
**Establishing Long Term Coastal and Marine
Programs in Latin America and the Caribbean**

Pilot Studies of Ecuador and the Gulf of Fonseca

Integrating Education, Applied Research and Extension

Background Paper No. 2



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PREFACE

This document is the second of two background papers that have been prepared to explore the feasibility of adapting the Sea Grant model of University-based education, research and extension to countries of Latin America and the Caribbean. It is part of an initiative directed by the NOAA/OAR Office of International Activities and the University of Rhode Island Coastal Resources Center and Sea Grant Program. Financial support comes from the U.S. State Department's Ocean, Environment and Science Initiative, and the NOAA National Sea Grant Office. The initiative was catalyzed by expressions of interest from government and university officials in Honduras, Nicaragua, El Salvador and Ecuador to develop long-term Sea Grant-like programs.

The first background paper describes the structure and operating principles of NSGCP, summarizes NSGCP experience with international partnerships, and explores other similar program experience with linked education, research and extension. This paper explores options for establishing Sea Grant-like programs in two case study sites: Ecuador and the Gulf of Fonseca. Fact finding visits were conducted in January/February 2003 (Costa Rica, Guatemala, Nicaragua, El Salvador and Honduras), June/July 2003 (Costa Rica, Nicaragua, Honduras, and El Salvador), and July 2003 (Ecuador). More than 100 governmental and non-governmental actors as well as representatives of regional and international organizations were consulted. The purpose of these visits was to:

- Assess the social, economic, political, and environmental issues affecting Ecuador and the Gulf of Fonseca in order to better understand the issues that a program based upon the model of the U.S. National Sea Grant Program might address
- Survey the landscape of past and current activities related to the sustainable development and conservation of coastal and marine resources
- Assess University education, research and extension capacity in coastal and marine topics
- Outline the gaps and adaptations needed to establish Sea Grant-type programs in Ecuador and the Gulf of Fonseca
- Explore options for structuring long-term programs of coastal and marine education, research and extension

The country visits were the beginning of an iterative process between partners and key actors that served as the basis for the next phase of dialogue—national and regional roundtable discussions. Roundtables were convened in Ecuador, 16 October 2003 and Honduras, 21-22 October 2003. The Honduras roundtable was regional, with participants from the three nations surrounding the Gulf of Fonseca. The Roundtables provided a venue for all relevant actors to discuss similar topics as those listed above. Agendas and summaries of meeting outputs are available upon request. Roundtable participants are listed in Annex 1.

This report draws from the consultations, Roundtables, and literature review that took place over the period January-October 2003. It is prepared by James Tobey and Matt Wilburn with contributions from Jill Hepp, Emilio Ochoa, Stephen Olsen, Barry Costa Pierce, and Agnes Saborio Coze. We wish to express our appreciation to everyone who has helped with this effort, especially ESPOL University in Ecuador, the University of Zamorano in Honduras, and the Center for Aquatic Ecosystems Research in Nicaragua.

ACRONYMS

ANDA	National Association of Aquaculture Producers (Nicaragua)
ANDAH	National Aquaculture Association of Honduras
CCAD	Central American Commission on Environment and Development
CENAIM	National Aquaculture and Marine Research Center (Ecuador)
CENAREC	Center of Coastal Resources Training and Extension at ESPOL University
CICYT	Scientific and Technological Research Center at ESPOL University
CIDEA	Center for Aquatic Ecosystems Research at the University of Central America
CIIFEN	International Center of Research on the El Niño Phenomenon
CIOP	Fisheries Oceanography Research Center at ESPOL University
CODDEFAGOLF	Committee for the Defense and Development of Flora and Fauna of the Gulf of Fonseca
CURLA	Central Regional University of the Atlantic Coast (Honduras)
DANIDA	Danish International Development Agency
DIGMER	Merchant marine of the Ecuador navy
ESPOL	Coastal Polytechnic University (Ecuador)
FAO	United Nations Food and Agriculture Organization
IDB	Inter-American Development Bank
INOCAR	Naval Oceanographic Institute (Ecuador)
INP	National Fisheries Institute (Ecuador)
JICA	Japanese International Cooperation Agency
LAC	Latin America and the Caribbean
NOAA	National Oceanic and Atmospheric Administration, U.S. Department of Commerce
NOAA/OAR	NOAA Office of Oceanic and Atmospheric Research
NSGCP	National Sea Grant College Program
NSGO	National Sea Grant Organization
OSPESCA	Central American Organization of the Fisheries and Aquaculture Sectors
PMRC	Coastal Resources Management Program (Ecuador)
SICA	Central American Integration System
TNC	The Nature Conservancy
UAM	American University of Managua (Nicaragua)
UCA	University of Central America (Nicaragua)
UCV	Coastal law enforcement coordination units (Ecuador)
UNA	National Agricultural University (Honduras)
UNAH	National University of Honduras
UNI	University of Engineering (Nicaragua)
USAID	United States Agency for International Development
USFQ	University of San Francisco of Quito (Ecuador)
WWF	World Wide Fund for Nature
Zamorano	Pan American School of Agriculture (Honduras)
ZEM	Special area management zones (Ecuador)

1. INTRODUCTION

For more than three decades the National Sea Grant College Program (NSGCP) has promoted sustainable development, created new technologies, products and services, enhanced coastal and marine resource management, reduced the loss of life and property, and promoted coastal and marine education. The Program has formed a learning network across dozens of coastal states that integrates coastal and marine education, research and extension on selected topics. In this paper we explore options for transferring the NSGCP model to coastal nations and subregions of Latin America and the Caribbean (LAC) and creating a regional learning network.

Our analysis is focused on two pilot locations: the mainland coast of Ecuador in South America and the Gulf of Fonseca in Central America. For each location we have reviewed with in-country partners how to design and establish long-term programs that integrate coastal and marine education, applied science and extension services. Our review has focused on four major areas of inquiry:

- The coastal and marine context and the key issues for applied science and extension
- The institutional landscape and efforts to date to address critical coastal and marine issues
- University capacity in education, research and extension and the benefits that a program structure modeled after Sea Grant could provide
- Program development strategies

Section 2 provides a brief overview of the social, economic and environmental context in the LAC region. Section 3 describes the benefits of adapting the model of the NSGCP to countries in Latin America and the Caribbean. Sections 4 and 5 explore opportunities for establishing Sea Grant-like programs in Ecuador and the Gulf of Fonseca. The last sections present our conclusions and describe next steps.

2. COASTAL AND MARINE CONCERNS IN THE LAC CONTEXT

It is easy to grasp the strategic importance of coastal and marine resources to LAC countries by simply reminding oneself of the dimensions of the resource base—the LAC region has almost 60,000 linear kilometres of coast. Another important feature is that all the Latin American countries except two (Paraguay and Bolivia) are coastal.

There is much diversity across coastal areas in the LAC region, but nearly everywhere common features are the steady decline in the coastal and marine resource base, increasing vulnerability to natural hazards, and rising poverty and income inequality. The Inter-American Development Bank has identified six major coastal and marine issues for the LAC region (IDB, 1998):

- Declining coastal water quality from land-based sources
- Impoverishment of coastal communities
- Depletion of commercial fisheries stocks
- Degradation of coastal ecosystems
- Land use and resource allocation conflicts in the coastal zone
- Coastal erosion, flooding and shoreline instability

The driving forces of these problems include growing population density, poverty, over exploitation of natural resources, insecure property rights in water and land, and policy choices at the national level (IDB, 1998; Burke et al., 2000).

It is important to understand the general context of the LAC region because it shapes coastal and marine resource use and issues. Profound social and economic changes have taken place over the past 20 years. In most countries, a political democratization process has opened up new opportunities for public participation, inflation has been reduced, foreign investment increased and free market reforms introduced, such as privatization of state enterprises. The average annual growth rate of GDP per capita was positive between 1989 and 1998 in all LAC countries except four: Venezuela, Surinam, Nicaragua and Haiti. There has been a change in the sectoral structure of LAC economies whereby services (including tourism, financial services and free trade zones) have increased their relative weight in GNP. Tourism now accounts for about 12 percent of GDP in LAC, one-quarter of foreign exchange earnings and provides one-fifth of all jobs. Most of the tourism is beach tourism.

These reforms appear to be laying a foundation for a rate of progress that seemed impossible during the “lost decade” of the 1980s. However, there are many conflicting trends. The progress of the nineties brought with it social costs. The region is still characterized by an unequal distribution of wealth and the gap between incomes is widening. Real wages have fallen and unemployment is now higher than in 1990 (UNEP, 2000). In 2003 the LAC region saw an increase in unemployment, poverty, and political disturbances. Social tension has reached the stage whereby some Latin American cities and rural areas have the highest rates of crime and violence in the world.

The General Context of the LAC Region

- Growing human pressures on coastal and marine environment
- Decline in the coastal and marine resource base
- Worsening income inequality, poverty, unemployment and political disturbances
- Continued reliance on resource intensive sectors
- Growing rural and urban population density
- Rapidly growing coastal tourism

Another conflicting trend is that despite the increase in the relative importance of services in national economies, there continues to be enormous pressure on exportable natural resources. Direct environmental pressure on the resource base and environmental damage continue to grow. There has been an upward trend during the past two decades in the volume of exports from sectors with a recognized environmental impact—fishery, forestry, agriculture, and mining sectors (ECLAC, 2002). The region continues to be more reliant on primary commodities and raw material exports than other parts of the world with similar income levels. Overexploitation of resources has already had direct impacts on output, for example, in marine fishing where catches have continued to decline.

Population pressure, livelihood needs and land scarcity mean that the traditional effects of primary activities, particularly changes in land use, are now being concentrated in smaller, more fragile areas that are environmentally more sensitive, and perhaps more vulnerable. In many cases, landless people have settled in flood-prone coastal areas because these are the only lands available to them for settlement. In those instances, unsustainable use of coastal areas and resources may appear to be the only alternative short of migration to urban areas. The economic dependence and vulnerability of poor, rural communities on coastal resources and lands are among the major challenges of social development in coastal regions.

The challenges are compounded by the fact that the region’s rural population is not expected to fall significantly over the coming decades. The percent of the population that is urban in the LAC region living in built up coastal areas has almost doubled over the last two decades. At this time, 76 percent of the region’s population is urban (World Bank, 2003) and 60 of the region’s largest 77 cities are coastal (Hinrichsen, 1998). Urban development is frequently rapid, spontaneous and disorganised, leading to uncontrolled growth and the transformation of natural areas of great ecological value (e.g. deltas and estuaries, mangrove swamps, coastal lagoons). Despite this growth of coastal urban population, the total

rural population has not declined, meaning that the degree of population pressure on resources is unlikely to subside.

Central to the LAC region's environmental problems are land use changes, especially the conversion of forests to agricultural land uses. Between 1961 and 1999 over 150 million hectares were incorporated into agricultural production in the region, and much of this land was converted from forest (FAO, 2001). Although agricultural land area is still increasing, the rate has slowed, especially in the last few years. Mexico, Central America, and Ecuador are exceptions.¹ The environmental impact of agriculture is more than just the conversion of land. Economic reform throughout LAC has had the effect of modernizing the region's agriculture, making it more intensive, with the result of greater use of fertilizers and pesticides.

Deforestation is the main cause of biodiversity loss in the region and multiple problems affecting natural resources, especially water and soils. Of the 418 million hectares of natural forest lost worldwide over the past 30 years, more than 40 percent was in Latin America (Armstrong and Brandriss, 2003). Deforestation has largely been a function of poverty, unemployment, and inequitable land distribution that cause the poor to clear tropical forests for subsistence farming and domestic needs. This eventually leads to loss not only of livelihoods but also environmental services such as soil productivity, watershed protection, regulation of microclimates, availability and regulation of water resources, and biodiversity.

Major Trends

- Deforestation
- Loss of critical habitats
- Deterioration of coastal watersheds
- Overfishing and depletion of fish stocks
- Inadequate investments in coastal and marine resource management
- Increasing vulnerability to natural hazards

Land use changes have led to erosion in watersheds and this erosion is reflected in the sedimentation of reservoirs and marine ecosystems. Degradation usually starts in the upper watersheds but the sedimentation, other effluents and changes to fresh water flows greatly influence coastal and marine ecosystems, damaging coral reefs and other living marine resources. About one-third of the region's reef areas are considered at high risk due to sedimentation caused by deforestation, runoff of nutrients from sewage and agriculture, and destructive fishing practices (Burke et al, 2000). Mangrove deforestation is especially damaging to the productivity of near-shore areas as well as to shoreline flooding. Mangrove habitat is one of the LAC region's high value ecosystems. Almost 40 percent of the more than 17 million hectares of mangrove swamp that exist in the world are found within the LAC region, 8 of that 40 percent is found in Central America.

All countries face difficult problems with regard to overexploitation and management of inshore fisheries (Christy, 1997). Inshore fisheries are of lesser value than the other types of fisheries in Latin America and the Caribbean, but employ the largest number of fishermen as well as people associated with the fishing industry as providers of materials and equipment, and as processors, marketers, and distributors.

The other types of marine fisheries in the LAC region are the fishery for highly migratory species, particularly tuna, which are found in all ocean regions. Another fishery is for shoaling pelagic species (species that feed on the surface and are found in large schools). These fisheries tend to be located only where there are major upwelling currents that bring nutrients to the surface from deep ocean areas. The most important of these upwellings occurs off Chile and Peru. It is one of the top five commercial fisheries of the world. The fourth type of fishery is the fishery for demersal stocks (those feeding on the bottom) found on the extended continental shelf. The most significant area of extended shelf lies off the

¹ For these countries, FAO data show an annual deforestation rate of 1.2 percent in the period 1990-2000, which is much higher than the LAC rate of 0.5 percent (FAO, 2001).

coasts of Argentina, Uruguay and to some extent Brazil. This area has rich resources of groundfish, such as Argentine hake and southern blue whiting, as well as large stocks of squids.

In many cases, fishing fleets are larger than what the oceans can sustain. In addition, few marine resources are administered through a management plan with a regular mandate for stock assessments. As a consequence, knowledge of the status of fishery stocks is limited. However, experts agree that the important fisheries are overfished or at their biological limit (Costanza, et al., 2000).

Institutional Responses

The 1980s were a period of great difficulty for environmental management. The adjustments resulting from the economic crisis that struck the region affected recently created environmental institutions, which were weak to begin with, leaving them with many responsibilities but few resources. In the 1990s, the region underwent an intense democratization process in parallel with economic reform. Furthermore, in almost all of the countries civil society became an important counterpart for government institutions to address issues in areas such as health, the environment and human rights. Progress was made on environmental matters in the nineties as a result of a growing political commitment to sustainable development goals among all social actors, national, regional and international. The improvement in general legislation has strengthened the possibilities for management of coastal areas and resources. Many of the laws governing fishing, protected natural areas, environmental impact or land use were passed during the '90s.

Some countries have established national coastal management programs and supporting legislation, but these are the exception rather than the norm. Also, some countries have started to move toward a more integrated management model. Integrated coastal management initiatives in LAC countries with the greatest institutional and administrative significance are Brazil, Costa Rica and Puerto Rico, followed by Mexico, Belize, Ecuador, Chile and Colombia (Barragan, 2001)

The global conventions concluded since 1992 have also resulted in a number of important institutional changes and innovative cooperative mechanisms to address environmental issues. Most countries have set up specific bodies such as commissions, institutes or national programs to begin addressing environmental and resource issues. Nations, donors, and lender institutions are also promoting policies and implementation plans that attempt to mainstream the environment in key economic sectors, such as water, forestry, tourism, and energy. Regionally, the countries' environmental authorities have set up the Forum of Ministers of the Environment of Latin America and the Caribbean, which consists of the 33 ministries or equivalent authorities. There are also subregional treaties whose aim is the conservation of shared natural resources, such as the Central American Commission on Environment and Development (CCAD)

The individuals and institutions consulted in the development of this paper are aware of the seriousness of coastal and marine issues and the requirement that growth be built on a foundation of sustainable resource use and environmental protection measures. They also recognize that the environmental management capabilities achieved so far have not been enough to contain resource overexploitation and environmental degradation. Institutional platforms, capabilities and public policies still need to be improved considerably. Public-sector environmental budgets have fluctuated sharply over the past decade, and in many cases have shown a tendency to fall, mostly because of the position of public finances and the weakness and discontinuity of environmental governance. Budget deficits and the need to generate resources to meet external debt obligations have generally resulted in budget cuts, to which environment-related areas are extremely vulnerable.

Education of all sectors of society will be critical to ensure that the goals of sustainable development become a priority on the political agenda of LAC countries. Progress in meeting sustainable development goals can only be made if the public is informed and civil society is proactive. Much effort is still needed to give sustainable development goals greater relevance and importance in the LAC political sphere.

Some of the measures that countries can take to strengthen domestic political commitment to sustainable coastal and marine development goals are: introducing the concept of sustainable development at all levels of national educational systems; widely publicizing national sustainable development goals; investing in research, data generation and analysis of environmental problems and trends so that public opinion has a factual basis on which to form judgements; and continuing to strengthen democracy and channels of communication through which all social groups can assert their priorities and feel a sense of shared responsibility.

3. BENEFITS OF APPLYING THE NSGCP MODEL TO THE LAC REGION

The above leads us to the conclusion that the state of the coastal and marine environment in the LAC region has witnessed a global decline in the last ten years and that the pressure exerted on the coastline will increase. The main reasons for this are the distribution of the population, natural resource dependence, over exploitation, and inadequate institutional investments in coastal and marine resource management. The corrective measures implemented have been insufficient to reverse the negative trends of deforestation, pollution of coastal waters, decline of fisheries, destruction of critical habitats, loss of biodiversity, and misappropriation of public property. It further shows growing social tensions, economic vulnerability, problems of poverty and inequitable income distribution.

To meet challenges such as these, there is a need to find new mechanisms and management models specific to Latin America. These mechanisms and models can pool countries' energies toward the wise use of coastal and marine resources, strengthen education and political commitment to sustainable coastal and marine development, contribute to improving the levels of scientific knowledge and regional cooperation, and transfer innovative technologies and environmental awareness to resource users. The NSGCP offers a model for a new and regionally significant approach to encourage the wise use of coastal and marine resources. This model applies university-based research and technologies to issues relating to the responsible use of marine resources.

Applied research and its extension to resource users can improve economic well being and stimulate cost savings through the development of new products, innovations, and technologies in marine sectors such as fisheries, marine biotechnology, aquaculture, seafood processing, and the marina industry. The returns to society of research and development in the long-term are significant, as has been powerfully demonstrated by investments in agriculture (Runge et al., 2003). Scientific and technical innovations can also improve the adaptive ability of coastal economies, increase the flexibility of resource allocation, and reduce vulnerability to external market and global environmental change. Increased and more accessible environmental information and statistics are needed to help identify and prioritize the problem areas to which national environmental management resources should be channeled.

Key attributes of the NSGCP that are relevant to the LAC context include the following:

Formulating Agendas to Address the Urgent Needs of Society. NSGCP is a strategic program that develops medium and long-term goals and priorities in close collaboration with stakeholders and communities. This promotes participatory governance and channels resources to the most pressing social, economic, and environmental issues. NSGCP provides an opportunity for

diverse actors to coalesce around issues of common concern and focus on targeted strategies to address those issues.

Continuity and Permanence. The program is designed and implemented for the long-term. Long-term commitment builds a community of coastal managers, policy experts, educators, researchers and private sector partners dedicated to resolving priority coastal and marine issues. This permanence makes long term strategic planning possible.

Trust and Objectivity. Continuity and long-term presence builds trust with stakeholder groups and creates a supportive constituency, which is critical to successful extension work. NSGCP also adopts a non-advocacy role and is viewed as a transparent and neutral university-based forum to promote the exchange of reliable scientific information.

Catalyzing the Strengths of Multiple Institutions. NSGCP serves as the catalyst for bringing intellectual and physical resources to bear on the needs and opportunities of communities. Rather than create new institutions, the program mobilizes and sustains long-term connections with existing public, private and civil society institutions to address coastal and marine challenges. This minimizes duplication of effort, leverages resources, and creates assets of considerable pragmatic value at a comparatively low cost to society.

Standards of Excellence. NSGCP operates under a formal system of checks and balances with rules that define performance expectations and responsibilities. Program granting decisions are based on rigorous peer review. Funding is reduced or withdrawn from programs and individuals that do not meet standards of professional excellence in management, education, research and extension. Excellence is judged primarily against the relevance of the activity to priority coastal and marine issues.

Representational Governance and Local Ownership. NSGCP promotes representational governance. It is designed as a decentralized system that responds to the priority issues posed by coastal conservation and development in a given place. Strategic plans, implementation strategies, and program assessments involving all coastal stakeholders are required of each State program.

Regional Networks for Learning. NSGCP functions as a learning network on common themes with national, state and local links. Thematic focus areas gather the intellectual resources from throughout the national network, sharing information and ideas, and acting as a well-informed voice for responsible stewardship of coastal ecosystems at small and large geographic scales.

As it has in the United States, programs in LAC countries fashioned after the NSGCP model could become engines for economic growth and cost savings through the development of new products, innovations, and technologies. Research and extension to reduce the risks of natural disasters in coastal regions hold the potential for saving lives and hundreds of millions of dollars in avoided property damages. Education efforts can enhance the general public's awareness and knowledge in relation to coastal and marine issues.

An important benefit for LAC countries of the NSGCP model is continuity and coordination. Coastal and marine projects come and go and are usually conducted in isolation of one another. This reduces their cumulative impact and results in a constant reinventing of the wheel. A long-term program with a structure like NSGCP provides a clearinghouse for information and institutional memory, increasing the effectiveness and efficiency of otherwise isolated coastal and marine initiatives. A program structured like NSGCP would shift attention towards tangible future scenarios and allow actors to pool resources towards proactive and strategic investments in research and extension.

The network structure of the NSGCP promotes cross program and regional cooperation, technology transfer and capacity building. These characteristics are much needed. There is currently inadequate professional communication between the various disciplines (oceanographers, marine biologists, and social scientists) in the LAC region (Tarifeño-Silva, 2002). This situation often leads to finding solutions from a monodisciplinary approach.

Latin America is not known for the success of its regional integration initiatives despite a continuous coastline and relative linguistic uniformity. South-South cooperation in coastal management is rare and there is very little experience with LAC networks working toward the improvement of coastal management practices (ECLAC, 1999).² Some LAC countries have vast experience in certain coastal and marine technologies (such as Chile in marine culture of salmon) but other countries have no access to the experience. A coastal and marine initiative across LAC countries would not only help to find a specific Latin American management model, but would also contribute to improving the levels of technical training, scientific knowledge, exchange of experiences and South-South cooperation. Country programs fashioned after NSGCP in the LAC region would facilitate functioning connections between programs allowing different countries to share ideas and exchange information and technical expertise.

In areas where several countries share coastal and marine resources, such as the Gulf of Fonseca, the NSGCP model could promote harmonization of management efforts, policies, best management practices, and monitoring strategies. Greater coordination and harmonization of independent management approaches would reduce costs and improve effectiveness. A collaborative forum also provides an opportunity for diverse participants to evaluate effectiveness of programs and projects and to propose adjustments as circumstances change or as new information becomes available.

For the network of U.S. Sea Grant programs, the establishment of other programs similar to NSGCP in countries of LAC would provide greater opportunities for collaboration and two-way benefits between LAC countries and the U.S. It would create a vehicle for exchanges of information, collaborative research, curriculum development, education, and extension on coastal and marine issues of shared interest. It may encourage greater national and state spending in the U.S. to partner with countries in LAC. In-country program contacts can also help to expedite scientific research permitting processes that can often be confusing and time consuming for foreign investigators.

² A new three-year project funded at the end of 2003 by the AVINA Foundation will create a leaning network directed at leaders in integrated coastal management in Latin America. This project is entitled "A Network of Leaders for Collective Learning and Action to Put the Principles of Sustainable Coastal Development in Practice."

value of fisheries exports has risen to more than \$300 million during the last four years. Ecuador is the number one producer of farmed tilapia in the LAC region. Until recently, Ecuador was one of the largest producers in the world of shrimp grown in ponds with over 140 thousand hectares of ponds in production. Lately the industry has greatly declined due to disease problems. Remote sensing imagery shows that 26.5 percent of the mangroves that were present in 1969 had been destroyed by 1995 (Olsen, 2000). An estimated 10 percent of the destruction is attributed to the expansion of urban areas and the rest has been caused by shrimp mariculture (Olsen, 2000).

A national Roundtable was convened in October 2003 to explore interest and options for a program designed after the NSGCP. Plenary presentations and breakout working groups identified priority coastal issues. The issues tended to fall into three categories, environmental, social, and institutional. Environmental issues identified are decline in coastal water quality, decline in near-shore fisheries, loss of habitat (especially mangroves), overexploitation of resources, insufficient scientific knowledge and data, and extreme climatic events (El Niño). Social issues identified include poverty, lack of alternative livelihoods, population growth, public health, resource use conflicts, weak systems of extension, and inadequate education and public awareness. Legal and institutional issues identified include an overlap in jurisdiction, responsibilities, and mandates, often resulting in conflicts between government agencies while diminishing compliance and enforcement of laws and regulations, and institutional capacity to effectively address critical issues.

There is a close concurrence of these issues and the priorities for both the USAID-funded national coastal management project from 1986-93 and the National Coastal Management Program from 1996-2001 funded by Ecuador with a \$12.7 million IDB loan. The coastal management efforts have focused mainly on five environmental issues:

- Mangrove ecosystems
- Near-shore artisanal fisheries
- Sustainable mariculture
- Shorefront development
- Coastal water quality and environmental sanitation

In addressing these issues, social and institutional efforts were made in areas such as public education, enforcement, community planning and empowerment, decentralized governance, conflict resolution, scientific studies and baseline analysis.

The coastal and marine issues in the Galapagos Islands are different from mainland Ecuador. Conservation of biodiversity, marine fishery management, and ecotourism are priorities in the Galapagos Islands where most of the tourism in Ecuador is focused. There are 80,000 tourists visiting the Galapagos per year. There is little international tourism in the mainland coastal areas of Ecuador. There is, however, a significant and growing local tourism—primarily beach tourism.

Efforts to Address Coastal and Marine Issues

A sequence of laws, decrees and programs extending back to the 1950s have been designed to control deforestation and soil erosion, unplanned urban expansion, water quality degradation, and the overexploitation of fisheries. Unfortunately the poor implementation of these policy measures has too often had a marginal effect on long-term trends.

The approach of the USAID-funded coastal management program in the 1980's was to design a management process that would incrementally build institutional capacity and field test approaches at a

pilot scale before recommending national reforms (Olsen, 2000; Robadue, 1995; Arriaga, 2000). Ecuador was selected by USAID as one of three pilot projects designed to test the usefulness of applying lessons learned from coastal management initiatives in the United States to similar problems and opportunities in developing countries. The project sponsored by USAID began in 1986 and continued through 1993.

The project developed a national strategy document that resulted in a 1989 Executive Decree to establish a Coastal Resources Management Program (PMRC) within the Office of the President of the Republic. A National Coastal Resource Management Commission was formed with the mandate to develop national policy on coastal issues and promote collaboration among government agencies. The General Secretary of the Administration of the government of Ecuador presides over the Commission, which includes representatives from seven government agencies.

The Executive Decree established special management zones (known locally as Zonas Especiales de Manejo, or ZEMs) and gave the PMRC two years to prepare integrated coastal resource management plans for each site. The ZEMs were selected as microcosms of the challenges posed by the development and management of the Ecuadorian coast. There are now six geographic areas designated as ZEMs. They encompass only about 8 percent of the shore, but represent the full variety of problems that can be found throughout the coast. The preparation and the implementation of plans that address priorities for conservation and development in each of the ZEMs featured comprehensive and participatory planning and decision-making. All the ZEM plans were endorsed, first locally, and then by the National Commission on Coastal Resources Management. Each ZEM has a Committee composed of local authorities and civil society. The ZEM Committees and ZEM plans do not have regulatory authority.

Coastal law enforcement coordination units, known as “Ranger Corps” (known locally as Unidades de Conservación y Vigilancia, or UCVs) were also established by the same Executive Decree to improve the effectiveness of enforcing existing laws governing shore use, mangrove forest protection, water pollution, near-shore fisheries, and mariculture. The Ranger Corps draws together local level governmental administrative and enforcement officers. Today there are UCV units in seven locations along the mainland coast, each of which is led by a port captain of the General Direction of the Merchant Marine of the Ecuadorian Navy (known locally as DIGMER). This is Ecuador’s equivalent of a Coast Guard.

PMRC program activities in the ZEMs and the work of the National Coastal Resource Management Commission were brought to a halt for nearly three years in the transition from USAID funding to a program administered by the Government of Ecuador and funded by an IDB loan. From 1996-2001 the PMRC program focused on implementation of ZEM plans and other actions in the national strategy on the priority issues of the five environmental issues identified earlier. A second IDB loan to support coastal management in the order of \$14 million is currently being negotiated and is expected to be disbursed in early 2004. In the transition to a new IDB loan there was another halt of activities of the coastal management program.

The PMRC program has been based on approaches of public participation and partnerships. The Ranger Corps are composed of groups with members from various organizations. Members typically include the Forestry Agency, Subsecretary of Fisheries, Ecuadorian Tourism Corporation, and DIGMER.

The National Fisheries Institute (Instituto Nacional de Pesca, or INP) is an important organization in marine fisheries and has been a partner with the PMRC. For example, INP documented baseline conditions in critical artisanal fisheries—the shrimp postlarvae fishery and the fishery for adult egg-bearing female shrimp upon which many shrimp hatcheries depends. As a result of this research the INP added an extension component to their work and collaborated closely with fishers to gather catch data and identify options for conserving marine resources.

Other organizations that have been closely involved in coastal and marine affairs include Fundación Pedro Vicente Maldonado, the Subsecretary of Coastal Environmental Management in the Ministry of Environment, the Coastal Polytechnic University (ESPOL), and the recently inaugurated International Center of Research on the El Niño Phenomenon (CIIFEN) in Guayaquil.

CIIFEN is a center that draws together scientific information on El Niño and its impacts, and plays a coordination role with regional and national partners in research and extension. CIIFEN is forming a national technical committee that include three Ecuadorian Universities and the Naval Oceanographic Institute (Instituto Oceanográfico de la Armada, or INOCAR). Climate change has a major social and economic impact on Ecuador's coastal and marine zone and, therefore, there is a great need for better information systems and adaptive technologies. Currently, a major gap in the CIIFEN program is extension capability.

The offices of the Coastal Resource Management Program are located in Guayaquil, as are most of the other organizations mentioned so far. It is important to note that there is another group of organizations that is primarily located in the nation's capital in Quito with a primary orientation of biodiversity conservation in critical conservation areas and protected area management. This group includes the Nature Conservancy, World Wide Fund for Nature (WWF), Conservation International, and the Universidad San Francisco de Quito. To date, the biodiversity conservation organizations in Quito and the coastal and marine management organizations in Guayaquil have not coordinated efforts to a large degree. One integrating mechanism is the National Biodiversity Working Group organized by IUCN, but it does not have a marine focus.

In terms of marine systems, the predominant focus of the Quito organizations is directed at the Galapagos Islands. Ninety-seven percent of the Galapagos are within a national park and the province has a unique administrative structure. Because of this, and because of the distance and cost of operating in the Islands, the PMRC has not integrated the Galapagos into its activities.

Institutions of Higher Education

The University with the most advanced academic and research programs in coastal and marine topics is the Coastal Polytechnic University (Escuela Superior Politécnica del Litoral, or ESPOL). ESPOL was founded in 1958 as a polytechnic institution with the basic goal of improving the use of natural resource and technological development of the country. The university is based in Guayaquil and has several campuses. The main campus is located in a rural setting outside of Guayaquil. Another campus is located in the Santa Elena Peninsula west of Guayaquil in Guayas Province. ESPOL is a public university but the national government supports only about 51 percent of the budget with the rest generated by outside support. The university has about 9,000 students, offers 45 undergraduate and graduate degrees, and has about 30 Ph.D. level professors.

One of the oldest colleges of ESPOL is the College of Marine Engineering and Marine Sciences, which offers five major degree programs (Naval Engineering, Oceanography, Tourism, Biology and Aquaculture). The College has about 500 students and 22 professors. Master degrees (M.Sc.) are offered in three areas: Coastal Resources Management, Marine Aquaculture, and Port Management.

The College of Marine Engineering and Marine Sciences has three associated centers—National Coastal Resources Center (CENAREC), National Aquaculture and Marine Research Center (CENAIM), and the Fisheries Oceanography Research Center (CIOP).

CENAIM is an aquaculture research center with an international reputation for excellence. It is a partnership of the State, private sector and ESPOL. The objective of the Center is to promote the

sustainable development of aquaculture productivity and diversification in Ecuador through scientific research, technology development, training and outreach. The research facilities of CENAIM are located in San Pedro de Manglaralto. The facilities include 20 laboratories, experimental tanks, a specialized library, offices, and living quarters and food services. The Center has 65 staff, of which 14 have Ph.D.s or M.Sc. degrees.

The focus of CENAIM is primarily scientific research but has interest in expanding into more extension services if funding could be secured. CENAIM currently provides extension to small mariculture farms in Pedernales. There is also interest in working in El Oro Province to provide extension services to small farmers.

The National Coastal Resources Center (CENAREC) was created by ESPOL to partner with and provide training to technical staff of the Coastal Resources Management Program (PMRC). The Center has hosted four two-week training courses in ICM with participants from throughout Latin America. The Center is currently involved in extension activities that include working with coastal communities in biodiversity management, mangrove and river basin management in Guayas Province, and strengthening environmental management capacity of the municipalities.

The Fisheries Oceanography Research Center (CIOP) was created in December 2002 by the College of Marine Engineering and Marine Sciences to provide science and technology services and to develop research in support of fishing operations and fisheries development. CIOP has funding from the fishing industry, the National Science and Technology Foundation, and international donors. Current research projects are the development of atlases of the eastern Pacific pelagic fisheries and development of fishing charts to improve the efficiency of the tuna fishing fleet.

ESPOL has a partnership with a consortium of Belgian Universities. Phase one of the partnership extended from 1999-2002 and carried with it \$3.2 million of external financial support. A second phase that will extend from 2003-2008 will be funded at a similar level. The overall objective is to enhance academic program excellence through innovations in education in parallel with institutional capacity building in the administration and execution of applied scientific research. One of four components targets environmental management of agriculture and aquaculture. Research areas include coastal impacts of pesticide use in the banana sector, irrigation and agriculture studies in the Santa Elena peninsula, monitoring of benthic communities and natural populations of shrimp, and an alert system for shrimp epidemiology.

ESPOL has a Center for coordination of scientific research—the Scientific and Technological Research Center (CICYT). CICYT establishes priorities for research through its Research Council, provides logistic services to projects and researchers, offers training in how to conduct research for graduate students and faculty, and is responsible for communications.

There are many other private and public universities located both on the coast and in Quito with studies in areas associated with the development and sustainable use of coastal and marine resources:

- Catholic University of Ecuador (Pontificia Universidad Católica del Ecuador) has academic programs in five locations with two in coastal areas—Esmeraldas and Manabí. The Manabí program has facilities in the communities of Portoviejo, Chone y Bahía and offers academic programs in marine biology and sustainable tourism
- Universidad San Francisco de Quito (USFQ) is a private, liberal arts university in Quito. It has grown rapidly since it was founded in 1988 and now has 3,500 undergraduates, 45 majors, and 11 Master's programs, including Environmental Management. It hosts an Institute of Applied

Ecology that has an emphasis on marine conservation. Last year, USFQ opened a new campus on the island of San Cristóbal, Galapagos Islands. This campus will offer an intensive semester program for international and national students in areas of marine biology; two-year Associate degrees in natural resource management and tourism management; and, graduate programs in marine biology, conservation, and protected areas management will be developed. USFQ also has field extension projects on the Galapagos Islands and on the mainland coast in Punta Galera and Machalilla National Park near Plata Island. In the Galapagos they are focusing on capacity building of fishers in the marine reserve and doing baseline research on tourism on Isabela Island. In Machalilla they are working on development of a marine reserve, and in Punta Galera they are working to improve the information base.

- Catholic University of Guayaquil (La Universidad Católica de Santiago de Guayaquil) is located in Guayaquil. It is a private, non-profit institution with more than 5,500 students enrolled in degree programs.
- The University of Guayaquil was founded in 1867. It has a student body of some 60 thousand, offers 31 degrees and has campuses in 6 other locations along the coast and on the Galapagos Islands. The College of Natural Sciences offers degrees in biology and environmental engineering, among others, with studies in conservation, mangrove rehabilitation, and environmental impact analysis.
- The Naval Oceanographic Institute (INOCAR) carries out oceanographic research on issues of national interest related to the sea and coastal zones
- Technical University of Machala

Opportunities for Program Development

There was universal agreement among participants at the national Roundtable that the concept of the NSGCP has value for Ecuador. The group found the following aspects of the NSGCP concept particularly appealing:

Long term planning, continuity, and national commitment. Currently, there is a lack of vision and an agenda for the coast. The NSGCP would promote the development of a national agenda and strategic plan for the management of the coastal and marine zone, and provide a structure for creating and improving national and municipal policies. It would also create conditions favorable for institutional collaboration and generation of leveraged funding. Currently, there is a lack of a vision and agenda for the coast.

Integration of research, education and extension. The application of the NSGCP would accelerate the development of extension services, currently an area of weakness. Extension services and carefully targeted applied research are clearly needed to provide technical backup to a great diversity of coastal resource users along the coast. The connection of education and research with extension would ensure that information is available to those who need it and overall public awareness and education would be improved.

Neutrality and independence. The independence of NSGCP encourages objectivity and decreases the swings in direction that result from political shifts. Program independence and decentralized operation are critical for continuity of effort.

Quality control. The NSGCP has a clear and transparent process, mechanisms of quality control, peer review, and periodic evaluation.

Discussions on how to structure a program like the NSGCP in Ecuador centered on a network of institutions with a lead university responsible for administration. The strongest candidate lead institution is the Coastal Polytechnic University (ESPOL). ESPOL has the greatest depth of academic and research programs in fields of coastal and marine science. Faculty and university leaders at all levels up to University President confirmed support for a coastal and marine program like NSGCP, including in-kind financial support. The Scientific and Technological Research Center at ESPOL could be the administrative home for a new program of coastal and marine research and extension since it already provides leadership and support for science and technology to the university.

Although the lead institution would be responsible for program administration, Roundtable and other in-country discussions emphasized that the program should be designed as a network involving multiple institutions, as is the NSGCP. The program would thus be a mechanism to direct research and extension services on priority themes across professionals from many different institutions. In the NSGCP, organizations outside of the administering university may submit proposals for competitive and non-competitive grants. While all grants are not open competition, all proposals undergo peer review.

Some of the key institutions identified as important members of a national network on coastal and marine issues include ESPOL, National Fisheries Institute (INP), The Nature Conservancy, Conservation International, Universidad San Francisco de Quito, National Oceanic Institute (INOCAR), Ministry of Environment, Pontificia Universidad Católica del Ecuador, University of Guayaquil, PMRC, US Peace Corps, and International Center for the Study of El Niño (CIIFEN).

Based on the Roundtable discussion and review of the current priorities of existing institutions, candidate applied research and extension themes for an Ecuador program modeled after NSGCP include:

- Conservation hotspots and marine protected areas
- Sustainable mariculture and promotion of alternative species
- Enhanced management of artisanal fisheries
- Integrated coastal watershed management
- Climate change adaptation
- Zoning and shorefront use
- Social and economic causes and consequences of deforestation
- Public education
- Sustainable tourism

Given the prevalence of poverty, a program focus on actions that have positive economic impacts would be important. In the actual development of a program, detailed guidelines for thematic areas would be developed by the program Director with the assistance of the national network of program partners.

Funding for a new program will be a challenge. New and innovative financial mechanisms are required in order to ensure this is a long-term and continuous program. An annual allocation from the government of Ecuador may not be a realistic option. By contrast, a one-time government grant to establish an endowment might be possible. For example, the government of Ecuador made a \$7 million grant to CENAIM for example. It is being managed as a trust fund with interest supporting part of CENAIM's costs of operation.

5. GULF OF FONSECA CASE STUDY

Coastal and Marine Issues

The marine environment of the Gulf of Fonseca is shared by Nicaragua, Honduras, and El Salvador. The Gulf is a shallow depression with an area of approximately 3,200 square kilometers, and a coastal length of 261 kilometers of which 185 kilometers are in Honduras, 47 are in Nicaragua, and 29 kilometers are in El Salvador and (Sherman and Tang, 1999). It is estimated that there are over a million people living near the Gulf, with some 600,000 in Honduras, 240,000 in Nicaragua, and 160,000 in El Salvador (Varela, 2002). Most of these people are dependent on the Gulf's natural resources for subsistence and livelihood. Resource dependent activities include shrimp post-larvae collection, artisanal fishing, mangrove harvest for structural wood and fuel, and small-scale agriculture.

The three countries surrounding the Gulf are some of the poorest in Latin America. Nicaragua and Honduras are the second and third poorest countries in Latin America with an average annual income of \$430 and \$730 per year, respectively. Unemployment is high around the Gulf, probably exceeding 40 percent. The situation is worse in parts of Nicaragua where it is estimated that over 60 percent of the population living near the Estero Real are unemployed. Out-migration from the region is high, but the overall birth rate is high as well. Those that remain in the area are usually women and children. Unemployment, low income, high birth rate, and poor social infrastructure make the majority of people living in the Gulf highly vulnerable.

According to the majority of the individuals that we met with, the most significant constraints to environmental and social stability in the Gulf of Fonseca are poverty and the lack of alternative economic opportunities.

The Gulf of Fonseca is an area of internationally recognized natural value. Due to its extensive wetlands, mangrove ecosystems and importance for migratory waterfowl the entire area around the Gulf has been placed on the RAMSAR list of Wetlands of International Importance. It is estimated that the coastal zone contains over 70 species of migratory birds, 50 species of fish, 22 mammals and reptiles, and a vast variety of plants and trees (Varela, 2002). One of the most distinct ecological features of this region is the extensive mangrove ecosystem. The area contains some 22 percent of total mangrove area of the Pacific coasts of Central America (Guatemala to Panama) (Sherman and Tang, 1999). This mangrove system traps nutrients and sediments, stabilizes the coastline, and is a breeding ground for commercially important fish, mollusks, and crustaceans. The wetlands, consisting of mangrove forests, creeks, tidal flats, and seasonal lagoons, comprise nearly 33 percent of the total area of 163,000 hectares of plains and coastal areas around the Gulf (Vergne et al, 1993).

The estuaries and salt flats bordering the Gulf are ideal for shrimp farming. Farmed shrimp exports are one of the top foreign exchange earners for Nicaragua and Honduras. Last year, Honduras exported about \$84 million in farmed shrimp making it the second largest export sector in Honduras after coffee. Shrimp farming is not a significant industry in El Salvador, although shrimp post-larvae facilities are an important part of the economy in the area around La Union.

Nicaragua currently has over 9,000 hectares of shrimp ponds in production and it is estimated that the industry generates over 16,000 jobs. It is estimated that another 20,000 people receive direct and indirect benefits from shrimp farming (Saborio, 2001). Private producers operate approximately 4,000 hectares and about 5,000 hectares are operated by 130 shrimp cooperatives. Of the latter, 90 cooperatives have joined together to form 4 unions, which in turn have joined to form a single federation. The goal of the

federation is to increase market power and access to credit. The private industry is represented by the National Association of Aquaculture Producers (ANDA).

Until Hurricane Mitch, Honduras had approximately 18,500 hectares in shrimp production—currently there are about 12,500 hectares in production. The farms that remained idle post-Hurricane Mitch are mostly small and medium operations. Unlike Nicaragua, the shrimp farm industry in Honduras is primarily private. The National Aquaculture Association of Honduras (ANDAH) was formed to collectively organize the industry and give it a unified voice. ANDAH actively promotes good management practices and provides a forum for decision making on issues affecting the industry.

There is little government oversight of the shrimp aquaculture industry in Nicaragua and Honduras. Poor siting and production practices, and over development of the industry can degrade the coastal environment and damage the natural resource base that the industry depends on. The main environmental concern associated with shrimp farming in the Gulf is conversion of mangrove and other habitat and associated conflicts with artisanal fishers. Although most of the industry in Honduras was initially sited on salt flats, individuals wanting to enter the industry but without access to suitable land often convert mangroves into ponds. Estimates of mangrove loss in southern Honduras due to shrimp pond construction range between 2,100 and 4,300 hectares (Collinson, 1997).

Upstream deforestation is a critical problem confronting the marine and coastal environment of the Gulf of Fonseca. Upland deforestation, inadequate erosion prevention measures, agriculture, and the damming of major rivers (such as the Nacaome in Honduras) are the primary causes of changes to microclimate, desertification in the region, deposition of sediment loads in the Gulf, eutrophication, and reduced freshwater flow to the Gulf (Vergne et al., 1993). Deforestation reduces watersheds' ability to naturally regulate water runoff and stabilize soils. As population in the region increases and soil stability decreases, natural disasters such as Hurricanes, drought, and earthquakes produce more severe consequences for the population of over one million in the Gulf.

Some 76 percent of the total freshwater input to the Gulf is from Honduras (Vergne et al., 1993). The major Honduran rivers are the Choluteca and Nacaome Rivers. At this time there are few governance mechanisms that link upstream and downstream users in the major watersheds. The Choluteca River originates near Tegucigalpa and passes through areas of high population density and human activity. The river transports chemicals, pesticides, heavy metals, fertilizers, and human waste. Large tracts of dry, tropical forest in the Choluteca River watershed have been cut for fuel, construction material, and to make way for hillside agriculture and grazing. Some 74 percent of the watershed is deforested (De Ferranti, 2000). Similarly, some 70 percent of the Nacaome River watershed has been deforested. As forests are cut or burned for farming and livestock subsistence on the steep slopes soil erosion increases and the land quickly becomes unproductive, forcing people to move yet again to clear more forests. These human-induced impacts compound natural variations in climate, which tend toward seasonal drought in the winter months. In some cases, perennial streams no longer flow during the dry season.

The Estero Real in Nicaragua is also an important source of freshwater flow to the Gulf and carries increasing sediment loads and nutrients (US Embassy, Managua, 2003). In El Salvador, almost all of the original primary forests surrounding the Gulf have been cleared for agriculture and cattle production.

Other issues in the Gulf of Fonseca include uncertain territorial boundaries and overlapping legal jurisdictions. This condition has made it difficult for nations and ministries to regulate the harvest and trade of marine and coastal resources, such as shrimp post-larvae, fish, mollusks, and mangrove wood. Most of these resources fall under one or more systems of state *de jure* control, but in practice rules governing these extensive harvest practices are difficult to enforce due to these uncertain sovereign boundaries and legal jurisdiction among different government agencies.

Finally, commercial shipping may become an issue in the future. There is a proposal to construct a dry canal linking the Pacific port of Cutuco in the Gulf of Fonseca near the town of La Union, El Salvador with an Atlantic port in Honduras. A Japanese-led consortium has offered a \$121 million dollar loan to the government of El Salvador for the construction of the new port. The port would accommodate 2-3 ships weekly carrying over 4,500 containers per ship. Containers would be transported from Cutuco by train or truck to the Atlantic coast of Honduras, providing a new means of access to the Atlantic from the Pacific.

Environmental concerns include the impact of dredging and the potential of oil spills. It is projected that over 1.2 billion tons of soil will be dredged in the Gulf to create the necessary shipping lanes. How this would affect living marine organisms and water circulation dynamics in the Gulf has not yet been studied. Oil spill disaster response plans would also need to be developed. As a shallow depression the Gulf is highly vulnerable to oil spills, especially during the dry season when currents tend to flow inward toward the coastal areas of the Gulf. The consequences of a single oil spill could be disastrous for mangrove systems, the shrimp farm industry, and fishers.

Efforts to Address Coastal and Marine Issues

Two of the largest ongoing projects in the Gulf region dealing with coastal and marine issues are PROARCA and PROGOLFO, funded by the U.S. Agency for International Development (USAID) and the Danish Development Agency (DANIDA), respectively.

PROARCA is a Central American environmental project executed by the World Wide Fund for Nature (WWF), The Rainforest Alliance, and The Nature Conservancy (TNC). The project is now in its second phase and 7th year with a level of funding equal to about \$1 million per year. The project works closely with the governments of member countries and key actors to develop norms, policies, and land use plans governing the management of protected areas within the framework of the Mesoamerican Biological Corridor. PROARCA has a Regional Technical Advisor for the Gulf based in Tegucigalpa, Honduras. PROARCA-COSTAS, involves very localized cases of coastal management in Belize, Honduras, Nicaragua and Panama.

PROGOLFO has four main objectives: increase production, develop income generating activities, environmental improvement of the Gulf, and improvement of social well being through sexual education and population growth. Decentralized management and community empowerment are strategies of the project. For example, the project seeks to improve community access to government ministries, strengthen local capacity to protect the areas that have been designated as RAMSAR sites, and works with an Association of Municipalities of the Gulf of Fonseca.

Key Weaknesses in the Gulf

- Lack of real and effective coordination among the countries
- Lack of long-term programs, continuity and follow-up
- Lack of integrative mechanisms between investigation, extension and education
- Lack of information and awareness on marine and coastal issues
- Lack of political will

Roundtable Summary Report, Tegucigalpa, October 21-22, 2003

The regional environmental and development coordinating body is the Central American Commission on Environment and Development (CCAD). CCAD is responsible for coordinating regional environmental activities and establishing policy frameworks within which actors in the Gulf can cooperate. CCAD is nested within the Central American Integration System (SICA) created in 1991 through an international

treaty known as the Tegucigalpa Protocol. SICA is an umbrella organization designed to facilitate economic, environmental, political, and social integration throughout the seven Central American countries.

Another regional body that is involved with fisheries policy and research is the Central American Organization of the Fisheries and Aquaculture Sectors (OSPESCA), which is a part of CCAD. Currently, the Director of OSPESCA is also the Director of the Fisheries Department for the government of El Salvador.

Work on coastal and marine issues in Nicaragua include those of the Center for Aquatic Ecosystems Research (CIDEA) at the University of Central America in Managua. CIDEA works closely with marine and coastal resource users, with a specialization in research, training and extension in mariculture. Non-governmental actors also play an important role in the development of coastal communities. The Center to Promote Research of Rural and Social Development in Managua focuses on alternative technologies, marketing and trade, and social infrastructure such as education, electrification, and clean water. Its programs are directed at improving household well-being and providing assistance to small producers, including shrimp farmers.

In both Nicaragua and Honduras, municipalities are playing an increasingly important role in environmental management and economic development of the Gulf region. In the Gulf region of Nicaragua, five municipalities backed by a social consortium of shrimp farmers, agriculturists, and mangrove harvesters, have generated a joint proposal to establish a social and environmental program, focused on improved production, employment generation, restoration of the Gulf environment, and education of natural resource users. In Honduras, an association of seven Gulf municipalities has formed to work on issues of common concern, especially water quality and quantity.

In Honduras, the Committee for the Defense and Development of the Flora and Fauna of the Gulf of Fonseca (CODDEFAGOLF) is an NGO in Honduras with wide visibility and international recognition for its work in environmental outreach in the Gulf.

The University of Zamorano located near Tegucigalpa has many locally and externally funded efforts related to the coastal and marine environment of the Gulf. Zamorano provides technical assistance in agriculture, aquaculture, forestry and rural development. Its program of tilapia aquaculture research and extension has had a significant impact on the growth of farmed tilapia in the country.

PROMANGLE is a community-based forestry project with external donor support operating out of the Honduras Forestry Department within the Agriculture Ministry. PROMANGLE has a staff of 15, including 5 extension agents that work with community volunteers to replant mangrove swamps cleared by small independent shrimp farmers operating in protected areas without permits. PROMANGLE manages 13 plots, where they have two years of data measuring growth rates, stocking density, and other environmental parameters. PROMANGLE also helps to develop community woodlots using fast-growing species to take pressure off mangrove harvest for fuel and for construction. The program maintains and operates a research facility near San Lorenzo, including GIS capabilities and a seedling nursery, which provides a base for mangrove extension activities.

Most Important Attributes of Past Project Success in the Gulf

Flexibility in implementation

Wide consultation

Strong extension component

Good communication

Roundtable Summary Report, Tegucigalpa, October 21-22, 2003

The Food and Agriculture Organization (FAO) has formed a multi-sectoral committee in Honduras with the purpose of sharing information and coordinating efforts at stabilization in dry upland areas along the Pacific coast. The FAO initiative provides baseline information and data, such as spatial information on food insecurity, food production, and public health.

There are many NGO's in El Salvador with development activities in the Gulf region focused on coastal and marine themes. The Maquilishuat Foundation is an NGO in El Salvador that focuses on social development in poor rural and urban areas, including regions bordering the Gulf. It directs activities in training, technical assistance, natural resource conservation, and community relations. FUNDAMUNI is an NGO that is currently focused on watershed management in the Gulf with support from USAID. ADESGOLFO is another NGO that works with municipalities to develop ordinances to protect marine resources and improve solid waste management. They are currently working with 80 communities. Finally, the Consortium of Sustainable Development coordinates activities with many organizations around the Gulf on economic development issues.

Institutions of Higher Education

The U.S. National Sea Grant Program and the University of Puerto Rico Sea Grant Program worked with two Universities in Honduras and Nicaragua as part of the U.S. supported Hurricane Mitch recovery program. The University of Central America (UCA), Managua and the University of Zamorano were selected as partners in an extension program targeting the shrimp farm industry. A Technical Assessment Team led by the University of Puerto Rico surveyed a number of institutions and ultimately identified these two universities as the strongest institutions in terms of being able to provide technical assistance, outreach, and training.

There are seven primary universities in Honduras. In addition to the University of Zamorano, they are Centro Universitario Regional del Litoral Atlántico (CURLA), Universidad Nacional de Honduras (UNAH), Universidad Nacional Agraria (UNA), Universidad Católica, Escuela Nacional de Ciencia (Ciencia) Forestal, Universidad de San Pedro, Universidad Tecnología (?), and the Universidad José Cecilio (Cecilio) de Valle. None of these universities have marine and coastal resource programs. Marine biology is taught at UNA, and aquaculture courses are offered at UNAH, UNA and Zamorano. Zamorano and CURLA are the only institutions with research and extension programs in Honduras.

In addition to UCA, the main universities in Nicaragua are Universidad Autónoma de Nicaragua (UNAN), UNAN León which is not affiliated with the Managua campus, Universidad Nacional Agraria (UNA), Universidad de Ingeniería (UNI) and the Universidad Americana de Managua (UAM). Among these, UCA and UAM are private universities. UNI has an environmental science program but does not necessarily have any programs focused on marine or coastal related topics. At this time, UCA is the only institution conducting research and extension related to the marine and coastal environment of Nicaragua.

Below, we review UCA and the University of Zamorano. Our assessment is based on questions drawn from several guides on institutional capacity assessment (WWF's *Organizational Assessment Guide*, TNC's *Institutional Training Assessment*, and the Coastal Resource Center's *Organizational Capacity Assessment: Assessing Institutional Development of a Marine Center within a University*). The questions were grouped around three broad categories: internal capacity including vision, mission, strategies, governance structure, financial resources, programmatic initiatives, and linkages with other actors in public, private, and civil society.

University of Zamorano

Zamorano (also known as the Pan American School of Agriculture) is a private, international technical college established in Honduras in 1941. Zamorano's mission is to prepare leaders for the Americas in sustainable agriculture, agribusiness, natural resources management, agro-industry, and rural development. Its broader vision is to transform the rural populations of Latin America into globally sustainable and competitive sectors. A Sustainable Development and Competitiveness Strategy was adopted in 2002 with a focus on competitiveness, environmental responsibility, and international industry standards.

Zamorano is unique in that all students and faculty live on campus. Infrastructure includes dormitories for students, administrative offices, classrooms, 72 staff residencies, guest housing and conference facilities, library; dining facilities, clinic, laundry, barbershop, bookstore, bank, churches, recreational facilities, workshops, sawmill, etc. There are 663 employees with 201 in administrative positions, 124 faculty and medical staff, and 328 maintenance and clerical positions. Total land area is 5,495 hectares with a large portion under forest cover or used for agricultural production.

The University is recognized throughout Latin America for its academic programs in agriculture, sustainable rural development and natural resources management. Zamorano trains thousands of farmers, extension agents, technicians, educators, policy makers, and researchers each year, usually in the context of rural development projects that integrate good science with technology transfer. Many leaders in government in Honduras and other countries throughout Latin America are Zamorano graduates. As a result, Zamorano is often called on to provide information on important environmental and social issues that may influence decision making.

One of the key attributes of Zamorano is that academic programs bridge the gap between theory and practice. Classroom education is linked with fieldwork and learning by doing 'real-world' environment and development issues. Coursework, research, and extension is offered in aquaculture (especially tilapia farming). Other academic disciplines that are indirectly related to the use of the Gulf's marine and coastal resources are agriculture, forestry, and watershed management. Human activities in the upper watersheds create significant impacts upon downstream marine and coastal resource user groups and the coastal environment as a whole.

Zamorano actively builds partnerships with other institutions to tackle critical development challenges and advance its interests while achieving a common vision or strategy based upon the needs and interests of its user constituencies and partners. The University maintains programmatic and strategic relations with multilateral donor organizations, NGOs, civil society organizations, other universities and research institutions, the private sector, government agencies, and the media. The Dean of Outreach and the Director of Outreach are specifically responsible for maintaining these types of external relationships. Many are expressed in the form of Memorandums of Understanding (MOU).

Characteristics of the University of Zamorano

- Classroom education systematically linked with learning-by-doing, extension, and applied research
- Strategic and long-term planning
- Experience in methods of project administration
- Financial stability through successful fund-raising and business operations
- Project development based on the needs and interests of user constituencies
- Strong relationships with government, private sector and other institutions in the country and Central America.

The projects and academic programs of the University are strategic, based upon the development of medium and long-term goals and priorities for research, education, and extension in close collaboration with resource users. Once objectives are established and individual projects identified with funds

obligated, work plans are developed. The work plan for each project identifies the individuals responsible for particular areas of work, the tasks, the process, and the timing. Each of the projects has specific, measurable objectives and indicators designed for internal purposes as well as for funding organizations. An evaluation and monitoring unit has been established to determine whether or not projects and programs are achieving their intended objectives. The unit monitors project objectives and results through a variety of techniques, and provides a process to identify project modifications to improve implementation. Good practices and lessons learned are made available to managers and staff within other units and departments. Other types of reporting are a function of the reporting requirements established by the client or donor agency. Strategic planning, clear allocation of responsibilities and strict monitoring and evaluation processes contribute to organizational stability and accountability.

The University of Zamorano is one of the best funded and stable universities in Latin America. The university has an endowment of some \$42 million. In most years, the Board of Trustees has decided to reinvest most of the interest rather than use it to help finance Zamorano's operating budget. Some of the interest is used to support scholarships for Honduran students and environmental activities in Honduras.

Forty three percent of Zamorano's income comes from tuition and fund raising for student financial aid. In the past three years Zamorano has raised over \$6 million from donors to establish scholarship endowments dedicated to providing full or partial needs-based scholarships to students. Approximately 35 percent of university income is generated from seven vertically integrated production and service enterprises (primarily agriculture and food service enterprises). Zamorano also has joint ventures with the private sector in areas such as sugar cane production, seed processing, vegetable production for export, poultry production and coffee processing. Additional income comes from grants from various overseas organizations for research, extension, and training.

The Board of Trustees, the International Board of Advisors, and a Development Committee are active in fundraising. All trustees make personal contributions to Zamorano, and many of them facilitate the interaction of the overseas institution with U.S. and international philanthropists, foundations and donor agencies.

University of Central America, Center for Aquatic Ecosystems Research

The University of Central America (UCA) of Managua was created in 1961 as part of the Jesuit University worldwide network. The main mission of the University is to focus on human and socio-economic development in Nicaragua. Currently, the University holds 114 full time professors and 275 part time professors. There are around 6,500 enrolled students in five departments. UCA's mission is to contribute to the equitable and sustainable human development of Nicaragua and the region through high quality teaching, research and social outreach, inspired by Christian values.

The Department of Science and Technology for the Environment (S&T) has 264 students. Currently, the department has several majors including fisheries engineering and aquaculture. The Department also has several research centers and among them is the Center for Aquatic Ecosystems Research (CIDEA), the focus of this section.

CIDEA was created in 1996 through an act passed by the University's Board of Directors. This act provides CIDEA with the authority to function as an independent unit within the university but provides no direct funding to CIDEA. The Director of CIDEA reports to the Dean of S&T who reports to the President of the University. An informal CIDEA Board of Directors was established by the Director of CIDEA and this Board acts as an ad hoc advisory committee. This Board includes the Chairman/President of the University's Board, the President of UCA, the General Secretary/Provost of UCA, Financial

Director of UCA, and the Dean of S&T. CIDEA's decision-making authority resides with the Director as long as the Board of Directors approves.

The Center's original mission was focused upon the sustainable development of the aquaculture industry in Nicaragua with a specific focus on increasing productivity while reducing environmental impacts. In the year 2000, the Center adopted a program of research, education, and extension with assistance from the University of Puerto Rico Sea Grant.

CIDEA's first strategic plan is currently being reviewed by the Board of Directors. In the strategic plan, CIDEA has chosen to broaden its scope and begin focusing on wider marine and coastal issues. The center is interested in expanding its activities to areas such as marine fishing and agriculture in the Gulf region of Nicaragua. To date, the fisheries sector has received very little support in terms of technical assistance or training. CIDEA is working toward conducting more constituent driven research and broadening its extension activities to solve local problems on the Pacific coast of Nicaragua as well as in the Gulf of Fonseca. The center is also working toward developing better linkages with the university's facilities on the Caribbean coast and would eventually like to place an extension agent in Bluefields and/or Puerto Cabeza.

The Center employs 23 people, of whom 16 are technicians and professionals who teach, conduct research, hold workshops, and provide training and technical assistance. Physical infrastructure includes an office and laboratories in Managua and a training facility in Puerto Morazan, Department of Chinandega near the Gulf. The training facility can hold 30 people and has dorms that can accommodate 24 people. CIDEA has also acquired a facility in San Carlos on Lake Nicaragua that can be used for training. Other equipment includes four vehicles, a tractor, and two small boats with outboard engines.

UCA contributes infrastructure, utilities, maintenance, computer services and teaching salaries, but projects executed by CIDEA are fully funded by external resources. The Center has raised an average of \$341,200 per year. During the period from 1996-2000 CIDEA funding was primarily dependent upon the Japanese International Cooperation Agency (JICA). Currently, CIDEA's sources of funding are diversified. CIDEA works with and has relationships with a wide variety of international and national NGOs, private industry, national and local government, external donors and multilateral organizations, and other Nicaraguan universities. An agreement with the university ensures CIDEA funding for one year if CIDEA is unable to raise sufficient funds to cover operational costs or staff salaries. CIDEA has not yet had to rely on this agreement to but has had difficulty covering short-term operating costs at various times.

Administration of projects includes development of work plans, definition of staff responsibilities, and identification of specific, measurable, and relevant outcome indicators. CIDEA would like for all project and programmatic activities to align with its strategic plan. The project coordinator and relevant team members meet with the Director to discuss where the projects are in the process and whether or not the intended outcomes have been completed. CIDEA makes an effort to share and discuss the status of projects with its staff and clients, determine the lessons learned, and identify the challenges that remain. As a result, the planning and implementation process is modified to adapt to changing circumstances.

Primary research areas include water quality research of the Estero Real, a major source of freshwater to the Gulf; nutrition and pathology of shrimp; and shrimp production efficiency. The results of research are disseminated through a variety of mechanisms including workshops, training programs, environmental education programs, and direct technical assistance. The Center's education and training component is designed to extend information and research results to students, local user constituencies, and professionals. Since 2000, CIDEA has convened 67 training workshops; 11 for students, 37 for the cooperatives of shrimp producers and 19 to professionals working in the field. These workshops have

covered U.S. Seafood Safety and Handling Standards/HACCP compliance, shrimp nutrition and pathology, shrimp farm bio-security, pond management, improved water quality, quality and protection of the environment in relation to aquaculture, protection and conservation of the mangrove ecosystem, management of solid waste, and credit and business management.

Research and technical assistance are closely linked. Technical assistance has traditionally focused on the needs of small shrimp producers and farmer cooperatives in regions with high poverty levels. Areas of research and technical assistance focus on water quality, the conditions of the shrimp larvae, sample populations of shrimp larvae, pathology, nutrition follow ups, pond management, densities and harvesting techniques, and handling and the management of the product. Since 2000, 16 cooperatives and more than 100 members have received technical assistance from CIDEA. CIDEA operates a 30-minute radio program providing advice to producers throughout the region on aquatic and related environmental issues, technologies, and best management practices.

The Center has established strong relationships with the shrimp farm industry through the process of extension. Meetings are periodically held with the presidents of the four shrimp cooperative unions, comprised of more than 150 cooperatives. At these meetings CIDEA staff identify problems and needs and develop strategies for research, technical assistance, and training.

CIDEA also develops relationships with local municipal offices, schools, and health centers in the communities where its' activities take place to ensure that its activities are aligned with development needs and goals or to take on new areas of assistance. For example, CIDEA assisted with the development of Nicaragua's development strategy for the municipality of Puerto Morazan by engaging institutions and NGOs operating in the region and identifying common goals and objectives. The majority of the Center's projects are identified through the process of extension or by working directly with user constituencies to identify their needs. CIDEA also provides services to national government bodies. For example, CIDEA currently has an agreement to conduct research for the Ministry of Industry, Finance, and Commerce.

Opportunities for Program Development

We found widespread interest in the concept of the NSGCP, as well as agreement that the model would be beneficial and feasible for application to the Gulf. Important principles of implementation for such a program in the Gulf highlighted at the Roundtable discussions held in October 2003 included:

- Flexibility in implementation and administrative agility
- Formal integration into the structure of the lead University
- Wide consultation and strong feedback loops between program activities and resource user groups
- Transparency in decision making and information sharing
- Partnerships and cooperation across the region and across government, private, NGO, University and community groups
- Neutrality and high standards excellence

High priority topics that stood out at the Roundtable that would be candidates for applied research and extension themes for the Gulf include:

- Improved shrimp mariculture practices and promotion of alternative forms of mariculture
- Problems with microbiological water quality
- High sedimentation levels

- Loss of mangroves and disappearance of dry forest
- Fisheries overexploitation and destructive practices
- Biodiversity inventory and restoration of critical ecological systems
- Public education and environmental awareness

Specific mechanisms for implementation of a program in the Gulf and key steps to begin the process were also identified at the Roundtable and through individual consultations. A university-led, but decentralized regional program involving alliances between universities, government agencies, NGOs, internationally funded projects and communities is envisaged. A key objective of a program focused upon the Gulf of Fonseca would be to pool resources and efforts, furthering the capacity of higher education institutions in marine and coastal research, education and extension.

Benefits of a Regional Coastal and Marine Program

Create common objectives while maintaining independence

Provide an impartial vision between the community, government, and different actors

Develop relationships between countries and organizations to share information and workplans

Permanence and continuity

Roundtable Summary Report, Tegucigalpa, October 21-22, 2003

In addition to a University administrative body, Roundtable participants noted that the governance structure for a program in the Gulf should include a Scientific Committee to oversee peer review of proposals. Other critical program groups include regional Committees that would provide the mechanisms for regional coherence, planning, and institutional connectivity and cooperation.

Based on our comprehensive capacity assessment of the University of Zamorano, this institution ranks high in terms of possessing the experience and institutional features required to successfully administer a program modeled after the NSGCP. Zamorano is probably in the best position to act as a central administrative body to a regional program due to its experience, capacity and resources to mobilize efforts in research, extension, and education in the region. As a regional program, we would envisage other Universities in Nicaragua and El Salvador also playing important programmatic roles with the lead university. Some form of associate university programs with Country Program Coordinators identified at each associate university might be appropriate for a Gulf of Fonseca regional program. Our review of institutional and academic capacity suggests that the strongest candidates for associate university programs would be UCA/CIDEA and the University of El Salvador.

Extension was highlighted at the Roundtable as particularly important to a long-term coastal and marine program in the Gulf. Public support for extension is limited in Nicaragua, Honduras and El Salvador. The same benefits of extension in the United States would apply to the Gulf. For example, extension agents develop trust and social capital with communities over time and understand local issues and problems. They provide feedback from users to researchers regarding the efficacy of applied technologies and information as well as the shortfalls and remaining needs.

Sea Grant was considered an idea program to support the sustainable development of the region because it includes aspects that are likely to produce success. It would also allow for more economic opportunities for an ecologically vulnerable area. Lastly, it would allow for the exchange of information and the exchange of action plans.

Roundtable Summary Report, Tegucigalpa, October 21-22, 2003

Key steps to begin the process of program development were identified at the Roundtable. They include selection of the lead university for program administration, development of detailed program proposal, formal program incorporation within the university, formation of national and regional program support groups, definition of program priorities, consultation with government ministries, and fund raising.

6. CONCLUSIONS

This paper has looked at the overall coastal and marine context of the LAC region, made a case for the benefits of applying the NSGCP model to the LAC region, and explored opportunities in two specific locations: Ecuador and the Gulf of Fonseca. Our long-term vision is the successful establishment of many country programs modeled after the NSGCP in Latin America and the Caribbean, generating an operational South-South and North-South network of information sharing and learning across both LAC programs and U.S. Sea Grant College programs. Both the concept and execution of such a network would be novel and we believe would provide unprecedented opportunities to advance sustainable coastal and marine development. This type of program would catalyze greater public spending on education, science and technology, and extension to resource users—critical to increase productivity of coastal and marine sectors and to find innovative solutions to problems.

In both Ecuador and the Gulf of Fonseca the need for and advantages of programs modeled after the NSGCP ring clearly. The Roundtable discussions and other consultations have identified initial thematic priorities and important partners working on coastal and marine issues. We conclude that University capacity exists in both Ecuador and the three countries of the Gulf of Fonseca to execute long term coastal and marine programs.

In both locations, we see a strong interest in using a new program like NSGCP to pool resources and build a network of interested parties who will increase collaboration on coastal and marine issues. We also find that extension services are relatively weak in both locations and should be emphasized relative to applied research.

Program focus in both the Gulf of Fonseca and Ecuador would need to be tailored to the reality of overwhelming poverty and economic vulnerability. This means promoting new and innovative technologies and extending knowledge to enhance income and employment in the coastal and marine sectors while being conscious of social and environmental problems. It also means developing programs in recognition of important environment and poverty linkages. For example, poverty reduction is usually enhanced by an increase in the proportion of educational resources going to primary education and to the poorest groups and regions (Lipton, et al., 1998). Women's education, in particular, affects nearly every dimension of development, from lowering fertility rates to raising productivity and improving environmental management (World Bank, 1996). Investments in public health services, nutrition, safe drinking water, and improved sewage disposal also contribute to poverty reduction.

Elements of a governance structure include a university administrative unit with Program Director and staff. A Scientific Technical Committee or similar structure would be required to oversee review of competitive and non-competitive grant proposals. Sea Grant College Programs in the United States might be able to help with peer reviews. In the United States, extension work is not necessarily based on competitive grants, but there is always peer review. An Advisory Committee would be needed to help guide program direction and find linkages across collaborating partners and issues. An Advisory Board may also be needed to provide oversight to the Program Director and assist in areas such as external relations and fund raising. More detailed thoughts on a potential institutional design are developed in Annex 2.

Program start up will be the most difficult and critical phase. The development of institutional arrangements and detailed program guidance will take time. Therefore, it would be beneficial to work with a collaborative partner in the U.S. with knowledge of NSGCP and experience in coastal and marine resource management. A study tour to the United States to visit and learn from Sea Grant programs and the National Sea Grant Office would also be invaluable.

Securing sources of funding for programs is a major challenge because we can not necessarily expect central government support as in the United States. Each program will need to be financially entrepreneurial. Once a national commitment to a program like NSGCP is demonstrated and some of the guidelines and governance structures are in place, we feel that a proactive program will be in a good position to attract external support from international donor organizations. National government policy commitments will also be critical to attract international support and to ensure that the programs are integrated into long-term national strategies.

7. NEXT STEPS

Based on this paper and Background Paper 1, a proposal for action will be developed and circulated to key partners and donor institutions. The proposal, background papers and Roundtable reports will be circulated at the White Water to Blue Water Conference, March 21-26, 2004 in Miami, Florida where representatives from twenty-six nations from the wider Caribbean region and a host of regional and international organizations, Universities, government and non-government organizations will be present. Sessions will be held at the Conference on transferring the NSGCP model to the LAC region.

Refinement of the proposal will continue after the March 2004 Conference in collaboration with NOAA and other U.S. partners, country partners, and funding organizations. Finally, directed discussions among interested partners on funding and implementation mechanisms will occur at a special Symposium that is planned for September 2004.

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ANNEX 1

List of Roundtable Participants ESPOL University, Guayaquil, Ecuador October 16, 2003

Gina Andrade
Director of the Center of Coastal Resources
Training and Extension
ESPOL University, Guayaquil

Luis Arriaga
Executive Director
National Fisheries Institute, Guayaquil

Juan Carlos Avilés
GIS Specialist
Coastal Resource Management Program
Guayaquil

Robert Bensted-Smith
Director, Center for Biodiversity Conservation
Conservation International, Quito

Alba Calles
VLIR Project
ESPOL University, Guayaquil

Paúl Carrión
Director of the Scientific and Technological
Research Center
ESPOL University, Guayaquil

Rocío Cedeño
Project Specialist
USAID, Quito

Eduardo Cervantes
Dean of the Faculty of Maritime Engineering
and Marine Sciences
ESPOL University, Guayaquil

Pilar Cornejo
ESPOL University, Guayaquil

David Delgado
Office of Coastal Environmental Management
Ministry of Environment, Guayaquil

Luis Domínguez
VLIR Project
ESPOL University, Guayaquil

Francisco Garcés
Director, Natural Resources Program
Peace Corps, Quito

Sonia Guartatanga
VLIR Project
ESPOL University, Guayaquil

Paúl Herrera
VLIR Project
ESPOL University, Guayaquil

Ing. Pilar Icaza
University of Guayaquil, Guayaquil

Juan Iturralde
The Nature Conservancy, Quito

John Jacob
Texas A&M University
Galveston, Texas

Jerry Landívar
Coordinator of Aquaculture Engineering
ESPOL University, Guayaquil

Arq. Jorge Luis Loor
Assistant Secretary for Coastal Environmental
Management
Ministry of Environment, Guayaquil

David Matamoros
VLIR Project
ESPOL University, Guayaquil

Eduardo Moreira
Office of Coastal Environmental Management
Ministry of Environment, Guayaquil

Julio Navarrete
National UCV Specialist
Coastal Resource Management Program
Guayaquil

Javier Ochoa
Information Technology Center
ESPOL University, Guayaquil

Emilio Ochoa
ESPOL University, Guayaquil

Edwin Pinto
INOCAR, Guayaquil

Gunther Reck
Executive Director of the Institute of Applied
Ecology
San Francisco University, Quito

Verónica Ruíz
VLIR Project
ESPOL University, Guayaquil

James Tobey
University of Rhode Island
Narragansett, RI

Mauricio Velázquez
University of Guayaquil, Guayaquil

Guido Yanez
Santiago Catholic University of Guayaquil
Guayaquil

Dr. Miguel Acosta Yépez
Director of Marine Biology
Pontificia Catholic University of Quito
University Extension in Bahía

List of Roundtable Participants
Zamorano University, Tegucigalpa, Honduras
October 21-22, 2003

David Alarid
Regional Environmental Hub Office for Central
America and the Caribbean
U.S. Embassy
San Jose, Costa Rica

Jose Enrique Barraza
Ministry of Environment and Natural Resources
El Salvador

Andrea Borel
Regional Environmental Hub Office for Central
America and the Caribbean
U.S. Embassy
San Jose, Costa Rica

Luis Caballero
Zamorano University
Tegucigalpa, Honduras

Eduardo Canales
Green-Pro
Honduras

Mario Contreras
Zamorano University
Tegucigalpa, Honduras

Agnes Saborio Coze
Director of the Center for Aquatic Ecosystems
Research (CIDEA)
University of Central America
Managua, Nicaragua

Arlene de Franco
MIFIC
Nicaragua

Conrado Gonzalez
Protected Areas
Tegucigalpa, Honduras

Aldo Guerrero
Organization Two Seas
Nicaragua

John Jacob
Texas A&M University
Galveston, TX

Alba Margarita Salazar de Jurado
SICA/OSPESCA
El Salvador

Daniel Meyer
Zamorano University
Tegucigalpa, Honduras

Suyapa Triminio de Meyer
Zamorano University
Tegucigalpa, Honduras

Edas Muñoz
WWF and Proarca/USAID
Tegucigalpa, Honduras

Margarita Núñez
PASMA-MIFIC
Nicaragua

Emilio Ochoa
ESPOL University
Guayaquil, Ecuador

Ivonne Oviedo
Areas Protegidas y Vida Silvestre –AFE
Honduras

Mayra Pérez
University of Central America
Managua, Nicaragua

George Pilz
Zamorano University
Tegucigalpa, Honduras

Osmin Pocasangre
University of El Salvador
El Salvador

Mario Gonzalez Recinos
SICA/OSPESCA
El Salvador

Jorge Restrepo
Zamorano University
Tegucigalpa, Honduras

Martín Schwarz
Zamorano University
Tegucigalpa, Honduras

Vera Solis
University of Central America
Managua, Nicaragua

Barbara Thomas
U.S. Embassy
El Salvador

James Tobey
University of Rhode Island
Narragansett, RI

José Villatoro
Inter-American Development Bank
Tegucigalpa, Honduras

Matt Wilburn
NOAA/OAR Office of International Activities
Washington, D.C.

Nestor Windevoxhel
Chief of Party, PROARCA
Guatemala City, Guatemala

Ana Martha Zentino
University of El Salvador