or watering lawns), and preserve or restore terrestrial vegetation.
- Tourists and tourism providers are collaborating to protect sea turtle nesting sites, establish artificial reefs and assess reef fish populations.

Depleted Harvests (Overfishing)

- Edible reef fishes and invertebrates (animals without backbones) have been overfished in most of the wider Caribbean, with large predators often having been the first to disappear. Smaller animals are removed in fine-mesh fish traps, and abandoned traps may capture prey for months before disintegrating. Particularly vulnerable to exploitation are animals that change sex as they mature, need more than one habitat to complete their life cycle, aggregate to breed or lay egg, stay in a home "territory" that is easily found, or move slowly.
- As prey become scarce, the ones that remain are smaller, of reduced economic value and harder to catch. Fishing becomes more dangerous and seafood is more costly. Reefs are more likely to be damaged by fishing gear, and animals or seaweeds that kill corals or prevent their larvae from settling are more likely to proliferate.
- Responsible fishing practices are possible when local communities are engaged in management. They include fair distribution of fishing rights, protecting nursery habitats, and restricting fishing during the reproductive season, especially at aggregation/spawning sites, and generally obeying fishery regulations. Higher prices can be charged for live or smoked fishery products.
- Plants (like edible seaweeds which photosynthesize on their own, given light and nutrients) and animals that filter their own food from seawater (like shellfish, although we don't have an example of this in the exhibit) are good candidates for marine culture. Naturally growing sea plumes (a type of horny gorgonian coral) are being carefully cropped for cosmetics in the Bahamas, and "live rocks" cultivated for aquaria in Florida. Raising shrimps and other animals that need feeding is costly and more likely to result in environmental damage or destruction.

Marine Reserves

- Fishery reserves can help depleted fish stocks to recover naturally, but to be successful, local fishing communities must be full participants in the management process. Moreover, benefits and inconveniences must be spread equally among all groups of affected fishers. Reserves must also encompass all habitats used by the animals that are being protected (for example, nearshore patch reefs and offshore fore reefs for lobsters in the Florida Keys). Having several examples of each habitat type provides "insurance" against catastrophic losses such as may occur during hurricanes.
- Fishers can benefit by "spillover" of large animals that move away and can be caught outside of reserves or when large protected animals reproduce and their larvae are carried by currents to areas that are open for fishing. Other kinds of management actions (such as seasonal or size limits) can also benefit fisheries stocks; moreover, fish larvae are just naturally more successful at settling in some years than others, regardless of whether or not they are fished. However, locally produced larvae may be virtually absent in severely overfished areas, and many years may pass before larvae from elsewhere appear and restock a reserve.
- Fishing families can really only afford to relinquish rights to fish in reserves when other sources of income are available. Successful reserves create jobs (with training if necessary - but that is not stated

in the exhibit) within the fishing community for educators, wardens or technicians. Jobs are also available for tour guides, fee collectors and concessionaires when ecotourism is compatible with the reserve, especially if "charismatic" animals (like Goliath groupers, turtles, dolphins, whale sharks) are present.

Reef Repair Experiments

- Rebuilding of fish stocks in protected reserves helps corals when the animals that harm corals are once again controlled by their own predators *(e.g.,* the lobster, grouper and snapper that are often overfished) or if populations of large parrotfishes recover and eat the algae that can kill corals or prevent their larvae from settling. And corals that grow create habitats for many other animals that depend on reefs for shelter, feeding or breeding.
- Grounding sites in seagrass meadows in the Florida Keys are being restored by planting grass plugs and adding stakes that attract birds—their droppings act as a natural fertilizer for the young grasses! Artificially rehabilitating reefs will be much harder. One approach is focused on trying to breed and reintroduce the long-spined sea urchins to remove excess seaweeds. Seafood stocks (like Queen conch) may also need artificial culturing in areas where their larvae are too scarce to naturally repopulate reefs. Preventing the accidental release of pathogens that cause diseases along with the cultured organisms is still a huge challenge.
- Some protected reefs are being restocked with live corals that have been propagated underwater from naturally occurring fragments (especially the staghorn and elkhorn corals that are important reef builders). And there are other attempts to bypass the dangers of larval transport in currents by artificially "seeding" reefs with cultured coral larvae.

The Future?

- Since everyone shares responsibility for what has already happened to coral reefs, everyone is asked to help save and protect what is left of our natural resources.
- Coral reefs have declined from decades of overfishing, sediment and other pollution, ship groundings, diseases and bleaching from global warming, introductions of alien organisms (like lionfishes), etc. When old corals die on a reef that is being overgrown by seaweeds, it has virtually no future.
- Everyone can help repair the damage that has been done. Some solutions are simple, like using trash bins or mooring buoys for dive boats. Some are difficult, like collecting invasive lionfish, or culturing corals to rehabilitate reefs. Preventing loss (as of coastal vegetation or fish spawning aggregation sites) is less costly than restoration. Remedies which are costly at first give long-term benefits (like using solar power, conserving water with composting toilets, establishing public nature trails at wastewater nutrient retention ponds).

THANKS AND APPRECIATION

Thanks to everyone who has helped with the production of this exhibit, and especially **a huge thank you very much to you for helping us bring the exhibit** to the public in Ft. Lauderdale. We thank you for your efforts to get this message out, to help people see and do what can be done to protect and conserve the coral reefs of the Wider Caribbean. Thank you!