Introduction to the Smithsonian Marine Science Network

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ABSTRACT. The "Smithsonian Marine Science Symposium" contained more than 70 oral and poster presentations by Smithsonian scholars and collaborators and represented the first major dissemination of marine research results since the establishment of the Marine Science Network (MSN) in 1998. The MSN operates a unique array of laboratories and research vessels that spans the latitudinal gradient of the western Atlantic (Chesapeake Bay, Indian River Lagoon, Mesoamerican Barrier Reef, and Panamanian Coast) and crosses the isthmus of Panama. The Network is dedicated to understanding the rich biodiversity and complex ecosystem dynamics that sustain coastal processes and productivity. We study evolutionary, ecological, and environmental change in the ocean's coastal zones, increasing scientific knowledge of these environments and improving society's appreciation of the ocean's effect on our lives. Coastal environments are of immense economic and environmental importance and comprise 95% of the ocean's fisheries. Our coasts are the most densely populated and fastest growing communities in the USA. The MSN ensures integrated support of "Discovering and Understanding Life's Diversity," a core Smithsonian scientific mission. The MSN's goals are to ensure that the whole of the integrated Network is larger than the sum of its parts, leading to enhanced productivity through collaborative and comparative research, marine infrastructure development and support, professional training and outreach, and effective allocation of resources.

INTRODUCTION

The "Smithsonian Marine Science Symposium" was held 15–16 November 2007 to celebrate individual and long-term pan-institutional marine research, with a particular focus on highlights of the first ten years since the establishment of the Marine Science Network (MSN) in 1998. The symposium was convened by the Office of the Under Secretary for Science and represented the first gathering, of this magnitude, of Smithsonian marine scientists. The symposium presented marine research findings by Smithsonian scholars and their collaborators with emphasis on marine biodiversity, evolution, and speciation; biogeography, invasive species, and marine conservation, including life histories and microbial and behavioral ecology; and forces of ecological change in marine systems. The symposium carried on a tradition of Smithsonian marine science that began nearly 150 years ago and resulted in some of the world's foremost collections of marine specimens. More than 70 presentations

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and posters discussed results of marine research from the Chesapeake Bay, Indian River Lagoon and Florida Keys, the Mesoamerican Barrier Reef in Belize, the Atlantic and Pacific Coasts of the Isthmus of Panama, and other international research sites. Thirty-nine papers from this symposium are presented in this 38th volume of *Smithsonian Contributions to the Marine Sciences*, and additional marine education posters reside on http://www.si.edu/marinescience. Smithsonian speakers included marine research leaders, collaborators, and fellows from the Smithsonian Environmental Research Center, National Zoological Park, National Museum of Natural History, Smithsonian Marine Station at Fort Pierce, Caribbean Coral Reef Ecosystems Program, Smithsonian Tropical Research Institute, and the Office of the Under Secretary for Science.

The Smithsonian Institution operates a unique network of coastal laboratories and long-term research sites on the east coast of North and Central America that extends along the western Atlantic Ocean and bridges the Panamanian isthmus from the Caribbean Sea to the Pacific Ocean (Figure 1). Scientific diving supports a significant amount of Smithsonian marine research throughout the Network and internationally (Lang and Baldwin, 1996; Lang, 2007).

The Marine Science Network concept was developed in 1998 from the bottom up and has achieved the following important milestones:

1998: Formalization of a pan-institutional Smithsonian Marine Science Network initiated at two-day inaugural workshop at Smithsonian Environmental Research Center, with more than 50 Smithsonian Institution participants.
1999: Dedication of new Carrie Bow Cay Marine Field Station.
1999: Dedication of new Smithsonian Marine Station at Fort Pierce.
2000: MSN concept and infrastructure allocations approved by the Under Secretary for Science.
2001: Launch of the MSN website www.si.edu/marinescience.
2001: Annual MSN Calls for Proposals for infrastructure, marine research awards, and postdoctoral fellowships.
2003: Dedication of Bocas del Toro Marine Laboratory.
2006: Science Executive Committee review of Smithsonian marine science, including MSN.
2007: Formulation of Big Questions in Marine Science:
1. What are the major spatial and temporal patterns in distribution of biodiversity?
2. How does biodiversity, and the loss of biodiversity, affect the functioning of ecosystems?
3. How are humans changing the magnitude and distribution of biodiversity and what are the patterns and consequences?

2007: Smithsonian Marine Science Symposium.

The MSN is administered as a pan-institutional program through the Office of the Under Secretary for Science. It is governed by a seven-member Steering Committee composed of Michael Lang (Office of the Under Secretaray for Science), Anson Hines (Smithsonian Environmental Research Center), Eldredge Bermingham (Smithsonian Tropical Research Institute), Klaus Ruetzler (National Museum of Natural History), Robert Fleischer (National Zoological Park), Valerie Paul (Smithsonian Marine Station at Fort Pierce), and Phillip Taylor (National Science Foundation). Additional Smithsonian scientists participate by invitation in MSN research proposals and postdoctoral fellowship review panels, MSN symposia and workshop committees, and special projects. Support for MSN infrastructure, research, and postdoctoral fellowships is provided by the Office of the Under Secretary for Science's Johnson and Hunterdon Oceanographic Research Endowments.

There are four main unifying disciplinary themes to Smithsonian marine research: systematics, evolutionary biology, ecology, and geology. Biogeography is a key research element, linking systematics, ecology, and evolutionary biology. Mechanisms of biogeographic isolation are central elements in evolutionary theory, population dynamics, conservation biology, and patterns of biodiversity. Biogeographic patterns are crucial data in the determination of introduced and native species. Site-specific, long-term measurements of environmental variables allow for analysis of change over multiple time scales, which is necessary to detect patterns in typically complex ecological data. The Smithsonian Marine Science Network is uniquely positioned to monitor long-term change at its component sites. It has an extensive array of programs that address many of the most pressing environmental issues in marine ecosystems, including biological invasions, eutrophication, harmful species and parasites, plankton blooms and red tides, linkages among coastal ecosystems, global warming including sea-level rise, El Niño/La Niña effects, UV radiation impacts, habitat destruction, fisheries impacts, ecology of key habitats (estuaries, coral reefs, mangroves, seagrasses, wetlands), and biodiversity inventories.

The Smithsonian's marine education programs consist of public outreach and professional training. A series

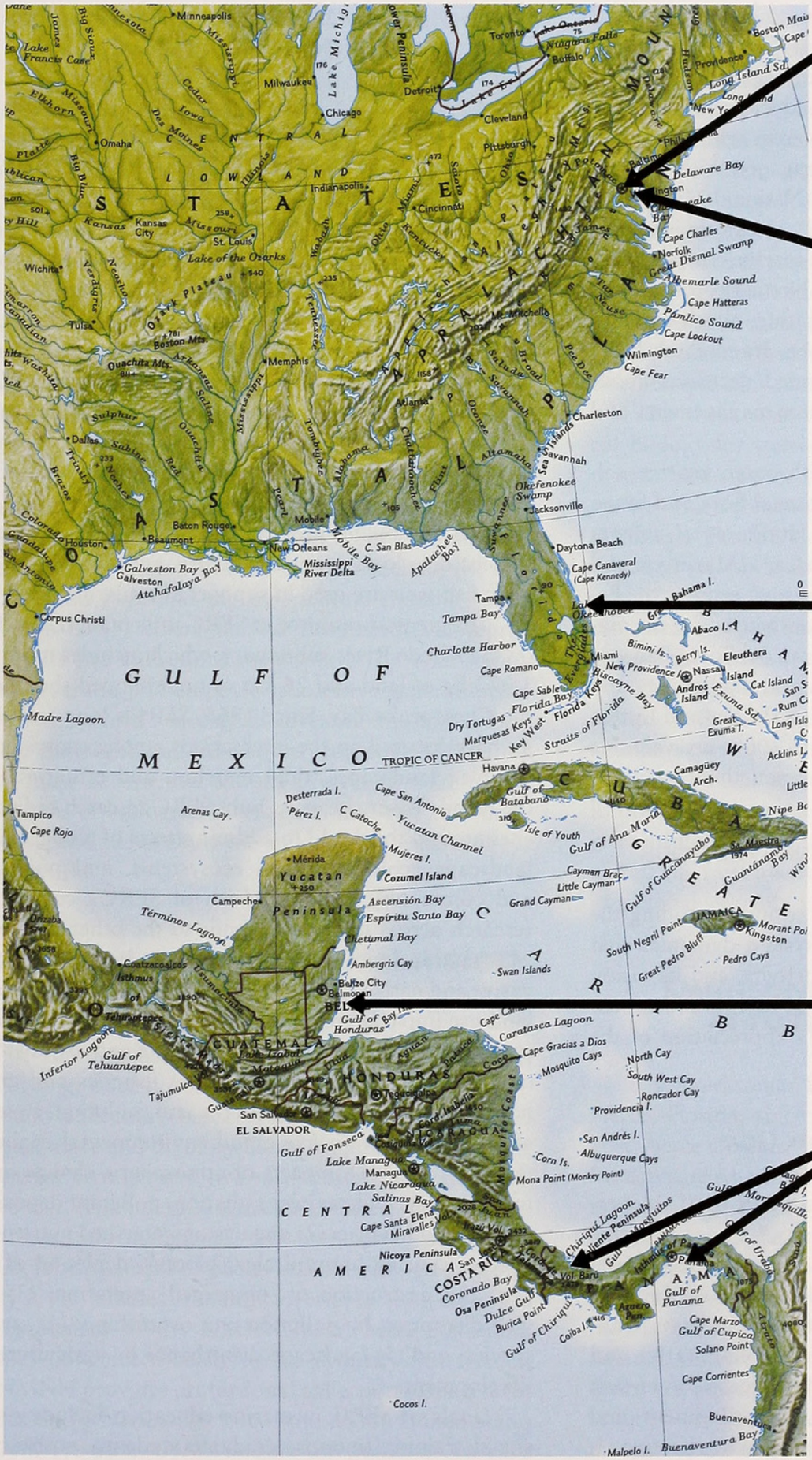

FIGURE 1. Map showing locations of the Smithsonian Marine Science Network members.

of these activities are aimed at promoting awareness and conservation of marine environments and at communicating the Smithsonian's research findings to the general public. By integrating research with education, the Smithsonian produces tomorrow's discoverers while pursuing today's discoveries. The public is engaged with interactive exhibits and scientists (e.g., the National Museum of Natural History's Sant Ocean Hall), symposia, popular books, lectures, and films about the marine environment. The Smithsonian Marine Science Network contributes to the public interest by disseminating novel environmental information around the globe. Its research helps build a solid foundation for informed decisions about environmental policy, natural resource management, and conservation.

Other recent coordinated Smithsonian marine science efforts of note are marine-terrestrial flora and fauna of Cayos Cochinos Archipelago, Honduras (Guzman, 1998), natural history of the Pelican Cays (Macintyre and Rützler, 2000), the Twin Cays mangrove ecosystem, Belize (Macintyre et al., 2004), and investigations of the marine fauna and environments of Bocas del Toro, Panama (Collin, 2005). Smithsonian taxonomic field guides and keys of algae, invertebrates, and fishes (Littler and Littler, 2000; Collin et al., 2005; Robertson, 2009) are valuable tools for biologists, divers, and fishermen alike.

Marine Science Network Mission and Vision

The MSN mission is dedicated to understanding the rich biodiversity and complex ecosystem dynamics that sustain coastal processes and productivity, and its vision is "to increase scientific knowledge of marine coastal environments and to improve society's appreciation of the ocean's effect on our lives."

Marine Science Network Goals

The MSN provides integrated support of "Discovering and Understanding Life's Diversity," a core scientific mission of the 2005–2010 Smithsonian Science Strategic Plan. The MSN ensures that the whole of the integrated Network is greater than the sum of its parts, leading to enhanced productivity through collaborative and comparative research facilitated by increased inter-unit coordination, marine infrastructure development and support, professional training and outreach, effective allocation of research funding, and transparent management, participation, and support for Smithsonian marine scientists through availability of shared resources and facility access.

SMITHSONIAN ENVIRONMENTAL RESEARCH CENTER (CHESAPEAKE BAY)

The Smithsonian Environmental Research Center (SERC) advances stewardship of the biosphere through interdisciplinary research and education. With a resident staff of more than 100 scientists, technicians, fellows, and students, SERC has experienced significant growth in the last few years. The SERC laboratories, educational facilities, and primary field sites are located 25 miles east of Washington, D.C., on the western shore of Chesapeake Bay. Its campus includes a growing complex of offices, laboratories, maintenance shops, a library, housing, and facilities for public programs. A dock, fleet of research vessels, dive locker, wet laboratory, aquarium room, and large fish-weir are used in support of estuarine research.

The greatest resource at SERC is its main research site on the Rhode River subestuary, which includes more than 1,072 ha of land and 26 km of undeveloped shoreline of the Chesapeake Bay. Since 1965, SERC's long-term studies have focused on the interactions among ecosystems in complex landscapes, tidal marshes, and estuaries. With the Rhode River site as its hub, SERC research radiates to sites around the world to address effects of global change, landscape ecology, coastal ecosystems, and population and community ecology. Much of SERC's comparative research across latitudes extends to the other sites of the MSN and includes studies of mangrove biocomplexity, invasive and native species biodiversity, estuarine food webs, land use impacts linked to water quality, carbon processing and global change, nutrient loading and low dissolved oxygen, ecosystem management of fisheries and crucial habitats, and life history patterns and evolution. Research at SERC focuses on five grand environmental challenges (Hines, 2009): (1) impacts of atmospheric change on climate, sea level, ultraviolet radiation, pollutant deposition, and carbon balance; (2) impacts of watershed nutrient discharges causing harmful algal blooms, depletion of oxygen, and destruction of submerged vegetation; (3) food web disruption by pollution and overfishing; (4) invasive species; and (5) landscape disturbance by agriculture and development.

Goals of SERC in marine education include professional training (interns, graduate students, postdoctoral fellows, and visiting scientists), teacher training, site visits and public programs, and distance learning.

NATIONAL ZOOLOGICAL PARK (WASHINGTON, D.C.)

The Smithsonian's National Zoological Park (NZP) was founded in 1889. Its mission is to provide leadership in animal care, science, education, and sustainability. Approximately 2,000 individuals of 400 different species constitute its animal collection. The NZP consists of a 163 acre urban park located in Rock Creek Park in northwest Washington, D.C., and the 3,200 acre Conservation and Research Center in Front Royal, Virginia, emphasizing reproductive physiology, analysis of habitat and species relationships, and the training of conservation scientists.

The National Zoological Park conducts international marine research on sea turtles and sea birds, ecology of bottlenose dolphins, Weddell seal lactation, life history and reproductive strategies of gray and harbor seals, nutritional ecology of sea otters, and cryopreservation of endangered coral species. Marine exhibits include the Seal and Sea Lion Pool and the Invertebrate Exhibit, which opened in 1987, where marine invertebrates comprise 75% of its live collections on display. The NZP's tools to inspire, train, and empower successive generations to care for the world's biological diversity are its exhibits, science, outreach, and education programs. Ultimately, efforts must be oriented toward protecting wildlife and other forms of biological diversity so that we, and future societies, continue to enjoy the incalculable benefits of our natural world.

NATIONAL MUSEUM OF NATURAL HISTORY (WASHINGTON, D.C.)

The National Museum of Natural History (NMNH) has a distinguished history of more than 150 years of sampling and collections-based research. Major collections represent algae and dinoflagellates, foraminifera, sponges, cnidarians, ctenophores, worms, crustaceans, mollusks, bryozoans, echinoderms, tunicates, fishes, marine reptiles, birds, and mammals), now numbering more than 33,000,000 specimens of plants and animals. Of approximately 2,415 families of marine invertebrates, nearly 67% are represented in the NMNH invertebrate collection, which is not limited solely to the diversity-rich tropics. The NMNH provides professional collection management services to the National Science Foundation United States Antarctic Program (USAP) and the international scientific community. A primary focus of this project is improving access to the collections through its cataloging (inventory) program (more than 900,000 USAP specimens) and loan program. More than 170,000 USAP specimens in 138 separate transactions were either lent or returned from loan between 1995 and the end of 2004, supporting the research efforts of scientists in 22 countries. Several hundred lots of archive samples from the Palmer Long-Term Ecological Research Program were also accessioned (Lemaitre et al., 2009).

The focus of marine science at NMNH addresses the diversity of marine life, where species occur, how they are related to each other, how marine diversity developed and how it is maintained, what are the human impacts on marine life, and how marine life-forms are used by people.

The Museum administers the Laboratories of Analytical Biology for state-of-the art molecular work and two marine field stations (Carrie Bow Cay, Belize, and Smithsonian Marine Station at Fort Pierce, Florida), member facilities of the MSN. Since 1966 the Museum has funded the *Atoll Research Bulletin*, which publishes research reports on the geology and ecology of islands and their adjacent coral reef and mangrove communities in tropical sites around the world.

The NMNH Ocean Initiative comprises the Sant Ocean Hall, the Ocean Web Portal, the Sant Chair in Marine Science, and interdisciplinary marine research at NMNH. Virtual access to the Museum's key marine collections is being created. The Initiative aims to train future generations of marine scientists and educate the public about, and raise awareness of, the importance of the ocean as a global system.

SMITHSONIAN MARINE STATION AT FORT PIERCE (FLORIDA)

The Smithsonian Institution has had a presence in Fort Pierce, Florida, since 1969 and was known then as the Fort Pierce Bureau. From 1969 to 1981, the Fort Pierce Bureau carried out studies including underwater oceanography with research submersibles, a survey of the Indian River Lagoon, coral reef research, and research on life histories of marine invertebrates, partly in collaboration with the newly formed Harbor Branch Foundation (now the Harbor Branch Oceanographic Institution at Florida Atlantic University). In 1981, the Fort Pierce Bureau was dissolved, and in its place the Smithsonian Marine Station at Link Port was formally recognized as an organizational unit under the auspices of the National Museum of Natural History. The Station took over the barge, acquired originally by the Smithsonian in 1973 from federal surplus, that

was docked at the Harbor Branch campus. In 1996, the Smithsonian purchased, from the MacArthur Foundation, 8 acres of property 7 miles south near the Fort Pierce Inlet with easement access to the Indian River Lagoon. St. Lucie County enacted a 25 year lease of a county dock and adjacent land at a site on the inlet across from the Station, whose main building was completed and dedicated in 1999.

The Smithsonian Marine Station at Fort Pierce (SMSFP) is a marine science research center located on the Indian River Lagoon along 156 miles of Florida's central Atlantic coast. The Indian River Lagoon is a long, narrow, and shallow estuary adjacent to the Atlantic Ocean, separated by a strip of barrier islands. Biologists at SMSFP have the advantage of working just 20 miles from the Florida current, a stream of warm water from the Caribbean that moves northward past Florida's coastline as part of the larger, complex system of currents known as the Gulf Stream. The current carries with it many tropical marine organisms, allowing researchers to work at the interface of the Northern Hemisphere's tropical and temperate regions. Situated in a biogeographic transitional zone between the temperate and subtropical provinces, the SMSFP facility provides access to an extraordinary diversity of marine and estuarine species and to a variety of habitats, which include mangroves, salt marshes and sandy beaches, rocky intertidal substrates, seagrass beds, mud and sand flats, coral reefs, worm reefs, *Coquina* hard bottoms, deep coral rubble zones, shallow- to deep-water sandy plains, and the blue waters of the Gulf Stream.

The Marine Station supports and conducts scholarly research in the marine sciences, emphasizing studies of biodiversity, life histories, and ecology of marine organisms (Paul et al., 2009). The results of this research enable policy makers to make informed environmental decisions in guiding conservation and sustainable management of marine resources, as well as providing the basis for innovative applications in medicine, aquaculture, and the effective balance between development and conservation. For Smithsonian scientists, the SMSFP provides an important link with other MSN facilities in the tropics at the Smithsonian Tropical Research Institute (STRI) in Panama and Carrie Bow Cay in Belize and in the temperate region, the Smithsonian Environmental Research Center on the Chesapeake Bay.

The facilities at the Smithsonian Marine Station at Fort Pierce include an 8,000 square foot facility that houses a histology laboratory, an electron microscopy lab, a confocal microscope, a combination electrophoresis/DNA/chemistry laboratory, a photographic darkroom, flow-through seawater tables and aquaria, an industrial shop, and offices and laboratories for visiting scientists and fellowship recipients. The 39-foot R/V *Sunburst* and two smaller vessels are used for scientific diving, dredging, and trawling in the Indian River Lagoon, Continental Shelf, and Gulf Stream.

The Marine Station's educational efforts include postdoctoral fellows and interns, public events and lectures, school programs and public tours, a web site, the Indian River Lagoon Species Inventory, and the Marine Ecosystems Exhibit, which was established in 2001 with the following ecosystems on display: coral reef, seagrass, mangrove, hardbottom and nearshore habitats, and *Oculina* reef).

CARIBBEAN CORAL REEF ECOSYSTEMS PROGRAM (CARRIE BOW CAY, BELIZE)

Coral reefs are unique biogeological structures that thrive in clear, nutrient-poor (oligotrophic) tropical oceans and support a rich and diverse biological community. Reef systems are driven by the symbiosis between scleractinian corals and microscopic dinoflagellate algae (zooxanthellae) as their chief energy source. The largest, best developed, least polluted, and least commercially exploited coral reef in the Atlantic region is the Mesoamerican Barrier Reef in Belize. It is a complex of reefs, atolls, islands, oceanic mangroves, and seagrass meadows that extends over 160 km. For its unique characteristics and unperturbed condition, the Belize barrier reef has been declared a World Heritage Site.

In the early 1970s, Rützler et al. (2009) discovered the formidable qualities of the Belize (then British Honduras) barrier reef. After careful comparison with other locations in the western Caribbean, it was chosen as the site of an interdisciplinary long-term study of systematics, ecology, behavior, and evolution of reef organisms and the dynamics and historical development of reef communities (Rützler and Macintyre, 1982). Carrie Bow Cay, only three hours by plane and boat from Miami, was found to be the ideal logistical base because of its location on top of the barrier reef, only meters away from a variety of habitat types (reef flat, spur and groove, deep fore-reef slope, patch reefs, seagrass meadows, and mangroves), and its undisputed ownership by a Belizean family able to cater to all Smithsonian needs for lodging, food, local transportation, and contacts with government.

In 1985, as part of the U.S. Congress Caribbean Basin Initiative, the National Museum of Natural History received an increase to its budget base to continue and intensify study of Caribbean coral reef ecosystems. These funds allowed for the expansion of research facilities on

Carrie Bow Cay and the update of CCRE equipment. In the years since, CCRE has accomplished the following: amassed thousands of specimens of marine plants, invertebrates, and fishes, which are organized in an enormous database; assisted the government of Belize in shaping and justifying its coastal conservation policy; participated continuously in the Caribbean-wide reef monitoring network (CARICOMP); established the first meteorological oceanographic monitoring station in coastal Belize; and, above all, published well over 850 scientific papers in reviewed journals, as well as several books, doctoral dissertations, popular articles, and photo and video documentaries. Between 60 and 80 scientists use Carrie Bow Cay each year as a part of ongoing CCRE research.

The Carrie Bow Cay Laboratory serves primarily in support of SI marine scientists' research projects and their external collaborators. Seasonal hurricanes during the past 35 years could not destroy Carrie Bow Cay facilities to the extent that a devastating fire did in December 1997. Improved facilities now include dry and wet labs, housing, generator, compressor, small boats and scuba cylinders, and essential facilities such as solar power, a running-seawater system, and weather station.

CCRE's educational and outreach programs include its Belize teachers' mangrove workshops, publications, symposia, advisory consults with Belizean Ministries, and fellows and interns.

SMITHSONIAN TROPICAL RESEARCH INSTITUTE (REPUBLIC OF PANAMA)

The Smithsonian Tropical Research Institute's (STRI) marine research program in the Republic of Panama dates to 1964 when small laboratories were established on the Pacific and Caribbean coasts within the former Canal Zone. Today, STRI operates marine stations at Bocas del Toro and Galeta Point in the Caribbean and the Naos marine laboratory complex in the Pacific. Until 2008, the R/V *Urraca*, a 96 foot nearshore coastal oceanographic vessel, was outfitted with remotely operated vehicle, scientific diving, and dredging capabilities, and was operated under University National Oceanographic Laboratory System (UNOLS) research fleet standards.

At the Panama Canal, the Isthmus of Panama narrows to less than 100 km, separating oceans that are very different tropical marine ecosystems. The Caribbean is a relatively stable ocean, with small fluctuations in temperature and relatively low tidal variation. Its transparent, nutrient-poor waters are ideal for the growth of reefs, and it ranks just behind the Indian Ocean and the Indo-West Pacific in terms of numbers of marine species. The tropical eastern Pacific, in contrast, exhibits much greater fluctuations in tides and temperature, with seasonal upwelling locally and longer-term variation resulting from the El Niño southern oscillation cycle. Its more nutrient-rich waters support commercial fisheries of major importance. The creation of these two distinct marine realms by the rise of the Isthmus of Panama during the past 10 million years also contributed to the formation of the modern biological and geological world. During this interval, the Gulf Stream was established, the mammals of North America conquered a newly connected South America, the Ice Ages began, and modern man arose. The Isthmus played a major role in this history, and set in motion a fascinating natural experiment, as the animals and plants of the two oceans went their separate evolutionary ways.

There are also major differences within each ocean. In the Pacific, seasonal upwelling of nutrient-rich waters is strong in the Gulf of Panama, where trade winds blow freely across the Isthmus, but absent in the Gulf of Chiriqui, where the high terrain blocks these winds. The more stable conditions in the Gulf of Chiriqui support the best developed coral reefs in the tropical eastern Pacific. On the Caribbean side, the San Blas Archipelago is bathed in clear oceanic waters, whereas the reefs and mangroves of the enormous Chiriqui Lagoon of Bocas del Toro are enriched by runoff from the land. Thus, Panama can be considered a nation of four ocean types, providing unique opportunities for understanding how and why marine ecosystems function as they do.

Understanding the history and ecology of Panama's diverse marine environments has been a major theme of STRI's research over the past four decades (Robertson et al., 2009). Major programs include between-ocean comparisons of physical and biological oceanography, geological reconstruction of events leading up to and following the rise of the Isthmus, studies of marine biodiversity, and analyses of the vulnerability of marine habitats to natural and anthropogenic change. In celebration of STRI's role in coral reef research, the Smithsonian's 150th anniversary, and the International Year of the Reef, the Smithsonian hosted the Eighth International Coral Reef Symposium in Panama in 1996. This meeting brought 1,500 reef scientists and managers to Panama from around the world and resulted in the publication of a two-volume proceedings (Lessios and Macintyre, 1997) and an international traveling exhibit that has already brought STRI's marine discoveries to Miami, the District of Columbia, Honduras, and Jamaica.

The Marine Environmental Sciences Program (MESP) at STRI collects and analyzes fundamental oceanographic information that provides critical information for studies such as El Niño and coral bleaching. The Panama Paleontology Project in Bocas del Toro seeks to record the history of the divergence between the two oceans over the past 10 million years and the evolutionary response of marine organisms to these changes. Results from this project are the geological reconstruction of the closure of the Isthmus of Panama 3 million years ago and the discovery of a major extinction event in the Caribbean about 2 million years ago. Through a combination of molecular and paleontological information, STRI's molecular evolution program has developed a model system for determining the rate at which organisms diverge genetically through time (Panama molecular clock). This achievement allows for the phylogenetic reconstruction of marine life elsewhere in the world.

Educational programs within STRI include a marine fellowship program, school group visits (Culebra Nature Center, Galeta Point Marine Lab, Bocas del Toro Lab), public seminars, advisory consults with the Panamanian government, and graduate courses.

CONCLUSION

The Smithsonian Institution is unique among federal agencies, research organizations, and universities with its investment in comprehensive, long-term marine studies of crucial ecosystems at a latitudinal gradient of stable sites. Thousands of marine science publications provide results and data for synthesis and a new baseline for modeling and forecasting. Continued opportunities remain for many important marine organisms to be identified by conventional and molecular techniques and described. Deep reefs are becoming increasingly important as a focal area to understand how the reef system in toto functions and to quantify their physical, chemical, and biological contributions to the shallow reefs that we have studied for more than three decades (Lang and Smith, 2006). Life histories require further analysis to aid ecological understanding and fisheries management. Thirty-five-year multidisciplinary databases allow for early detection and evaluation of community changes, invertebrate diseases, invasive species, and recruitment caused by environmental degradation and catastrophic events.

The MSN continues to provide support for individual and pan-institutional collaborative research, postdoctoral marine science fellows, marine science staff and infrastructure support, marine outreach and education, and workshops and symposia: for example, Bocas del Toro taxonomy; coral reef management; mangrove ecology of Twin Cays, Belize; marine genetics; sea turtle conservation and population management; seagrass and mangrove ecosystems; neogastropod evolution; marine invasives of the Gulf of Mexico; and marine invasive species across latitudinal gradients. Outcomes of the integration of the Smithsonian marine facilities and programs since 1998 are the facilitated freedom of movement of scientists between units and the increased collaborations and co-authored publications. The MSN was highlighted as a model for pan-institutional Smithsonian programs by the Smithsonian Science Commission in 2003. The most likely keys to its success were the bottom-up development of the Network concept, starting with the Institution's staff scientists, and the availability of research funding through the Office of the Under Secretary for Science to enable marine research and postdoctoral fellowships.

The Smithsonian Marine Science Network and the Smithsonian Scientific Diving Program provide the facilities and support for the efficient conduct of marine research. The primary objective of the marine research effort is the advancement of science. The deliverable is mainly in the form of peer-reviewed publications for dissemination throughout the scientific community and to the public.

The importance of the MSN is its contribution to the knowledge of complex ecosystems including seagrasses, mangrove islands, bays, estuaries, and coral reefs, and the preservation of these precious resources by learning about their rich biodiversity, function, and interconnectedness. Only a long-term commitment will allow us to understand the dynamics of coastal processes and organisms, obtain the cooperation of the public, and educate a new generation.

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