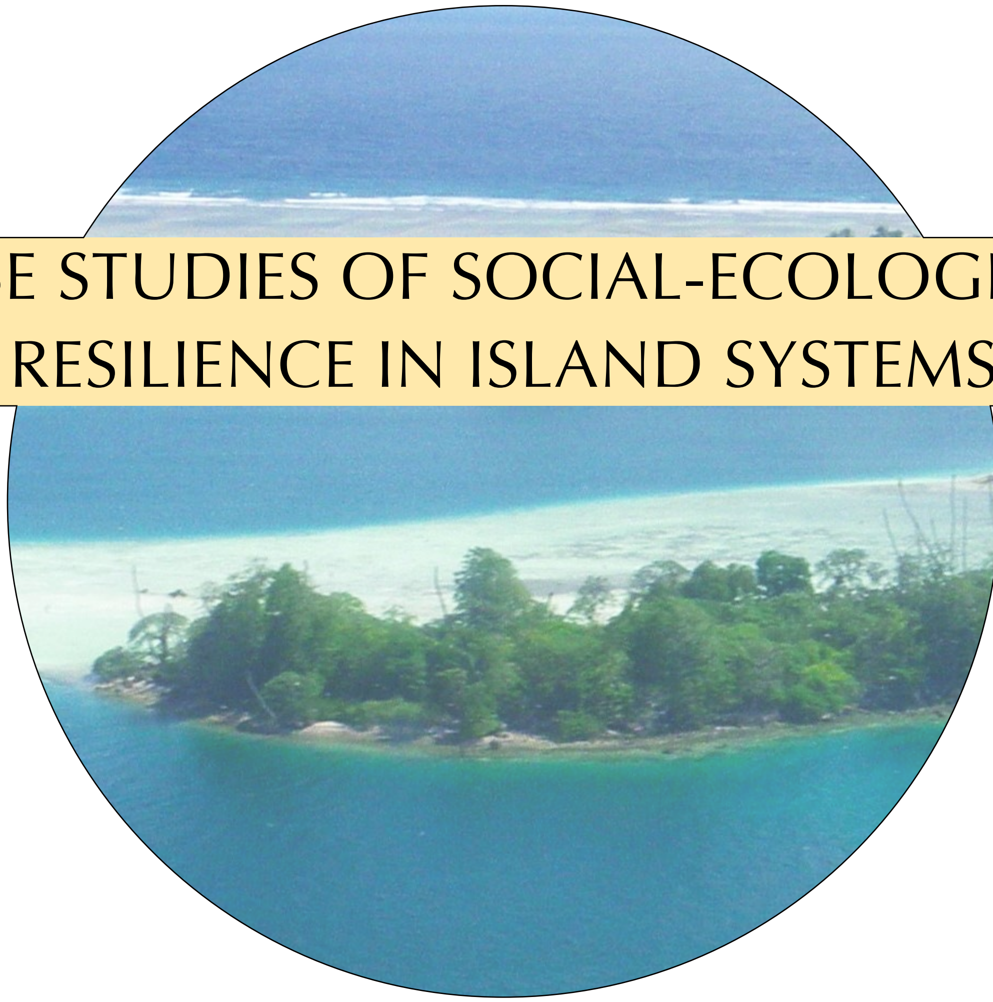
RESILIENCE SOURCEBOOK

INSPIRED BY THE 2013 MILSTEIN SCIENCE SYMPOSIUM

UNDERSTANDING SOCIAL AND ECOLOGICAL RESILIENCE IN ISLAND SYSTEMS

INFORMING POLICY AND SHARING LESSONS FOR MANAGEMENT

CASE STUDIES OF SOCIAL-ECOLOGICAL RESILIENCE IN ISLAND SYSTEMS



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CENTER FOR BIODIVERSITY AND CONSERVATION

APPLYING THE BIOSPHERE RESERVE MODEL TO BUILD ECOLOGICAL & SOCIOECONOMIC RESILIENCE

San Andres Archipelago, Colombia

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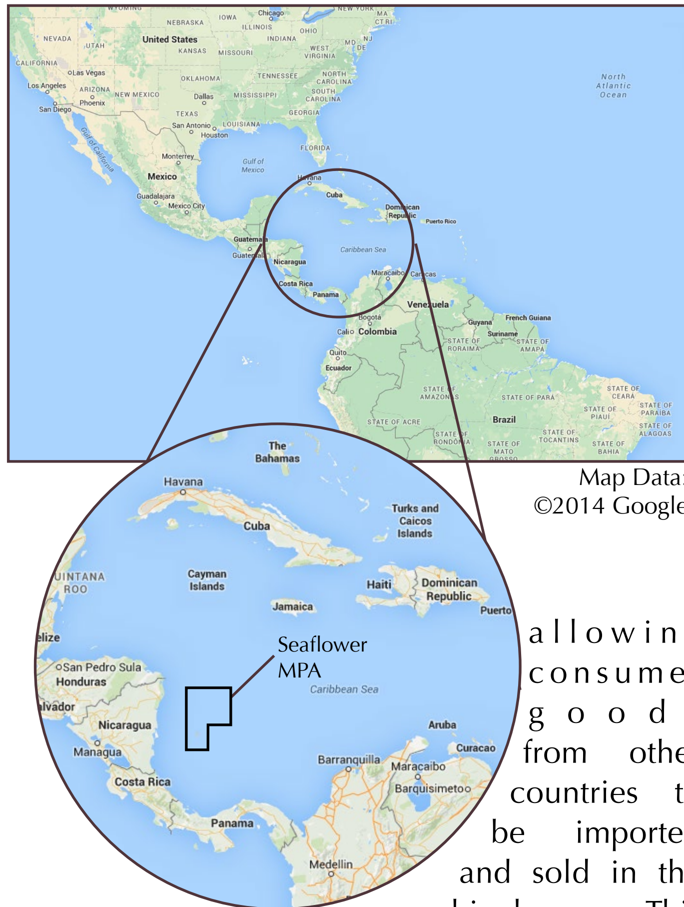
The Setting

The San Andres Archipelago is a remote, oceanic department of Colombia in the western Caribbean made up of three very small inhabited islands and extensive barrier and fringing reefs, atolls, banks, and cays (57 square kilometers of terrestrial area in total). The largest open-ocean coral reefs in the Caribbean, the reef systems are particularly complex due to exposure to currents, wave action, and other physical oceanographic factors[I]. These ecosystems are important locally for fisheries, tourism, and shoreline protection, providing a wealth of ecosystem services, and also are significant for global conservation being rich in marine biodiversity.

The three main islands – San Andres, Old Providence, and Santa Catalina – have a total population of 80,000. This breaks down to about 75,000, 5,000, and 200 inhabitants, respectively, with land areas of 27 km2, 17 km2, and 1 km2. The community has a long social, economic, and political history distinct from mainland Colombia. Indigenous islanders, now known as *raizales*, descend from English settlers, African slaves, and migrants from other English-speaking Caribbean islands. Besides having a different language, religion, ethnicity, and culture from the rest of the country, the archipelago's isolation meant that the community had a high degree of autonomy for over 300 years, controlling their own natural resources and economy until the latter half of the 20th century.

The Disturbance

In 1953, Colombia declared San Andres a free port, allowing consumer goods from other countries to be imported and sold in the archipelago. This was unique in Colombia because at that time the country had a fundamentally closed economy. Simultaneously, exportation from the islands was permitted only to mainland Colombia at prices fixed by the government. This restriction destroyed the informal, long-time thriving direct export of fruits, predominantly coconuts and citrus, from San Andres to other parts of the Caribbean. Immediately following the declaration, the airport in San Andres was expanded to accommodate large passenger and cargo planes, a network of roads was constructed, and swamps were filled for urban development, paving the watershed of the northern half of the island in the process. San Andres fast developed into an inexpensive tourism and shopping zone for mainland Colombians.



Map Data: ©2014 Google

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[I] Burke L, Maidens J. Reefs at Risk in the Caribbean. Washington DC: World Resources Institute; 2004.

Forty years later, in 1990, the country opened its economy to international trade, leading to the collapse of the free-port commercial model and an almost total economic dependence on "sun, sand, and sea" mass tourism.

After the free-port declaration, commercial and tourism-related development proceeded unplanned and unregulated for nearly 50 years. Acre after acre of woodland and farmland was converted to commercial and residential development. By 1999 mature forest remained on only five percent of the land; data is not available on conversion of farmland. Islanders traditionally pursued mixed livelihoods. Within a household, family members would fish, farm, own a small business, and practice a trade. The shift from small-scale agriculture and fishing to mass tourism and commerce resulted in economic and political marginalization of native islanders. Losing control of their livelihoods, economy, and natural resources, the people experienced a severe decline in their quality of life. By 2000, household surveys in San Andres Island revealed that unemployment and under-employment had reached 53.6 percent, with 48 percent of all households living in absolute poverty on less than US$1 per person per day[II].

The transition was accompanied by considerable migration from mainland Colombia, resulting in a level of population growth unprecedented in the Caribbean. The population grew from 5,675 in 1950 to 23,000 in 1973. By 1985 population was 36,000; ten years later it was 65,000; and only six years later it was officially 78,000 (although estimates are as high as 100,000 with some even higher). Virtually all the immigrants settled in San Andres Island and were from other departments of Colombia. Population density in San Andres was 116 people per square kilometer (pkm^2) in 1951.

San Andres Bay. Photo credit: CORALINA

By 1964 it had more than quadrupled to 534 pkm^2. Thirty years later, it was over 2,000 pkm^2. In less than a decade, it increased another 50 percent, making San Andres the most densely populated oceanic island in the Americas and one of the most densely populated in the world[III].

The uncontrolled growth led to serious environmental problems including unsustainable use of coastal and marine resources, over-extraction of freshwater, pollution from poor waste management, soil erosion and loss of agricultural productivity, deforestation, and emergence of slums and shantytowns. To give a couple of examples, by 1999 only 1 percent of the groundwater was found to be potable, with 69 percent very polluted and 30 percent somewhat polluted[IV]. In another example, the percentage of live coral cover in the nearshore marine environment declined from over 70 percent in 1970 to 22.1 percent in 2000[V]. The reasons for this severe decline are unknown but are assumed to stem from both natural and human factors. Studies in other regions have identified a strong correlation between coral reef degradation and coastal population density[VI]. Such a broad

[II] Newball R. Evaluación económica del diseño e implementación de un área marina protegida (MPA) en el Archipiélago Caribeño. 2000. Tesis de grado. Bogotá: Universidad de los Andes.

[III] Howard, M., Nicholson, D. Población, Tenencia de la Tierra y Aspectos Socioeconómicos de la Isla de San Andrés. *Atlas de la Reserva de la Biosfera Seaflower. Archipielago de San Andres, Providencia y Santa Catalina*. Santa Marta: Instituto de Investigaciones Marinas y Costeros-INVEMAR: 2012. pp. 159-165.

[IV] CORALINA. Integrated Groundwater Management Plan for San Andres 2000-2009. San Andres: DFID/ CORALINA: 1999.

[V] Garzón -Ferreira J, Rodríguez, A. Informe sobre el estado de salud y la dinámica del ecosistema de arrecifes coralinos en el Caribe. Unpublished report. Santa Marta: Instituto de Investigaciones Marinas y Costeros-INVEMAR: 2000.

[VI] Howard, M., Taylor, E. San Andres, Colombia. *Extreme Heritage Management: The Practices and Policies of Densely Populated Islands*. G. Baldacchino, ed. New York: Berghahn Books: 2012. pp. 218-245.

spectrum of environmental problems weakens resilience by threatening ecosystem health, destroying biodiversity, reducing fresh and coastal water quality, and producing a spiral of increasing poverty and environmental degradation.

The Response

To reverse these trends and shift to a model of sustainable development, CORALINA, the government agency representing Colombia's National Environment System in the archipelago, sought a solution in collaboration with the community. After examining various alternatives, islanders decided that a large multiple-use protected area on land and sea, such as a biosphere reserve, would be a viable tool to reduce human impacts on vulnerable ecosystems and enhance sustainable use. The people recognized that, to be effective, solutions to their ecological problems must also reduce poverty. In 2000, the entire San Andres Archipelago was declared the Seaflower Biosphere Reserve (BR) by UNESCO. The national declaration of the Seaflower Marine Protected Area (MPA) followed in 2005. Seaflower is one of the world's largest marine biosphere reserves, covering about 200,000 km2 of ocean.

The goal of UNESCO biosphere reserves is to achieve a balance between environmental conservation, economic development, and cultural survival. Seeking to equally achieve these sometimes conflicting objectives makes BRs distinct from more traditional protected areas. Ideally – through training and demonstration projects – an effective BR will reduce poverty and environmental degradation and strengthen ecological resilience and human well-being. The BR is the center of the islanders' vision of how to improve environmental and economic resilience and achieve a sustainable future. Since 2000, CORALINA and the community have carried out a number of projects in the BR that link conservation with local socioeconomic benefit to build resilience. A summary of one such project that offers replicable actions and lessons learned is presented here.

Project Example: Actions

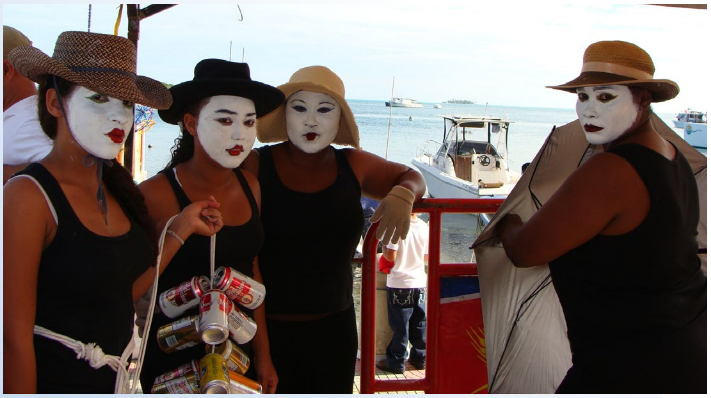
CORALINA and local stakeholders, with support from international funders and US-based experts who volunteered their time, carried out a project to improve coral reef conservation thorough community-based watershed management. The project, which began in 2008 and has ongoing activities, focused on the connections between land-based activities and coastal water quality. This project improved monitoring of fresh and coastal waters; controlled sedimentation and pollution to the marine environment from poor land-based practices in agriculture, construction, and waste disposal; and built capacity of local scientists, BR managers, farmers, householders, and the private sector. Activities were underpinned by scientific and indigenous knowledge, fused new technologies with traditional practices, and incorporated conservation, livelihoods, and training.

Monitoring. Effective monitoring is essential to maintain and understand resilience, so existing monitoring of ground and coastal waters was evaluated as to human capacity, training needs, site selection, timing, field methods, testing parameters, lab analysis, data management, and application of results. Protocols to measure saline intrusion into the aquifer from sea-level rise were improved. BR staff members were trained and, to expand capacity and stewardship, so were volunteers. Community volunteers learned regulations, standards, and to spot threats. Workers from businesses that sell, bottle, or distribute water were trained to monitor their own wells, as were hoteliers. Courses in water quality monitoring and

Marine ecosystems, Seaflower MPA. Photo credit: CORALINA analysis were offered at the local branch of the national training institute (Instituto Nacional de Formación Técnica Profesional de San Andrés). A regular bulletin with results and tips was produced for owners/concessionaires of commercial wells. Because the tourism sector is the largest freshwater consumer, monitoring results were disseminated to tourist facilities.

Land-based pollution. Land-based pollution sites were mapped, and four sites with different pollution problems were selected for community-based demonstration projects. Solutions appropriate for the local environment and technical capacity were selected by stakeholders and implemented at each site.

- Village Pilot Project 1. Problem - Household sewage. Solution - Neighborhood wastewater treatment system. An integrated water supply and septic treatment system for domestic waste was built in cooperation with the community, connecting 19 residences to a communal system.
- Village Pilot Project 2. Problem - Runoff into coastal waters. Solution – Community-led introduction of best practices. Bad practices were identified including direct dumping of garbage, poor disposal of household waste, and unsustainable methods of land clearing. Villagers set up an alliance to train residents in best practices, and joined with government and schools in coast and gully cleanups.
- Village Pilot Project 3. Problem - Soil erosion. Solution - Low-tech erosion control structures. Areas of severe erosion were identified in the watershed. Stakeholders designed and built structures using found materials (old tires and natural debris such as fallen trees and sugarcane trash) to stabilize slopes and control erosion.
- Village Pilot Project 4. Problem – Waste from animal-raising. Solution - Waste management beds. Submerged beds were designed using traditional methods, farmers were trained in construction and use, and demonstration beds were built at 10 pig farms.



Seaflower MPA community promoters.
Photo credit: CORALINA

Construction sites. A public-private (contractors, engineers, architects) partnership was established to reduce pollution and sedimentation from construction sites. Stricter EIA requirements were developed for large constructions, standards were set for housing projects and septic tanks, a guide to the new standards and regulations was produced, and surveillance of construction sites was improved by local government, BR staff, and volunteer inspectors from the community.

Agriculture. Farms were inventoried, with information gathered on practices, crops, animals, and issues facing farmers. Farmers were trained on-site in innovative technologies; with each farmer choosing his/her own preferred methods to implement. New practices include use of manure, natural fertilizer, composting, and worm culture; application of biological controls and natural pesticides; methods to improve production and control erosion such as crop rotation, cover cropping, stabling cattle, pastoral-forestry, urban gardens, and selective land clearing; and efficient ways to store and use water. Information was distributed house-to-house on problems of agricultural burning, deforestation, and erosion, and improved methods of land clearing and tree management.

Neighborhoods. Field technicians visited households, giving personalized training in waste management. Water supplies were expanded through household and communal rainwater harvesting. Schools held special events and launched an adopt-a-mangrove program. Outreach campaigns with radio spots, interviews, posters,

Cove-Seaside Village Alliance, Seaflower Biosphere Reserve. Photo credit: CORALINA

etc. were implemented, with bilingual education materials distributed at meetings, workshops, and door-to-door.

RESULTS

Protecting the marine ecosystems that surround San Andres, especially coral reefs, is essential for ecological and socioeconomic resilience. This project aimed to set up a broad-based program of on-going actions to reduce or prevent land-based pollution from sources such as erosion, agriculture, urban runoff, and wastewater. Since this project began, awareness of the negative impacts of land-based activities on the watershed and marine ecosystems has grown. Coastal water quality monitoring has found consistent reductions in suspended solids and reduced discharges from pollution sources. In addition, the visiting experts reported that efforts to educate farmers in better farming and field management practices to reduce agricultural pollution, including erosion, were comprehensive and successful.

Results continue – and continually change. Volunteers are still playing an active role in surveillance, farmers are using new sustainable practices, and stakeholders are monitoring water quality side-by-side with authorities. On the other hand, enforcement of the new construction standards has been spotty because local government must put these into practice. Everyone was on board at first, but maintaining support in a constantly shifting political environment is challenging: weak governance is characterized by administrative changes, instability, internal disagreements, and lack of resources. In a more positive result, erosion control structures led to natural regeneration of vegetation; slopes quickly reforested so pilot sites are now erosion-free. When conceived by the community and BR staff, there was no evidence that this low-tech, innovative method using mostly organic found materials would be so effective.

Lessons Learned

Biosphere Reserves offer an effective alternative development model for small islands, especially because building and maintaining resilience calls for programs that integrate sustainable development's "three pillars" – social, economic and environmental – which is at the core of the BR concept. Many lessons have been learned to improve resilience.

- In islands with high poverty, environmental conservation and poverty alleviation must go hand-in-hand, so conservation initiatives should incorporate strategies to improve livelihoods, promote food security, and generate income.
- Multi-disciplinary approaches that consider all facets of resilience are essential. In this project, support of outside experts from diverse fields (agriculture, engineering, marine ecology, etc.) was of inestimable value as they shared new techniques and information with local managers, scientists, and civil society. CORALINA staff members have built lasting relationships with a number of international experts who have supported Seaflower for over a decade; these experts share their knowledge and build local capacity, but are not involved in decision-making. In this project, CORALINA invited a water resources engineer, agronomist, and two experts in marine protected areas to visit San Andres to work with the BR team, farmers, and fishers. The BR project covered their expenses and the experts very generously contributed their time, as is almost always the case with international experts who support Seaflower.
- Sustainable agriculture practices are part of the local heritage; so in the project example, empowering farmers to integrate traditional

methods with new low-tech alternatives helped build socioeconomic and environmental resilience.

- Implementing community-based pilot projects, each of which tackled a different problem in a different village, resulted in successful demonstration projects that could be easily replicated.
- Community ownership of the individual projects facilitated their success. Community members are more likely to take ownership of conservation interventions when: 1) they recognize and select the problem they want to work on; 2) design and carry out their own solutions; and, 3) if an NGO or government institution is facilitating the process, if that organization is led and staffed by people who are also from the community. All of these factors were present in this project.
- In small island contexts, having locals on the staff of NGOs and government institutions that work on these projects is especially important. Small islands often have strong "we-they" dynamics given their often tightly knit social structures, social solidarity and cohesion, and emphasis on an island identity. This dynamic may be even more pronounced in island dependencies, versus independent states, that have suffered loss of power and marginalization by the ruling country's institutions and dominant culture, as is the case in San Andres. The community viewed all projects selected and run by islanders as re-establishing and strengthening local control over their traditional territory.
- New practices cannot be imposed; stakeholders must choose their own solutions. However, people need knowledge to make informed decisions. Therefore, training, capacity building, and sharing power and information pave the way for real change.
- Actions on small islands impact both land and sea, and institutional jurisdictions overlap, so the full range of stakeholders must be involved. Participatory programs and partnerships are fundamental to resilience. In this example, BR management (CORALINA) collaborated with other public institutions, civil society (students, farmers, householders) and the private sector. This builds resilience, not only of the natural environment but also of the human society and its institutions.

Brown booby, Seaflower MPA. Photo credit: CORALINA

Lead Organization

- Corporation for the Sustainable Development of the Archipelago of San Andres, Old Providence, and Santa Catalina-CORALINA
  http://www.coralina.gov.co/intranet/

Funding Summary

- NOAA International Coral Reef Program
  http://coralreef.noaa.gov
- Global Environment Facility
  http://www.thegef.org/gef/

The first phase of this project was awarded the 2012 Michel Batisse Award for Biosphere Reserve Management by UNESCO.

The Milstein Science Symposium

The collection of this case study and others like it results from the April 2013 Milstein Science Symposium, Understanding Ecological and Social Resilience in Island Systems: Informing Policy and Sharing Lessons for Management. Held at the American Museum of Natural History, the Milstein Science Symposium convened local resource managers, researchers, educators, island leaders, policy makers, and other leading conservation practitioners to examine characteristics, qualities, and processes that may foster resilience for coastal and marine systems as well as explore interactions, linkages, and feedback loops in complex social-ecological systems and what this means for management. The Milstein Science Symposium was organized in collaboration with The Nature Conservancy, the Gordon and Betty Moore Foundation, the National Science Foundation, The Christensen Fund, the Coral Reef Alliance (CORAL), the Scripps Institution of Oceanography at the University of California San Diego, the University of California Santa Barbara, the United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries, and Small Island Developing States (UN-OHRLLS), and the Wildlife Conservation Society.

The 2013 Milstein Science Symposium was proudly sponsored by the Irma and Paul Milstein Family.

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To learn more about the CBC, please visit our website:

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