

# BBP in Brief

A NEWSLETTER OF THE BAHAMAS BIOCOMPLEXITY PROJECT

Produced by the American Museum of Natural History's Center for Biodiversity and Conservation (AMNH-CBC)

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## Welcome...

This is the newsletter of the Bahamas Biocomplexity Project, or "BBP," also available at <http://bbp.amnh.org/bbpinbrief/>. Here you can learn about the activities and progress of the BBP team and its partners. We welcome your submissions about research progress, upcoming field plans, meetings, or any other information you feel would be of interest to project partners. Submissions for consideration in future newsletters may be made to Kate Holmes or Christine Engels ([bbp.in.brief@amnh.org](mailto:bbp.in.brief@amnh.org)).

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## When Are No-Take Zones an Economically Optimal Fishery Management Strategy?

James Sanchirico (Resources for the Future), Urmila Maldavkar (St. Olaf College), Alan Hastings (UC Davis), and James Wilen (UC Davis)

Notable declines in marine resource stocks, along with a growing marine conservation movement, have fueled debate over how to manage ocean ecosystems sustainably. Many marine conservationists and scientists are calling for increasing the scale and scope of fishery closures or no-take marine reserves. Many commercial and recreational fishermen, on the other hand, fear the immediate impacts on their livelihoods and the possibility of losing access to particular fishing grounds in the future. Developing models that illuminate the economic and ecological trade-offs involved in deciding the sites for marine reserves is therefore important to help reduce conflict over contentious sites, avoid some transactions costs, and provide a common ground for discussion among various groups in a negotiation process. In our study, recently published in the journal *Ecological Applications* (volume 16, issue 5, pages 1643-1659), we developed a model for identifying potential scenarios for which the positive ecological benefits within reserves can be obtained at the same time that fisheries profits are actually increased. The analysis asked the following questions: (1) when would closing off areas to fishing lead to greater overall fishing profits than when all areas are open to fishing? And (2) how do different biological and economic processes and conditions affect the likelihood that closures emerge as an economically optimal solution? In this model, a planner chooses a catch rate in the two areas that maximizes overall fishing profits. This analysis focuses on when a marine reserve (with no fishing, and therefore a catch rate of zero) is part of the economically optimal set of catch rates.

While the ecological and economic trade-offs that emerged were complex and varied, some interesting patterns were revealed through this analysis. Similar to previous studies, the analysis found circumstances where closing one area could result in a win-win solution where both an ecological indicator and an indicator of the fishing interests improve. Also, reserves are not always part of an economically optimal solution, so that sometimes it is optimal to have fishing allowed in both areas. Reserves are more likely part of the optimal solution when the area to be closed has higher fishing costs (e.g., travel costs to the fishing grounds) and/or the area is a strong net exporter of biomass to the fished area.

Some surprising and counterintuitive results also emerged from the study. First, circumstances exist for which fishing profits are actually maximized when the area with the lower cost of fishing, such as areas closer to port than areas further away, is closed. This occurs when the strength of the "spillover effect" – the movement of fishes from protected, high abundance areas to fishable areas outside the reserve – is great enough to outweigh the loss in profitability from closing the lower cost area. Second, closing the low rather than the high biologically productive area is more likely



Bahamian fishermen preparing their nets for a day out fishing. © G. Shester

*Continued on page 2...*

to lead to an increase in fishery profits. This conclusion runs counter to common advice that closing the high biologically productive areas (e.g., “biological hotspots”) will directly benefit fishermen. Intuitively, this result stems from the fact that the high biologically productive areas are also the ones that contribute a relatively larger share to the system-wide profits. In addition to finding conditions for which setting the optimal catch rate to zero maximizes profit, the model highlights the biological and economic importance of ecological connectivity, such as the movement of fishes from one area to another. While more specific models might be more realistic for a particular marine species, this general model illuminates qualitative properties of spatial and dynamic economic-ecological systems—properties that improve our understanding of how to manage more complex systems. As such, the model can be used to investigate other types of spatial management, such as employing different intensities and types of uses in a zoned system. As information on the nature and strength of ecological connectivity in marine systems increases, the ability to tailor policies to account for these interactions will increase. In fact, in many countries we are likely to move toward a zonal approach, with varying types of uses permitted across zones, with no-take zones and rotating harvest zones as possible uses. A key component in the planning of a zonal system will involve the identification of bioeconomic hotspots that might or might not be good candidates to be closed to all extractive uses. Importantly, our analysis shows that hotspots need to be viewed by both biological and economic factors, rather than biological factors alone.

## Education and Outreach Summer Update: *Treasures in the Sea*

Christine Engels and Jennifer Stenzel (AMNH-CBC)

This was a busy summer for the education teams of the Center for Biodiversity and Conservation (CBC) and the Bahamas National Trust (BNT). Apart from continuing the development of *Treasures in the Sea: Our Bahamian Marine Resources*, a teacher resource book that addresses marine conservation concepts, team members presented at conferences and workshops, requested reviews from educators and scientists, and started the process of pilot-testing the activities with teachers in the classroom. Carried out in partnership with the Bahamas National Trust (BNT) and with the support of the Bahamas Reef Environment Educational Foundation (BREEF) and the Bahamas Ministry of Education, Science and

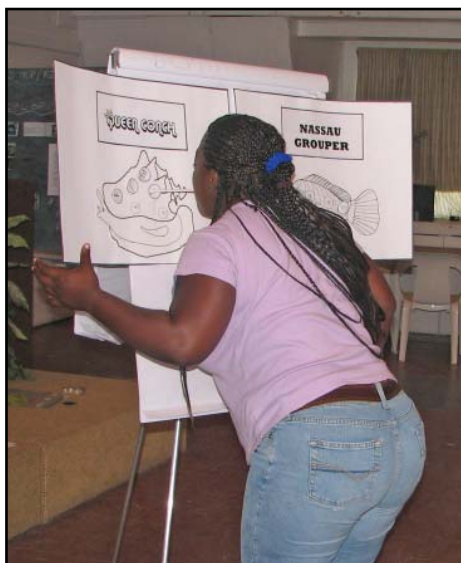
Technology, the *Treasures* initiative aims to build the capacity of Bahamian educators to teach about marine conservation. The lesson plans are geared to grade levels three to six and emphasize the application of critical thinking and skills development by taking a hands-on approach that actively engages students in learning about and addressing issues in their local environment. Bahamas Biocomplexity Project (BBP) research provides the context for these educational materials and BBP researchers advise on the accuracy of the scientific content.

In July, CBC Outreach Manager Meg Domroese and CBC Outreach/Evaluation Specialist Christine Engels presented a session (co-authored by Lynn Gape and Monique Sweeting of the BNT, and Kate Holmes of the CBC) entitled, “From the Coastal Northeast to the Caribbean: Linking Marine Education to Local Realities” at the National Marine Educators Association Conference. They described how *Treasures in the Sea* is a collaborative project to develop a resource for educators in The Bahamas to incorporate marine conservation concepts into the curriculum by focusing on some of the country’s most culturally and economically important marine species, namely the Nassau grouper, the queen conch, and the spiny lobster. Attendees reviewed an activity and provided feedback on how it could be applied in the classroom.

In August the *Treasures* team met in The Bahamas to refine activities and coordinate next steps in the development of the resource. Ms. Engels and Ms. Gape then continued on to San Salvador for a week-long teacher workshop coordinated by BREEF (see article in this issue). One afternoon was devoted to present *Treasures* and provided teachers from primary schools with an opportunity to try different types of activities from the resource. One of their favorite activities was Pass the Part Straw Relay Game, a lively game that requires students to use their motor skills and their knowledge of the parts of a queen conch and the Nassau grouper. All the participants said they

would try this activity in their classroom because it is fun and provides a good reinforcement for the lesson. Teachers supplied positive feedback and suggestions for how to improve many of the activities. Facilitators also requested teachers to pilot-test activities in their classrooms this fall and to provide comments and opinions on their experiences. This type of feedback will help improve the resource, making it more useful for the realities of teaching in The Bahamas.

Next steps for the *Treasures* team are to compile the feedback received from reviewers and pilot-testers to complete the final draft of the resource. *Treasures* will then be forwarded to an editor, a designer, a copy-editor, and finally to the printers for final production. Distribution of the resource is scheduled for the middle of next year, when CBC and BNT educators are planning workshops to introduce teachers to the *Treasures* concept and hands-on activities. For more information about this project visit <http://cbc.amnh.org/center/programs/marine.html> or contact Christine Engels at [cengels@amnh.org](mailto:cengels@amnh.org).



A Bahamian teacher trying out “Pass the Part Straw Relay,” an interactive game designed to help teach Bahamian students the anatomy of important marine organisms. © AMNH-CBC

## Teachers Underwater - The BREEF Summer Workshop

Charlene Carey and Casuarina Mckinney (BREEF)

The Eighth Marine Conservation Teacher Training Workshop took place this August at the Gerace Research Center on San Salvador. Sponsored by the Bahamas Reef Environment Educational Foundation (BREEF) in collaboration with the Ministry of Education, Science and Technology, the goals of the workshop were to provide Bahamian educators with hands-on experiences in the marine environment that they could share with students and promote an appreciation for and knowledge of the ocean as well as a desire to protect it. This year's workshop was funded by members and sponsors of BREEF, and by grants from the Lyford Cay Foundation, The James R. Dougherty Jr. Foundation, and the Moore Charitable Trust Foundation.



Bahamian school teachers enjoying a snorkeling session during the 2006 BREEF Teacher Training Workshop.  
© BREEF

coastal ecology, marine conservation, sustainable development, and environmental stewardship. Christine Engels, Outreach/Evaluation Specialist at the American Museum of Natural History's Center for Biodiversity and Conservation, facilitated a session on *Treasures in the Sea*, a teacher resource book for the primary grade level that addresses marine conservation concepts by focusing on some of The Bahamas' most important marine species – the Nassau grouper, queen conch, and Caribbean spiny lobster (see article above). Ms. Engels introduced the project and provided participants with an opportunity to try five different types of activities. Participants offered positive feedback and suggestions for how to improve several of the lessons. The book's lesson plans are being pilot-tested in Bahamian classrooms this fall and feedback from the teachers will help improve the resource, which is scheduled for production and distribution by the middle of next year.

Another session, facilitated by Lynn Gape, Education Director of the Bahamas National Trust, focused on wetland education and promoted the *Wondrous West Indian Wetlands: Teacher's Resource Book*. Teachers modeled several activities presented in the book and had a chance to think about how these could fit in their own classes. One of the teachers stated that "the lessons on mangroves, rocky and sandy shores, pollution, and coral reefs will all be put to good use in new and exciting ways." Other presenters included representatives from BREEF; the Ministry of Education, Science and Technology; The BEST Commission; Dolphin Encounters; The Department of Marine Resources; The Marine Science Magnet Program at C.V. Bethel Senior High School; and the San Salvador Living Jewels Foundation.

Particular attention was paid during the workshop to the status of the marine environments and marine fish populations in The Bahamas and around the world. Workshop participants were made aware of the critical status of many marine species and the steps that are being taken to ensure that the fish, conch, and crawfish that we depend on do not become extinct. As one of the teachers affirmed, "The BREEF experience made me more aware of the coastal environment and how to help protect it for future generations."

BREEF is a non-profit Bahamian foundation that promotes a sustainable relationship between Bahamians, visitors and the Bahamian marine environment. It achieves this through teacher training, public education, fisheries workshops, and school programs. Please contact BREEF at [breef@breef.org](mailto:breef@breef.org) with any questions or to find out how you can get involved.

By all accounts, the workshop was a huge success. Twenty-three primary and secondary teachers from public and private schools throughout The Bahamas attended the intensive nine-day workshop, which included lessons on mangrove wetlands, coral reefs, seagrass beds, beaches, and rocky intertidal zones. Field trips to each of these environments focused on ecology, scientific survey methods, and activities to help teachers better understand and instruct about these habitats. Snorkeling lessons were an integral part of the workshop, building skills and confidence in the water. One teacher was happy to share that "the facilitators were able to get me (who could not swim) totally comfortable with the water in a week! At the end of the workshop I snorkeled in about twenty feet of water and I've been snorkeling ever since."

Apart from the field activities, teachers heard lectures and participated in hands-on sessions facilitated by a diverse array of professionals on topics such as

## Living Jewels of San Salvador

Melanie DeVore (Georgia College and State University)

The Living Jewels Foundation is working hard to bring awareness of the natural richness of San Salvador to the public. Through photos, music, and eye-catching tags on diving equipment, the word that this island and its surrounding cays support a remarkable number of unique, threatened, and endangered ecosystems is going around. San Salvador's Living Jewels Foundation (SSLJ) is a local organization whose primary goal is to establish and support a National Land and Sea Park on San Salvador. The Foundation received a \$10,000 private donation through the Bahamas National Trust (BNT) to assist in the preparation of a proposal to declare a local national park. With assistance from The Nature Conservancy (TNC), SSLJ is also in the process of becoming a legal non-profit Bahamian entity.

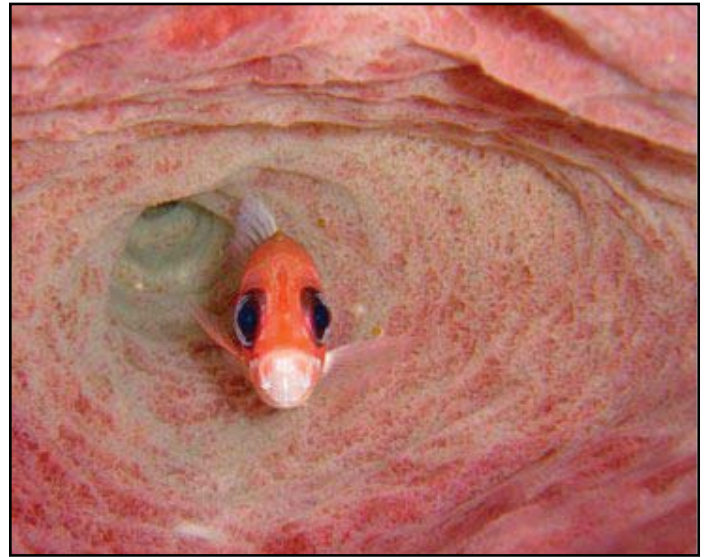
Of paramount importance are the breathtaking reefs of San Salvador that attract thousands of visitors and are an invaluable resource for the local tourist industry. The need to protect the reefs and the income of Bahamians has prompted SSLJ to sell dive tags to visitors through the Gerace Research Center, The Riding Rock Inn, and Club Med. As of September 2006, more than \$16,715 has been raised through the sale of dive tags and t-shirts.

Similar dive tag programs have been highly successful in Bonaire and Indonesia where they have generated the monetary support needed to manage and protect reefs. The concept is a simple one. Foreign tourists voluntarily pay for annual, waterproof tags that show their support for this local marine conservation effort and can be clipped to diving equipment or attached to backpacks and keychains. The 2006 tag features a photograph of a hammerhead shark taken by Sandy Voegeli, an active member of SSLJ. Each \$10 tag adds to the growing monetary base needed to provide a boat and salary for a Bahamian park warden. Tags will illustrate a new photograph every year.

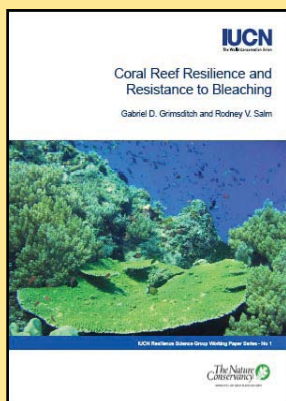
Another photo taken by Sandy Voegeli has also been drawing a lot of attention to the hidden treasures tucked under the waters of San Salvador Island. A secretive squirrelfish peaking out its home within a barrel sponge was captured by Voegeli's camera and secured second place out of a pool of 500 submitted entries in an international photo contest sponsored by The Ocean Conservancy. The cash award for Voegeli's winning picture has already been earmarked for donation to SSLJ.

In addition to dive tag sales and photos, the BNT and SSLJ are negotiating with a Bahamian musician to re-record a song about the crown jewels of The Bahamas in the local beat of junkanoo. The "Living Jewels" lyrics, written by Ron Shaklee, a geography professor who has been visiting San Salvador for many years, transmits the message to conserve the "living jewels of land, sky, and sea," such as corals, sea birds, conchs, and iguanas, and teaches kids about the perils of overfishing, habitat destruction, and pollution. SSLJ plans to broadcast the "Living Jewels" song on the national radio stations soon. So, keep your ears open for this catchy and fun approach to conservation education.

For more information about the San Salvador Living Jewels Foundation visit <http://www.savesansalvador.com/> or contact Sandy Voegeli at [vjvoegeli@hotmail.com](mailto:vjvoegeli@hotmail.com). For information about the "Living Jewels" song, contact Ron Shaklee at [bahamaron@hotmail.com](mailto:bahamaron@hotmail.com).

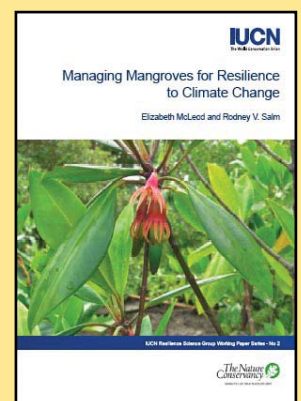


The award-winning photo of a squirrelfish inside a barrel sponge. © S. Voegeli



### Climate Survival Guides for Corals and Mangroves

The World Conservation Union (IUCN) and The Nature Conservancy (TNC) recently published two reports outlining strategies to help vulnerable marine ecosystems survive the impacts of climate change. The reports, "Coral Reef Resilience and Resistance to Bleaching" and "Managing Mangroves for Resilience to Climate Change" describe the human threats to the ecosystems and the risks generated by climate change factors. Recommendations for helping corals and mangroves survive include improved reef monitoring, creation of marine protected areas, establishment of green belts and buffer zones to allow mangrove migration, and management of human demands on plantations. While the measures proposed will not stop climate change in the short term, scientists hope they will help to reverse the trends. To download the guides search for the titles at the IUCN online bookstore <http://www.iucn.org/bookstore/booksonline.htm>.





## BBP General Meeting January 24-27, 2007 at Davis, California

The BBP is planning its next General Meeting, to be hosted by Alan Hastings at the University of California, Davis, for 24-27 January 2007. The meeting will kick off with research updates from various working groups and will then move on to sessions focused on integrating research results across BBP working groups and disciplines. Questions regarding the meeting agenda can be directed to Dan Brumbaugh ([brumba@amnh.org](mailto:brumba@amnh.org), 831-420-3963); questions on logistics can be directed to Kate Holmes ([kholmes@amnh.org](mailto:kholmes@amnh.org), (212) 313-7651).

## BBP Collaborators and Partners



## What is BBP?

The Bahamas Biocomplexity Project (BBP) is a five-year initiative funded primarily by the National Science Foundation to investigate the complex environmental and social factors that affect the design, management, and effectiveness of networks of marine protected areas (MPAs). Researchers involved in the project include oceanographers, biologists, and social scientists from nine institutions working in collaboration with various governmental and non-governmental groups in The Bahamas.

Ultimately, the primary goal of the project is to integrate studies of natural and human processes, leading to a more sophisticated understanding of how individual MPAs work, and how they could work as part of a network throughout The Bahamas and in other coral reef ecosystems. Other important goals include the integration of this research with education and decision-making.

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