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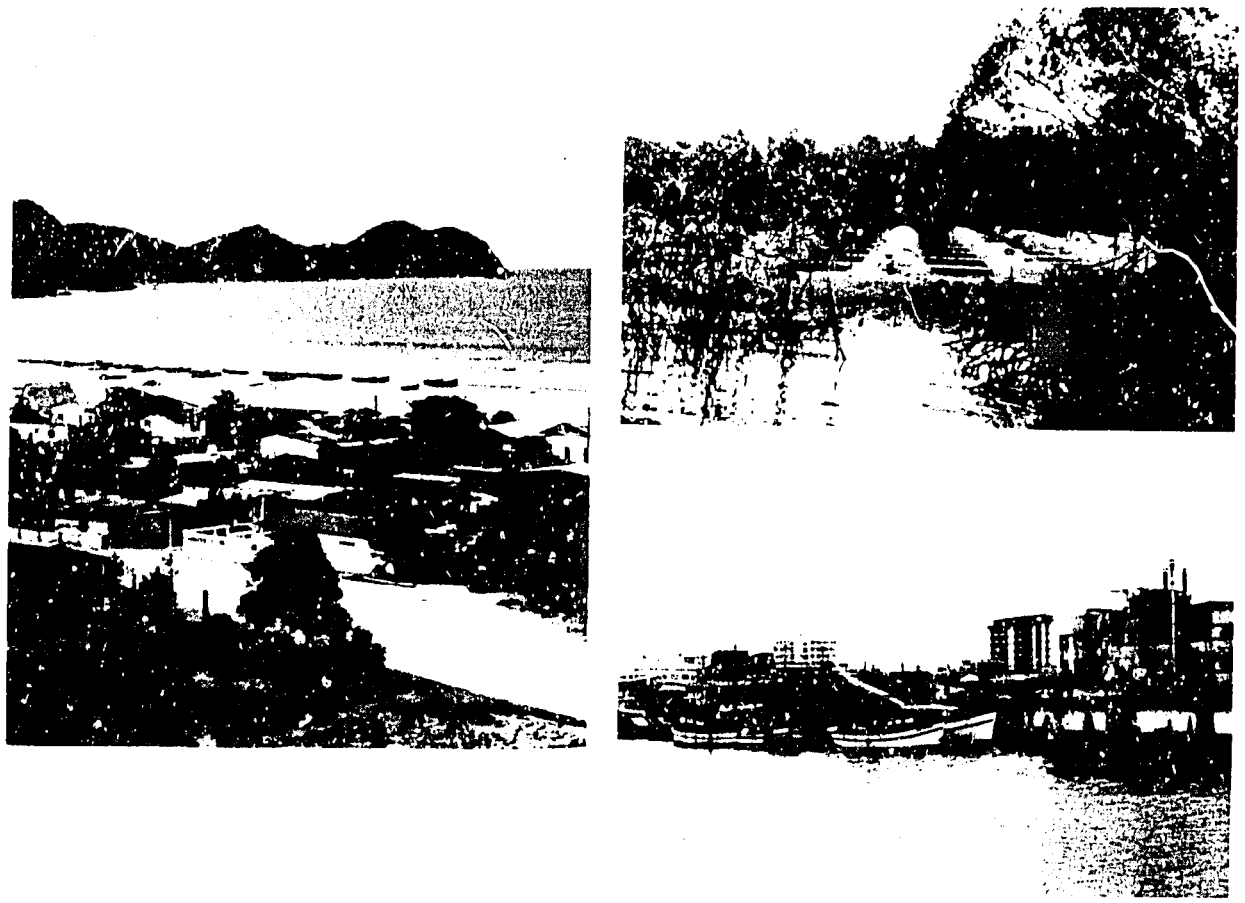
A PROFILE OF ECUADOR'S COASTAL REGION

Bruce Epler and Stephen Olsen



International Coastal Resources Management Project

COASTAL RESOURCES CENTER

The University of Rhode Island
Government of Ecuador
U.S. Agency for International Development

A PROFILE OF ECUADOR'S COASTAL REGION

Bruce Epler and Stephen Olsen

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The University of Rhode Island
Coastal Resources Center

Programa de Manejo de Recursos Costeros
Dirección Ejecutiva
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Office of Environment and Natural Resources
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The four major goals of the International Coastal Resources Management Project (CRMP) are to: 1) apply, as appropriate, existing experience in coastal resources management to developing countries; 2) assist three developing nations in the design and implementation of integrated coastal resources management programs; 3) advance the state of the art of coastal resources management in developing countries; and 4) build the University of Rhode Island's capability to assist developing nations with coastal resources management.

The CRMP works with the cooperating pilot countries to:

- formulate and implement integrated coastal resources management strategies
- develop procedures for the assessment of the impacts of coastal development proposals
- develop institutional and technical solutions for resource use conflicts
- support research to better understand the issues that affect the condition and use of coastal ecosystems
- improve the capabilities of in-country professional staff to plan for and manage coastal development

The countries selected for pilot projects are Ecuador, Sri Lanka, and Thailand.

The International Coastal Resources Management Project is funded by the Office of Environment and Natural Resources, Bureau for Research and Development, U.S. Agency for International Development through a cooperative agreement with the University of Rhode Island. Supplemental funds were provided by USAID/Ecuador.

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LIST OF ACRONYMS

AITEC	Acción International Técnica International Technical Action
BEDE	Banco Ecuatoriano de Desarrollo Ecuadorian Development Bank
BID	Banco Interamericano de Desarrollo Inter-American Development Bank
BNF	Banco Nacional de Fomento National Development Bank
CAF	Corporación Andina de Fomento Andean Development Corporation
CEDEGE	Comisión de Estudios para el Desarrollo de la Cuenca del Río Guayas Study Commission for the Development of the Guayas River Basin
CEDIG	Centro Ecuatoriano de Investigación Geográfica Ecuadorian Center for Geographic Studies
CELADE	Centro Latinoamericano de Demografía Latin American Demography Center
CEPAR	Centro de Estudios de Población y Paternidad Responsable Center for the Study of Population and Paternal Responsibility
CEPE	Corporación Estatal Petrolera Ecuatoriana Ecuadorian Petroleum Corporation
CESA	Control Ecuatoriano de Servicios Agrícolas Ecuadorian Control for Agricultural Services
CLIRSEN	Centro de Levantamientos Integrados de Recursos Naturales por Sensores Remotos Center for Remote Sensing of Natural Resources (Military Geographic Institute)
CNDP	Consejo Nacional de Desarrollo Pesquero National Council for the Development of Fishing
CONADE	Consejo Nacional de Desarrollo National Planning Council
CPC	Camara de Productores de Camaron Chamber of Shrimp Producers
CPPS	Comisión Permanente del Pacífico Sur Permanent Commission for the South Pacific
CRM	Centro de Rehabilitación de Manabí Center for Rehabilitation of Manabi
CRMP	Proyecto de Manejo de Recursos Costeros Coastal Resources Management Project
CZM	Manejo de Zona Costera Coastal Zone Management
DDF	Dirección de Desarrollo Forestal Directorate for Forest Development
DGP	Dirección General de Pesca National Fishing Directorate

DIGEIM	Dirección General de Intereses Maritimos de la Armada Office of Maritime Affairs of the Navy
DIGEMA	Dirección General del Medio Ambiente Department of the Environment
DIGMER	Dirección General de la Marina Mercante y del Litoral National Merchant Marine and Directorate for the Coast
DINAF	Dirección Nacional Forestal National Forestry Department
DINEFONASA	Dirección Nacional Ejecutiva del FONASA National Board of Directors of FONASA
DITURIS	Dirección Nacional de Turismo National Tourism Department
EMAG	Empresa Municipal de Alcantarillado de Guayaquil Municipal Sewage Company of Guayaquil
EPNA	Empresa Pesquera Nacional National Fishing Company
ESPOL	Escuela Superior Politécnica del Litoral Polytechnic University of the Coast
FAO	Organización de las Naciones Unidas para la Alimentación y Agricultura Food and Agriculture Organization of the United Nations
FONAPAR	Fondo Nacional de Participación National Fund for Participation
FONAPRE	Fondo Nacional de Preinversión National Pre-investment Studies Fund
FONASA	Fondo Nacional de Saneamiento Ambiental National Fund for Environmental Sanitation
GDP	Producto Interno Bruto Gross Domestic Product
IEOS	Instituto Ecuatoriano de Obras Sanitarias Ecuadorian Institute for Sanitary Works
IERAC	Instituto Ecuatoriano de Reforma Agraria y Colonización Ecuadorian Agrarian Reform and Colonization Institute
IESS	Instituto Ecuatoriano de Seguridad Social Ecuadorian Social Security Institute
IGM	Instituto Geográfico Militar Military Geographic Institute
ILDIS	Instituto Latinoamericano de Investigación Social Latin American Institute for Social Studies
INEC	Instituto Nacional de Estadísticas y Censos National Statistic and Census Institute
INECEL	Instituto Ecuatoriano de Electrificación Ecuadorian Institute of Electricity
INEMIN	Instituto Ecuatoriano de Minería Ecuadorian Mining Institute

INERHI	Instituto Ecuatoriano de Recursos Hidráulicos Ecuadorian Institute of Water Resources
INIAP	Instituto Nacional de Investigaciones Agropecuarias National Farming Research Institute
INOCAR	Instituto Oceanográfico de la Armada Oceanographic Institute of the Navy
INP	Instituto Nacional de Pesca National Institute of Fishing
JUNAPLA	Junta Nacional de Planificación National Planning Board
MAG	Ministerio de Agricultura y Ganaderia Ministry of Agriculture and Ranching
MICIP	Ministerio de Industrias, Comercio, Integración y Pesca Ministry of Industry, Commerce, Trade, and Fishing
OAS	Organizacion de Estados Americanos Organization of American States
OIPE	Oficina Integrada de Planificación de Esmeraldas Esmeraldas Planning Office
OMP	Organizacion Mundial de Tourismo World Tourism Organization
OPEC/OPEP	Organizacion de Paises Expurtando Petroleum Organization of Petroleum Exporting Countries
ORSTROM	Office de la Recherche Scientifique et Technique Outre-mer Office of Scientific Research and Remote Sensing Techniques
PMRC	Proyecto de Manejo de Recursos Costeros Coastal Resources Management Project
PREDESUR	Programa de Desarrollo del Sur Program for the Development of the South
PRONAREG	Programa Nacional de Regionalizacion Agraria National Program for Agricultural Regionalization
SRP	Subsecretaria de Recursos Pesqueros Subsecretariat of Fisheries Resources
SUINBA	Superintendencia del Terminal Petrolero de Balao Superintendent of the Balao Petroleum Terminal
SUINLI	Superintendencia del Terminal Petrolero de La Libertad Superintendent of the Libertad Petroleum Terminal
SUINSA	Superintendencia del Terminal del Salitral Superintendent of the Salitral Petroleum Terminal
TEPRE	Terminal de Productos Limpios de la Refineria Estatal State Clean Products Refinery Terminal
TRANSNAVE	Transportes Navieros Ecuatorianos Ecuadorian Sea Transport
UNCLOS	Convención de la Ley del Mar de las Naciones Unidas Law of the Sea Convention of the United Nations

UNDP	Programa de Desarrollo de las Naciones Unidas United Nations Development Program
UNFPA	Fondo para las Actividades Poblaciónales de las Naciones Unidas United Nations Fund for Population Activities
USAID	United States Agency for International Development

INTRODUCTION

The Resources of Ecuador's Coastal Region

Ecuador's coastal region, when defined to include the provinces that encompass the lowlands between the ocean and the Andes, has emerged as the stronghold of progress and development for the country. In the past 35 years, activities in the coastal region have transformed Ecuador's economy and coastal ecosystems. The recent boom in shrimp mariculture along the coast has made this the largest private sector activity in the country. Producing and exporting hundreds of millions of dollars worth of shrimp a year, the industry is second only to petroleum in the value of goods exported. Ecuador's estuaries provide critical habitat for fish and shellfish populations that support artisanal fishermen who produce a critically important source of protein for the region's rapidly growing population. Industrial fisheries, which started in the 1950s, have modernized and diversified in the last 20 years. The country's coastal ecosystems contain the nation's best farmland and produce virtually all of the nation's agricultural exports. The coastal city of Guayaquil, the nation's largest and most quickly growing city, is the center for banking and industry, and is a thriving seaport. Coastal tourism is becoming an important industry. Oil is transported across the Andes to the coast for refining, storage, and export. Petroleum companies are currently exploring for offshore natural gas deposits.

However, the very resources that have provided the foundation for this economic development in the coastal region are in jeopardy. Rapid population growth and accompanying development have put a variety of pressures on Ecuador's coastal ecosystems. Economic boom-and-bust cycles, frequent in the development of coastal Ecuador, have led to periodic overexploitation of resources followed by abandonment. In some instances, the resources that fueled these booms have never recuperated. Once-luxuriant coastal forests that supported a thriving shipbuilding and lumber export trade a century ago have virtually all been replaced by low-yielding, frequently eroding pastures and wastelands. Agricultural activities, both along the coast and inland, are accelerating erosion and contaminating rivers and estuaries with dangerous agrichemicals. The construction of shrimp ponds has brought almost complete eradication, in several estuaries, of mangroves—the very habitat that sustains the wild shrimp populations from which mariculture ponds are stocked. The construction of upstream dams threatens both estuarine habitats and water quality by altering the volume, timing, and quality of river discharges. Declining water quality from a variety of causes threatens public health, the shrimp mariculture industry, and the ability of estuarine habitats to support fisheries. In addition to overuse and contamination of resources, conflicts among incompatible activities—such as fish processing and tourism—and poor siting of coastal structures are all too apparent along Ecuador's 950 kilometers (km) of open shore. Not only are such problems expensive and avoidable, but they threaten to undermine tourism, which has the potential to capitalize on the sandy beaches and scenic bays of this extraordinarily diverse coastline.

The quality of life for some sectors of the population has already been adversely affected by unsustainable resource exploitation. It is essential that the resource base that could indefinitely produce a rich bounty of agricultural products, lumber, fisheries, and cultured seafood is not needlessly degraded and does not lose its ability to produce the goods and benefits that are central to Ecuador's economy and political stability. Because, historically, these resources have tended to be regarded as public property and no one's responsibility, their development has generally been excessive, unplanned, and destructive. In the words of Harvard University economist Theodore Panayotou, "Make man-made capital open access and very soon it will resemble the condition of tropical forests and fisheries: run down, unmaintained, even vandalized." Ecuador's future economic development in large measure depends upon how its coastal ecosystems are utilized and managed.

Emergence of a Coastal Resources Management Program

In the 1980s, the Ecuadorian Navy recognized that the management of the country's coastal resources was a national priority. Demands of intensified development pressure, increasing public awareness of the complexities and value of coastal resources, and the natural disasters along the coastal fringe associated with a severe El Niño in 1982-83 all underscored this need for coastal management. The signing of the Law of the Sea Treaty by 119 countries in 1982, which provided Ecuador with jurisdiction over approximately one million square kilometers of ocean, also played a part in the new emphasis on coastal resources.

In 1985, the United States Agency for International Development (USAID) entered into a cooperative agreement with the University of Rhode Island to implement the International Coastal Resources Management Project (PMRC) selected Ecuador as one of three pilot countries for testing whether the concepts and techniques of integrated coastal resources management that had evolved in the previous decade could be applied to developing tropical nations. The United States, like Ecuador, is blessed with rich resources along its coastlines, and, like Ecuador, its population has become concentrated in these areas. Conflicts among user groups, declines in fisheries and water quality, and a complex and fragmented institutional framework prompted experimentation with a new approach to resource management. This approach stresses strong public participation in the formulation of strategies, along with an integrated plan for both conservation and development that attempts to strike a balance among competing activities. Gradually, the theme in developing and developed nations alike is shifting from behavior that exploits as quickly as possible for maximum short-term profits to behavior that sustains benefits and the quality of life. Such concepts and techniques have flowered in the past—in the pre-Inca period in coastal Ecuador, a very large population developed highly sophisticated forms of sustainable agriculture (Marcos, 1987)—and are re-emerging today. Since the beginning of the Coastal Resources Management Project in 1985, CRM in Ecuador has evolved greatly, including the formation of an official government program that is now dealing with a vide range of coastal management efforts. The history, current efforts, and future directio nof Ecuador's CRM program are discussed in detail in Chapter XII.

When the Coastal Resources Management Project (PMRC), sponsored by USAID and implemented by the University of Rhode Island, began in Ecuador, there was no government agency with a mandate to lead a new initiative in natural resources management, and the major issues and opportunities to be addressed in a CRM program were poorly understood. Support for such an initiative among coastal leaders and government agencies was weak and fragmented. The first challenge for the program was to understand the historical forces that had created present patterns of resource use and, too often, resource degradation. Coastal leaders and government agencies needed to examine the issues and opportunities together, and create a political context within which new approaches and patterns of behavior could evolve.

It was clear that understanding how resources are allocated along the coast, and creating the political context to effect major changes in that allocation through management, would require a broad-based effort that specifically attempted to involve a diversity of interest groups as well as the public at large, a private voluntary organization dedicated to public education and the promotion of sustainable forms of development along the coast. The Fundación is composed primarily of university faculty, and its board of directors includes educators and political activists representing a broad spectrum of views and experience.

Under the energetic and able leadership of Emilio Ochoa and Washington Macias, the Fundación Maldonado began the process of preparing profiles, in Spanish, of development trends and resource management issues in each of the four coastal provinces. The premise was that an issue requiring resolution would come into focus when examined

in its local context. Development of the profiles required the review of studies and existing data. An effort was made to review the history of each province and to link that history to the role natural resources had played in the province. The Fundación worked to provide a well-documented, readable account of the evolution of coastal activities and the present condition of coastal resources in each province, and to identify specific geographic sites where resource management issues most urgently required attention. The process featured meetings and the active collaboration of many individuals with relevant expertise and influence.

Public workshops were held to review the draft and discuss the initial conclusions and recommendations, and later to review a revised version that attempted to incorporate new information and perspectives. These workshops were well-attended and in some cases lasted eight hours or more. The documents—which provide the foundation for this document—resulting from this process were *Ecuador: Perfil de Sus Recursos Costeros*, published by the Fundación Maldonado in 1987.

Major Coastal Management Issues

Ecuador's coastal management program is now addressing a complex web of interrelated problems and opportunities:

- Dumping of urban wastes, industrial effluents, and mercury from mining, and the increased use of agrichemicals are all contributing to deterioration of one of society's most precious resources: water. In most instances, these wastes, as well as domestic sewage, are discharged directly into rivers and estuaries without any treatment. Polluted water is the primary carrier of disease along the coast and is also affecting the productivity of some shrimp hatcheries and grow-out ponds.

- The shrimp mariculture industry has destroyed nearly all of the mangrove habitat in some estuaries. Such destruction of intertidal habitat threatens to affect natural supplies of postlarval shrimp used for stocking ponds, and is likely to affect the abundance of important stocks of fish and shellfish. Moreover, loss of the buffering action of coastal vegetation increases flooding and erosion, changes sedimentation patterns, and may reduce the ability of estuaries to absorb pollutants.

- Nearshore and offshore fish stocks are under increasing pressure as the artisanal and industrial fisheries use more diversified and intensive fishing techniques. Fishermen all along the coast have seen major declines in once-abundant nearshore stocks and have to venture farther offshore to make a living. Information on the ability of the fisheries to sustain productivity is sketchy. Regulations are lax, and current government incentives will have the effect of further increasing fishing effort.

- Food production is not keeping pace with population increases. Unfortunately, those suffering the most are the poorest Ecuadorians. The average protein intake has declined in recent decades, largely due to the emphasis on producing agricultural crops for export to help pay the nation's debt rather than on producing food for the people.

- Public services are not keeping pace with population growth, particularly in sprawling urban barrios. Providing potable water, waste treatment, schools, and basic health services are urgent priorities in many areas of the coast.

- The potential effects of inland irrigation and hydroelectric projects have been studied, but many speculate that environmental damage will exceed what had been projected, particularly in estuaries where reductions in freshwater inflow may set off a chain reaction of shifts in the characteristics of these ecosystems.

- Many activities--for example, fishing, tourism, agriculture, and mariculture—are sometimes incompatible. Conflicts consequently arise over uses of the shore and over practices that affect water quality.

- Structures have been built along the shoreline with no appreciation for natural coastal processes. This practice has in many instances changed beach dynamics, accelerated erosion, and led to property loss.

- At unpredictable intervals, the natural climatic phenomenon known as El Niño triggers intense rainfall and flooding along the Ecuadorian coast. Coastal development in many instances does not take into account these periodic disasters.

- Despite the high quality of its universities and technicians, Ecuador lacks the research tradition and expertise required to tackle coastal zone issues. Development of libraries, data banks, and educational courses, as well as improved information flow, is essential if these shortcomings are to be overcome.

A Profile of Ecuador's Coastal Region is an English-language synthesis and elaboration of two documents that resulted from the initial coastal management planning process—*Ecuador: Perfil de Sus Recursos Costeros*—published by the Fundación Maldonado in 1987—and *Una Vision Global*—an overview that placed CRM issues within the context of national development trends, published in 1989. It contains much new data. It reviews the characteristics and condition of the resource base from a national perspective and links it to the nation's political and economic development. It provides an overview of Ecuador's CRM Program, including descriptions of its major components, management strategies, and implementation mechanisms.

Table 1. Ecuador Fact Sheet. (Unless otherwise stated, data are from 1990.)

Total Area	270,670 km^2
Population Characteristics	
Total Population	9.6 million
Density (inhabitants per km^2)	34.9
Percentage of population in rural areas	44.9
Percentage of population of Indian descent	25
Rate of growth (1974-82)	-2.9
Crude birth rate (per 1,000)	35.4
Infant mortality (per 1,000 live births)	63.4
Life expectancy	65.4
Health	
Population per physician	908
Population per hospital bed	590
Nutrition	
Caloric intake—percent of requirements	101
Per capita protein intake—percent of requirements (1970)	65.9
Access to Piped Water	
percent of population—urban	84.4
percent of population— rural	41.7
Access to Sewage	
percent of population—urban	79.6
percent of population—rural	36.8
Geographic Distribution of Population	
Coast	49.3
Sierra	45.9
Oriente and Galapagos	4.8
Weights and Measures	Metric
Language	Spanish
Major Religion	Roman Catholic (95%)
Economics	
Currency	Sucre
Gross Domestic Product (GDP)	U.S. $10.2 billion
Rate of Growth in GDP (1982-1988)	72.4
GDP per capita	U.S. $1,062
Rate of Inflation	48.6
Income Distribution (1971)	
percent of national income—highest quartile	60
percent of national income—lowest quartile	40
Total Exports (in U.S.$)	2,714,328
Total Imports (CIF)	1,710,785
Principal GDP	
Petrol	1,238,401
Banana/Plantain	467,938
Shrimp	340,291
Rate of Employment	
percent Employed	35.3
percent Unemployed	14.7
percent Underemployed	50
Growth Trends	
GDP Per Capita (average, 1970-1980) percent*	4.1
Kilometers of Roads (1989)	38,530
Asphalt	6,750
Hard-packed	14,700
Dirt	17,000
Principal Cities	
Guayaquil	1.6 million
Quito	1.4 million
Oceanographic Characteristics	
Length of coast	950 km

Territorial sea	1,060,053 km^2
Galapagos	8,000 km^2

* These have declined since 1983.

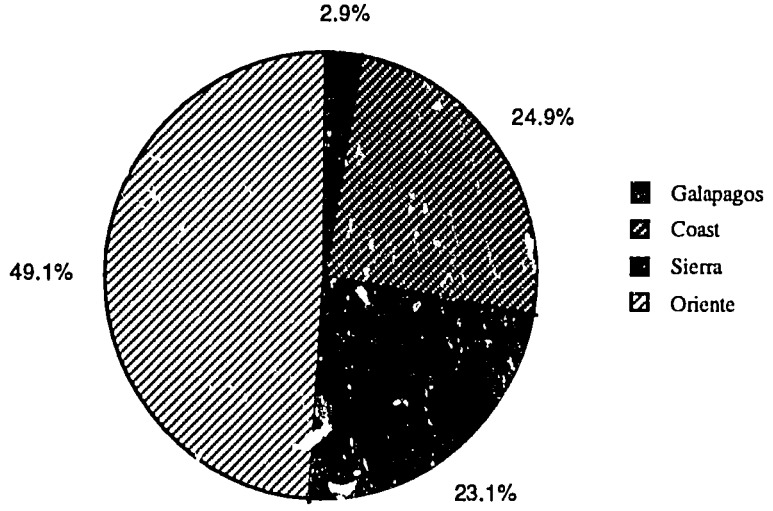
Sources: CONADE, 1991
Banco Central, 1991
Fundacion Hanns Seidel, 1991
The Economist Intelligence Unit, 1992
World Bank, 1984
INEC, 1985
Smith, 1985.

I. GENERAL DESCRIPTION

Setting

Ecuador is located on the west coast of South America and, as its name implies, is transected by the equator. (See map, Figure 1.) Precise figures on the country's size cannot be given because the territorial boundary with Peru remains in dispute. It is generally accepted, however, that Ecuador encompasses approximately 270,670 square kilometers (km^2), which is roughly equivalent in area to Italy or to the state of Colorado in the United States. Most of the country, including its capital, Quito, and Guayaquil, its largest city, lies south of the equator.

The country is divided into four geographically distinct zones that are also separate political and economic entities: the coast; the Andes mountains, or the Sierra; the upper Amazon basin, or the Oriente; and the Galapagos Islands, located 1,000 km offshore in the Pacific. Figure 2 shows the relative size of each region. Basic information on Ecuador is summarized in Table 1.



Total Area: 270,670 km^2

Figure 2. Composition of Ecuador by Region
Source: Linke, 1960.

The Coast. Historically, the population and the political and economic power were concentrated in the Andes; the coastal region ranked second in importance. Since the 1950s, economic growth that was a result of expansion and diversification in agriculture, industry, commerce, fishing, and petroleum-related activities and, more recently, the culture of shrimp, has thrust the coast into prominence.

Climate and ecosystems along the coast change as one travels from north to south or inland from west to east. The northern extremity of the coast is tropical rain forest that receives over 3,000 millimeters (mm) of rain annually, one of the highest in the Western Hemisphere. To the south, drier, desertlike conditions prevail. Complex systems of estuaries and mangrove swamps, cliffs, and beaches, are found along the coastal fringe. Inland areas of the coastal region are more humid, and are dedicated to agriculture.

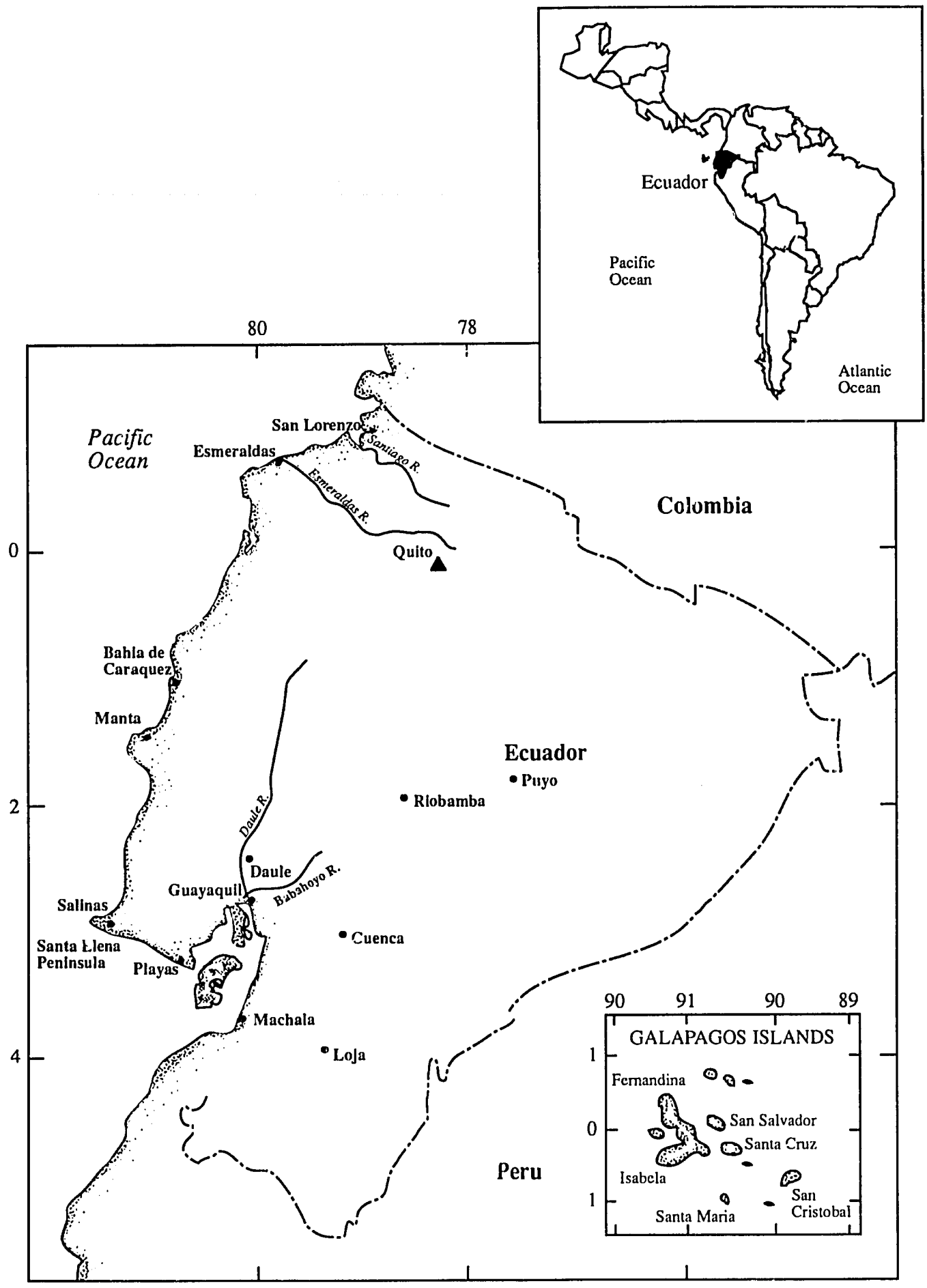


Figure 1. Map of Ecuador

The coast has two marked seasons: a rainy winter from December through early May, and a dry summer for the remainder of the year. Annual mean temperatures vary little along the coast, commonly ranging from about 24°C to 27°C.

The coastal plain comprises four major provinces: Esmeraldas, Manabi, Guayas, and El Oro (Figure 3). Roughly 90 percent (60,504 km²) of the coastal region lies within these provinces, but Los Rios and a few of the Andean provinces also have a portion of coastal plain within their boundaries. The coastal region is economically dependent on agriculture and shrimp mariculture, although commerce and manufacturing are important in Guayas and fishing is important in Manta. Approximately 50 percent of the coastal region has been altered for agriculture and cattle production. Features of the four provinces bordering the ocean are summarized in Table 2.

The Sierra. The Ecuadorian Andes comprise a western and eastern cordillera running more or less parallel to the coast. In total, there are more than a dozen snow-capped volcanic peaks that rise above 4,900 meters (m). The highest, Chimborazo, 6,390 m, is visible from the coast on a clear day. The cordilleras are separated by an elevated plateau with minor transverse ranges that give rise to 10 minor and three major river systems. The plateau, about 650 km long, with a maximum width of 70 km, slopes gently toward the south, varying in altitude from 2,400 m to 2,900 m (Linke, 1960). Rivers flowing to the east eventually mingle with the waters of the Amazon, while those flowing west meander across the coastal plain before entering the Pacific.

Most Andean towns and cities are nestled in fertile, temperate valleys below the elevation of 3,000 m. Quito, the second oldest capital in South America, has an elevation of 2,835 m. The annual mean temperature in Quito is 13.5°C, though daily temperatures generally oscillate between 16°C and 24°C, giving rise to the saying that Quito experiences four seasons each day. In general, Andean seasons are not as well defined as those on the coast. June to December are normally dry months. The rest of the year, sunny, warm mornings and chilly, overcast or rainy afternoons prevail.

The Oriente. The eastern slopes of the Andes descend gently into dense tropical forests and flat jungles of the upper Amazon Jungle, known as the Oriente. Ecuador suffered heavy losses of land in this region (equal in size to present-day Ecuador) in 1942 in a territorial dispute with Peru.

The Oriente makes up about 50 percent of Ecuador's land mass, yet contains only 3.3 percent of the country's population, which includes small aboriginal groups. Settlements are usually adjacent to rivers. However, the discovery of oil fields in Lago Agrio, in the northern Oriente, during the late 1960s has transformed the Ecuadorian economy and spurred a new thrust to colonize this region. Several roads have subsequently been constructed, large tracts of forests are being cut, and considerable investment has been made in African palm plantations and cattle ranches.

Virgin forests influence the climate, making the Oriente subtropical rather than tropical. Temperatures range between 23°C and 28°C, with periods of rain and sun on a normal day.

The Galapagos Islands. The Galapagos Islands are a group of 13 major and 17 minor islands and 47 islets that encompass approximately 8,000 km² of land located some 1,000 km off the Ecuadorian coast. They are of recent volcanic origin, rising to heights of 1,700 m above sea level from the Galapagos platform. The interior waters of the archipelago cover 50,000 km².

The first flurry of human activity on the Galapagos Islands occurred in the early 1800s, when foreign vessels, mostly from the northeastern United States, frequented the

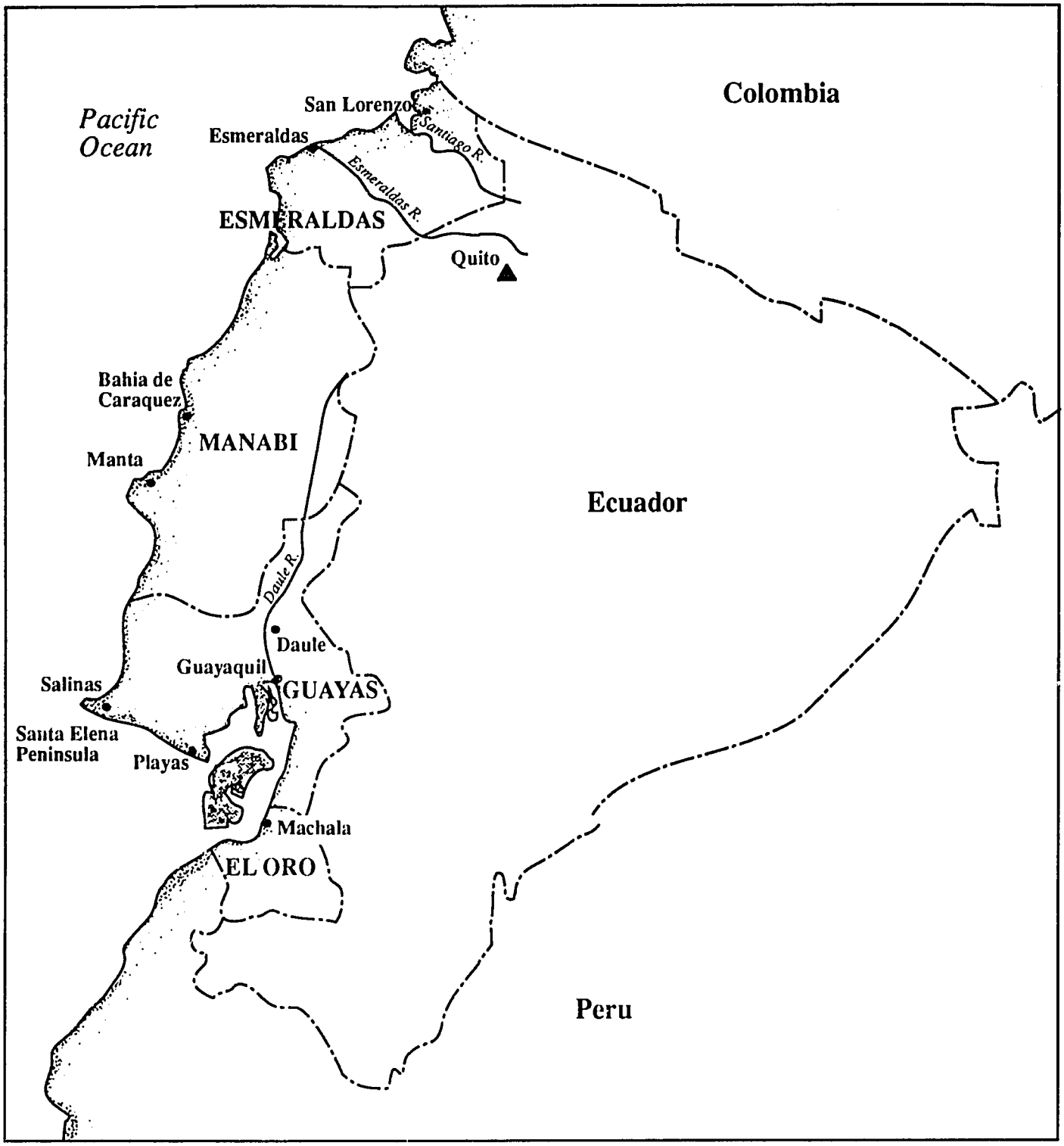


Figure 3. Coastal Provinces of Mainland Ecuador

Source: Fundación Maldonado, 1989.

Table 2. Features of Provinces with Coastlines.

Province	Esmeraldas	Manabi	El Oro	Guayas	Overall
Size (km^2)	15,056	18,831	5,816	20,801	60,504
Percent of Area	25	31	10	34	1
Length of Coast (km)	234	307	259	150	950
Interior Waters (km)	479	98	77	NA	NA
Total Coast (km)	713	405	336	1,405	2,859
Population (1990)	307,190	1,026,066	415,073	2,463,423	4,211,752
Population Density/km^2*	20	54	71	118	70
Maximum Altitude (m)	2,500	400	4,000	800	4,000
Principal Rivers	Esmeraldas, Cayapas, Santiago, Viche, Repartidero, and Verde	Chone and Chico	Jubones	Guayas, Babahoyo, and Daule	Guayas and Esmeraldas
Economic Base	Agriculture (Bananas, Cacao)	Fishing, Agriculture (Coffee), and Shrimp Mariculture	Agriculture (Bananas, Cacao Coffee) and Shrimp Mariculture	Industry, Commerce, Agriculture (Rice, Cacao), and Shrimp Mariculture	Agriculture, Fishing, and Shrimp Mariculture

* Based on the 1990 census
NA - Not Available

islands in search of whales. Initial Ecuadorian colonization attempts, dating back to 1832, failed. A lasting settlement was not established until 1893.

Charles Darwin made a visit to the Galapagos in 1835. The observations he made of the islands' unique flora and fauna became the foundation of the work he published after his return and, eventually, of *The Origin of Species*, published in 1859.

Recognition of the scientific and social value placed on Galapagos flora and fauna prompted the government of Ecuador to enact legislation in 1934, 1936, and 1959 to preserve the ecological integrity of the islands by setting aside roughly 97 percent of the land mass as a national park. An international foundation bearing Darwin's name was created to assist in protecting the islands, and was incorporated in Belgium in 1959. Construction on the Charles Darwin Research Station was started in 1960. In 1968, the Galapagos National Park Service began operation and in 1986, Executive Decree Number 1810-A was signed, declaring all internal waters and a 15-mile buffer zone as the Galapagos Marine Resources Reserve.

Recently, the Galapagos have emerged as one of South America's premier tourist attractions. In 1981, approximately U.S. $16.2 million was spent by visitors to the islands, and there are indications that the amount increased sharply in 1986, since the number of tourists increased from 17,445 in 1980 to 42,000 in 1989. The resident population of the islands has also undergone rapid expansion, from about 4,500 in 1973 to nearly 10,000 in 1990.

History

Archaeological evidence indicates that pre-Columbian groups inhabited Ecuador possibly as far back as 10,000 years ago, and that several sites appear to have been continually inhabited for 8,000 years. Many of these early civilizations resided along the coast. Scientists reason that the major currents and associated winds made Ecuador a geographic focal point for pre-Columbian coastal trade. This factor, combined with the favorable climate of the coastal region, makes it probable that early civilizations (known to have included many skilled navigators) settled in coastal Ecuador.

Archaeologists have distinguished four periods of development for pre-Columbian civilizations in Ecuador, briefly described below. (Also see Figure 4.)

Pre-Ceramic Period (Before 3000 B.C.). Evidence indicates that small groups lived along the Santa Elena Peninsula around 7000 B.C. Initially, these inhabitants survived by gathering food, hunting, and fishing, but developed basic horticultural and navigation skills about 6000 B.C. The most notable excavations for this time period have been unearthed at Las Vegas in the province of Guayas.

Formative Period (3000 B.C.-500 B.C.). The Formative Period is divided into an early and a late period. The early period is marked by the emergence of the Valdivia culture, named after a small fishing village on the northern coast of Guayas (Figure 5). Valdivian artifacts, dating from 3200 B.C., are some of the earliest known ceramic finds in the New World (Meggers, 1966).

Within the group were skilled mariners who traded along the coast between Peru and Central America. Similarities between Valdivian and Asian pottery have led many archaeologists to theorize that Valdivians were in contact with the Jomon culture of Japan.

The economic and cultural center during the Valdivia phase was established in Real Alto, near Chanduy, in approximately 4000 B.C. There are indications that the culture occupied a larger area. Artifacts include pottery, some of which was fired; figurines; bones; fish hooks cut out of pearl-oyster shells, and notched stone sinkers. Except for a few sites in Peru, there is no evidence of the early Formative Period in the Andean highlands.

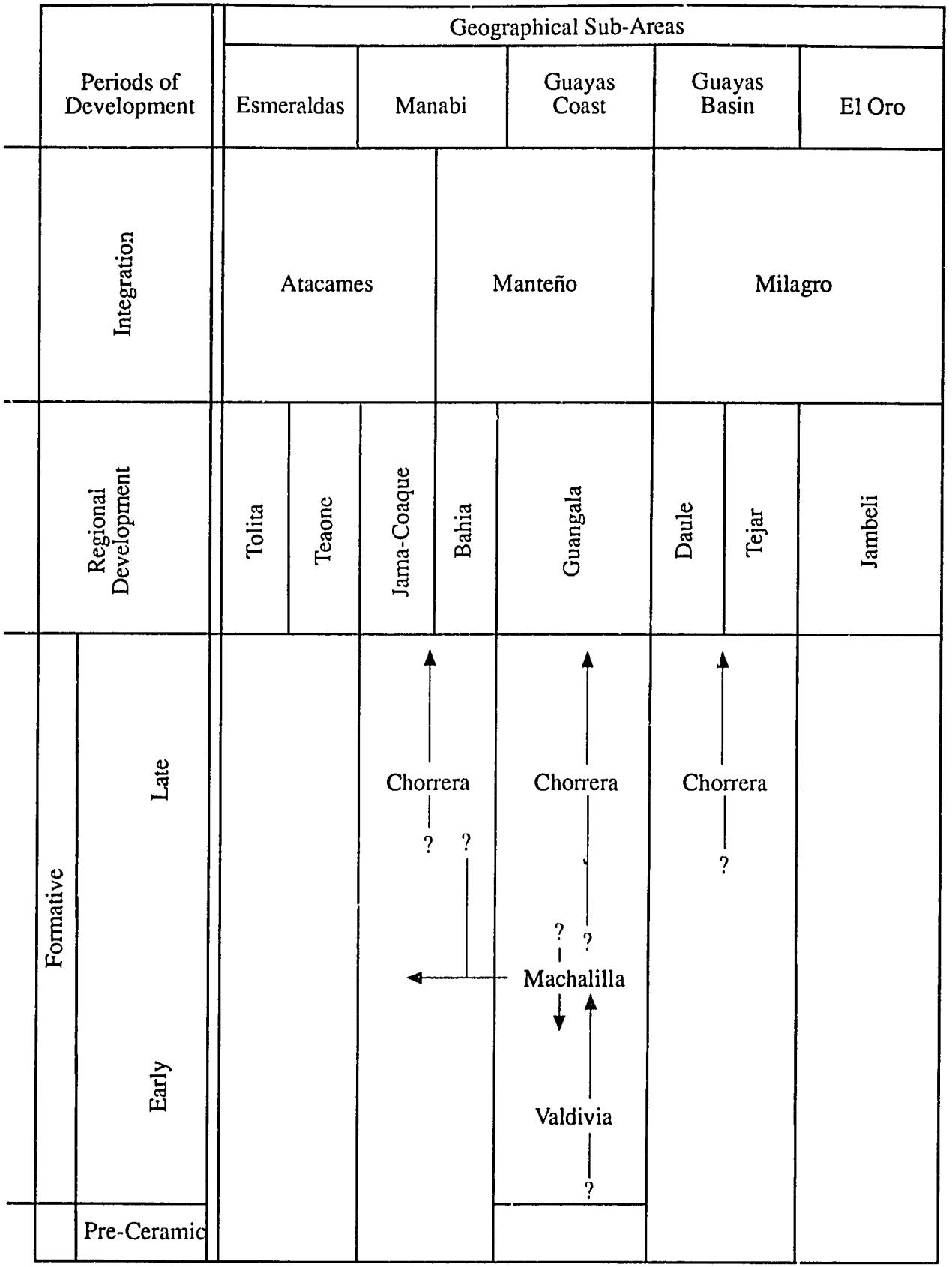


Figure 4. Chronological Chart of Ecuadorian Coastal Archaeological Phases.

Source: Meggers, 1966.

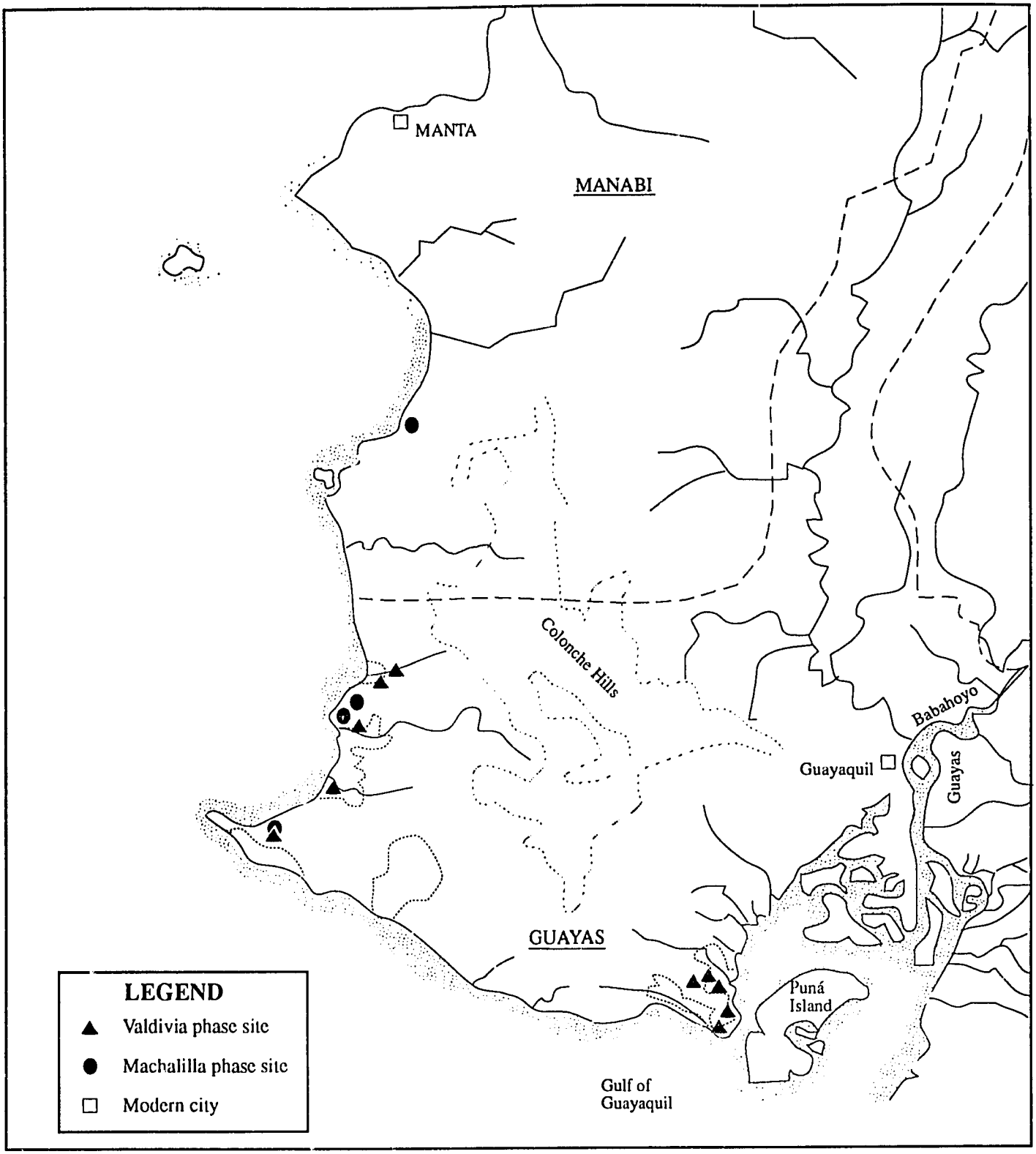


Figure 5. Sites of Valdivia and Machalilla Phases

Source: Meggers, 1966.

After the demise of the Valdivians, two advanced cultures appeared in coastal Ecuador: the Machalilla (2250-1300 B.C.) and the Chorrera (1300-550 B.C.). Machalilla sites are generally restricted to the shoreline. The majority of known Chorrera sites are either on the Guayas coast from the Santa Elena Peninsula northward to the Palmar region, or along the banks of the Daule and Babahoyo Rivers. The pottery produced by these groups was more complex and technologically advanced than that previously found.

Regional Development Period (500 B.C.-A.D. 500). The Regional Development Period was a time of differentiation in socio-political organization, decorative art styles, and elaboration of technology. Pottery forms proliferated; new shapes included goblets, compotera (shallow bowls on a tall, wide pedestal base), and polypod and tetrapod bowls with a variety of leg shapes. Decorative techniques were more diverse than during any other period. For the first time, there is direct evidence of metallurgy (Meggers, 1966). During this period at least ten cultures, or phases, are known to have existed. Eight of these were found in the coastal region. Variations in the technology employed by each reflect differences in the local environment and in the resources available, as well as differences in influence. Subsistence appears to have been heavily reliant on fishing, hunting, and agriculture, which became well-developed. Archaeologists believe that several of these cultures, most notably the Bahia, were skilled seafarers. The most important sites from this period were left by the Tolita, who inhabited the northern coast of Esmeraldas and the island of La Tolita. Artifacts from this culture, which include copper, gold, and platinum objects, can be found in many foreign museums. Artifacts of stone and shell are rare, but beads made of basalt, shale, serpentine, and chlorite schist, and stylized hollow figurines are common.

Integration Period (A.D. 500-1500s). This period dates from approximately A.D. 500 to the Spanish conquest. Advances include improvements in agricultural techniques, which permitted population expansion, establishment of urban centers, occupational division of labor, and greater use of metals, particularly copper, silver, and gold. The quality of pottery—presumably because of the shift to the use of metals—declined. The people gave their energy not only to adapting to the existing environment but to manipulating it, with the result that slopes were terraced, wells dug, and artificial mounds constructed (Meggers, 1966). In the early 1500s, early Spanish explorers reported that large balsa rafts, some weighing up to 30 tons, were commonly seen along the entire coast. Three important cultures inhabited the coastal region during this period.

1. The Manteño Culture. Evidence of the Manteño culture was discovered just north of Bahia de Caraquez and a short distance inland. Early Spanish chronicles reveal that agricultural crops included maize, manioc, beans, potatoes, guavas, and avocados. Elaborate terraces and small reservoirs were constructed to preserve water for irrigation. Stones were widely used in building, and temples were constructed. Textiles were produced and exported, and the seafaring tradition was continued.

2. The Milagro Culture. People of the Milagro culture inhabited most of the Guayas basin, including the lower elevations in the northern area of El Oro province. Agriculture provided the principal supply of food, but hunting and fishing were also important. Artificial mounds were constructed to protect valuable land from seasonal flooding. Metal ornaments and implements were common.

3. The Atacames Culture. The people of the Atacames culture lived along much of the coast of Esmeraldas and were visited by the Spanish conquistador Francisco Pizarro in the 1520s. Three thousand homes were said to have been seen on the site that is now Atacames. Artifacts included flat-bottomed bowls and annular-based jars.

In summary, the coast of Ecuador has a rich pre-Columbian cultural heritage. Marcos (1987) estimates, based on the density of archaeological sites, production techniques, and the size and modification of the natural environment, that about 1 million inhabitants resided in coastal Ecuador toward the end of the 15th century.

The Incas. Led by King Tupac-Yupanqui, the Incas conquered the southern provinces of Ecuador between 1480 and 1534, but there is little evidence of Inca presence in coastal Ecuador. Ecuador, however, was never fully integrated as part of Tachuantinsuzo, the "four parts of the earth" of the Incas.

Colonial Period (1500s-1822). In the early 1500s, Francisco Pizarro laid siege to Cuzco, Peru, killing the king of the Incas, Atahuallpa, and bringing a quick demise to the Inca empire. After this siege, Pizarro's envoys, Sebastian de Benalcazar and Francisco de Orellana, marched north into Ecuador. Benalcazar founded Villa de San Francisco de Quito in 1534, and twice he attempted to establish the town of Guayaquil, but both settlements were destroyed by coastal Indians. Orellana succeeded in establishing Santiago de Guayaquil in 1537. (It was Orellana who was the first European to navigate the Amazon River, a journey of 3,600 miles.)

The region of the Sierra, because of its potential for agriculture and its "healthy" climate, was chosen as the location of colonial administrative and economic power. In 1563, Quito was made the Seat of Royal Audience. The economy of the region developed as new agricultural crops and animals were introduced. Despite numerous peasant uprisings, Quito continued to grow. Its population reached 28,500 in 1780 (Linke, 1960).

Guayaquil, on the other hand, was a focus of commerce. The city was not without its problems: fire and termites repeatedly destroyed its wooden structures. Despite these problems and others such as tropical diseases—principally yellow fever and malaria, and attacks by British pirates—including Sir Francis Drake, Thomas Cavendish, and William Dampier—the city flourished. By the end of the 16th century, Guayaquil rivaled Callao, Peru as the principal port on the Pacific coast of the Americas. The 16th century witnessed the creation of coastal plantations that exported cacao to markets in Mexico and Spain, but during the 1630s Venezuela seized control of these cacao markets. Guayaquil did not rise to prominence again until timber from the Guayas Basin and skilled carpenters made it important for the export of tropical woods and naval construction.

These activities continued from the mid-17th through the early 18th centuries. During this time, large tracts of forests were cut and replaced by farms, and cattle ranching developed in Chanduy, Chongon, and Colonche on the Santa Elena Peninsula. In 1774, King Carlos III of Spain initiated measures to stimulate trade among the colonies. Cacao exports from Guayaquil jumped from 2,350 metric tons (mt) in 1779 to 5,250 mt by 1810. This first cacao boom brought trade and prosperity to Guayaquil. Also, tobacco plantations were established in the coastal fields near Daule and Balzar. Slaves were brought in to work the plantations, since the coastal Indians—in contrast to their counterparts in the Sierra—fiercely resisted subjugation by plantation owners. Import taxes imposed by Spain in 1810 cut down the trade from Guayaquil; the boom was over and the city fell upon hard times.

Despite Guayaquil's contact with major markets of the world, traffic and trade between coastal and mountain communities remained poor and sporadic.

The Republic (1822-Present). Ecuadorians often boast that the first cry for independence from Spain in Latin America was heard in Quito in 1809. Shortly thereafter, Ecuador joined Colombia and Venezuela, under the leadership of Simon Bolivar, in the war for independence. The decisive battle for Ecuador took place on the slopes of Mt. Pichincha on May 24, 1822, when Field Marshal Antonio Jose de Sucre led the rebellious forces to overwhelm Spanish royalists. Ecuador, Colombia, and Venezuela united to create the Confederation of Gran Colombia. Within eight years the Confederation began to

disintegrate. First Venezuela seceded, and then Ecuador. When Ecuador declared its independence in 1830, it claimed an area of some 706,000 km². Annexation of the Galapagos in 1832 added another 8,000 km².[1]

The first president of Ecuador was the Venezuelan-born general Juan Jose Flores. His dictatorial rule lasted until 1845. In 1843, a Constitutional Congress under his control passed a new constitution, later to be known as the Charter of Slavery, and two years later the March Revolution and its bloody fighting put an end to his regime. The rebels proved incapable of ruling, the national government broke down, and internal struggles, often directed at replacing foreign-born military leaders, created chaos over the next 15 years.

Gabriel Garcia Moreno, an ardent conservative, took control and ruled between 1861 and 1875. Most of his attention was focused on attempts to unify the country. His tactics and philosophy, however, clashed with a growing liberalist movement on the coast. Garcia Moreno was assassinated just before his inauguration to a third term. Some of his more notable accomplishments include initiation of construction on the Guayaquil-Quito railroad, which was intended to unify the country by stimulating trade; support of compulsory education; and construction of schools, technical institutions, and roads.

Meanwhile, liberalism was beginning to flourish in Guayaquil. Trade—exports of cacao and imports of wheat, flour, and wine from Peru and Chile, as well as cotton cloth from the United States—and related development in banking and finance stimulated the economy. Coastal residents increasingly opposed the "feudalistic Catholic" philosophy of the Sierra, but it was not until 1886 that coastal-born Eloy Alfaro directed the liberals to victory after a year-long civil war. Alfaro presided over Ecuador for two terms (1895-1901 and 1906-11), but was burned by an angry mob in the streets of Quito in 1912. He was succeeded by General Leonidas Plaza.

Between 1916 and 1922, a succession of powerful coastal bankers controlled the government. This was a period of coastal development and expansion marked by high cacao exports, the appearance of sugar cane plantations and mills, development of a small coastal petroleum industry on the Santa Elena Peninsula, and creation of the first trade unions. The prosperity was short-lived. A pest, witchbroom, devastated cacao production, the sucre was drastically devalued, and the cost of living increased. Workers found the quality of their lives deteriorating. In November 1922, Guayaquil was the scene of the country's first great workers' strike. Three years later, the Ecuadorian Socialist Party was founded.

During this period, the political and social gap between the population on the coast and that in the Sierra was widening. In 1925, an army comprising mostly inhabitants of the Sierra launched the July Revolution, which, without firing a shot, ended political domination of banking interests. The junta then handed control to a government board of civilians. The military named Dr. Isidro Ayoa as provisional president.

Conservatives and liberals clashed again in 1932 during the Four-Day War, one of the cruelest encounters in the country's history. Elections were eventually held, and Juan de Dios Martinez Merca was elected president. Shortly after Martinez assumed power, the Chamber of Deputies, brilliantly manipulated by Dr. Velasco Ibarra, urged the president to resign. Following months of excitement, elections were held in which Ibarra obtained the vast majority of the votes. This was the first, but by no means the last time, that the charismatic Velasco Ibarra would assume the position of president. He came to dominate the political scene as Ecuador's almost permanent *caudillo* ("strong man"). Between 1932 and 1972, Ibarra made several attempts for the presidency; he was elected five times and deposed four times. During this stormy period, 1935-40, seven presidents or dictators assumed power.

Dr. Carlos Arroyo del Rio, a wealthy Guayaquil-born lawyer, was president in 1941 when Peruvian forces entered Ecuador's southern coastal provinces over a boundary

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[1]Due to a repeated loss of territory to neighboring countries, Ecuador is now 40 percent of its original size.

dispute, and he has the dubious distinction of being the leader who signed the 1942 Protocol of Rio de Janeiro, in which Ecuador renounced its rights to an area in the western Oriente and along the southern border roughly equal in size to present-day Ecuador. Ecuadorians still contest the agreement. Criticism of the Arroyo del Rio regime arose, riots erupted in Guayaquil, and Velasco Ibarra returned from exile to proclaim himself president. After he served three years in office, the military seized power.

Free elections were held in 1948. Galo Plaza, son of two-term president General Leonidas Plaza, assumed power. Plaza's democratic rule lasted until 1952, when he stepped down. During Plaza's term in office, exports of coastal agricultural crops—principally, bananas, cacao, sugar, and coffee—doubled, the sucre and cost of living remained stable and inventories of resources were made. However, climatic conditions caused a succession of poor harvests in the Sierra, and the 1949 earthquake, one of the country's worst catastrophes, destroyed mountain villages and killed over 5,000, forcing many more to resettle on the coast.

Velasco Ibarra returned to power in 1952, managing this time to complete a term in office. His flamboyant personality, his visits to remote corners of the Republic, and his tact and skill in settling labor disputes are legendary, but he was not able to maintain a healthy currency or to manage a sound fiscal policy. In the same year, Ecuador, with Chile and Peru, claimed an exclusive maritime zone within 200 nautical miles (370 km) of its shores. This claim received international recognition with the signing of the Law of the Sea Treaty in 1982.

Dr. Camila Ponce Enriquez won the presidential election in 1956. During his term, three major labor strikes along the coast created tensions, but on the whole, the economic situation of the country improved. More open fiscal policies attracted foreign loans, some of which were used to revitalize Guayaquil's port, to complete construction of a railroad from San Lorenzo to Quito, and to finance various development projects.

Velasco Ibarra returned in 1968. In 1972, the 78-year-old politician was exiled for the last time by a military coup at the start of the oil boom in the Oriente. Two military regimes, the first led by General Rodriquez Lara and the second by Admiral Proveda Burb , ruled the country during the subsequent seven years. During these regimes, the country joined the Organization of Petroleum Exporting Countries (OPEC), and experienced a period of economic growth and prosperity financed by petrodollars.

The return to free elections came in 1979, when Jaime Roldos became president. Shortly after his election, Roldos, his wife, and several members of the government died in a plane crash near the Peruvian border. Osvaldo Hurtado, his vice-president, completed the term. Leon Febres Cordero, an ardent supporter of the free market, was elected in 1984 and succeeded by Rodrigo Borja in 1988.

Political instability has been a characteristic of Ecuador since independence. On the average, governments have lasted less than two years, and military intervention in government has been a recurrent feature. Since independence, there have been 18 changes of constitution (Smith, 1985).

Conflicts Between the Coast and the Sierra

Because of vast geographic, climatic, and cultural differences in the two principal regions of Ecuador, competition for economic and political resources between the coast and the Sierra has long been a source of tension. The two major cities, Quito in the Sierra and Guayaquil on the coast, dominate the political and economic life of Ecuador. Quito is the hub of political power, while Guayaquil, the principal port, has emerged as the center of economic development and the agro-export industry. Political scientist Kasza (1981) has examined the conflicts between these two cities. This section is based on his study.

The relationship is often embittered by a harsh regionalist rhetoric that ascribes to the opposing party innumerable prejudices, negative character traits, and a selfish concern

with regional needs to the detriment of the nation as a whole. Historically, the difficulties between the two cities extend beyond their metropolitan areas to encompass cultural regions and cultural identities, which intensify disputes rooted in different economic and political interests. According to Kasza, the indigenous people of the Sierra, who lived in permanent agricultural communities, were conquered first by the Incas and then by the Spanish within the same century. Being sedentary with well-established societal structures, they were easily dominated. The coastal Indians, however, were hunting and fishing tribes who were never conquered by the Incas and who mounted savage resistance to Spanish domination. The shortage of Indian labor on the coast was offset by importation of African slaves. The current distinctions between the character of coastal and Sierra inhabitants still parallel these early differences—the coastal native is described as more independent, aggressive, socially and geographically mobile, and more open to modern political and economic organizations than is his counterpart in the Sierra, who retains a much stronger tie with his traditional community.

Another important factor that has contributed to the differences between the two cities is the Catholic church. Since Quito was the seat of Spanish dominance, and both the pleasant climate and the compliant natives made colonial rule relatively easy in that region, the church became well-established and highly influential in the Sierra. In contrast, the church's penetration into the coastal region was limited, even two centuries after Spanish rule began. The church exerted influence not only in religious matters. Through the church, Quito became the center of artistic and educational activities, a legacy reflected today in the higher educational levels common in Quito compared to Guayaquil. While the Sierra is steeped in traditional artistic and intellectual pursuits, the coastal region is noted more for innovative business and political activism.

Over time, the relative isolation and stagnation of the Sierra caused it to lose its economic supremacy to the coast, which was participating in world trade. However, the political structure established early on has persisted, and Quito remains the political center of the country. This separation of economic and political power has led to a strong sense of inequity on the part of Guayaquil's elite, who pride themselves on being the dynamic entrepreneurial force behind Ecuador's economic growth and feel that their productive accomplishments entitle them to a certain freedom from the interference of the central government. The allocation of government financial resources is also often a point of dispute, with coastal areas frequently claiming to be shortchanged.

Some of these deep-seated regional conflicts have been resolved over the past decade, principally through greater decentralization of several government agencies into Guayaquil, resulting in more autonomy for managers in coastal regions. Kasza ends his analysis on a note of optimism. Regional differences can be resolved, at least to some degree, he says, with greater administrative decentralization, regional integration in recruitment to the military and government bureaucracy, and the promotion of interregional trade and investment.

Population and Demography

Prior to the arrival of the Spanish in the early 1530s, Ecuador had a human population comprising numerous Indian tribes. By some estimates there have been as many as 50 separate tribes in Ecuador that have never been united. These Indians continued to dominate the population well after the arrival of the Spanish. The culture and economic activities of these people were quite distinct and have remained so to this day.

Along with the Spanish and the Indians, the population later began to include the Africans who were brought to Ecuador as slaves. Little data are available on ethnic composition, rate of growth, or locations of the population prior to the first national census conducted in 1950. Early writings and estimates of populations in specific areas do, however, provide an indication of the changes in demography.

During the Colonial Period, the population was concentrated in the Sierra. A small portion, employed in cultivating cacao, harvesting timber, boat building, mining, and commerce, lived on the coast, primarily in Guayas. In 1780, 91.2 percent of the population was found in the Sierra, versus 8.8 percent along the coast. By 1840, the coastal population increased to approximately 15 percent of the national total. Between 1875 and 1925, the flourishing trade in cacao attracted a large number of immigrants to Guayaquil and rural coastal areas.

The first national census (1950) numbered the population at 3,202,757, of which 40.5 percent lived on the coast. Between 1950 and 1990, the total population tripled, to 9.6 million (Figure 6), while the coastal population grew nearly fourfold, to 4.2 million—49 percent of all Ecuadorians.

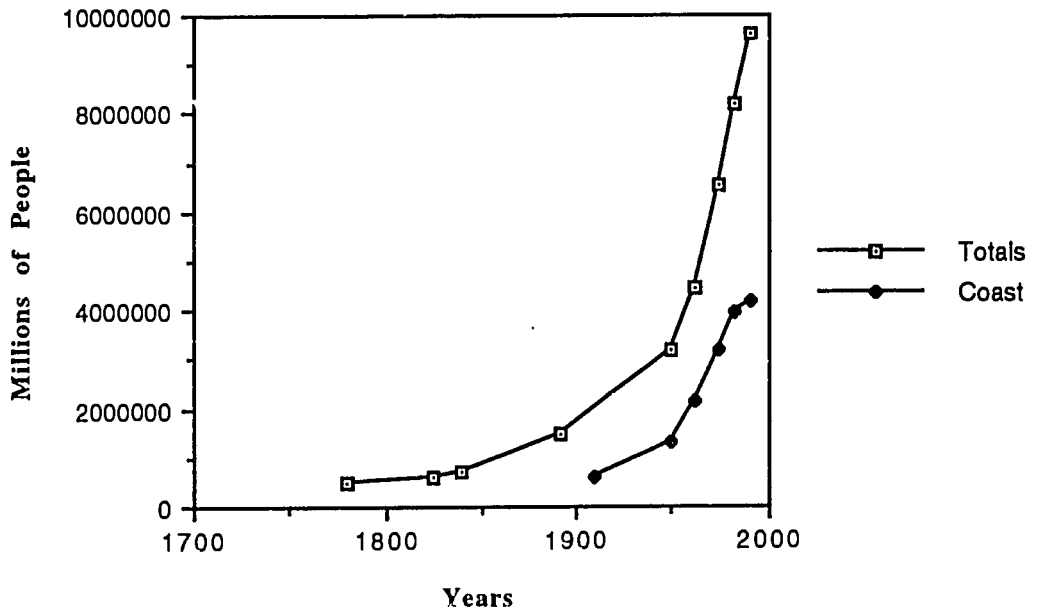


Figure 6. Population Trends, 1780-1990.
Sources: INEC, 1950, 1962, 1974, 1982, and 1990.

Since 1950, coastal populations have grown at a much higher rate than in the Sierra. The density of the coastal population surpassed that of the Sierra in the mid-1970s (Table 3), reaching 70 inhabitants/km^2 in 1990. Guayas was the most densely populated province, with 121/km^2.

Further examination of data reveals another trend. The 1950 census classified 28.5 percent of Ecuador's inhabitants as living in urban areas, 15.4 percent in suburbs, and 56.1 percent in rural areas. Data for 1990 (Table 4) indicate that 55 percent reside in urban areas—62 percent of these on the coast. Thus, between 1950 and 1990, urban populations increased more than 30 percent above the national average. In 1950, there were only five cities with 21,000 or more inhabitants, and Guayaquil was the only coastal city falling into this category. By 1990, there were 22 cities in this category, 14 on the coast and 8 in the Sierra. Five coastal cities (Guayaquil, Machala, Portoviejo, Manta, and Esmeraldas) now boast populations in excess of 100,000. Areas of population density are depicted in Figure 7.

Table 3. Population Densities by Region and for All Coastal Provinces, 1950-90.

Region/Province	Inhabitants/km^2 1950	1962	1974	1982	1990
Oriente	0.4	0.6	2	2	3
Galapagos	0.2	0.3	.75	1	1.2
Sierra	28	35	48	59	70
Coast	19	32	48	63	70
Coastal Provinces					
Guayas	28	47	72	97	121
Esmeraldas	5			17	20
Manabi	23			48	54
El Oro				59	70

Sources: INEC, Censo de Población de 1950, 1962, 1974, 1982, and 1990
INEC, Proyección de la Población del Ecuador, 1979
INEC, Areas de las Provincias, 1981.

The population of Ecuador is projected to exceed 12 million by 1995. Growth will continue to be concentrated in urban areas and on the coast. For example, 58 percent of the populace, 7.2 million, will reside in urban areas. Guayaquil's population is anticipated to exceed 2.1 million and that of Quito 1.5 million by 1995. Of the total population, 50 percent (6.1 million) will be found on the coast, 45 percent in the Sierra, and 5 percent in either the Oriente or the Galapagos. Population densities are expected to increase to 45 inhabitants/km^2 nationally—84/km^2 in the Sierra and 92/km^2 on the coast.

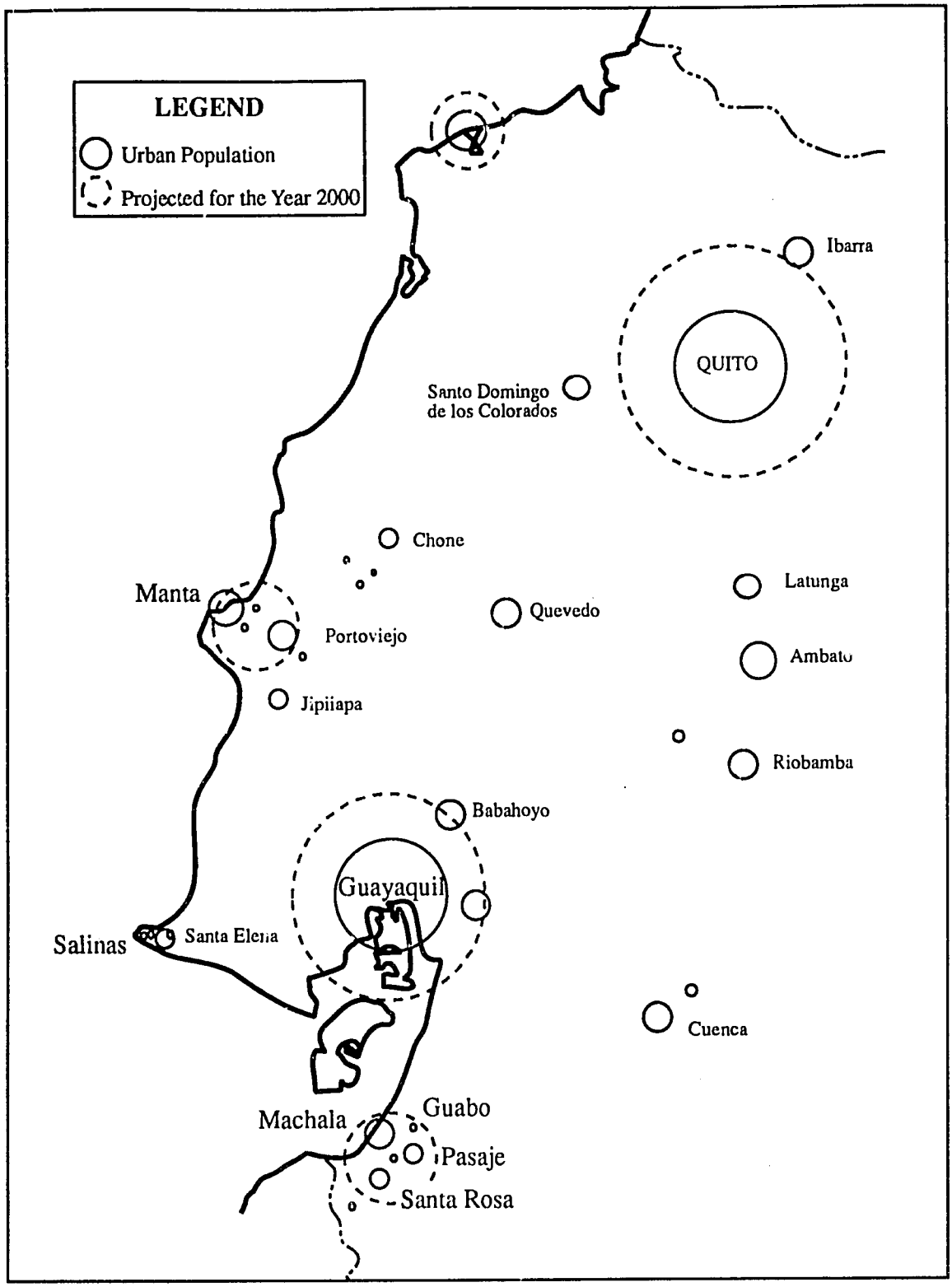


Figure 7. Population Centers within Ecuador: 1982 and 2000

Source: Dirección Investigacion y Desarrollo, 1986.

Table 4. Population by Province, 1990.

Provinces	Total Population (in 000s)	Percentage of Total Population	Population Growth % Since 1982	Percentage in Urban Areas	Percentage in Rural Areas
Coastal Provinces					
El Oro	415.1	4.3	24	70.1	29.9
Esmeraldas	307.2	3.9	23	43.7	56.3
Guayas	2463.4	25.6	21	76.3	23.7
Manabi	1026.1	10.7	18	42.1	57.9
Los Rios	530.8	5.5	16	38.1	61.9
All Coastal Provinces	4742.6	49.3	20	61.9	38.1
Sierra Provinces					
Carchi	142.0	1.5	11	40.4	59.6
Imbabura	273.3	2.8	10	47.5	52.5
Pichincha	1734.9	18.0	26	73.5	26.5
Cotopaxi	283.2	2.9	2	23.4	76.6
Tungurahua	366.5	3.8	12	41.5	58.5
Bolivar	70.6	1.8	17	19.3	80.7
Chimborazo	360.6	3.7	14	32.7	67.3
Canar	189.1	2.0	8	29.4	70.6
Azuay	506.5	5.3	15	43.3	56.7
Loja	389.6	4.0	8	40.1	59.9
All Sierra Provinces	4416.4	45.9	16	51.2	48.8
Oriente Provinces					
Napo	102.6	1.1	11	23.1	76.9
Pastaza	40.7	0.4	28	36.4	63.6
Morona Santiago	95.7	1.0	36	24.6	75.4
Zamora Chinchipe	66.7	0.7	43	24.5	75.5
Sucumbios	77.4	0.8	----	26.2	73.8
All Oriente Provinces	383.2	4.0	45	25.8	74.2
Galapagos	9.7	0.1	59	81.1	18.9
Others	70.6	0.7			1.00
Total	9622.6	100.00	19	55.1	44.9

Slight discrepancies in subtotals and the total are due to rounding.
Source: INEC, 1990.

Quality of Life and Social Indicators

Until the 1970s, Ecuador had one of the most impoverished populations in the Western Hemisphere. Life expectancy, for example, in the mid-1940s was less than 30 years (Linke, 1960). Great increases in government revenues, attributed to the exploitation of oil in the 1970s, have been wisely used to enhance the quality of life in Ecuador. By 1980, per capita income was similar to that in the neighboring countries of Peru and Colombia. Ecuador is now among the world's middle-income countries (World Bank, 1984). Table 5 shows changes in quality of life for Ecuadorians since 1950.

Table 5. Quality of Life Indicators: 1950, 1960, 1970, 1980-82, and 1990.

	1950	1960	1970	1980-82	1990
Crude Death Rate (per thousand)	18.9	16.6	12.9	8.1	7.55
Life Expectancy (years)		50.7	55.9	61.2	65.4
Infant Mortality Rate (per thousand)		140	107	78	63.4
School Enrollment (percent)					
Primary		83	97		
Secondary		12	22	40	52.9
Higher		3	8	37	
Per Capita Income (U.S. Dollars)	119			1430	1062
Literacy Rate (percent)	43.7			85.5	90.1
Nutrition					
Calorie Intake (Percent of Requirement)				97	101
Per Capita Protein Intake (Percent of Requirement)			65.9		
Access to Piped Water					
percent in Urban Areas				40.8	84.4
percent in Rural Areas				11.2	41.7
Percent of Population with Access to Electricity				45	78
Population per Physician		3000		760	908
Population per Hospital Bed				500	590

Sources: Linke, 1960
World Bank, 1984
INEC, 1991
The Economist Intelligence Unit, 1992

Education. Linke (1960) states that, in 1956, 70 percent of Ecuadorian children between the ages of six and 12 attended primary school, 9 percent of those between 13 and 19 attended secondary school, and 1.26 percent of those between 20 and 26 attended universities. Between 1950 and 1986, enrollment in primary schools increased fivefold, in secondary schools 28-fold, and in universities 50-fold. By 1985, 49 percent of Ecuadorian secondary schools were built in coastal provinces and accounted for 47.3 percent of total national enrollment. There are also 10 universities located on the coast. The national literacy rate increased from 50 percent in 1950 to 85.5 percent in 1981. Despite these impressive advances, around 2 percent of coastal urban children and 23 percent of coastal rural children did not attend primary school in 1984 (UNESCO, 1985).

Health. Life expectancy in 1984 for Ecuadorians was 61 years and rose to 65 by 1990. Infant mortality was 78 per 1,000, versus 140 per 1,000 in 1960. The death rate has also decreased, from 18.9 per 1,000 in 1950-55 to 7.55 per 1,000 in 1990. Improvements have

also been made in medical care: in 1990 there were 11 doctors and 17 hospital beds per 10,000 people. Average caloric intake is 101 percent of the minimum required, but per capita protein intake is still below the minimum requirement (World Bank, 1984; Encyclopedia Britannica, 1992).

Tropical diseases have traditionally plagued Ecuador's coastal population. As recently as the mid-1940s, malaria accounted for approximately 25 percent of all deaths and tuberculosis for 20 percent. Campaigns for disease prevention, which were started in the late 1940s, have been relatively successful, but tropical diseases remain a problem in certain coastal areas, most notably in Esmeraldas.

Per Capita Income. Annual per capita income in U.S. dollars has risen twelvefold since 1950, from U.S. $119 to U.S. $1,430 in 1983 and dropped to U.S. $1,062 by 1990. The greatest increases have been seen since 1975. Inequality in the distribution of income still exists. Real gains in per capita income are substantially less, due to inflation, and have decreased substantially since 1982 (InterAmerican Development Bank, 1992).

Sewage Disposal. Many of the health problems—for instance, diarrhea, gastroenteritis, typhoid, and tuberculosis—are directly related to environmental conditions. Contaminated water supplies, nonexistent or inadequate sewage systems, and absence of safe refuse disposal favor the spread of these and other diseases. In the most developed and urban coastal province, Guayas, roughly 40 percent of the people have sewage service, slightly more than one-third use open-pit toilets, and the remainder have no visible means of wastewater disposal. At least 70 percent of the population in each of the other coastal provinces do not have access to wastewater disposal. Open-pit privies are the most common means to dispose of wastewater (Figure 8).

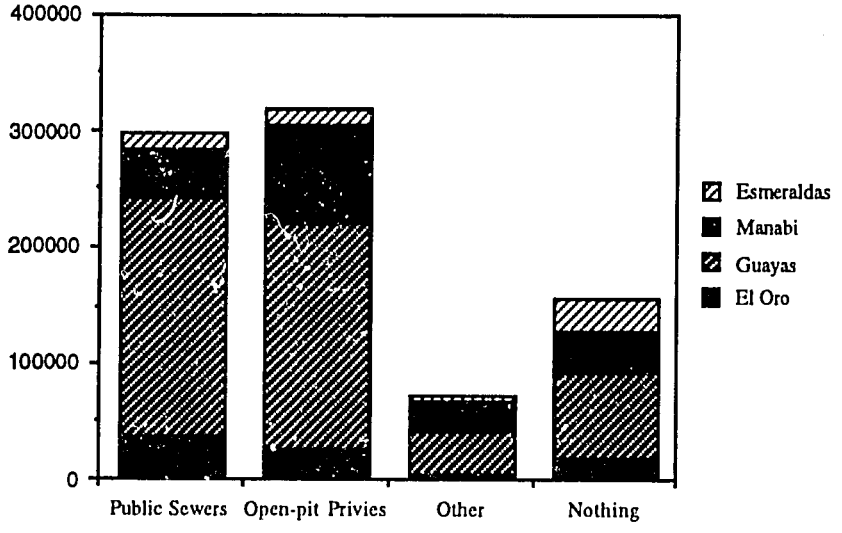


Figure 8. Wastewater Disposal Methods for Coastal Provinces: 1982
Source: INEC, 1982.

As one might anticipate, some form of wastewater disposal is available to more people in urban than in rural areas. In the former, a total of 20 to 37 percent nationally have neither sewerage systems nor outhouses, while 75 to 90 percent of all rural residents are without disposal facilities.

From an environmental point of view, the situation is actually much worse than these figures imply, since public sewers are often merely collecting systems, which means that wastes are dumped untreated into nearby rivers, estuaries, or the ocean. Furthermore, the groundwater table in the coastal area is high, and contamination of wells from sewers and privies is a problem.

Drinking Water. Figure 9 presents the percentage of homes in coastal provinces that receive drinking water from a public system. Residents of El Oro and Guayas (74 and 57 percent, respectively) have the greatest access to such systems. Remaining coastal provinces receive less than half of their drinking water from public systems.

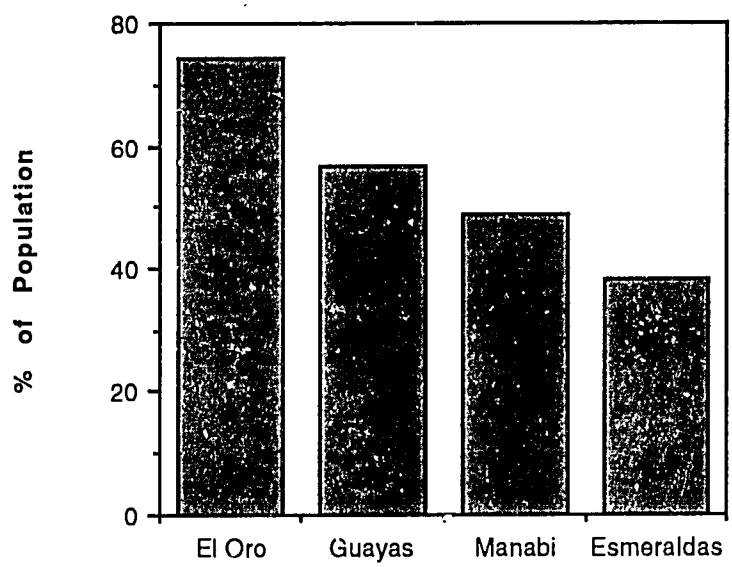


Figure 9. Coastal Population with Access to Publicly Supplied Water: 1982
Source: INEC, 1982.

The Economy

Early economic development in Ecuador reflected patterns seen in other countries of the Western Hemisphere. During the Colonial era, agriculture and animal husbandry predominated. Coastal residents also harvested timber and constructed vessels. Deposits of gold, which first lured the Spanish, were quickly exhausted. Regional development emerged during the Republic era and reflected differences in labor, resources, and entrepreneurial spirit. Coastal economies became dependent on exporting agricultural crops, and experienced a series of booms and busts dictated by fluctuations in production and world markets. Guayaquil emerged as the major economic center with the development of banking and commerce. The conservative population in the Sierra continued to be dependent on agriculture for domestic consumption.

Until the early 1970s—when Ecuador became a member of OPEC—agriculture was the mainstay of the Ecuadorian economy and employed more people than any other sector. Agriculture in the Sierra was directed toward stable domestic markets for grains, potatoes, and milk. In contrast, export-oriented coastal agriculture was periodically dominated by a single crop—mostly, cacao or bananas.

Small quantities of crude oil have been exported from coastal wells since the mid-1920s. Manufactured exports were basically restricted to woven toquilla straw hats known worldwide as Panama hats. During World War II, Ecuador exported copper, lead, gold, and rice.

Industrial development, centered in Guayaquil and Quito, began slowly in the 1950s. Industrial manufacturing is oriented toward domestic markets. Textiles, principally cotton, rayon, wool, and knitwear produced in the Sierra, emerged as Ecuador's largest industry. The influx of money generated from the coastal banana boom in the 1950s financed industrialization in Guayaquil. Medium-sized or small factories on the coast began producing cigarettes, soap, candles, processed foods, and other consumer goods. The fisheries simultaneously started to industrialize as larger vessels were brought in to harvest tuna and shrimp.

During the 1960s, economic growth was stable, averaging 5 to 6 percent per year. Agriculture continued to dominate the economy and constituted up to 95 percent of exports.

Discovery of oil in the Oriente in 1967 transformed Ecuador's economy. Construction of a pipeline, which runs from the Oriente up the Andes to 4,100 m before descending the western slope and traversing the coastal plain to an oil terminal, refinery, and port in Esmeraldas, was completed in 1971. In 1973, Ecuador became a member of OPEC. The subsequent quadrupling of world oil prices brought instant prosperity. GDP per capita jumped 11 percent in 1972 and 21 percent in 1973. During the remainder of the 1970s, income and output expanded rapidly, perhaps at a rate unprecedented in the country's history. Real GDP, in 1975 sucres, grew at almost 8 percent yearly. Real exports rose from U.S. $400 million in 1970 to approximately U.S. $1 billion by 1980; real manufacturing output went up 150 percent. Agriculture, which contributed 22 percent to GDP in 1972, grew slowly but was overwhelmed by petroleum; it represented only 15 percent of GDP by 1989, but remained the largest employer, with 47 percent of all workers (World Bank, 1984; Linke, 1960; Banco Central, 1990). The terms of trade turned strongly in Ecuador's favor. Exports of cultured shrimp boomed. The sucre/dollar exchange rate was stable at 25/1 between 1971 and 1981.

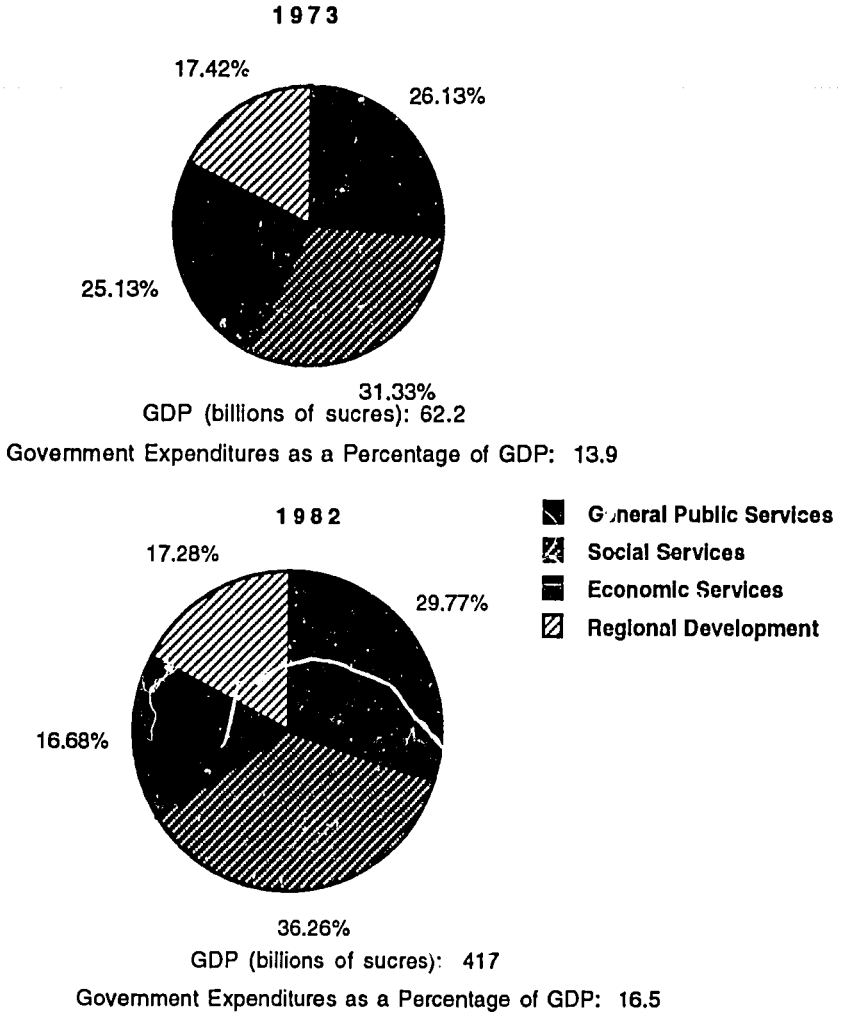
Government expenditures increased between 1973 and 1990, from 62 billion to 8,349 billion sucres (Figure 10). When measured as a percentage of GDP, government expenditures in 1991 were nearly half those of 1973. There was construction of major highways, airports, and rural development projects. That required new institutions—all of it paid for by petroleum exports, which went up 100 times in value during the decade. At constant 1983 prices, per capita GDP increased from U.S. $1,190 in 1972 to U.S. $1,430 in 1983 (World Bank, 1984). Imports by consumers and industries increased as oil revenues kept exchange rates favorable. Higher per capita incomes expanded demand, which accelerated industrial production. Between 1978 and 1983, the government, supported primarily by oil revenues, contributed 60 percent to GDP and the private sector contributed 40 percent.

The three most important sections in the Ecuadorian economy between 1978 and 1989 were: industrial manufacturing-18 percent of GDP; commerce-16 percent of GDP; and agriculture-15 percent of GDP. Petroleum and mining, and financial services each contributed 12 percent to GDP.

Stagnation in the world demand for oil and subsequent declines in oil revenues during the 1980s brought an abrupt halt to economic expansion. Per capita income dropped by 5 percent in 1982 (World Bank, 1984) and continues to decrease. GDP and per capita GDP oscillated during the late 1970s and in the 1980s rose and fell with the price of oil. During the 1980s, GDP, in 1975 sucres, only rose by 19.9 percent. Per capita GDP, in

1975 sucres, declined from 18,172 in 1980 to 16,887 in 1989 (Banco Central, 1990). In dollar terms, GDP per capita fell from $1,444 to $1,250 over the same period of time. The situation continued to deteriorate in 1990. A series of devaluations began in 1982. To continue the construction of development projects, the government increased external borrowing. The external debt rose from U.S. $750 million in 1976 to $7.6 billion by 1983 and reached $12.3 billion in 1991; three-fourths of this debt was owed by the public sector. Non-oil exports, with the exception of cultivated shrimp, increased slowly. Between 1985 and 1989, petroleum accounted for 46 percent of the total value of exports and generated an average of $882 million per year. Since few industries were export-oriented, devaluations and inflation made repayment of the debt more difficult. Simultaneously, access to external funds became more constrained. The Banco Central has been left with little liquidity, and the external debt service has fallen into arrears. In late 1982, Ecuador launched a series of austerity programs and received International Monetary Fund (IMF) support.

Since 1983, Ecuador has entered a series of complicated rescheduling agreements with creditor banks, but the external debt doubled from $4.8 billion in 1980 to an estimated $9.6 billion in 1987. The amount required to service this debt reached 31 percent of export revenue in 1986, up from 18 percent in 1980. High interest rates, 36 to 38 percent in 1985 and slightly over 50 percent in 1991, staggering inflation, and devaluations have slowed growth and investment. Simultaneously, the free market rate for the sucre has risen from 44 to a dollar (1982) to 150 by mid-1986 and, as of April 1991 to over 1,270 (Figure 11).



Source: Ministerio de Finanzas, Estadísticas Fiscales, No. 2.

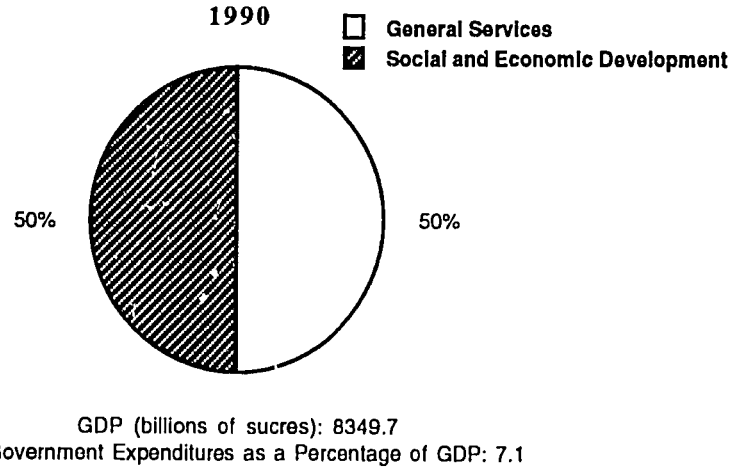


Figure 10. Quantity and Distribution of Government Expenditures: 1973, 1982, and 1990.

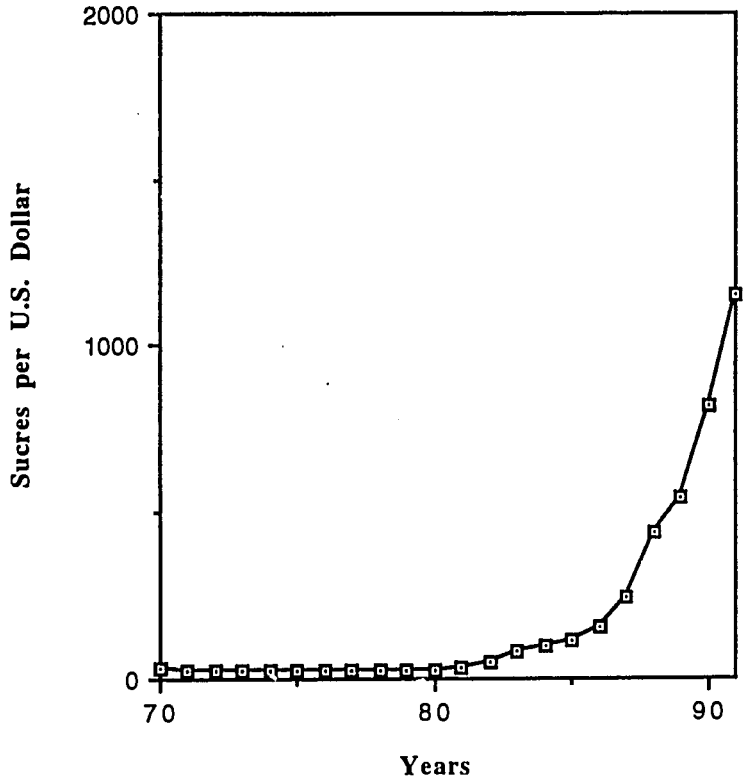


Figure 11. Variation in the Free Market Sucre/U.S. Dollar Exchange Rates, 1970-91.
Source: Banco Central, 1988 and 1991.

Employment. Between 1962 and 1982, the Ecuadorian labor force doubled to 3.2 million people and grew through the 1980s at an annual rate of 3.1 percent. As of 1990, 3,660,150 people were economically active (Fundación Hanns Seidel, 1991). Since the population has grown by two-and-a-half times over the same period, a smaller proportion of the population is employed and the number of dependents per worker has increased. More importantly, the work force is no longer concentrated in the Sierra, but has shifted to the coast and cities, predominantly to urban coastal areas. In 1962, for example, 29.8 percent of workers were found in urban areas, versus 51.4 percent in 1982. Also during the 1950s, agriculture accounted for about 50 percent of national employment, but had dropped to 32 percent by 1989 (Economist Intelligence Unit, 1992). Despite this, agriculture is still the largest single employer in absolute terms. Commerce, services, and construction have approximately doubled in percent of national employment over these two decades (Table 6).

The employment situation deteriorated throughout the 1980s. The rate of unemployment increased from 6.7 percent at the beginning of the decade to 12.3 percent in 1988, and continued to rise in the early 1990s. In addition, CONADE (1989) calculated that 50 percent of those economically active in 1988 were underemployed. The Fundación Hanns Seidel (1991) estimated that 50 percent of the labor force (3,029,000 people) in 1989 were underemployed and 14.7 percent unemployed. It is worth noting that the labor force is poorly trained, as 63.2 percent completed primary school (grades 1-6), 23 percent attended high school (grades 7-12), and only 13.7 percent have additional education.

Employment on the coast has grown more rapidly than in other regions of the country. In this decade, slightly over half the country's labor force is located on the coast. Approximately 55 percent of the coastal labor force is found in Guayas; Manabi supports 19 percent, and the remaining coastal provinces combined support 26 percent. Agriculture, including fisheries, is the largest employer in the region.

Table 6. Employment in Ecuador: 1950, 1962, 1974, 1982, and 1989 (expressed as percentages).

	1950	1962	1974	1982	1989
Employment by Area					
Urban		35.40	41.80	51.40	50.6
Rural		64.60	58.20	48.60	49.4
Employment by Sector					
Agriculture/Farming	50.00	55.60	46.20	33.50	32
Mining	0.00	0.20	0.30	0.30	0.6
Manufacturing	24.00	14.60	11.70	12.20	10.4
Electricity, Gas and Water		0.30	0.40	0.60	0.5
Construction	2.00	3.30	4.40	6.70	7.6
Transportation/Communication	2.20	3.00	2.80	4.30	4.9
Commerce	5.60	6.80	9.80	11.60	10.6
Banking and Finance	*	*	1.00	1.90	2.5
Services	12.00	13.20	17.00	23.70	24.6
Other Activities	4.20	2.00	4.80	1.70	0.7
New Employment		1.00	1.60	3.50	5.6
TOTAL	100	100	100	100	100
Employees as a Percentage of the Total Population	39	32	30	29	38
			1962-74	1974-82	1982-1988
Average Annual Increase in Employment as a Percentage			3	2	3.1

Source: INEC, I, II, III, IV, Censo de Población; Fundación Hanns Seidel, 1991; and Economist Intelligence Unit, 1992

Physical Infrastructure

As previously indicated, the absence of efficient communication and transportation between the coast and the Sierra has historically plagued national development and unification. While the lack of financial resources is usually blamed for Ecuador's failure to construct adequate transportation routes, one must recognize the formidable nature of the Andes mountains, which separate the coast from the Oriente, as well as other natural obstacles. Construction of transportation routes within a region has proven less challenging and costly, and consequently the first routes were internal, with each region remaining isolated from the rest of the country.

Railroads. In the late 1800s, construction started on the first major rail artery, the Guayaquil-Quito railroad. It involved traversing large tracts of swamp, crossing numerous

rivers and creeks, and penetrating tropical rain forests. Yet this was only the beginning. Climbing the steep, densely vegetated slopes of the Andes was an engineering challenge involving the construction of innumerable embankments and switchbacks. The 288-mile stretch of rail rises from sea level to 11,600 feet. When construction was complete, in 1908, the Guayaquil-Quito railroad linked the Sierra, for the first time, to the coast and the rest of the world. Subsequent spurs continued to facilitate trade and communication within Ecuador. By the mid-1950s, Ecuador had 1,200 km of rail, and Quito was connected both to Guayaquil and to San Lorenzo.

With Ecuador's physical topography and climate, construction on a rail line was by no means the end of the task. Torrential rains turn railbeds into raging rivers, and periodic landslides and earthquakes cause the disappearance of extensive sections of rail, so constant and costly maintenance is required. In fact, the unusually heavy rainfall associated with the 1982-83 El Niño washed out steep stretches of the Guayaquil-Quito railroad, and its operation, as of early 1992, still has not been restored. As of 1991, Ecuador had 565 km of usable track left (Fundación Hanns Seidel, 1991).

Roads. The first roads in Ecuador were constructed in the Sierra by the Incas to unite their empire. During the Colonial period, roads were built to facilitate delivery of agricultural crops in the Sierra. Until completion of the Guayaquil-Quito railroad, transport of goods between the coast and the Sierra was effected by pack animals that labored along paths leading up the western slope of the Andes. Cargo, principally agricultural products, was moved from rural coastal areas to ports such as Guayaquil and Esmeraldas, on rivers, and along the coast by ships. Roads in coastal areas were constructed in the late 1940s, when the enormous increase in agricultural production and export of bananas, coffee, cacao, and other products made them necessary. In 1940, Ecuador possessed 6,500 km of road. Of this, only 3,000 km were passable year-round.

The largest road project was the construction in the late 1950s of the Pan-American Highway, which linked the Sierra to the coast and to neighboring countries. Some sections of the highway periodically disappear in landslides. The city of Esmeraldas had no direct land link with the rest of the country until construction of the Quito-Quininde-Esmeraldas Road in 1957. By 1958, the national road network encompassed 11,200 km, of which 9,700 km could be traveled in all weather. By 1990, Ecuador had a little over 38,530 km of roads. Of this, about 21,500 km were classified as all-weather. The road network may be viewed as two north-south axes, one in the Sierra and the other in the coastal lowlands, with a series of transverse routes linking the Sierra to coastal ports (Figure 12). In addition, a few penetration roads cross the eastern cordillera to the piedmont zone of the Oriente. Road traffic has grown rapidly, from 76,000 vehicles in use in 1971 to 344,255 in 1989 (Fundación Hanns Seidel, 1991).

Shipping. Commerce by ocean and river vessels in Ecuador is believed to date back to an ancient civilization on Plata, a small island a mile or so off the coast of central Ecuador, which traded along the coast in 2700 B.C. Since the Colonial period, coastal development has been tightly tied to inland waterways and the ocean. Agricultural communities have traditionally sprung up along rivers. For hundreds of years, produce was shipped to ports by rivers and transshipped to the world markets on oceangoing vessels.

Guayaquil, Ecuador's largest port, located 30 miles up the Guayas River, has been tempered for over 450 years by repeated fluctuations in world and domestic supply and demand. Other Ecuadorian ports have fared the same, but never grew to the magnitude of Guayaquil. In the late 1950s, 60 percent of all exports and 90 percent of all imports passed through Guayaquil. In the early 1960s, major port reconstruction created a channel between the river and a long thin estuary known as the Estero Salado, and added new wharves and warehouses.

Manta, which exports coffee, taqua nuts, straw hats, and fish, has historically been the country's second port, but it was recently overtaken by Puerto Bolivar. Other ports

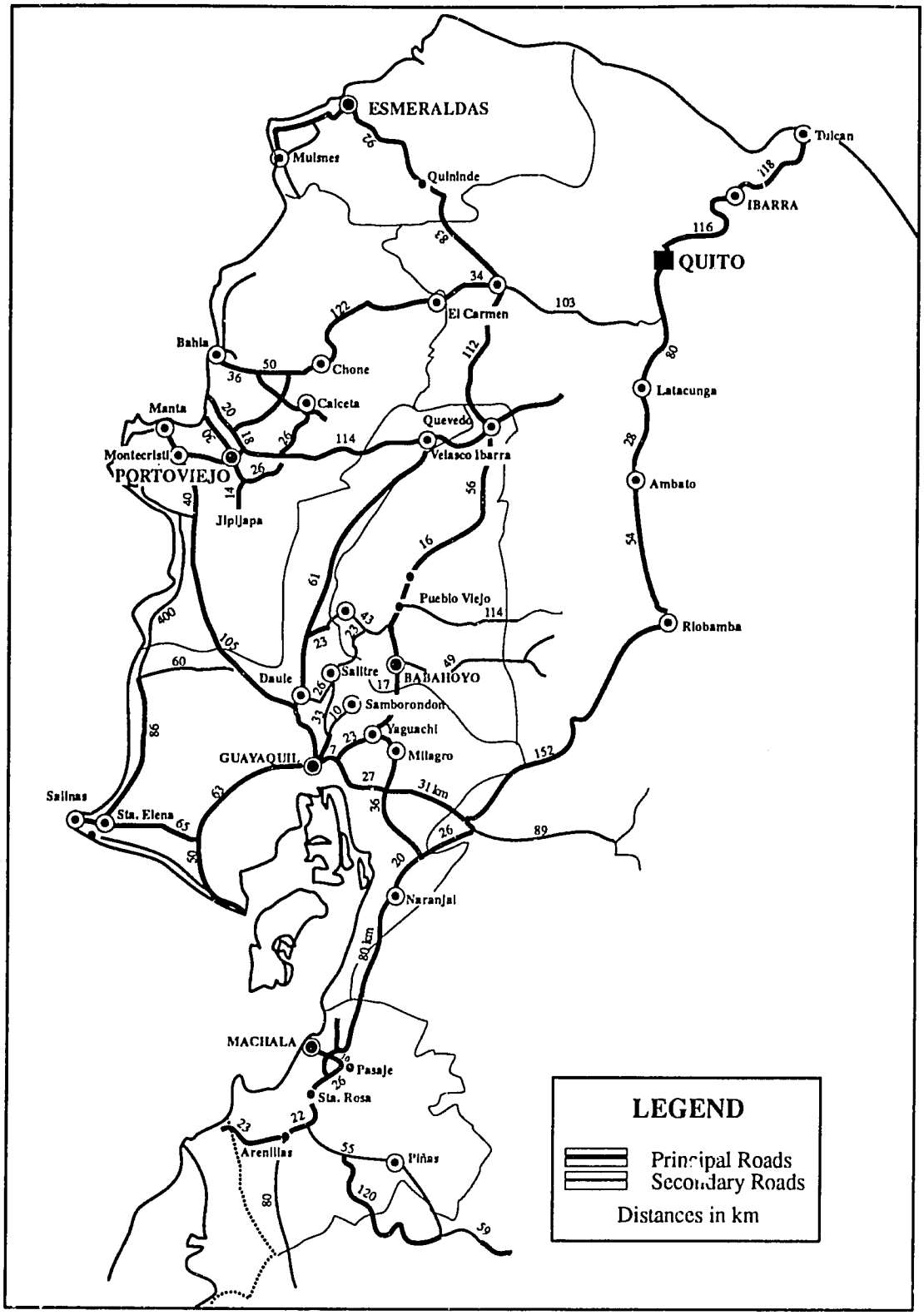


Figure 12. Road System in Western Ecuador

Source: Fundacion PVM, 1987.

include La Libertad, Bahia de Caraquez, Esmeraldas, and San Lorenzo, the last possibly offering the best natural harbor.

Oil exports and imports significantly changed maritime traffic and port structure. The principal change has been the construction of the Balao facility, entirely dedicated to oil export, near Esmeraldas.

Between 1970 and 1990, cargo moved through Ecuadorian ports increased by over 400 percent.

Airports. International airports are located in Guayaquil and Quito. Minor airports are scattered throughout the country and are used by seven domestic airlines. Of these minor airports, Manta has the potential for expansion into an international airport. A new international airport is currently under construction outside Guayaquil.

Issues for a Coastal Resources Management Program

Between 1950 and 1992, the population of Ecuador tripled, while the coastal population increased fourfold. Census data show another trend: in the same 30 years the urban population increased. It is expected that the 9.6 million counted in 1990 will grow to 12 million by 1995, with the population concentrated in urban areas and on the coast. This rapid growth has drastically altered and degraded coastal ecosystems and resources, and greater and more diversified pressures will be placed on coastal resources in the future. The implications of this increase in population for a CRM program in Ecuador are:

- The methods and rationale behind sustainable development employed by the early cultures of Ecuador should be examined for clues that can help in developing a modern balance between man and nature.

- The Ecuadorian economy has experienced a downswing since the early 1980s and, more recently, severe inflation. As the populace grows and becomes more impoverished, meeting basic human needs becomes more important. The government will be pressed to supply more and better services—such as potable water, sewage disposal and treatment, and supporting infrastructure--on a smaller budget.

- Government policies and philosophy have a direct bearing on the manner in which coastal resources are exploited. Therefore, government support must be solicited in any attempt to develop and implement coastal management. The relatively short tenure of government officials in Ecuador—on the average, less than two years—implies that a CRM program, if it is to meet long-term challenges, must gain broad public support to ensure continuous government backing.

II. THE COAST AS A RESOURCE BASE FOR DEVELOPMENT

Ecuador's coastal region, for the purpose of this profile, is defined as the alluvial plain that extends from the western base of the Andes to the Pacific, including a portion of the country's territorial sea adjacent to the continent. The terrestrial portion varies in width from 20 to 210 km, and stretches 1000 km between Colombia and Peru. The Galapagos Islands and surrounding waters are not included in this definition.

The coastal zone is an area of interaction between land and sea, and features renewable and non-renewable resources. For example, renewable resources include fish stocks, which, if properly managed, can be sustained over time, whereas non-renewable resources, such as mineral deposits, once exploited, cannot be replenished. Coastal resources may also be classified as physical (minerals, soils), living (fish stocks and ecosystems), and cultural (archaeological sites). They may be privately or publicly owned, and have multiple uses. In addition to resource allocation and utilization issues, the quality and value of a given resource is influenced by changes in the environment. A description of major resources in Ecuador's coastal zone is presented in this chapter. The quality of life and economic well-being of existing and future generations of Ecuadorians are strongly tied to the manner in which these resources are exploited and managed.

Marine Resources

Ecuador's Territorial Sea. Ecuador lays claim to a territorial sea that includes two separate areas (Figure 13). The largest, over 80 percent of the territorial sea, encompasses the interior waters of the Galapagos Islands and a band surrounding the islands which extends from a baseline connecting the extremities of the archipelago out to sea for 200 nautical miles. The interior waters of the Galapagos, plus a 15-mile surrounding buffer zone were declared a marine reserve in 1986. The second area, which is addressed in this study, begins from a baseline that connects the westernmost points of the continent and extends out to sea for 200 nautical miles. In addition, the area between these areas, 200 to 400 nautical miles from the coast, is considered a continental shelf claim. The total area of Ecuador's territorial sea is 1,060,053 km^2 (Table 7), and approximately 220,000 km^2 of this is adjacent to the continent.

Table 7. Summary Information on Ecuador's Territorial Sea.

Base Line Continental	199,277 km^2
Interior Continental Waters	20,860 km^2
Base Line Insular Waters	793,323 km^2
Interior Insular Waters	46,593 km^2
Length of Continental Coastline	950 km
Area of Continental Platform	24,000 km^2
Total Area of Territorial Sea	1,060,053 km^2

Source: Subsecretaria de Recursos Pesqueros, 1984.

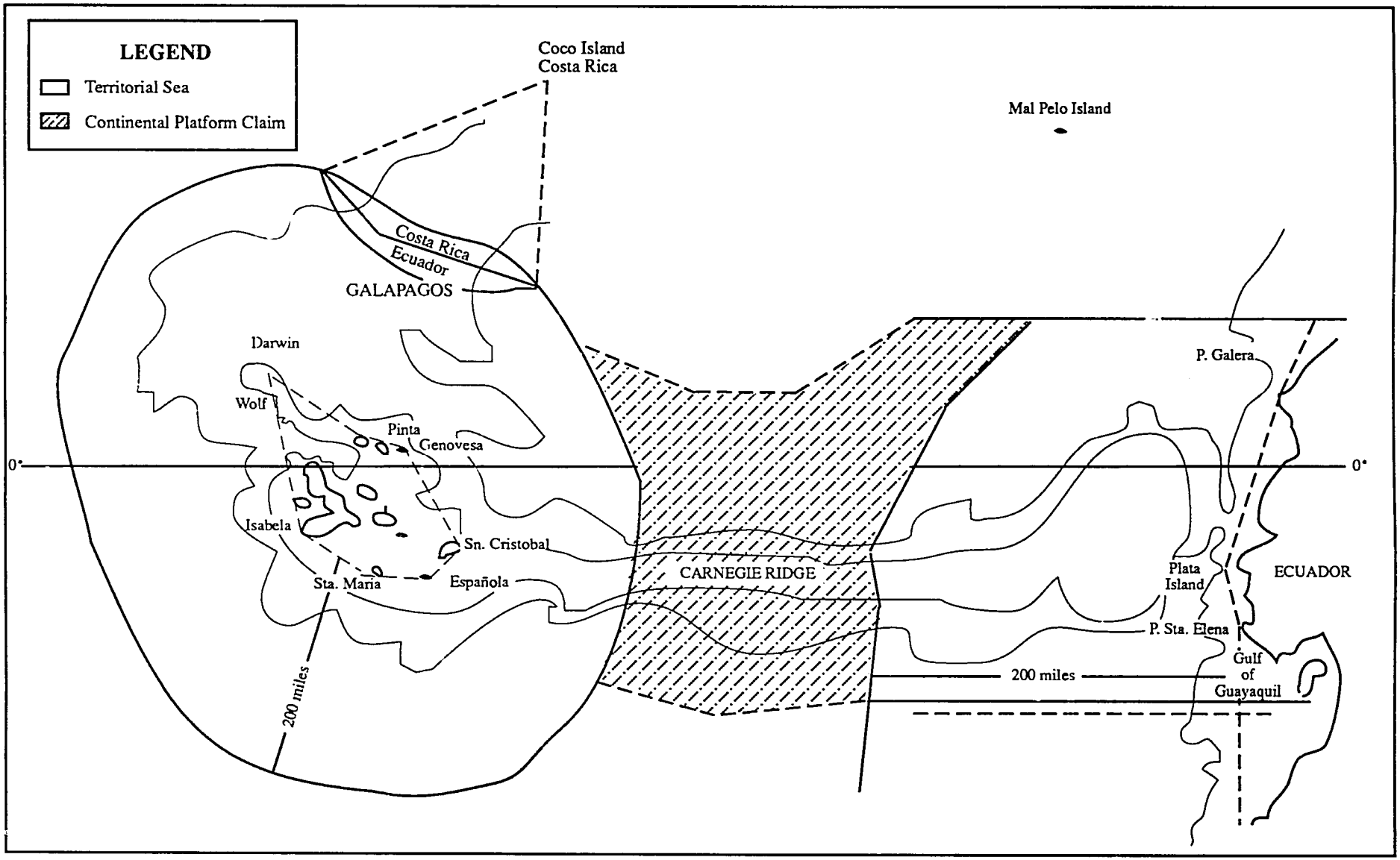


Figure 13. Ecuador's Territorial Sea and Continental Platform

Marine Currents. Ecuador's territorial sea is the zone of convergence for several major and minor ocean currents (Figure 14). One of the major currents is the Peru, or Humboldt, a system of coastal currents that sweeps along the coasts of Chile and Peru before veering west off southern Ecuador.

Another major current involves the subsurface transport of massive quantities of cold water and is known as the Equatorial Undercurrent, or the Cromwell. This current moves beneath and counter to the prevailing westward flow of both the Humboldt and the South Equatorial current.

Three lesser currents involved in the complex marine system off Ecuador are the Peru Coastal Countercurrent, the Northern Equatorial Countercurrent, and the North Equatorial Current. The flow, velocity, and intensity of these opposing currents vary seasonally. Their convergence off Ecuador is responsible for the abundance and wide array of marine organisms found. Nowhere is the contrast more apparent than in the Galapagos, where penguins can be seen alongside tropical birds. The difference is less striking along the continent, but one finds coral in the north and cold-water species in the south.

The west coast of South America is one of the most biologically productive areas in the world. The wind and water circulation patterns create a condition of upwelling in which cold, nutrient-rich water from lower depths is brought to the surface. The flow of relatively cool (as low as 15°C) fertile water extends 400 miles off South America. The high levels of nutrients in the upwelled water cause abundant growth of marine phytoplankton, which in turn provide a rich food supply for other organisms along the coast, including commercially valuable species of fish. Although it represents only about 0.2 percent of the world's ocean area, this area has been responsible for as much as 22 percent of the annual global fish production (Cribb, 1986).

Table 8. El Niño Events, 1900-92.

Year	Intensity	Year	Intensity
1900	3	1943	2
1902	3	1944	2
1905	3	1946	1
1911	3	1948	1
1912	3	1951	2
1914	3	1953	3
1917	2	1957	4
1918	4	1958	4
1919	3	1963	1
1923	2	1965	3
1925	4	1969	2
1926	4	1972	4
1929	3	1973	4
1930	3	1975	1
1932	2	1976	3
1939	3	1982	4
1940	2	1983	4
1941	4	1987	2*
		1992	2*

1 = very weak 2 = weak 3 = moderate 4 = strong

* Estimated by the author.

Source: Rasmusson, 1984.

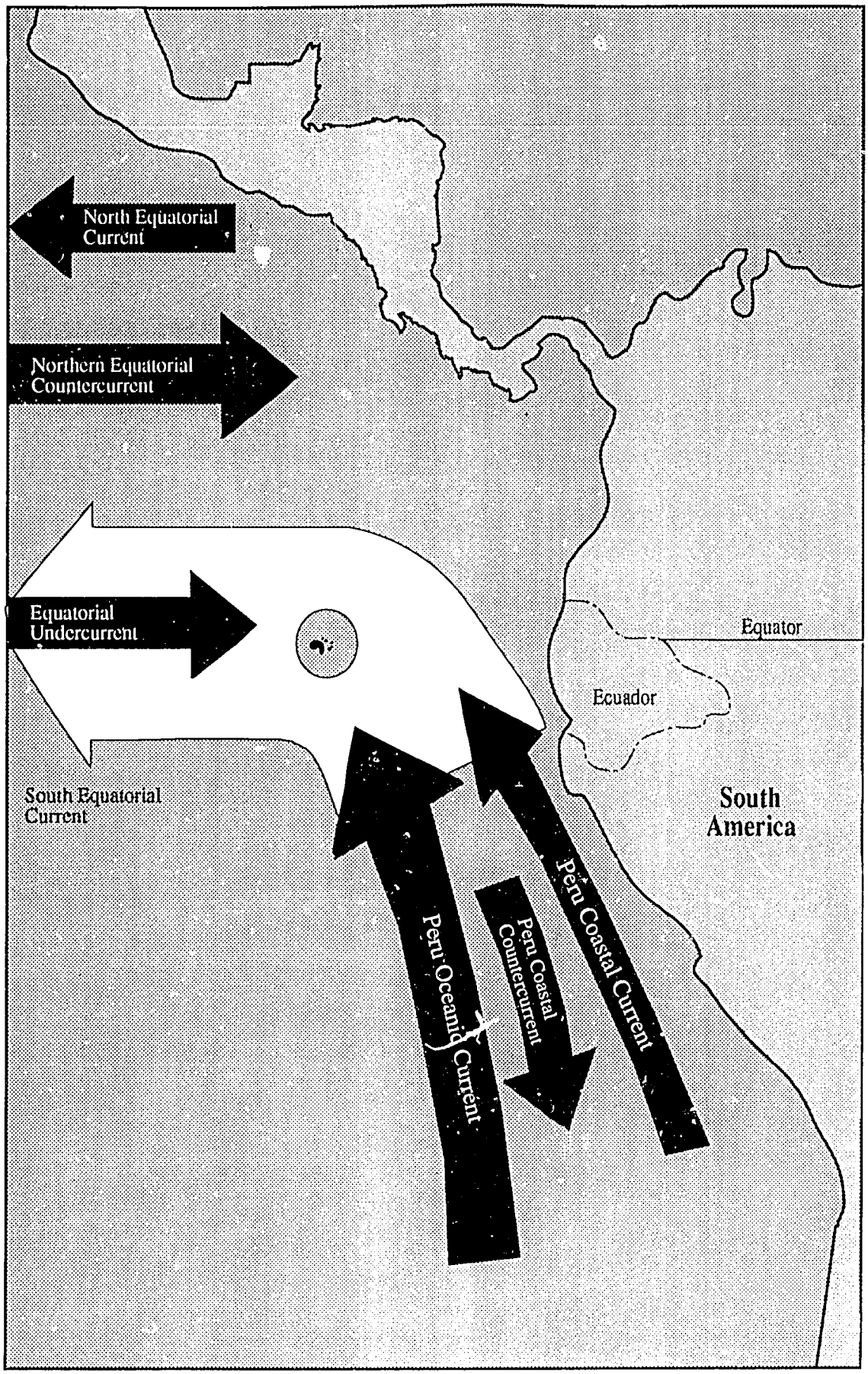


Figure 14. Ocean Currents off Ecuador

Source: Cribbs, 1986

This productivity can be disastrously affected by a climatic phenomenon known as El Niño—"the child," so named since it usually occurs at Christmastime. It is part of a global phenomenon call the El Niño Southern Oscillation. Atmospheric changes—oscillations—result in changes in wind and weather patterns that can affect the climate both locally and in other parts of the world. One effect of the El Niño is that the water drawn to the surface by upwelling is no longer cool and nutrient-rich, but warm and nutrient-poor. Productivity drops, and commercially important fish species may die, fail to reproduce, or migrate to different areas or to deeper water. If the El Niño is strong enough—such as in the severe 1982-1983 event—these populations can crash.

Another important effect of the El Niño is coastal flooding due to a rise in sea level and increased rainfall, causing loss of property and crops. In addition, the El Niño can have far-reaching effects—drought in Australia and Africa were attributed to the 1982-1983 El Niño.

The Continental Shelf. The continental shelf along the west coast of South America is narrow. From the mainland coast, the shelf averages less than 50 km in width. Its area, extending out to a depth of 200 m, covers between 24,000 km^2 (Subsecretaria de Recursos Pesqueros, 1984) and 29,000 km^2 (FAO/BID, 1986). Southern areas are more conducive to trawl fishing, whereas the northern portion of the platform is rocky and irregular.

Fisheries Resources. Scientific investigations of species composition, biomass, and potential yields for commercially exploited marine species off Ecuador are, for the most part, incomplete. Stock abundance and species composition for a given year are more difficult to forecast than in many other areas of the world, since stocks are heavily influenced by changes in ocean circulation. A brief discussion follows of the general composition of marine resources exploited off the coast of Ecuador.

1. Pelagic Species. Large and small pelagics—open water species—account for approximately 95 percent of the estimated potential yield, and 90 percent, by weight, of Ecuador's total landings. Because of the migratory nature of these species, the resource is shared by various nations. The greatest concentrations of pelagics are encountered within 70 miles of Manta and the Santa Elena Peninsula between June and November. The Subsecretariat of Fisheries Resources (1984) estimated the potential yield for these species at 600,000 mt, yet landings exceeded 1.2 million mt in 1985.

Stocks of large pelagics, such as yellowfin, skipjack, and bigeye tuna encountered in Ecuadorian waters are known as some of the richest in the world. A large portion of these stocks are concentrated around the Galapagos Islands. The potential yield from these species is estimated to exceed 110,000 mt. Data compiled by the Inter-American Tropical Tuna Commission indicate the average annual catch of tuna off Ecuador to be in the vicinity of 85,000 mt. Only about 30 percent of this is taken within Ecuadorian waters.

2. Demersal Species. Investigations by the Instituto Nacional de Pesca (INP) between 1980 and 1985 of commercially important demersal—bottom dwelling—species indicate that the maximum sustainable yield (MSY) is 7,000 mt at depths from 10 to 150 m. Other studies of important demersals encountered at a depth of 200 m estimate MSY to be slightly higher, at 9,500 mt. Of this, 2,700 mt, 28 percent, is commercially categorized as "first-class" fish and 6,800 mt as "second-class." The richest grounds are found directly off the Santa Elena Peninsula, extending south to the island of Puna and tapering off to the north.

3. Shrimp. Table 9 presents the species of commercially important shrimp in Ecuador. Most belong to the family Penacidae. Within this family, the species of greatest commercial importance to trawlers is *Penaeus occidentalis*, which accounts for over 50 percent of the

Table 9. Species Composition of Shrimp Landings in Ecuador.

Scientific Name	Common Name	English Name	Percentage of Capture
Penaeus occidentalis	Camarón blanco	White shrimp	50%
Penaeus stylirostris	Camarón blanco	White shrimp	10-50%
Penaeus vannamei	Camarón blanco	White shrimp	ca. 10%
Penaeus californiensis	Camarón café	Coffee shrimp	5-10%*
Penaeus brevitostris	Camarón rojo	Red shrimp	5-10%*
Trachypenaeus byrdi	Camarón cebra	Zebra shrimp	
Trachypenaeus favea	Camarón cebra	Zebra shrimp	
Trachypenaeus similis	Camarón cebra	Zebra shrimp	
Protrachypene precipna	Camarón pomada	Pomada shrimp	
Xiphopenaeus riveti	Titi	Titi shrimp	

* Incidence of capture for the genus *Penaeus*.

Source: Fundación Natura, 1981.

offshore catch. *P. vannamei* is the species preferred by shrimp mariculturists. Klima (1986) states that there appear to be two principal fisheries: one north of Manta, with both white and brown shrimp as major components, and the other south of Manta, composed mostly of white shrimp. The interaction of shrimp and stock delineation between the two areas is unknown.

Estimates of MSY for shrimp are not available. Total annual catch fluctuated between 6,300 and 10,730 mt during the 1980s. Examination of past landings reveals that such fluctuations are not uncommon. According to Klima (1986), catch per unit of effort (CPUE) jumped to 345 pounds per day (lbs/day) during the 1982-83 El Niño and thereafter dropped to 78 and 68 lbs/day.

Fishing effort by trawlers has remained relatively constant throughout the 1980s, yet there are reasons to be concerned about these stocks. Rapid growth of the shrimp mariculture industry is creating adverse effects on intertidal habitat and the postlarvae (PL) and juvenile shrimp populations. By some estimates, 20 to 25 percent of mangrove habitat, which serves as nurseries for shrimp and a host of finfish and shellfish, has been lost to mariculture. Also, in excess of 10 billion postlarvae are captured for stocking shrimp ponds each year. In the process of collecting PL of *P. vannamei*, species important to the offshore fisheries are killed. It is quite evident that adult white shrimp stocks were exploited at or near MSY before these changes occurred, and, with the exception of years that the El Niño occurs, there appears to be little possibility of increasing the catch. Klima (1986) warns that the current CPUE level in 1985 was extremely low (less than 40 lbs/day below that of other world penaeid fisheries utilizing similar vessels) and had declined precipitously from the CPUE of 1961-64, when the fishery had stabilized. However, there does appear to be a potential for increasing artisanal catches of Pomada shrimp and, possibly, of two species of deep-water shrimp.

4. Other Fisheries. In addition to the fisheries mentioned above, Ecuador has many unutilized or underutilized species. For example, during peak catches of dolphin fish in November and December, the market becomes glutted. Low prices motivate artisanal fishermen to bypass this species and switch effort to demersals. Shark and several species of fish, squid, scallops, and crab may also have development potential.

Freshwater fisheries are relatively insignificant in Ecuador. FAO/BID states that production is approximately 2,000 mt per year and that the bulk of this production is from the Guayas and Esmeraldas rivers.

In summary, MSY for fisheries resources off Ecuador are generally not available and are difficult to estimate, as changes in climatic and biological conditions create large fluctuations in stock abundance and composition. For example, total landings reached about 1,500,000 mt in 1985, versus a low of 331,000 mt in 1983. During El Niño years, the capture of pelagics declines significantly. Shrimp landings also fluctuate, but in the opposite direction—abundance increases during El Niño years. Scientific investigation of commercially important demersals indicates that they hold little potential for future development. Certain areas and species may already be overfished. A limited potential does exist in deep waters—as well as in areas unsuitable for industrial trawling—for artisanal fishermen to increase their landings. Too little is known concerning demersal species in waters deeper than 200 m to venture an opinion as to whether there are stocks that can be economically exploited.

The Coastline

Ecuador's coastline forms a slight arc approximately 950 km long, bowing west from north to south, with a succession of estuaries, most of which are small and interspersed with cliffs and rolling hills (Figure 15). Large estuaries are found at the mouths of the Guayas, Chone, and Santiago rivers. Lagoons, intertidal vegetation, and salt flats are common in low-lying areas, often behind beaches. Small, low, and heavily vegetated groups of islands are located just south of the Colombian border and off the province of El Oro. Two small, isolated islands are found farther offshore from Manabi. The most striking cliffs are found in Guayas province at Cabo San Francisco, Puntilla de Santa Elena, and Manglaralto. Wide beaches are plentiful along exposed sections of the coast, particularly from the Santa Elena Peninsula north.

The Guayas Estuary is formed by the Guayas River and the Estero Salado, a long, narrow, deep arm of the sea that extends from the Pacific to Guayaquil. The bordering 255 km of shoreline contain the country's greatest concentration of mangroves. The Guayas River basin is the largest on the west coast of South America and supports most of Ecuador's agricultural production. The estuary is the focal point of coastal commerce, is a major nursery ground for species of commercial importance, and is the most developed area for shrimp culture as well as the site of Ecuador's largest city, Guayaquil. The estuary's brackish water is yellow, due to heavy erosion, and is covered by mats of floating vegetation that originate from interior areas.

The Bahia de Caraquez, at the mouth of the Chone River, is not navigable, but is an important center for shrimp culture. San Lorenzo, at the mouth of the Santiago River in northern Ecuador, is an excellent harbor, although not highly developed.

The Intertidal Zone. Mangroves are the dominant vegetation along Ecuador's coastal fringe. Over 90 percent of all mangroves are located in estuaries. The largest concentration, nearly two-thirds of the total, are found in the Guayas Estuary. Mangrove complexes are broken by channels and salt flats. Landward of the mangroves, one encounters a wide array of vegetation, the composition of which varies from north to south, as well as from nearshore to inshore. North of Posorja in Guayas province, mangroves alternate with beaches, cliffs, and lagoons.

At least since Colonial times, mangroves have been a valuable resource. Reports from the 1700s and 1800s describe stands of massive mangrove trees that were the mainstay of Guayaquil's once-famous shipbuilding industry. Mangrove bark, used for tanning leather, was a major export until the late 1970s, when a new tanning process was developed. Mangrove pilings still remain in high demand for construction, particularly in

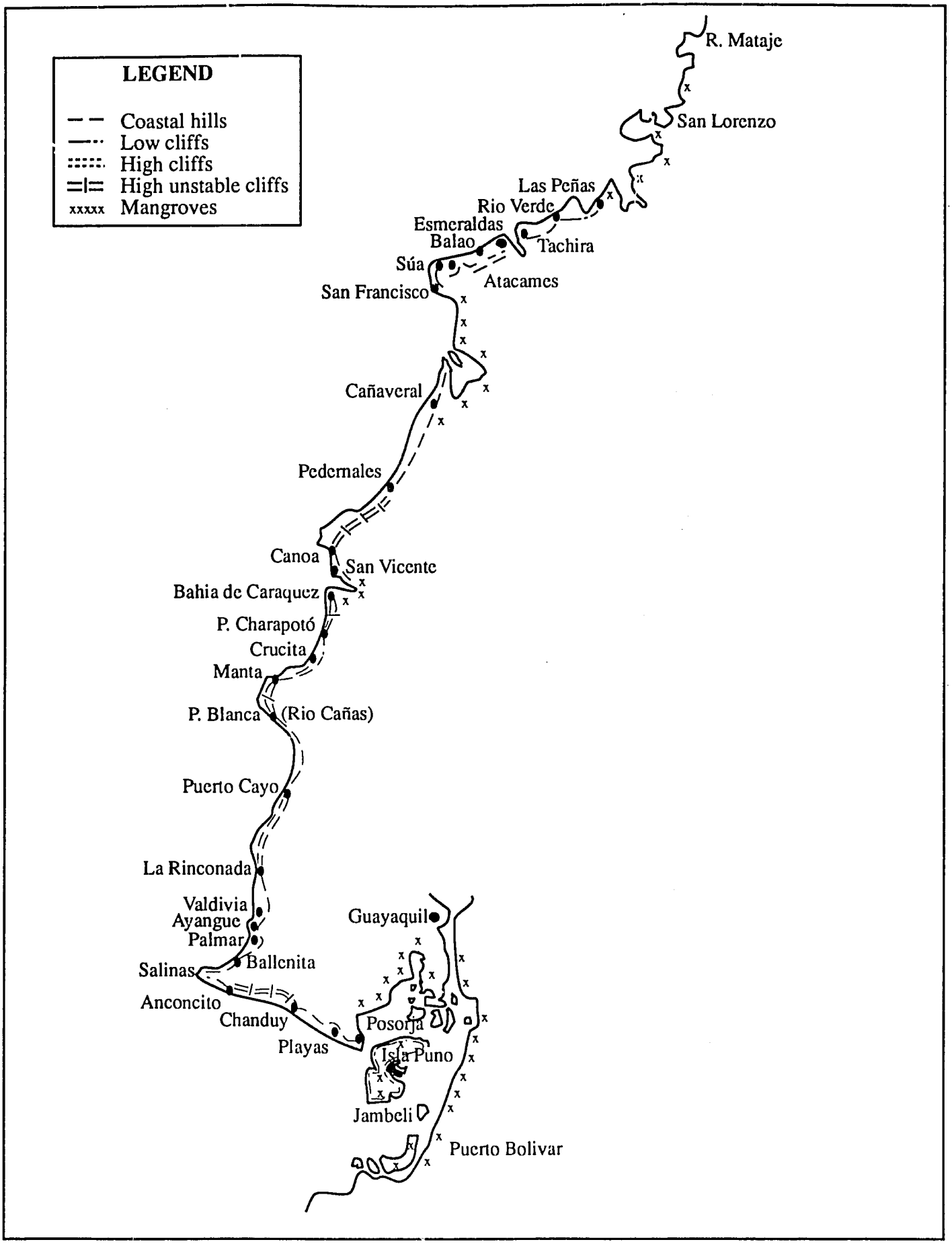


Figure 15. Geomorphology of Coastal Ecuador

Guayaquil. Some estimate that the recent construction of the highway around the city called for some 10,000 mangrove pilings. Mangroves are also a richly productive habitat for fish and shellfish, and support significant numbers of people that depend upon the mangroves as a place to harvest fish and shellfish and to produce charcoal. Numerical estimates of this productivity or the numbers of people directly dependent on mangroves are not available.

The most recent and greatest threat to mangroves is posed by the booming shrimp mariculture industry. Mangroves are being cut, burned, and uprooted for the construction of ponds. Studies by CLIRSEN, which document the changes in stands of mangrove trees between 1969 and 1991, reveal a 20 percent reduction in mangrove cover and an 85 percent reduction in salt flats (flats are preferred for shrimp pond construction because clearing costs are lower).

The greatest relative damage can be found in Manabi, where 70 percent of the mangroves and 80 percent of the salt flats have been lost. In total, 42,265 ha of mangroves and 44,000 ha of salt flats were destroyed within 16 years. In addition, close to 57,500 ha of beaches and low coastal agricultural land were converted to shrimp ponds.

The increasing rate at which mangroves have been cut has caused considerable concern. Scientists have shown that mangrove forests constitute one of the world's most productive ecosystems, providing a myriad of benefits. Aside from the direct benefits identified above, there are indirect benefits, including:

- buffering coastal areas from storms
- regulating and directing water flow
- providing breeding and nursery ground for marine and brackish-water species
- trapping sediment; erosion control
- providing energy, food, and protection to mammals, birds, and marine and brackish-water organisms
- contributing to the purification of waters

A series of laws dating from 1969 provides varying degrees of protection to vegetation on the coastal fringe, but enforcement has been poor. In 1985, in an attempt to rectify the situation, the Ecuadorian National Forestry Department (DINAF) and the Ecuadorian Institute of Water Resources (INERHI) designated 175,000 ha of mangroves, 20,000 ha of salt flats, and 167,000 ha of other coastal habitat for protection. Subsequently, the government declared all mangroves as protected forests, thus prohibiting all further cutting.

Despite the protected status afforded vegetation on the coastal fringe, its rapid destruction has continued unabated. In some instances, building permits issued before the moratorium are being honored, so intertidal land is still cleared for shrimp ponds. In other cases, the lucrative nature of the shrimp mariculture industry entices developers and investors to proceed with pond construction, risking completion of the job without a permit, or seeking permits only after building has begun.

Climate and Biodiversity

The varying altitudes in Ecuador (Figure 16) produce different major climatic zones. There are temperate valleys, tropical rain forests, coastal desert, and frigid areas in the Andes with snow-capped peaks. Within each, wind, rain, and soil combine to produce a variety of ecosystems, making Ecuador one of the world's richest countries in terms of

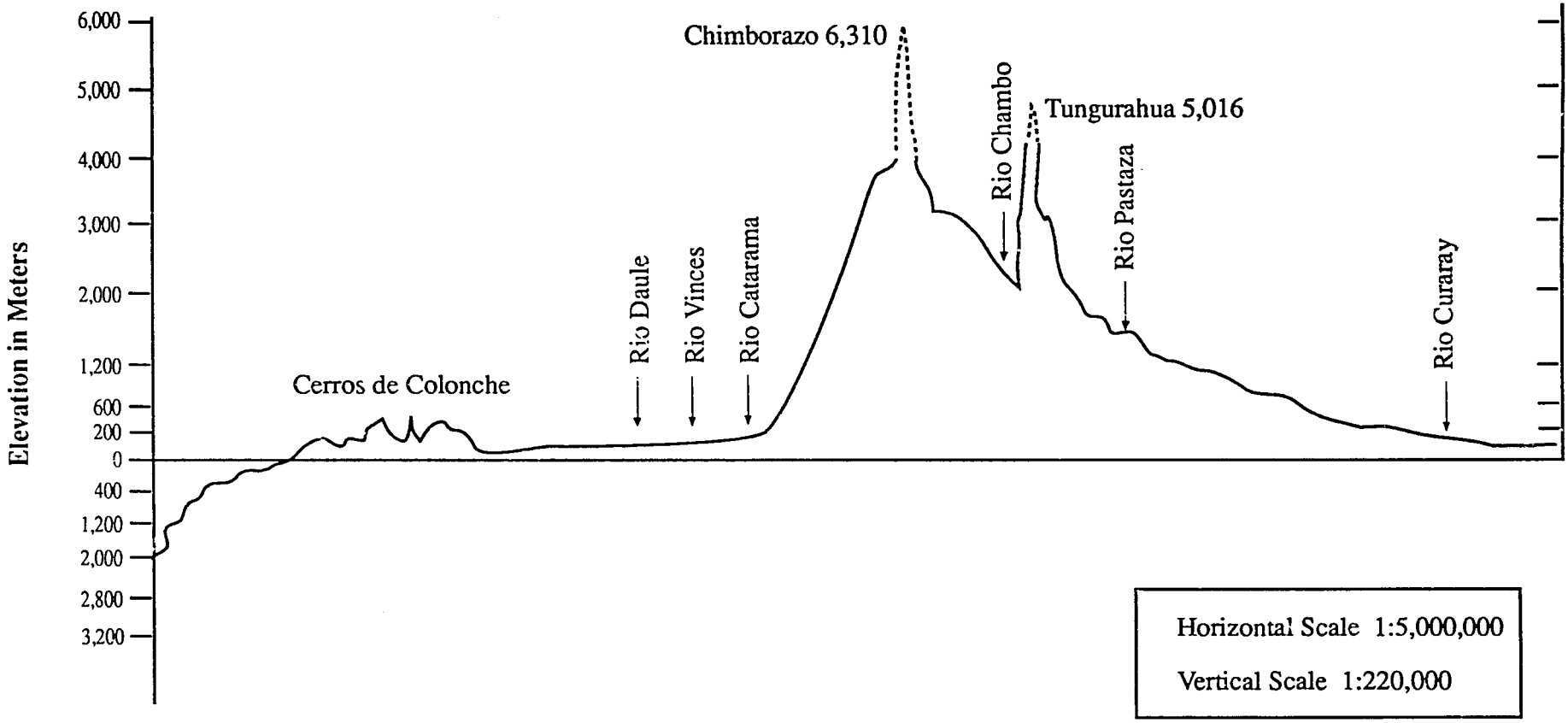


Figure 16. Transect of Continental Ecuador

climatic and biological diversity. The abundance of and contrast between flora and fauna, and the wide variety of agricultural crops produced are a reflection of this diversity.

Numerous approaches have been applied to identify the bioclimates and life zones within Ecuador. For example, Harding (n.d.) has published a map of vegetation that takes into account the relationships between temperature, precipitation, and the duration and intensity of the dry season (Figure 17).

Coastal Climates. Blandin (1977) used the climatic classification system developed by Koppen in his analysis of coastal Ecuador and identified seven climates. Acosta Solis (1977) used similar techniques, but concluded that the coast has five climates. Regardless, all studies conclude that the region has many climatic anomalies that reflect differences in altitude and precipitation; these are poorly understood and documented, and merit further investigation. In general, as one proceeds inland, rainfall increases from 250 mm near Salinas with the most tropical areas in the north, where annual rainfall exceeds 3,000 mm. Within only a few degrees of latitude, one passes from tropical rain forests in the north to desert in the south.

Biodiversity. Despite its small size, Ecuador can boast 1,400 species of birds, more than twice the number found in the United States and Canada, and 800 species of reptiles and amphibians (Table 10). The country is believed to contain between 20,000 and 25,000 species of plants, with over 1,250 timber species identified. According to Fundación Natura (1981), this is comparable to the number of plant species found in all of Central America or in the Amazon basin. Many scientists believe that Ecuador has more species of plants per unit area than any other country in South America and perhaps in the world (Gentry, 1977). Development, however, is leading to the demise of Ecuador's rich pool of plant and animal species.

While scientific research, particularly recently, has focused on the Ecuadorian Amazon, indications are that the coastal region is possibly richer in biodiversity. For example, Gentry (1977) states that "the almost 600 species per km² recorded from Rio Palenque reserve is probably the highest recorded plant diversity in the world." Gentry

Table 10. Numbers of Species Found Within Ecuador Compared with Similar Records for Larger Geographical Areas.

	World	N. America	S. America	Ecuador
Mammals	4060	303	818	
Birds	8656	670	2780	1400
Reptiles	5954	463	1115	800
Amphibians	3307		1095	
Plants	255,000			20,000

There is no universally accepted agreement on the number of species in Ecuador so these numbers are unofficial estimates.

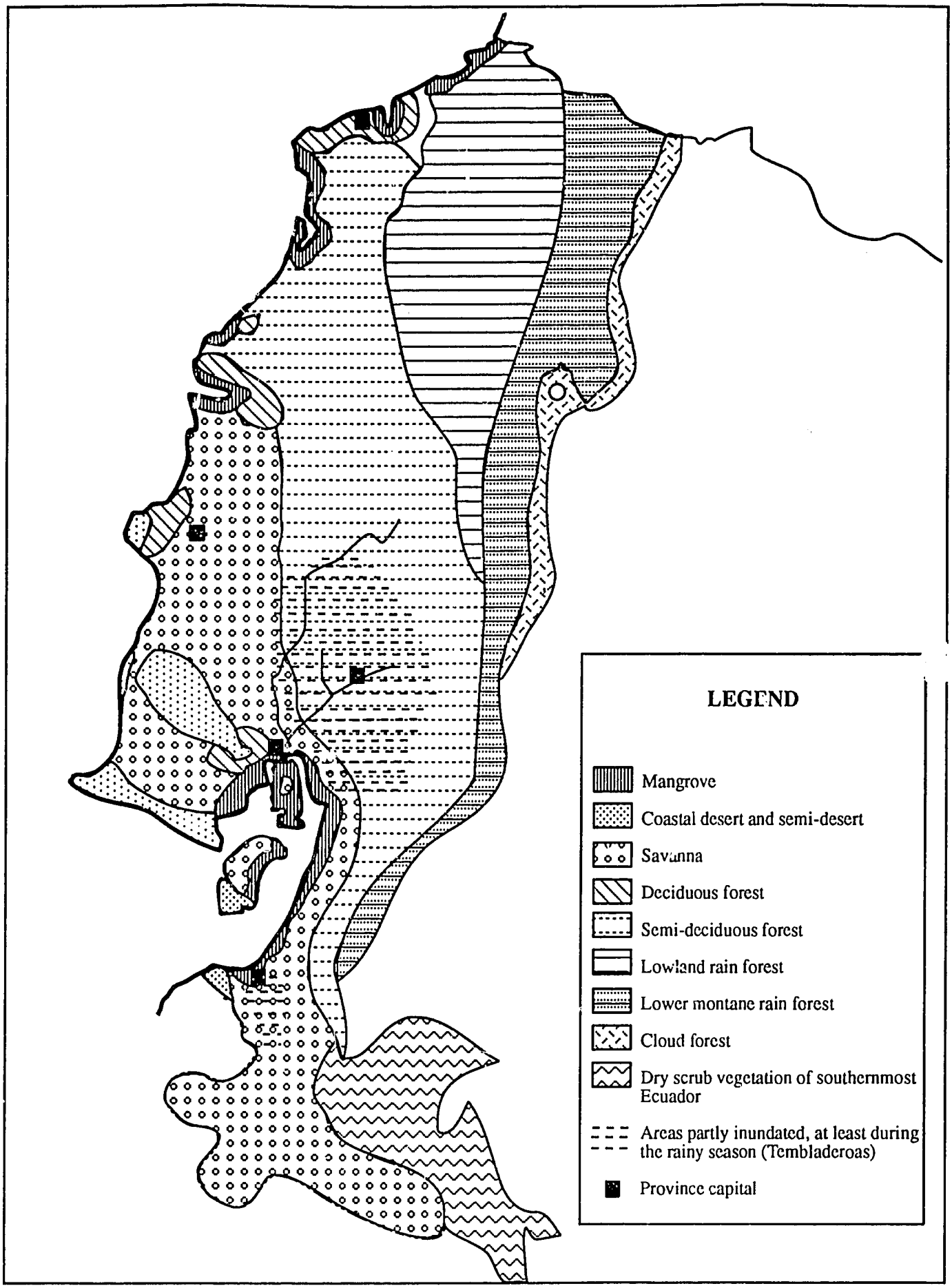


Figure 17. Vegetation Types of Coastal Ecuador

Source: Harding (Undated)

goes on to point out that threats to the Amazon region are growing daily, but are generally long-term due to the lack of roads and relative inaccessibility. In addition, large tracts are still in their natural state. The coast, in contrast, has been devastated for centuries by activities such as lumbering, clearing for firewood and charcoal, conversion to pastureland, overgrazing, and agriculture. The rate of economic and population expansion and, consequently, environmental change has increased exponentially over the last few decades. Gentry points out that of the 1,100 species identified in the Rio Palenque, 100 were still not described in scientific literature in 1978, but most of these have fallen to development and are now extinct. Colonial accounts indicate that about 200 years ago much of the coastal region was rich savanna pastureland, though the area is now covered by thorn scrub and cactus, alternating with vegetationless desert. Information on the floristic composition of the coast is scant. Species are obviously disappearing before they have been classified. Surviving species have undergone a type of negative selection, where species least valuable for timber or charcoal are becoming most common.

Gentry continues his discussion of endangered species and habitats in coastal Ecuador by classifying the coast into two phytogeographic regions, each with distinct flora:

1. Coastal Dry Forests. Tropical dry forest vegetation of the coast has been devastated for centuries by human activity and is considered an endangered habitat. This region (including the adjacent corner of Peru) contrasts sharply with other phytogeographic regions of Ecuador and with the rather homogeneous dry forest vegetation of western Central America and northern South America in its high degree of endemism. In fact, many of the most characteristic and dominant species of the coastal dry forest are endemic, some at the generic level.

The coastal dry forest, due to its unusually high levels of endemism, clearly merits protection. The need for preservation of this unique plant community is acute, although none of its species has yet become extinct (Gentry, 1977). This rather heavily populated region has been settled longer than have other lowland areas of Ecuador. For example, the now barren and desolate hills near Salinas were covered by magnificent dry forest as recently as the 1940s, but trees and even the shrubs were destroyed first for lumber and later for firewood and charcoal. Overgrazing by goats also contributed to the destruction.

A typical example of the obliteration of a plant species as a direct result of human exploitation is that of the Guayacan (*Tabebuia chrysantha*), a timber of the region from which the area's famous and economically important wood carvings are made. Though this species once was dominant throughout large areas and mature Guayacan forest is still reported in remote regions, Gentry was unable to locate even relatively undisturbed areas of Guayacan forest, finding only isolated mature trees.

2. Coastal Moist and Wet Forests. The vegetation of the northern coastal plain has not been considered to be especially threatened—fairly extensive, though rapidly diminishing, forested areas can still be found near the Colombian border. Actually, the rich Pacific lowland forest is not a single vegetational unit but two, both floristically different: moist forest and wet forest. From the viewpoint of endangered plant species, they must be considered separately. The lowland wet forest probably contains more acutely threatened plant species than any other category in Ecuador and Amazonian Peru, and possibly even in all of South America (Gentry, 1977).

Unfortunately, the flora of both moist and wet forests are poorly known. Although both forest regions have endemic species, there are many more apparent endemics in wet than in moist forests. Moist forest flora of Pacific Ecuador contain relatively few endangered plant species and are almost identical in composition to similar regions of Panama. Fairly extensive areas, not yet penetrated by roads, still exist.

On the basis of the many species known from the wet forest, one can conclude that the species carry strong endemic features. Moreover, the narrow strip of wet forest extending south along the base of the Andes is currently the country's fastest disappearing

habitat. It has been opened up within the last decade by road construction and improvement, and between 1971 and 1977 formerly extensive wet forest vegetation was converted to almost uninterrupted banana and African palm plantations. The northern part of this wet forest strip is poorly known, but the rapidity with which southern and central regions of wet forest have disappeared makes the whole habitat an acutely threatened one. Even if the endemic species—including an especially rich diversity of epiphytes—in the Ecuadorian wet forest extend north into the virtually unknown Choco, the wet forest on Colombia's southern Pacific coastal plain, they would have to be classified as extremely threatened.

Soils

Soils in Ecuador, due to climatic variations and differences in origin and age, are quite diverse. For example, soils in the Oriente tend to be shallow, lateritic, and relatively infertile; valleys in the Sierra are covered by alluvial, often granular soil; and generally fertile soils predominate on the coastal plain.

The coastal region is an alluvial plain, generally flat in contour, that contains a major portion of Ecuador's most productive soil. This region has traditionally produced the country's agricultural exports. The richest area is the Guayas basin. Soils in the upper reaches of this basin are dark, deep, fertile, and covered by a layer of volcanic ash. Flooding is not a problem and the soil is well-drained. Principal agricultural products are bananas, fruit, and African palm. Lower down the basin on the southern plain, soils are also deep and fertile, but poorly drained and wet. Rice, tobacco, and sugar are common crops. Soils in the northern portion of the coastal plain, due to heavy rains, are less fertile; they are shallow and leached of minerals. Along the coast from the Santa Elena Peninsula to Manabi, soils are fertile but exceptionally dry, and require irrigation to increase productivity.

Soil loss due to erosion is a major concern throughout the country. The problem is most severe in the Sierra, but intensified agricultural activity, overgrazing, and logging have led to erosion in many coastal areas. The process is greatly accelerated when the El Niño phenomenon brings torrential rains. Soil is also being degraded by overuse, prolonged planting with certain crops that deplete soil, such as cotton, and the practice of slash-and-burn clearing of land.

Rivers

Forty rivers meander across the coastal plain. (Larger rivers are listed in Table 11.) The largest, the Guayas, has a drainage basin of 35,243 km^2 and a discharge rate of 1,144 cubic meters per second (m^3/sec). Manabi, due to the fact that it is separated from interior portions of the coastal plains by a chain of hills, has the smallest rivers. The total discharge rate for all coastal rivers exceeds 2,900 m^3/sec. Between 80 billion and 140 billion m^3 of surface water are estimated to flow across Ecuador's coastal plain and into the Pacific Ocean each year (Whitaker and Colyer, 1990). The discharge rates vary seasonally, with peaks in March and April in southern and central rivers—such as the Daule and Peripa—that cross the coastal plain (Figure 18). Major northern rivers that originate in the Andes—the Esmeraldas and Cayapas—have less pronounced seasonal variations in rates of flow.

Table 11. Location by Province, Size of Drainage Basins, and Discharges from Major Coastal Rivers in Ecuador.

River	Province	Drainage (km^2)	Discharge (m^3/sec)
Esmeraldas	Esmeraldas	21,186	1,026.7
Cayapas	Esmeraldas	6,190	341.1
Muisne	Esmeraldas		25
Jama	Esmeraldas	1,607	22.4
Mataje	Esmeraldas		11.2
Atacames	Esmeraldas		1.6
Sua	Esmeraldas		0.6
Chone	Manabi	2,597	31
Portoviejo	Manabi	2,230	6.9
Jipijapa	Manabi		0.8
Jaramijo	Manabi		0.2
Manta	Manabi		0
Guayas	Guayas	35,243	1,143.7
Canar	Guayas		60.5
Taura	Guayas		60.1
Balao	Guayas		23.1
Jagua	Guayas		13.7
Naranjal	Guayas	3,060	12.1
San Pablo	Guayas		8.2
Churute	Guayas		2.1
Tenquel	Guayas		2.1
Zapotal	Guayas		0.5
Valdivia	Guayas		0.4
Manglaralto	Guayas		0.1
Barbasco	Guayas		0.1
Grande	Guayas		0.1
Jubones	El Oro	4,280	95.6
Arenillas	El Oro	550	19.9
Santa Rosa	El Oro	926	19.9
Zaramilla	El Oro	480	7.9
TOTAL		NA	2,915.9

NA = Not Available

Source: Twilley, 1986.

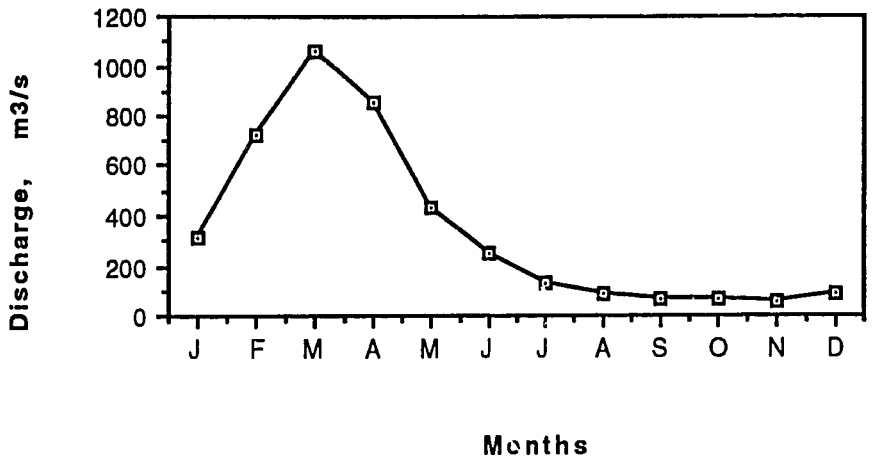


Figure 18. Average Monthly Discharges from the Daule and Peripa Rivers.

Irrigation

Archaeological evidence indicates that the Incas were the first to use irrigation in Ecuador. Until the mid-1900s, all irrigation projects were constructed and operated by the private sector. In many instances, water was leased or sold to the farmers downstream.

The first public institution created to administer, establish guidelines for, and control irrigation projects was the Instituto Ecuatoriano de Recursos Hidráulicos (INERHI), formed in 1966. Whitaker and Colyer (1990) estimated that in the late 1980s the private sector irrigated 330,000 ha, and the public sector 180,735 ha, but only a portion of public projects are regularly in use (Figure 19). According to the Fundación Natura, it has been estimated that by the end of the century the country must attempt to bring about 826,000 ha—4.3 percent of the area suitable for agriculture—under irrigation.

No estimates were seen on the amount of coastal land irrigated, but it is a large portion of the above. Future projects, such as those on the Daule-Peripa, and the Carrizal Chone project, will bring irrigation to an additional 150,000-200,000 has of coastal land.

Hydroelectric and Irrigated Projects

The state institute for electricity, INECEL, has embarked on a policy involving heavy investment in hydroelectric power. Plans call for ultimately providing 80 percent of the country's electricity from hydro sources. Many new projects, most of which will be on the coast, are planned for construction before the year 2000. The largest, the multipurpose Daule-Peripa Dam project in Guayas, is foreseen to generate electricity and bring over 100,000 ha under cultivation.

There is concern that the environmental impacts of these projects have not been properly assessed. For example, shrimp growers and hatcheries, already confronted with poor water quality, fear that increasing the area under irrigation will further decrease water quality. There is also concern that mangroves will be negatively impacted, as they need seasonal flowing and flushing to maintain their health.

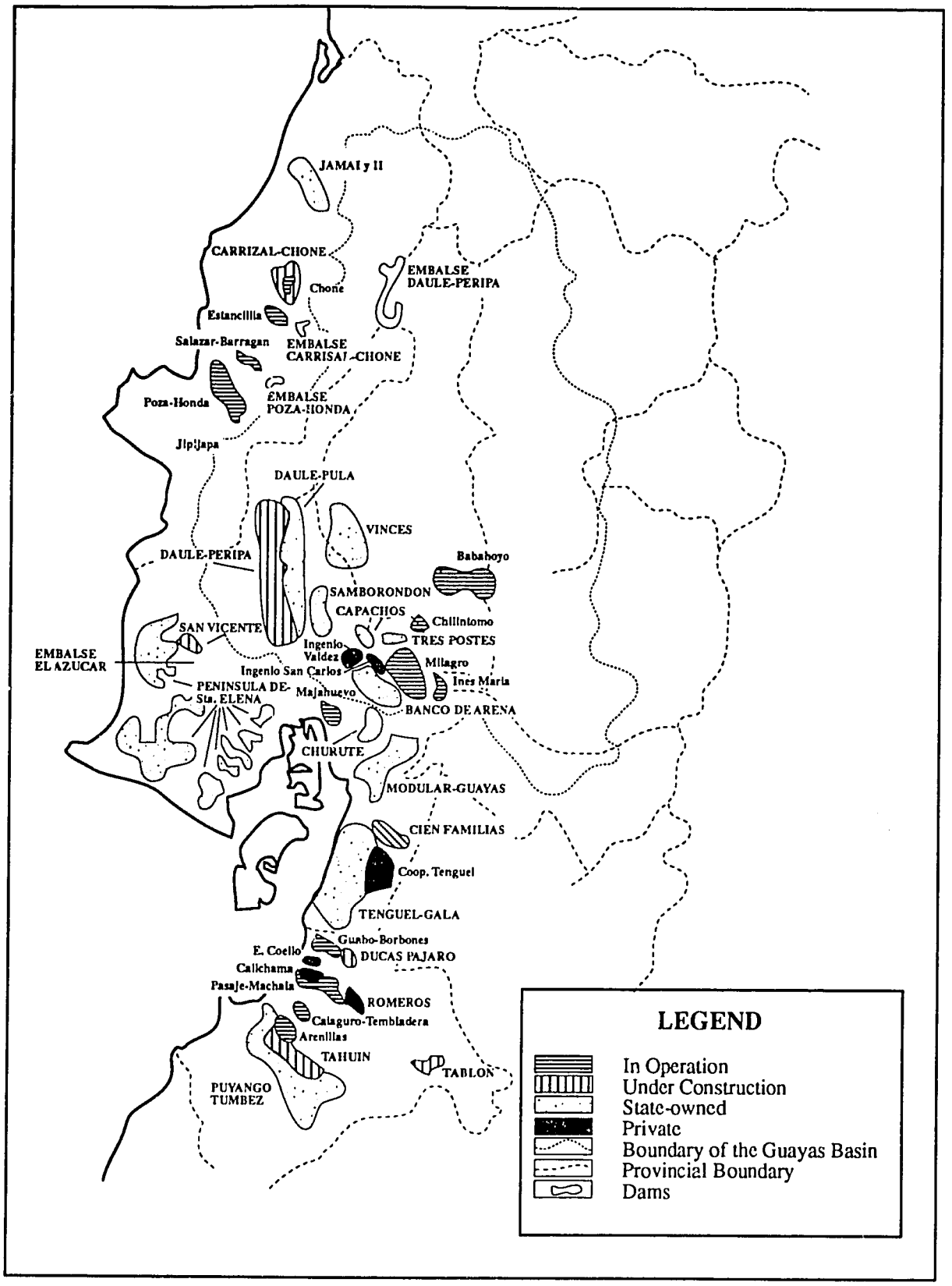


Figure 19. Irrigation Projects within Ecuador

Source: CEDEGE, Plan Regional de Desarrollo, CRM, Atlas Regional de Desarrollo

Mineral Deposits

Information on the quantity, value, and types of minerals exploited on the coast and the number of persons employed in these activities is not available. Government reports indicate, however, that as of February 1984, 119 mining concessions had been granted for coastal provinces, distributed as follows:

Esmeraldas	24
Manabi	5
Guayas	40
El Oro	50

Indications are that slightly over 50 percent of the mining concessions on the coast are employed in mineral exploitation. Of these, about 90 percent are involved in exploiting gold, which is found primarily in the interior of El Oro province. Other deposits of metallic minerals include copper in the upper regions of the Guayas and Esmeraldas rivers and titanium manganate south of the city of Esmeraldas.

The nonmetallic minerals exploited are used primarily in construction. Deposits include limestone and marble, which are worked from quarries in Manabi, Guayas, and El Oro, and siliceous sand in El Oro. In addition, stone, sand, clay, gypsum, and other construction materials are quarried from pits and riverbanks throughout the coast.

Modification of the mining code by the Febres Cordero government in 1985 has attracted investment in mining. In 1986 alone, 295 mining contracts were signed throughout the country (The Economist Intelligence Unit, 1988).

Petroleum Deposits

Oil is by far the country's most important mineral. Production started on the Santa Elena Peninsula in 1917, and this area remained the only oil-producing area until large reserves were discovered in the Oriente in 1967. Coastal production—412,300 barrels in 1986—accounted for less than 1 percent of national production, but, due to the low average production, the coast is the location for most of the country's oil wells—600 out of 900—and nearly all infrastructure for storage, refining, and shipping.

Liberalization of investment codes in 1987 has prompted new investment in exploration on the coast, offshore, and in the Oriente. For example, a tract of 1.2 million ha has been awarded off the Santa Elena Peninsula, along with a block of 200,000 ha in Manabi. Large gas reserves are known to exist under the Guayas Estuary, but as yet have not been exploited. Development of this resource or discovery of new oil reserves will transform the coastal economy and pose new threats to coastal resources.

PetroEcuador estimates crude oil reserves to be 4.08 billion barrels which, given anticipated rates of production, will be exhausted within two decades. Ecuador may become a net oil importer by the year 2008 (El Universo, 1992).

Protected Areas

Ecuador is increasingly aware of the need for preservation of natural areas, and has taken commendable steps toward the establishment of national parks, national forests, and ecological reserves. With the exception of the Galapagos Islands, which have been legally protected since 1936, protected areas on the continent have generally been designated within the last two decades. Unfortunately, as past experience has frequently shown, designation of a protected area is a long way from the establishment of an effectively protected sanctuary.

The first parcel of land set aside for preservation on the continent was the Pululahua Geobotanical Reserve in the Sierra province of Pichincha in 1966. Two years later, the Cotacachi-Cayapas Ecological Reserve, which encompasses 204,420 ha (70 percent of which is on the coast), was established. Between 1969 and 1986, five national parks (1,871,711 ha), eight ecological reserves (962,881 ha), two recreational areas (29,885 ha), and three protected forests (containing over 8,350 ha) were created. In total, 18 areas encompassing 2.8 million ha, had been given protected status by 1990. Two national parks, the Galapagos and Yasumi, account for nearly half of this area (Table 12).

Table 12. Protected Areas in Ecuador.

Name of Area	Number of Hectares	Geographic Location	Date of Creation
National Parks			
Galapagos	693,700	Province of Galapagos	05-14-36
Yasumi	679,730	Province of Napo	07-23-79
Sangay	271,925	Provinces of Tunguragua, Chimborazo, and Morona Santiago	07-26-79
Cotopaxi	33,393	Provinces of Cotopaxi, Pichincha and Napo	08-11-75
Machalilla	46,683	Province of Manabi (part sea)	07-26-79
Podocarpus	146,280	Provinces of Loja and Zamora Chinchipe	12-15-82
Ecological Reserves			
Cayambe Coca	403,103	Provinces of Pichincha, Imbabura and Napo	11-17-70
Cotacachi-Cayapas	204,420	Provinces of Imbabura and Esmeraldas	02-29-68
Manglares Churute	35,042	Provinces of Guayas, Taura Parish	07-26-79
Faunistica Cuyabeno	254,760	Province of Napo	07-25-78
Pululahua	3,383	Province of Pichincha, San Antonio Parish	01-28-66
Limoncocha	3,613	Province of Napo	10-01-65
Chongon-Colonche		Province of Guayas	08-08-79
Chimborazo	58,560		
Recreation Area			
El Bolicho	1,077	Province of Cotopaxi	07-26-70
Cajas	28,808	Province of Azuay	07-26-79
Protected Forests			
Pichincha	8,335	Province of Pichincha (Andean forest)	1983
Estero Salado	18	Province of Guayas, Guayaquil	1986
Total Area	2,872,830		

Source: Dirección Nacional Forestal, *Depto de Areas Naturales y Vida Silvestre.*

Three protected areas in Ecuador are located on the coast and a fourth, Cotacachi-Cayapas, encompasses both coastal and Andean territory.

1. Machalilla National Park. This, the largest coastal protected area, was created in 1979. It is sparsely inhabited and contains a large variety of the ecological zones characteristic of Ecuador. Included within the park are marine areas consisting of bays, beaches, cliffs, and a complex of channels through mangrove swamps. Cardenas and Greiner (1988) state that over 300 species of flora and fauna have been catalogued within the park. Artifacts and archaeological sites from the Machalilla culture are common throughout the park.

2. Chongon-Colonche Forest Reserve. This reserve, located in Manabi near Puerto Cayo, contains 35,000 ha of land, a two-mile extension out to sea, the small islands Salango and La Plata, and a marine component extending two nautical miles around each island.

3. Churute Mangrove Reserve. Creation of the Churute Mangrove Reserve in Guayas has been plagued with a variety of problems. First, a 1979 decree declared a reserve of 35,042 ha but failed to establish boundaries and to fund management and enforcement agencies. Consequently, 1,900 ha have been converted to shrimp ponds, 907 ha were cleared for agriculture and cattle ranching, some 1,400 ha are burned annually, and an undetermined number of forest species have been removed. Encroachment has become a pressing problem as parts of the reserve continue to be incorporated into private holdings. Hunting, the capture of wildlife, and the removal of plant species within the reserve are uncontrolled. Water pollution and the associated loss of habitat and species are growing problems. The Ministry of Agriculture and Livestock (MAG), in an effort to resolve these problems, is studying an emergency plan to establish reserve boundaries along a 141-km coastal perimeter that extends inland 500 m. The area included in this proposal covers 7,050 ha, or only 21 percent of the total area originally designated for protection. The success of this fall-back position is contingent upon defining and marking boundaries, gathering baseline data, documenting species and ecological zones, and the allocation of sufficient funds for management, surveillance, and enforcement.

4. Cotacachi-Cayapas Ecological Reserve. This reserve of 204,420 ha extends from the interior coastal plain of Esmeraldas up the western slope of the Andes into the Sierra province of Imbabura. Included in the park are large tracts of tropical wet and moist forests and numerous climatic zones which reflect differences in elevations. A small group of Indians, numbering perhaps fewer than 1,000 and quickly disappearing, practice swidden agriculture and engage in hunting in nearby tropical forests (USAID, 1982).

5. Estero Salado. Designation of a national park on the Estero Salado, southeast of Guayaquil, in 1979 has also run aground. Initially, hunting and fishing (except subsistence and sports fishing) were to be regulated, and industrial construction that could lead to contamination prohibited, but the designation was revoked when local municipalities claimed that the area was under their jurisdiction. In 1986, the area was declared a protected forest—a classification that affords a type of protection different from that of national parks. The responsibilities and relationships between different management entities still remained unclear in late 1987.

As of 1990, approximately 28,730 km^2, 10.6 percent of the country's total area, had been designated as protected. The largest part, approximately 65 percent of this, is national park, and 22 percent is ecological reserves.

Despite efforts to designate various types of protected areas, the status of these areas remains a matter of conjecture. Government decrees that fail to establish and to provide adequate funding for baseline data studies, boundary marking, effective administration, public education programs, surveillance, monitoring, and enforcement have limited meaning. Many protected areas, therefore, exist in name only.

Archaeological Sites

The coast and shoreline of Ecuador have numerous archaeological sites left by a sequence of pre-Columbian cultures that existed between 8000 B.C. and the Spanish conquest. Common artifacts include ruins; burial sites; pottery of various shapes, sizes, and finish; stone implements; figurines; and objects of copper, gold, lead, and platinum. Scientific investigations of these sites has for all practical purposes been conducted only within the last 30 years, so details on the exact chronology and activities of early residents

are still vague. It is evident that coastal Ecuador has a rich heritage that is important to the world, but increasing population and economic activities in the region are destroying valuable sites.

Issues for a CRM Program

Ecuador's coastal zone features a magnitude of varied but interrelated resources. Technological advances have created more efficient methods of exploitation, while population growth and cyclical changes in demand have produced greater pressure on resources. This is clearly illustrated by the desert that has replaced the once-vast tracts of tropical forests that grew on the Santa Elena Peninsula, and were harvested to support Guayaquil's shipbuilding industry during Colonial times. The area is currently the focus of a massive irrigation project that would make portions of the peninsula once again productive.

Coastal resources are critical to Ecuador's economy. Coastal agriculture, fishing, and shrimp mariculture account for nearly all the country's private sector exports and hard currency earnings, and provide employment for a large portion of the populace. It is essential to allow for development in these important industries without depleting the resources on which they depend.

Resources may be geographically isolated, yet exploitation of one can adversely affect the quality of resources in other locations. For example, erosion and mining in the interior lead to sedimentation in shipping channels and degradation of water quality, which has an adverse impact on hatcheries, shrimp grow-out ponds, fisheries stocks, and human health. The following are important issues that must be considered in management of Ecuador's coastal resource base:

- Resources should be managed to generate a stream of diverse benefits for existing and future generations of Ecuadorians. Coastal resource managers must devise management strategies tailored to reflect differences in the resource base at specific locations, and this requires decentralized decision-making and community participation.

- Specific resources must be viewed as components of regional, national, and, in the case of pelagics, international, wealth and must be managed as such. The challenge is to incorporate the complex interactions of social, political, and economic forces that dictate resource use at the community, regional, and national levels with a strategy that reflects the uniqueness of each of the resources of the coastal zone.

- The tendency in Ecuador is to protect large areas. Small reserves, recreational areas or town preserves do not exist. The average citizen does not have easy access to parks.

- The only areas on the coastal fringe that receive protection are Churute and Machalilla, which make up less than 3 percent of the nation's protected areas. These protected areas currently have little or no supporting infrastructure. Areas such as small zones of critical coastal habitat, and archaeological sites, have not been designated for preservation.

III. AGRICULTURE

Agriculture in the Sierra and on the Coast: Contrasts

Ecuador's political, economic, and social development has its roots in agriculture. Trends in migration and national policy reflect the evolution in each region's agricultural sector. One would anticipate that the diverse climates and growing conditions in Ecuador would complement each other; however, this is true only to a very limited degree. Actually, differences in labor, capital, availability of land, climates, growing conditions, communications, and transportation have led to contrasting and often conflicting patterns in development that are regionally and even locally unique. It is consequently helpful to compare aspects of agricultural development in the two principal farming areas—the Sierra and the coast—separately. A discussion of the Oriente is not presented because, to date, this region is sparsely settled and has little impact on national agricultural production. Production in the Galapagos Islands is also insignificant.

Despite the fact that the land area of the Sierra is slightly larger than the coast (7.2 milion versus 6.8 million ha), the area suitable for agriculture is much smaller. Approximately 2.1 million ha (30 percent of the Sierra) is too high and too frigid for agriculture. Another 3.3 million ha (46 percent of the region) of the Sierra is forest, but a large portion of this land is located on the steep slopes of the Andes, where limited access, erosion, and inability to use tractors severely limit agricultural potential. A small portion of the land is productive only under irrigation (Linke, 1960).

Land Ownership. Overall, land ownership in Ecuador is concentrated in the hands of a few people. Approximately 80 percent of agricultural land is in holdings larger than 50 ha, a situation common to many South American countries (International Institute for Environment and Development, 1986). Coastal agriculture, in particular, is characterized by large holdings, often in the form of plantations, employing capital-intensive technologies and few workers. Agricultural holdings in the Sierra, where labor has traditionally been abundant, tend to be smaller, relying on labor-intensive cultivation practices, since capital for investment is limited. While it is common to see groups of peasant farmers toiling with hoes and draft animals in the Sierra, tractors and small airplanes (for spraying pesticides) are prevalent in coastal agriculture.

Market Orientation. The market orientation is also different in the two regions. Production in the Sierra is geared almost exclusively toward domestic consumption, while coastal agriculture has traditionally been directed toward exports. In addition, farms in the Sierra grow a diversity of crops, whereas coastal communities tend to focus on a few export crops.

Coastal Crops

Agricultural development in coastal Ecuador and, consequently, its economy are characterized by dependency on periodic single-crop "booms" that are followed by sudden crashes, or "busts," due to crop failures, infestations by pests, flooding, and loss of markets.

Cacao. The first significant export crop was cacao, which sporadically continues to dominate coastal agricultural production. However, competition among South American colonies for European markets did not favor Ecuador until 1774, when Spain's King Carlos III removed bans and reduced duties that had hampered trade. Ecuador's first "cacao boom" followed, as exports doubled from 2,550 mt in 1779 to 5,250 mt in 1810.

Between 1825 and 1875, a period often referred to as Ecuador's "second cacao boom," the economy became increasingly dependent on cacao exports. The value of exports reached 82 million sucres by 1875, with 59 percent attributable to cacao. Production was concentrated mainly in the lower Guayas basin and in the provinces of Los Rios and El Oro. The opening of the Guayaquil-Quito railroad in 1908 and construction of new roads continued to open new areas to agriculture. By 1900, there were an estimated 58 million plants in 5,000 coastal locations. By 1908, production had expanded to 80 million plants in 6,000 locations, which encompassed 130,000 ha (Guia, 1909). This cacao boom peaked in 1914, when 47,200 mt were exported (Figure 20).

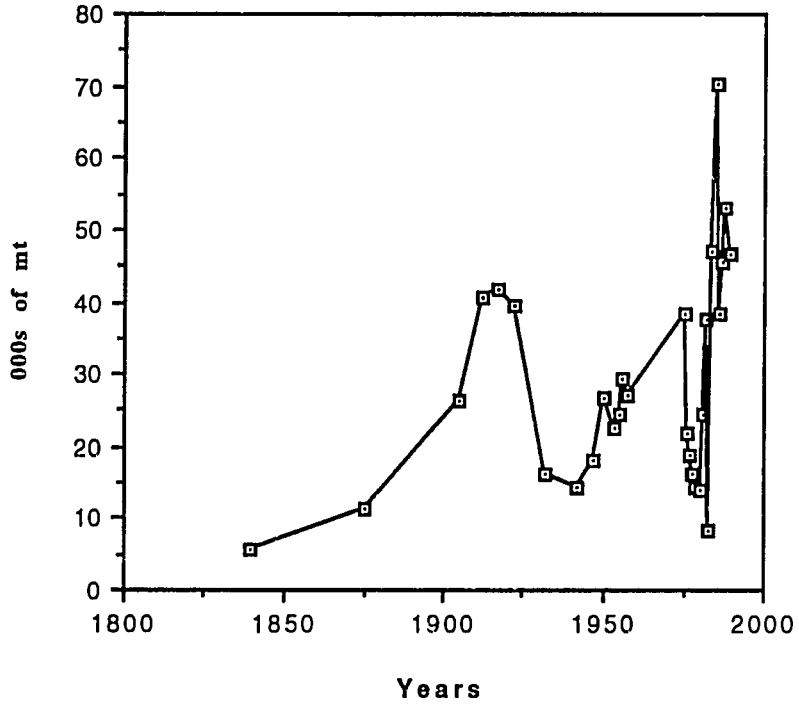


Figure 20. Coastal Exports of Granulated Cacao, 1839-1989.
Sources: Linke, 1960; The World Bank, 1984; Banco Central, 1990.[1]

The growth in exports slowed during World War I, due to shortages of steamships, increasing freight costs, difficulties in arranging letters of credit and currency exchange, and import restrictions by France and England. World prices for Ecuador's cacao exports subsequently fell, from U.S. $26.70 per 100 lbs in 1920 to $5.70 per 100 lbs in 1922. Simultaneously, production dropped when cacao pests reduced harvests. World demand for cacao continued to plummet with the onset of the Great Depression of 1929. Beginning with the Depression, the Ecuadorian economy fell into a crisis that would last 25 years. By 1933, cacao exports fell to about one-third the quantity exported in 1914. The economy was stagnant; labor strikes and the Revolution of 1925 expressed growing frustration. By the early 1940s, the value of exports was only about 13 percent of that of the previous high.

[1]Excludes cacao exports in liquid form.

Modest recuperation began during World War II, as prices increased and growers responded to government incentives to replant the estimated 30 million plants killed by pests or age. By 1958, Ecuador boasted 75 million plants, covering 160,000 ha in four coastal provinces (Linke, 1960). Production during the 1980s and early 1990s has been erratic, yet Ecuador currently stands as the largest producer of cacao in the world. The value of cacao exports has declined, however, from $96 million in 1984 to $54 million in 1991.

Rice. A few areas of the coast, namely the Yaquachi-Milagro area, fared well after World War I because they were able to diversify production, substituting rice and, to a lesser degree, coffee, for cacao. Rice had traditionally been grown in coastal wetlands for internal consumption, but after World War I, expansion of rice production temporarily rescued Ecuador's economy. Curtailment of the flow of cheap rice from the Far East during World War II caused world prices and Ecuadorian rice production to skyrocket. The price paid for rice in Guayaquil in 1947 was 10 times that in 1935. Coastal rice production leaped from 9,600 mt in 1939 to 67,000 mt in 1946, when it became the most important export—accounting for 43 percent of total exports, compared to .5 percent in 1926. By 1949, 75,000 ha were under rice cultivation, and by the late 1950s that figure had doubled.

As post-World War II markets returned to normal, rice from the Far East was again plentiful. Prices dropped, forcing Ecuador out of the market and threatening many growers with bankruptcy. Government assistance through export subsidies, quota systems, and the establishment of minimum domestic prices was required to prevent the industry from totally collapsing.

Rice is no longer a major export, but is a basic food staple for many Ecuadorians. Average annual production in the late 1980s approached 90,000 mt and approximately 150,000 ha of fertile flood plains were dedicated to the production of paddy rice.

Bananas. In the same way that rice replaced cacao, bananas replaced rice as the most important export crop in 1948. Banana prices first began climbing during World War II. Between 1925 and 1950, prices increased 13-fold. Hurricanes and pests, which destroyed banana plantations in the major producing countries in the Caribbean and in Central America, combined with labor problems in Central America, precipitated price increases. Ecuadorians, quick to see the opportunity, expanded banana production in all coastal provinces and in low-lying areas of the Sierra.

The pattern of development for banana plantations was different from and more explosive than that for other crops. Rice, cacao, palm, and rubber plantations were located near large rivers, which were used to transport crops. But bananas, which are more perishable, had to be grown in areas where rapid transportation by road and railroad was available. During the 1950s, coastal areas were completely transformed and became economically dependent on bananas. For example, colonists in El Carmen deforested 30,000 ha and 10,000 more were cut, as a 40-km band of banana trees was planted around Santo Domingo. A swath 15 km wide was also cut along the new Santo Domingo-Esmeraldas road.

Banana plantations sprang up just ahead of new roads. Other crops were replaced, and fertile public land was planted in bananas. Small and medium-sized farms accounted for 80 percent of production. An intense labor migration began. Workers left jobs with lumber companies in Esmeraldas, Manabi, and Los Rios for banana plantations. New farms were often abandoned for lack of roads to transport their crops.

In 1946, Ecuador exported 69,000 mt of bananas; in 1950, 170,000 mt; in 1957, 669,000 mt; in 1980, 1,347,000 mt and over 2,500,000 mt in 1991 (Figure 21). Between 1948 and 1960, value of exports grew 236 percent. By 1953, Ecuador emerged as the world's largest banana producer, a title it still retains. Currently, 80 percent of its exports are destined for U.S. markets.

From the end of World War II until the early 1960s, bananas dominated Ecuador's economy. The country was again reliant on one crop, investment was diverted from other undertakings, and growth was concentrated in coastal areas devoted to banana production and export. In the late 1950s, 80 percent of the national investment went into Guayaquil. Between 1950 and 1962, the city absorbed 64 percent of national migration.

In the early 1960s, the recovery of banana plantations in the Caribbean and in Central America, combined with the Philippines' entry into the market, caused world prices to fall. The drop caused inflation and devaluation of the sucre. Simultaneously, a new variety of banana, the Cavendisch, replaced the traditional Gross Michel grown in most Ecuadorian plantations. The shift caused significant change both in the industry structure and in production locations. Small and medium-sized producers lacked the capital required to replace existing trees, and because the Cavendisch gave higher-per-hectare yields, less land was required to meet falling market demand. The area under cultivation in the lower Guayas basin declined from 29,000 ha in 1968 to 12,000 ha by 1978. Esmeraldas was

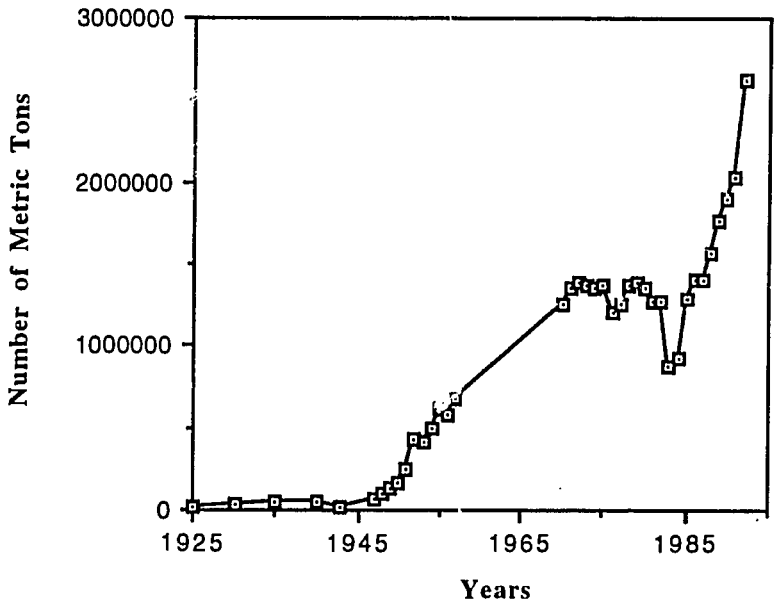


Figure 21. Coastal Banana Exports, 1925-91.
Sources: Linke, 1960; The World Bank, 1984; Banco Central, 1990.

hardest hit by changes in industry structure. In contrast, the area dedicated to bananas in El Oro increased, from 13,000 to 36,000 ha between 1962 and 1968. Large areas were also deforested near Quevedo, which had 100,000 ha in bananas by 1965. In short, fewer and larger producers emerged, and production became concentrated in southern coastal areas.

The heavy rains and flooding associated with the 1982-83 El Niño were particularly hard on banana crops. The reduction in harvest caused Ecuador to temporarily lose its position as the world's largest banana producer. The title was regained in 1985. In 1991 Ecuador exported 2 million mt of bananas with an FOB value of U.S. $716 million. Approximately 25 percent of the total value of Ecuadorian exports is attributable to bananas.

Crop Diversification. Recent government policies have encouraged crop diversification and taken marginal land out of banana production. Figure 22 illustrates increases in the

production of export crops between 1940 and 1989. Overall, production of these crops expanded 27-fold.

Agrichemicals. The increasing use of agricultural chemicals is of concern to many, particularly those cultivating shrimp, since good water quality is essential to shrimp production. Ecuador has very weak regulations governing the use of these chemicals. Table 13 lists the quantities of active ingredients in agrichemicals imported by Ecuador between 1978 and 1982. Roughly 46 percent of these imports are herbicides. Many chemicals that are banned or restricted in more developed countries are commonly used in Ecuador (Table 14), and there is no system whereby users of these chemicals are licensed.

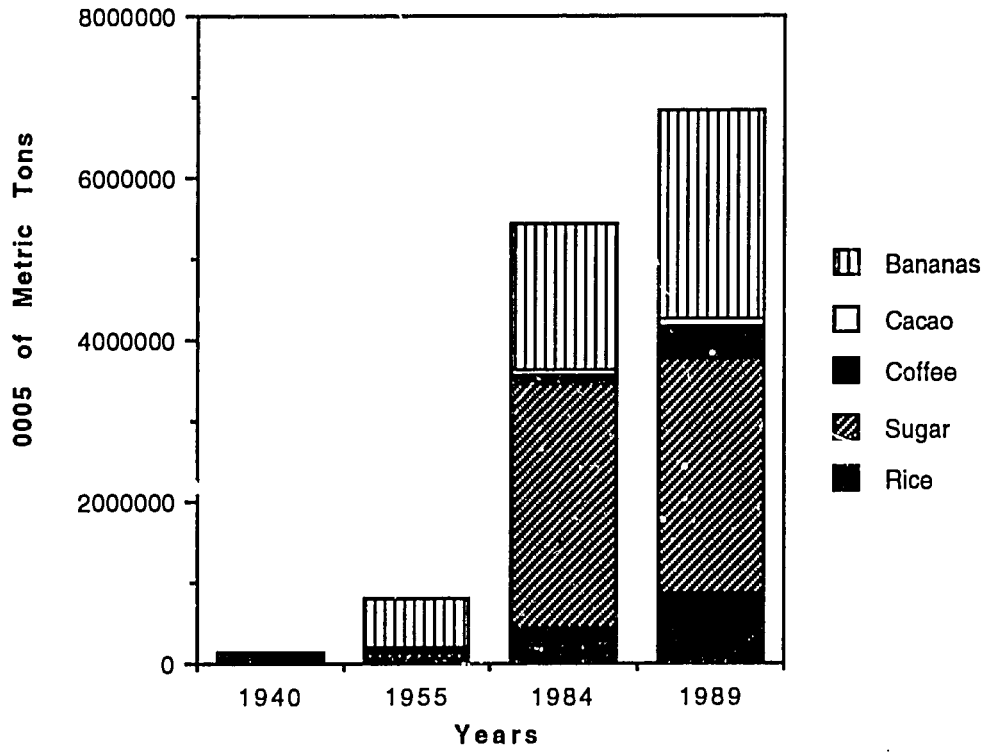


Figure 22. Production of Selected Coastal Crops: 1940, 1955, 1984, and 1989.
Sources: CONADE, 1985; The Economist Intelligence Unit, 1988; Banco Central, 1990.

Table 13. Pesticide Imports (in kilograms) by Active Ingredient, 1978-82.

	1978	1979	1980	1981	1982	TOTAL
Herbicide	1,655,513	1,654,092	1,659,300	2,042,772	2,223,689	9,235,366
Fungicide	728,466	966,799	1,353,787	926,124	11,22,236	5,097,412
Nematocide	531,660	882,521	466,981	361,971	394,317	2,637,450
Insecticide	503,575	464,229	585,773	478,177	419,864	2,451,618
Other	77,049	50,254	61,367	84,148	233,832	506,650
Adherents and Emulsifiers	48,067	132,090	38,650	62,091	42,319	323,217
Total (kg)	3,544,330	4,149,985	4,165,858	3,955,203	4,436,257	20,251,713
Total (mt)	1,772	2,075	2,083	1,978	2,218	10,126

Source: Fundación Natura, *Los Plaguicidas en el Ecuador*, 1985.

Table 14. Agrichemicals Used in Ecuador That Are Banned or Restricted in Other Countries, 1978-82.

Pesticide	Prohibited in	Restricted in	Crop	Region
1 Carfoburan		USA		
2 Paraquat	DNK, SWE PHL, TUR, IND	CAN, FIN, NZL		
3 2, 4D	COL, USA, GTM			
4 DBCP*	USA, ARG, CAN, COL, DEU, DNK, FIN, GTM, IND, NZL, SUN, PHL		Bananas	Coast
5 Fenamiphos		PHL		
6 Endrin*	EC, ARG, DEU, DNK, FIN, IND, JPN, NOR, NZL, PHL, SWE, THA, FRA	AUT, CAN	Rice, Cotton, Palm, Sugar Cane, Coffee, Fruit, Potatoes, Corn, Tobacco	Coast
7 BHC (HCH)*	COL, USA, EC, JPN, HUN, ARG, CAN, NZL, PHL, FRA	TUR	Rice, Cotton	Coast and Sierra
8 Aldicarb	PHL, NLD	AUT, USA, GNR		
9 Aldrin*	EC, ARG, CAN, DNK, FIN, HUN, JPN, NOR, SUN, PHL, SWE, TUR	AUT, NZL	Cotton, Rice, Bananas Coffee, Corn, Soybean, Potatoes	Coast and Sierra
10 Methyl Parathion*	HUN, IND, NOR, PHL, SUN, TUR, JPN	USA, GBR, SWE	Alfalfa, Rice, Coffee, Coast and Sierra, Sugar Cane, Corn Cotton, Barley	
11 Parathion*	HUN, IND, NOR, PHL, SUN, TUR, JPN	USA, GBR, SWE	Alfalfa, Rice, Coffee, Sugar Cane, Corn Cotton, Barley	Coast and Sierra
12 Methamidofos		PHL, GBR, USA		
13 Monocrotofos		USA, IND, GBR		
14 Lindane		COL, THA		
15 Chloro Picrin Methyl Bromide	DEU	PHL		
16 2, 4, 5T	DNK, FIN, GTM, IND, NOR, PHL, SUN, SWE, TUR, USA	CAN, HUN		

Table 14 (Continued).

Pesticide	Prohibited in	Restricted in	Crop	Region
17 Chlordane*	COL, USA, EC, JPN, HUN, ARG, CAN, NZL, PHL, FRA	TUR	Corn, Potatoes	
18 Haptaclore*	USA, ARG, CAN, DEU, DNK, FIN, NZL, SUN, SWE, TUR	AUT, PHL	Cotton, Rice, Sugar Cane Fruit, Corn, Pastures	Coast
19 Mirex	CAN, DNK, SWE, USA			
20 Captan*	FIN, NOR	IND, USA		
21 Dieldrin	FIN, HUN, JPN, NOR, PHL, SWE, TUR, EC, DEU, USA, ARG, CAN, SUN, DNK	IND, NZL, AUT		
22 Disulfoton		GER		
23 Chlorobenzilato	PHL	FIN, USA		

*Banned in seven or more countries

EC	European Economic Community	GTM	Guatemala
ARG	Argentina	HUN	Hungary
AUS	Australia	IND	India
AUT	Austria	JPN	Japan
CAN	Canada	NLD	Netherlands
CHE	Switzerland	NOR	Norway
CHL	Chile	NZL	New Zealand
COL	Columbia	PHL	Philippines
CRI	Costa Rica	SUN	Soviet Union
DEU	West Germany	SWE	Sweden
DNK	Denmark	THA	Thailand
FIN	Finland	TUR	Turkey
FRA	France	USA	United States
GBR	Great Britain		

Source: Fundación Natura, *Los Plaguicidas en el Ecuador*, 1985.

Coastal Area Dedicated to Crop Production. A breakdown of areas under cultivation and till in each of the five coastal provinces in 1985, along with a list of major crops, is presented in Table 15. To put this in perspective, 60 percent of the coastal area cultivated and 95 percent of the value of national agricultural exports are attributed to coastal crops—namely, cacao, coffee, and bananas. Historically, increases in agricultural production, with the exception of higher yields from the Cavendisch banana, are attributed to expansion of the area under cultivation, not to increased productivity per unit of land.

Table 15. Area under Cultivation in Coastal Provinces, and Major Crops, 1985.

Province	Hectares under Cultivation	Major Crops
Esmeraldas	75,000	African Palm, Bananas, Abaca, Hard Corn, Coffee, Yucca, and Cacao
Manabi	306,000	Coffee, Hard Corn, Plantain, Yucca
Guayas	279,000	Rice, Cacao, Sugar Cane, Hard Corn, Bananas, Cotton, and Straw
El Oro	73,000	Bananas, Cacao, Coffee, and Hard Corn
Los Rios	365,000	Cacao, Coffee, Rice, Soy, Hard Corn, Plantain, and Bananas
Total	1,098,000	

Sources: MAG, 1986.

During the late 1950s there were 405,300 ha of coastal land dedicated to growing major export crops. By 1989, this had increased fourfold to 1.6 million ha. Approximately 60 percent of the land used for raising these crops is located in provinces with coastlines, and over 75 percent is in the coastal region. In terms of production, 63 percent is attributed to the coastal region. Between 1985 and 1989, the amount of coastal land dedicated to crops increased by 131,000 ha per year. If this trend continues, 3 million ha of coastal land could be dedicated to crop production by the year 2000.

Cattle Production

Animal husbandry is a traditional component of Ecuadorian agriculture and has its roots in the Colonial period, when Spaniards introduced sheep to the Sierra. On the coast, ranching first became an important economic activity in the 18th century on the Santa Elena Peninsula, which quickly emerged as the center of cattle and dairy production on the coast, supplying milk and beef to Guayaquil and surrounding rural communities. Apparent overuse of the fragile semi-arid soils, combined with unconstrained deforestation and periodic droughts, have since rendered the peninsula useless for cattle and crop production.

Coastal Area Dedicated to Cattle Production. Of the 2,559,000 ha of natural and man-made pastures in Ecuador in 1974, approximately 44 percent were located on the coast and supported approximately one animal per hectare. At the time, 82 percent of the cattle farms were less than 50 ha in size and controlled 21 percent of the pastures. Approximately

6 percent of the ranches were classified as large (200 ha or more) and encompassed 50 percent of coastal pastureland. During the early 1970s, 70 to 93 percent (CONADE, 1974) of national beef production was concentrated on the coast, while the Sierra produced 80 percent of the country's milk. Approximately 40 percent of coastal ranching was concentrated in Manabi (349,000 head of cattle and 488,000 ha of pasture), 25 percent in Guayas, and the remainder scattered throughout the other coastal provinces.

A more recent study estimated that between 1951 and 1989, coastal land dedicated to pastures increased by 828 percent, from 384,500 to over 2 million ha (MAG, 1990). (See Table 16.) Based on the 6.3 percent per year rate of expansion experienced between 1975 and 1983, one can project that the coast will have about 4 million ha of pasture by the year 2000.

Table 16. Changes in the Coastal Area Dedicated to Agriculture, 1950, 1985 and 1989.

	1989 (000s of ha)	1985 (000s of ha)	1950 (000s of ha)	Percent Increase 1950 to 1989
Land under Cultivation	1621.3	1,096.7	665	244
Pastureland	2184.2	2,038.5	384.5	828
Total	3805.5	3,135.5	1,049.5	363

Sources: Linke, 1960; MAG, 1985; Banco Central, 1990.

Irrigation

The total annual discharge for all rivers in Ecuador has been estimated to be between 290 billion and 510 billion cubic meters, which is sufficient to irrigate six times the total area of land currently in crops in all of Ecuador (Whitaker and Alzamora, 1990). Many private irrigation projects are supplied by subterranean water. Information on supplies and the economics of utilizing groundwater is unknown, but obviously increases the potential supply of water for irrigation.

Based on climatic zones, the most appropriate areas for irrigation appear to be in the Sierra and the central and southern coastal plain, where irrigation could be used to grow additional crops during the dry season.

One of every four hectares currently under production is irrigated. Approximately 80 percent of the irrigation systems are privately owned. Laws passed in the early 1970s state that all water resources are publicly owned, but previous owners are allowed to continue to use water.

If projects under construction or design, or under serious study were to be constructed and fully implemented, the total area irrigated would double, from approximately 418,000 ha to 820,000 ha (Whitaker and Alzamora, 1990). The greatest proportion of this area would be on the Santa Elena Peninsula in the province of Manabi, and along the border with Peru. The Daule-Peripa Dam, constructed in 1988, would upon completion supply water to over 100,000 ha.

Whitaker and Alzamora (1990) are critical of Ecuador's policy, which actively promotes irrigation. A few of their supporting observations are:

- The application of poor technology reduces the efficiency of water use, so irrigation projects will not reach their full potential until proper technologies are employed.

- There is high and disproportionate government spending on irrigation, given its overall relative importance.

- The debt from irrigation projects in operation and under construction is estimated to be U.S. $1.1 billion, or 11.6 percent of the foreign debt. The irrigation component alone is approximately 3.3 percent of the foreign debt. These amounts will increase sharply if projects under design or study are financed. Benefits do not appear to exceed the strain placed on the economy.

- Irrigation is heavily subsidized; resources are consequently undervalued, so efficiency is low and many projects are not economically viable.

- There are indications that priorities have not been well established, and there is competition among agencies with overlapping jurisdictions.

- The majority of Ecuador's attention and financing has gone into constructing and operating irrigation projects. Less than 0.1 percent of the budget is dedicated to planning and administering irrigation, drainage, and flood control projects.

- These projects are not socially equitable, as they tend to benefit the large over the numerous small landholders.

Economic Contributions of Agriculture

Until the 1970s, agriculture, which includes crops, cattle, and fisheries, had been Ecuador's chief source of growth, its largest employer, and its principal source of foreign currency earnings. Between 1970 and 1983, agriculture accounted for 14 percent of GDP. Thirty-four percent of all Ecuadorians were employed in agriculture in 1982. Coastal crop production has traditionally been export-oriented and dominated by a single crop: cacao from the 1600s; rice in the early 1900s; bananas since the 1950s; and more recently, shrimp mariculture. In contrast, agriculture in the Sierra is more diverse and oriented toward products for domestic consumption—mostly grains, potatoes, beef, and milk. As of 1989, agriculture accounted for 18.5 percent of GDP and employed 32 percent of the labor force.

The shift toward greater agricultural production on the coast has accelerated since the 1950s. In real terms, agricultural export values increased from U.S. $160 million in 1970 to U.S. $1.5 billion by the end of the decade (World Bank, 1984). Much of this is attributed to the increase in fisheries exports, which government accounts include under agriculture. The percentage decrease in the value of agricultural products—69.7 percent of all exports in 1970, versus 50 percent in 1991—is attributed to oil revenues, which grew from 0.4 percent to over 40 percent of export earnings over the same period, and not to decreases in the value of exports. Similarly, the percentage of the population employed in agriculture has decreased. whereas the number actually working in the sector has increased. In other words, agricultural employment grew, but not as fast as the population.

Agriculture will continue to play a major role in Ecuador's economy, for it can alleviate the country's two most pressing problems: unemployment and the need for hard currency earnings. The coast will continue to be the focal point for agricultural development because more arable land is available, because it has supporting infrastructure in place, and because its soils are fertile (particularly in comparison with the Oriente).

Issues for a CRM Program

- Many herbicides and insecticides are used in Ecuador that have been banned or restricted in more developed countries. There is no system whereby users of these chemicals are licensed. Higher than recommended concentrations and indiscriminate use of these chemicals are prevalent.

- Aerial spraying is a common practice on large coastal plantations, and chemicals are dropped into irrigation ditches that empty into nearby rivers. Public wells are often adjacent to rivers and, in some instances, are contaminated with chemicals.

- Continued agricultural expansion will require more intensive cultivation and, consequently, greater quantities of agrichemicals and fertilizers.

- Coastal ecosystems with high biodiversity have undergone drastic changes as large tracts of natural vegetation have been cleared and converted to agricultural use. In addition, the expansion in agriculture has given rise to the construction of new roads and towns, and these have further altered the coastal environment and waterways. The predicted expansion of agriculture in the next few years is certain to infringe on marginal land and on the few remaining valuable tracts of tropical coastal forests. The loss of rich genetic pools and biodiversity is an issue of global importance.

- Large-scale projects—such as the Daule-Peripa Dam project designed to furnish water for irrigation and hydroelectric power and to control water flow—will transform coastal ecosystems even more. Associated changes in water flow patterns, combined with anticipated water contamination from erosion, agrichemicals, and fertilizers, have caused fishermen, shrimp growers, and conservationists to fear that existing ecosystems, as well as the activities dependent upon them, will be adversely affected. The large concentration of mangroves found along the Gulf of Guayaquil may be damaged, as the natural pulses on the ecosystem caused by seasonal fluctuations in water discharges will be dampened by the Daule-Peripa Dam (Odum, personal communication, 1991).

- It is crucial to deal with inland-generated problems in the coastal zone, and to reach the best possible balance, with compromises to ensure acceptable health and productivity of resources in both regions.

IV. FORESTRY

Historical Overview

Forests in Ecuador have been abused for four centuries. During the Colonial era, large tracts of virgin forest were cut for shipbuilding or to accommodate farms. In the early 20th century, the tropical forest of the Oriente was a major source of natural rubber. During the 1930s and 1940s, the country became a leading exporter of balsa wood. Since the 1960s, commercial exploitation has shifted to harvesting high-value tropical hardwoods for furniture, panels, and plywood.

In the Oriente, colonization, African palm plantations, cattle ranching, and petroleum-related activities have combined to cause extensive deforestation. In the Sierra, population pressures have led to the destruction of nearly all forest areas that can be potentially cultivated or converted to pasture. Other areas are being stripped for firewood, the major use for forest products in Ecuador. Since the early 1900s, large areas of the Sierra have been replanted with introduced Monterey pine and eucalyptus. Both species are fast-growing, but are subject to diseases for which there are as yet no cures. In addition, these species are not particularly effective in retarding erosion. Along the coast, colonization, expanding agricultural activities, and a burgeoning timber industry—primarily in the province of Esmeraldas—are causing extensive deforestation. Studies by FAO, INEC, and PRONAF estimate that 75 percent of the Ecuadorian population relies on firewood for cooking. Given the average per capita consumption of 2.1 kg per day of firewood calculated by the agencies above, 2,500 km^2 had to be cut in 1982 alone to meet this demand. An unknown amount is cut by plantation owners and colonists clearing land for farming and cattle.

There are little data for the amount of land previously covered by forest in Ecuador, although Linke (1960) estimates that 50,000 km^2 (75 percent) of the coast was covered by forests in 1951. Currently about 45 percent of Ecuador, 124,050 km^2 is covered with natural forest. Nearly all of this is found in the Oriente (Figure 23).

USAID (1982) reports that "extensive deforestation has occurred during the past three decades both on the coast and in the Oriente, totaling over 800,000 ha." The Ecuadorian Agrarian Reform and Colonization Institute (IERAC) in the past maintained a policy that 50 percent of a colonist's holdings had to be cleared of forest and put into "productive" use before a land title would be issued.

It is estimated that the natural forest cover has been reduced by nearly 40 percent since 1951. A mere 8 percent is available for reforestation (Fundación Natura, 1984). USAID (1982) states that, should these trends continue, it is likely that Ecuador's forest resource will be effectively depleted within 15 to 20 years.

Desertification, which is the end product of deforestation and soil erosion, is taking place at an alarming rate in many areas of the coast and highlands. It is estimated that within the past 25 years arid land in Ecuador has increased by 31.5 percent, with 10,000 km^2 now estimated to be arid. One recent study estimates a progressive rate of desertification of approximately 5,000 ha per year.

Economic Contributions

The total production value of forest industries, as a share of total manufacturing, increased from 2.2 percent in 1970 to 4.6 percent in 1976. Total full-time employment is believed to be in the vicinity of 30,000, excluding the gathering of firewood. Forestry contributes 3 to 4 percent to GDP. Despite its timber resources, Ecuador has historically run a trade deficit in forest products. In 1978, approximately U.S. $50 million of forest products, primarily pulp and paper, were imported. The corresponding value of exports

Figure 23. Remaining Natural Vegetation in Ecuador
(Blanks show deforested areas)

Source: Fundación Natura, 1981.

was about U.S. $17 million. Ecuador currently produces only about 20 percent of its natural-rubber requirement and imports, on average, U.S. $3.9 million of rubber products annually.

Coastal Forestry

Commercial exploitation of coastal forests dates back to the late 1500s, when timber from vast tracts in the Guayas basin was one of the most important economic resources. By the middle of the 17th century, the quality of Ecuadorian wood and the skills of carpenters engaged in naval construction were famous. The timber industry grew so quickly that labor shortages developed, and slaves were brought in from the Caribbean to fill the void.

The combination of an excellent harbor and accessible stands of timber made the Guayas basin an important source of hardwood logs for export between 1908 and 1929. Balsa emerged as the leading timber export during the 1920s. The war years (1941 to 1945) saw a dramatic increase in the demand for timber products. During this period, hardwood exports jumped from an average of 40 mt per year in the early 1930s to 1,200 mt by 1943. Balsa exports reached 13,623 mt the same year, up from 1,200 mt in 1936, and rubber exports, nearly all of which were from wild trees, averaged 2,354 mt per year. It has been estimated that of the 75 sawmills in Ecuador in 1943, the coastal area had 61, of which 40 were dedicated to cutting balsa.

Production of hardwood plywood began in Guayaquil in 1964. By 1970, plywood and veneer production reached 20,000 m^3. Much of the hardwood used in the production of plywood and veneer comes from the harvesting of wet and moist climax forests located in the northern portion of Esmeraldas province.

In addition to clearing land for timber, coastal forests were cut to create open areas for cacao, rice, and bananas, and for subsistence farming.

Deforestation is of growing concern throughout Ecuador, with the exception of the Galapagos Islands, and is a particularly acute problem on the coast. Only a fraction of coastal forests exist today, and these are quickly disappearing. Arid coastal forests, mainly in the provinces of El Oro, Manabi, and Guayas, have been destroyed, resulting in a scarcity of wood for fuel and building materials. A local charcoal industry is exacerbating the problem by exploiting the sparse vegetation that remains. MAG estimates that 190 km^2 have been cleared near Santo Domingo alone for the cultivation of African palm. Reforesting areas that have become increasingly arid is not a simple undertaking. Manabi, (as well as Loja in the Sierra), is the most severely affected by deforestation. In Guayas, the area surrounding Guayaquil has been completely deforested. The most striking example is found on the Santa Elena Peninsula, where centuries of uncontrolled cutting by communities and merchants to produce charcoal, firewood, furniture, railroad ties, and timber have devastated the forests. Though famous for its hardwoods in the 1500s and 1600s, only remnants of Santa Elena's luxuriant forests still stand. Many species of once-abundant local hardwoods have completely disappeared in the last 50 years, and the change to desert conditions is a growing problem.

The story is the same in El Oro, an area of exceptional ecological importance, as it buffers Ecuador's lush coast from the Peruvian desert. Here, forests have been cut for centuries to provide timber for shoring up mine shafts and for fueling blast furnaces used to separate metals. The years of exploitation have taken a heavy toll. For example, the zone around Zaruma and Portovelo has been totally deforested, and cutters are moving up the Puyango River valley in search of timber.

Until the 1950s, the tropical forests in the province of Esmeraldas were exploited, but left basically intact. Early settlers, which included Afro-Americans and Indians, depended largely on subsistence horticulture, the gathering of fruits and nuts, and artisanal fisheries. Small areas were cleared for gardens and cattle and to obtain trees for construction or sale, but habitat destruction, due to a sparse population, was minimal.

During World War II, large numbers of balsa trees were cut for export, but demand was short-lived and forests had time to recuperate.

The situation changed in the 1950s, when the construction of new roads opened up the area, bringing in an influx of colonists, banana growers, and timber companies. Since that time, more lumber has been cut in Esmeraldas (Figure 24) than in any other coastal province. Timber concessionaires are currently developing a network of roads, resulting in more colonization; those who are legally obliged to replant harvested areas argue that such efforts are useless, as colonists move in and occupy the land before it can b' replanted.

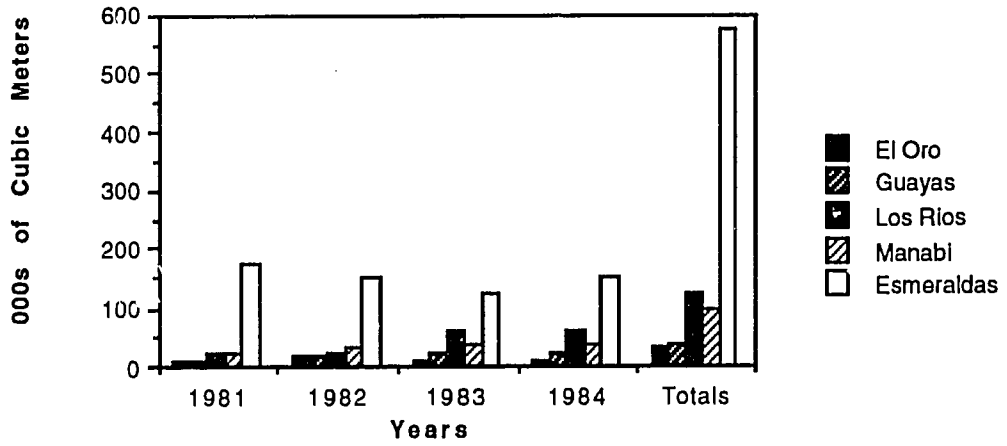


Figure 24. Cubic Meters of Timber Harvested in Ecuador's Coastal Plain, 1981-84.*

* Data for subsequent years are not available.

Source: MAG, 1986.

The Directorate for Forest Development (DDF) estimates that 80 km² of forest in Esmeraldas are being cut for agriculture each year. Dodson et al.(n.d.) estimate that over 90 percent of the coastal tropical forest that existed in Ecuador in 1938 remained in 1988. A projection of current trends in deforestation in Esmeraldas indicates that timber stands could be lost within 10 to 15 years. Conversion of virgin tracts of forests to agricultural land may in fact be accelerating, as two new roads (Ibarra/San Lorenzo and Quito/La Independencia) facilitate access to the remaining vestiges of tropical forest in northwestern Ecuador.

Issues for a CRM Program

The forests of coastal Ecuador have been indiscriminately harvested since Colonial times. The dramatic deforestation that has taken place for the past 25 years has grave implications, since a projection of this trend suggests that tropical timber stands of coastal forests could be depleted in 10 to 15 years. In most instances, little sustained benefit was attained from the exploitation of the forests. Reforestation efforts are meager in comparison to areas cleared.

Although the problems of forestry management will not be a central focus of the coastal management program, there are lessons to be learned from the overexploitation of this resource that should be considered when strategies are framed for coastal resources such as mangroves and fisheries:

- Forest biodiversity is being lost. A few "preferred" species are being planted, replacing Ecuador's 125 native timber species. In many areas, the natural diversity of species is so wide within a limited area that lumber companies are discarding a large percentage of the trees cut simply to gain access to more commercially desirable species. The loss of the rich genetic pool found in these forests is of global concern.

- Municipal expansion, new pipelines, and public works projects that construct dams for hydroelectricity, irrigation, and roads are also taking their toll on forest lands.

- Erosion and associated ramifications—loss of topsoil and fertility, transport of nutrients and contaminants, siltation, and the reduction of dissolved oxygen in rivers—are readily identifiable effects of deforestation with serious repercussions in the coastal zone. Desertification, the end result of deforestation and soil erosion, is taking place at an alarming rate in areas of the coast and highlands.

- The destruction of tropical rain forests is a topic of global concern. However, management models that incorporate biological, social, and economic realities to promote multiple and sustainable use of this precious resource are poorly developed. Techniques developed to manage temperate forests have little value in the tropics. Social issues are often ignored.

- There are no small areas of forest reserved for public recreation and enjoyment. Conservation efforts have focused on preserving large tracts of remote forests while totally ignoring the need to manage the smaller watersheds and ecosystems that directly sustain human populations.

- Reforestation, even in critical habitats such as water basins, is meager. CENDES (1984) states that between 1962 and 1983, only 908 km^2 of land was reforested in Ecuador. Only 28 percent of this, 254 km^2, was in coastal areas, which indicates that the average annual rate of reforestation on the coast was a mere 11.5 km^2.

- The private sector should be induced to invest in the future of forest crops. Achieving this goal requires clear policy on the rights of owning forests, along with incentives for reforestation and for internal production directed at import substitution.

V. FISHERIES

Historical Overview

Archaeological evidence indicates that the fishing tradition in Ecuador extends back to 5000 B.C. when communities on the Santa Elena Peninsula used small canoes to harvest seafood. Around 2000 B.C., sails were employed. Marcos (1985) postulates that fish were an integral part of early commerce and trade in the interior valleys of Santa Elena Peninsula many centuries before the Spanish discovered the Americas. Aboriginal populations also harvested conch (*Spondoylus princeps*), the shells of which were used as religious ornaments to ensure rain and fertility.

When the Spanish conquistadors first arrived, large balsa rafts set with sails were seen along the coast. During the Colonial period the fisheries declined in importance, although there was still a small flow of salted and dried fish products between the coast and Quito.

Until the 1950s, Ecuador's fishing industry was artisanal. Traditional balsa crafts, primitive canoes, and sailing vessels exploited nearshore stocks to supply a limited domestic market.

Industry Structure

Today, Ecuador's marine capture fisheries consist of an industrial and an artisanal sector. As is the case in most developing countries, the industrial sector is capital-intensive, employs relatively modern fishing technology, is often part of an integrated operation, and exports most of its production. The artisanal sector is labor-intensive; its supporting infrastructure is poorly developed or totally absent. Production is, for the most part, destined for local consumption. Harvesting techniques are simple. *Larveros,* or fishermen that harvest shrimp postlarvae to stock growout ponds, may be considered artisanal fishermen, but are not discussed in this section.

Industrial Fisheries. The industrial sector, which started in the 1950s, comprises specialized fleets that target offshore shrimp, tuna, small pelagics, and shellfish. The number of industrial vessels grew slowly during the 1970s and 1980s, to 495 vessels in 1991 (Table 17). The majority of the fleet and, consequently, supporting infrastructure and processing plants, are located along the southern coast between Manta and Guayaquil. This is also the area of greatest fishing effort (Figure 25). Some 6,000 people are employed in the processing sector. Industrial landings increased fairly steadily, from 55,500 mt in 1965 to 1,517,606 mt in 1985, and subsequently began to fall, reaching about 377,000 mt in 1991 (Figure 26).

The principal fisheries in the industrial sector are:

1. The Tuna Fleet. The main species of tuna taken by the Ecuadorian fleet are yellowfin and skipjack. Other species, such as bigeye, bluefin, albacore, and bonito are taken in lesser quantities. Much of the tuna taken off Ecuador during the 1960s was caught by foreign vessels, 50 percent of which were Japanese long-liners. A significant percentage of tuna caught in Ecuadorian waters between the 1950s and 1970s was taken by U.S. vessels and landed in San Pedro, California. Beginning in the early 1970s, Ecuador seized U.S. tuna clippers accused of violating the country's declared 200-mile territorial sea. Changes in oceanographic conditions in the 1970s resulted in scarcities of tuna and bait, causing the Ecuadorian fleet to replace the traditional pole-and-line vessels that fished 30 to 50 km offshore with large purse seiners and long liners capable of fishing outside

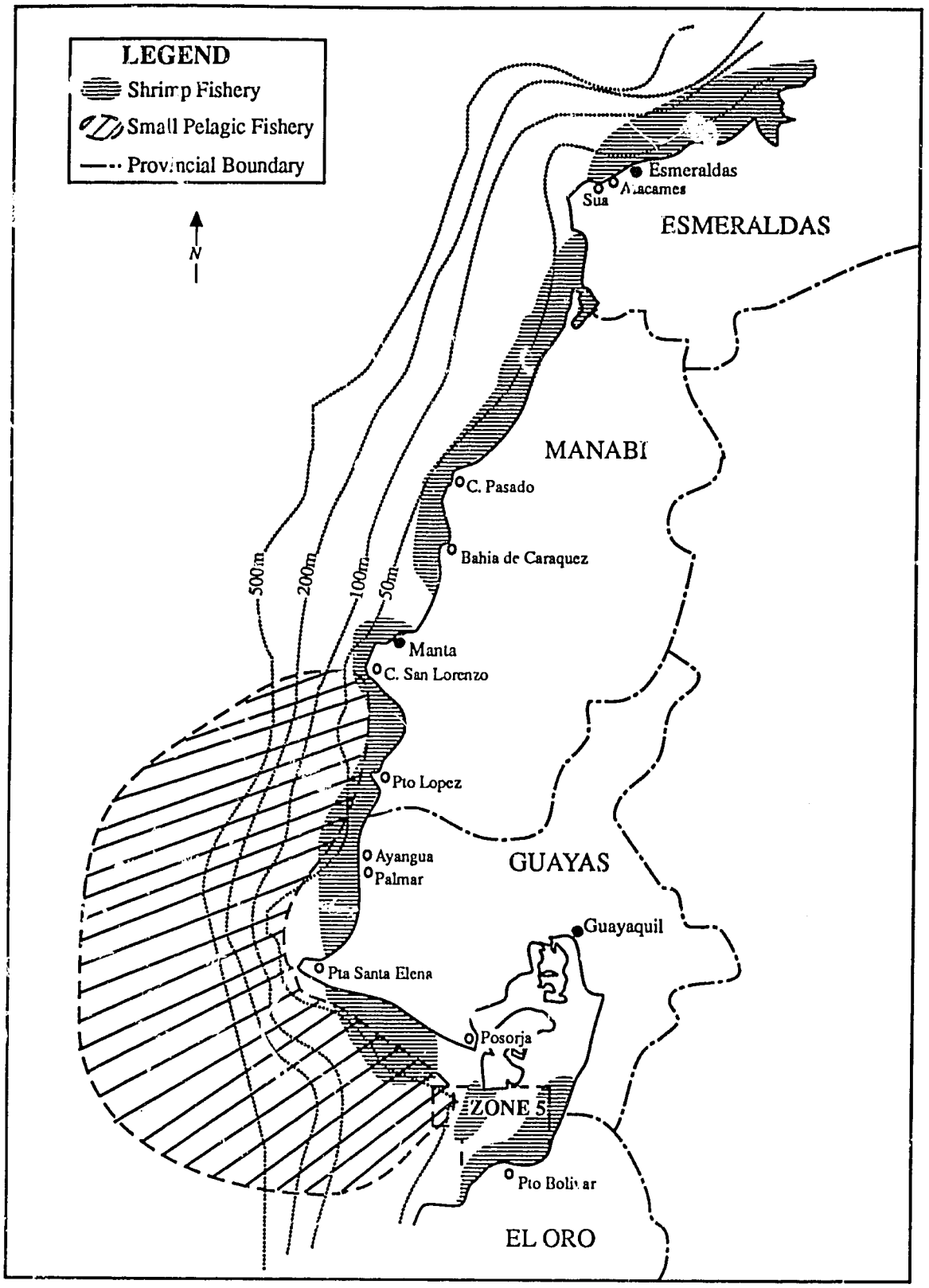


Figure 25. Fishing Zones of Ecuador's Industrial Fleets

Source: FAO/BID, 1986.

Table 17. Size of the Industrial Fishing Fleet According to Species Caught, 1975-91.

Year	Total		Tuna		Shrimp		White Fish		Lobster		Sardines	
	Number	NRT	Number	NRT	Number	NRT	Number	NRT	Number	NRT	Number	NRT
1975	361	8,902	57	3,389	247	4,660	54	750	3	103		
1976	357	9,392	55	3,079	241	4,673	56	1,517	5	123		
1977	364	9,597	58	3,363	245	4,895	60	1,305	1	29		
1978	382	12,838	69	4,875	229	4,643	83	3,291	1	29		
1979	409	13,421	58	5,237	250	5,047	100	3,107	1	29		
1980	431	15,000	57	5,272	246	5,140	127	4,560	1	29	0	
1981	410	14,790	50	4,693	227	5,097	132	4,972	1	29	0	
1982	449	17,507	56	5,440	230	4,981	162	7,057	1	29	0	
1983	467	19,179	57	6,563	250	5,516	58	2,820	1	29	101	9,250
1984	478	18,195	56	5,674	265	5,958	83*	3,261	3	41	71	3,381
1985	477	19,531	54	6,469	249	5,601	107*	3,701	2	34	65	3,726
1986	471	19,456	51	6,231	249	5,411	105	3,757	1	29	65	4,028
1987	496	19,702	51	6,044	267	5,581	109	3,8[illegible]	3	47	66	4,157
1988*	496	20,373	48	6,155	265	5,225	102	2,717	1	29	77	6,083
1989*	508	20,960	53	6,618	269	5,354	109	2,714	0		76	6,219
1990*	507	20,825	53	6428	258	5,051	..8	3038	0		74	6,206
1991*	495	20,819	56	6,700	257	5,047	103	2,803	0		75	6,172
1991*					247							

* Includes a few miscellaneous vessels that entered the fleet in 1988. NRT = Net Registered Tons

Sources: Subsecretaria de Recursos Pesqueros, 1988 and 1992.

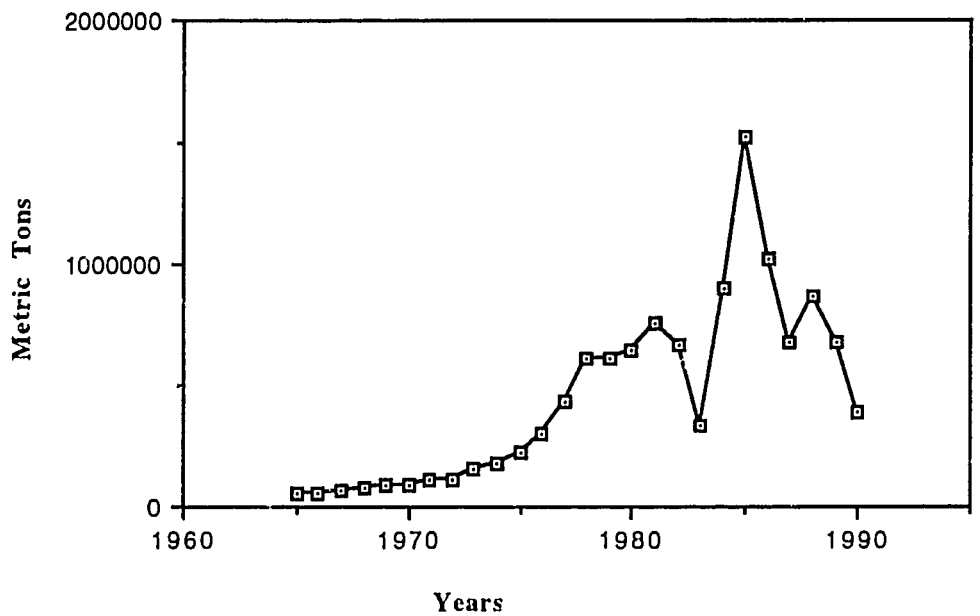


Figure 26. Total Landings for All Fish Species, 1965-90.
Sources: Subsecretaria de Recursos Pesqueros, 1984, 1987; FAO, 1985, and Scott and Torres, 1991.

Ecuadorian waters. The number of vessels in the fleet declined from 69 in 1978 to 56 in 1990, but vessels were larger. Ecuadorian tuna landings, 98 percent of which are attributed to the industrial fleet, rose from approximately 38,670 mt per year in the early 1981 to 58,500 mt in 1990. The 1982 Law of the Sea Treaty, although never signed by Ecuador, gave international recognition to Ecuador's maritime claims. The abundance of tuna found within the country's territorial sea, low fuel prices, and investment incentives lured international companies to invest in the construction of canneries and cold stores, and to bring in modern vessels under joint venture agreements. A significant portion of foreign catch has been taken around the Galapagos Islands. Efforts to increase domestic tuna landings during the 1980s, however, have been hampered by falling world prices. Scott and Torres (1991) state that no foreign vessels were licensed to fish in Ecuadorian waters in 1991.

2. *Small Pelagics.* In terms of weight, the capture of small pelagics—mackerel, sardines, herring, and anchovy—is the most important fishery in Ecuador. The landings of small pelagics increased from 132,000 mt in 1975 to 657,000 mt in 1980, but were heavily impacted by the El Niño in 1983, when landings fell to 204,000 mt. Stocks recovered quickly, and by 1985, recorded landings reached 1.26 million mt, but declined to 169,000 mt in 1990. Scott and Torres (1991) state that the declining trend witnessed over recent years and culminating in extremely low catch levels in 1990, has been attributed to overfishing combined with biological and oceanographic conditions.

Most vessels employ American-type purse seines introduced through joint ventures or purchased from Peru when that country's anchoveta resource crashed in 1972-73. Few vessels operate with electronics. Nets measuring 200 m in length and 20 m in depth are hauled in by power blocks. Discrepancies and contradictions in data sets make it difficult to estimate the number of vessels in the small pelagic fleet, the level of effort, and the actual amount landed.

3. *Shrimp Fishery.* Commercial offshore exploitation of shrimp started in Ecuador in 1952. The first exports registered in 1954 amounted to 249 mt, valued at U.S. $310,000. Two packing houses existed around the middle to late 1950s.

Sutinen et al. (1986) point out that during the early years of this fishery's development, production paralleled increases in the number of vessels. The annual rate of growth was fastest between 1954 and 1958, when the size of the fleet increased from 30 to 108 vessels, and production increased over fivefold, from 600 to 3,340 mt. More efficient double-rigged side trawlers, commonly used in the southeastern United States, were introduced in 1960. By 1961, vessels realized significant increases in their rates of catch. Fleet growth through the early 1960s was slow, but jumped to 248 vessels in 1969. The fishery grew to 250 to 264 vessels as it approached maturity during the 1970s and 1980s. Cyclical variations were observed both in production catch rates and in fleet size. Peak production coincides with El Niño years, when greater precipitation and warmer water temperatures enhance natural growth and shrimp abundance. After the 1982-83 El Niño, total production and average catch per vessel decreased again. Figure 28 shows total shrimp landings, the number of vessels, and average catch per vessel throughout the life of the fishery.

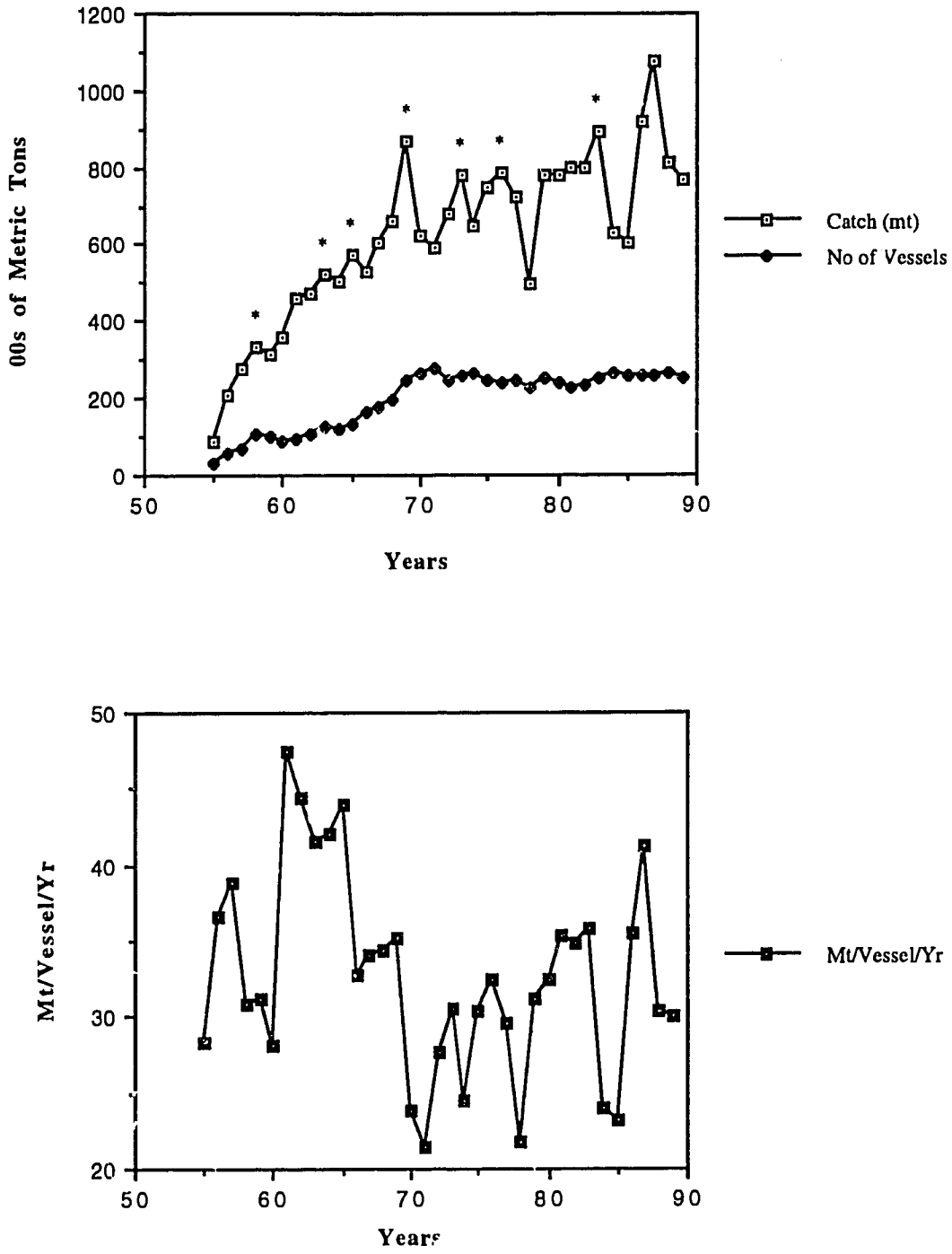


Figure 27. Total Shrimp Catch, Number of Vessels, and Catch per Vessel, 1955-89.

Note: Asterisk indicates El Niño events.

Sources: McPadden, 1984; Rasmusson, 1984; Scott and Torres, 1991.

During the 1980s, the shrimp fleet was relatively stable, averaging 242 boats. Most vessels, roughly 50 percent, are powered by engines of 200 to 290 horsepower (hp), but there appears to be a trend toward larger engines, in the 300-hp range. Vessel size ranges from 10 to 30 m in length. Scott and Torres (1991) report that about two-thirds of the fleet was constructed prior to 1970. The study goes on to highlight that the shrimp fleet is the most obsolete of all the catching subsectors, and recommends a reduction in fleet size to stimulate earnings and incentives to upgrade the sector.

Fishing activity is conducted along the entire coast in depths ranging from five to 80 m. White shrimp are normally found in greatest concentrations near major estuaries and the mouths of rivers. Red shrimp are found in greatest abundance off the Santa Elena Peninsula. Stocks are known to exist in deeper waters, but are lightly exploited.

Data on the species composition are not consistent, but this may be caused by variations in oceanic conditions that favor different species. Barniol (1980) and Cun and Marin (1982) estimate that *Penaeus occidentalis* comprised 50 to 60 percent of the white shrimp catch between 1965 and 1979, and *P. stylirostris* accounted for 25 to 40 percent. *P. vannamei* was generally less than 6 percent of the catch, but increased to 12 percent in 1973 and to 21 percent in 1979. This species is of greater importance in the Gulf of Guayaquil, where it makes up at least 30 percent of the white shrimp catch (McPadden, 1985). In contrast, 64 percent of the white shrimp harvested in the north between Palmar and Atacames was *P. vannamei* (Turner, 1986). Recent estimates by the National Fisheries Institute (INP) indicate that in 1990, *P. vannamei* accounted for 54.4 percent of the total shrimp catch, *P. stylirostris* 14.4 percent and *P. occidentalis* 8.3 percent, while *P. brevirostris* contributed 32.9 percent and *P. californiensis* 12 percent (Scott and Torres, 1991).

Fidel shrimp (*Solonocera florea*) has recently been exploited, particularly during the latter part of the year, and apparently the fishery has a potential for expansion. Attempts are also being made to harvest deep-water shrimp stocks, using fish traps (McPadden, 1985).

Most shrimp trawlers operate out of Guayaquil, with lesser numbers based in Posorja, Playas, Puerto Bolivar, Manta, and Esmeraldas. An estimated 66 percent of the catch is landed in Guayaquil, 24 percent in Esmeraldas, and 10 percent in Manta and Bahia de Caraquez (Arana et al., 1978).

Artisanal Fisheries. Artisanal fishermen work along Ecuador's entire coast. The number employed in the fishery from 1981 to 1983 was about 1,500. In the late 1980s the number has been estimated to be between 11,000 and 18,000, working out of 4,000 to 9,000 small vessels located in 57 to 70 landing sites (Herdson et al., 1982; Zapata and Fierro, 1986 and Scott and Torres. 1991). The largest of these sites are presented in Figure 28.

Artisanal fishing vessels generally fall into one of the following types: balsa (4 to 5 m long), canoa (3 to 6 m), bongo (5 to 12 m), bote (6 to 9 m), and lancha (8 to 12 m). Motors are used on the last three. The only vessels that have diesel engines (30 to 180 hp) are lanchas. Fallows and Contreras (1992) reported over 1,000 fiberglass vessels, most of which were equipped with outboards, in use in 1990.

The sector is poorly developed, has low or subsistence levels of production, and lacks investment, working capital, and infrastructure.

As one moves along the coast the type of artisanal fishing gear varies to reflect differences in infrastructure, demand, characteristics of the ocean floor, and species composition and abundance. For example, in a developed port such as Manta, artisanal fishermen use more sophisticated nets or long lines and motorized fiberglass vessels. In remote areas, dugout canoes powered by paddles or simple sails are common, and the gear used are hand lines and traps. Lobsters are harvested by diving. Small trawlers are used where shrimp are abundant. Most fishing activity is restricted within sight of land, with larger vessels venturing offshore. Major zones of artisanal fishing activity are presented in Figure 29.

Artisanal Fishing Ports

Esmeraldas
1. San Lorenzo
2. Limones
3. La Tola
4. Rocafuerte
5. Rio Verde
6. Palestina
7. Esmeraldas
8. Sua
9. Tonchigue
10. Galeria
11. Estero de Platano
12. Quingue
13. Caimito
14. San Francisco
15. Muisne
16. Chamanga

Manabi
17. Cojimies
18. Pedernales
19. Jama
20. Canoa/Cabo Pasado
21. Bahia de Caraquez/San Vicente
22. San Clemente
23. San Jacinto
24. Crucitas
25. Jaramijo
26. Manta
27. San Mateo
28. Santa Marianita
29. Lingique
30. San Lorenzo
31. Santa Rosa
32. Puerto Cayo
33. Machalilla
34. Puerto Lopez
35. Salango

Guayas
36. Valdivia (San Pedro)
37. Ayangue
38. Palmar
39. Monteverde
40. San Pablo
41. La Libertad
42. Santa Rosa
43. Salinas
44. Anconcito
45. El Real
46. Chanduy
47. Engabao
48. Playas
49. Posorja
50. Estero de Boca
51. Puna
52. Guayaquil/Puerto Lisa
53. Balao Grande

El Oro
54. Tendales
55. Puerto Bolivar
56. Puerto Jeli
57. Hualtaco

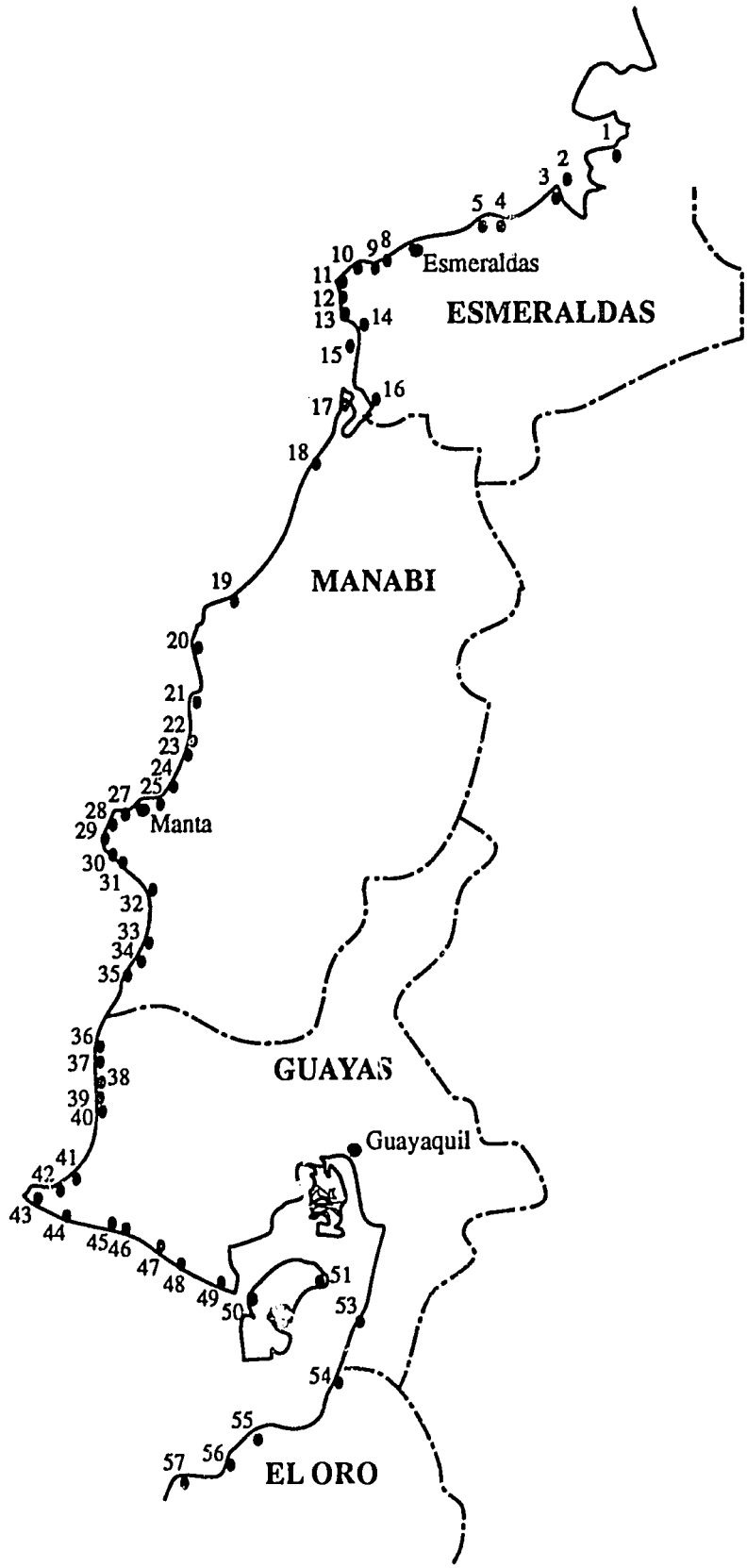


Figure 28. Artisanal Fishing Ports

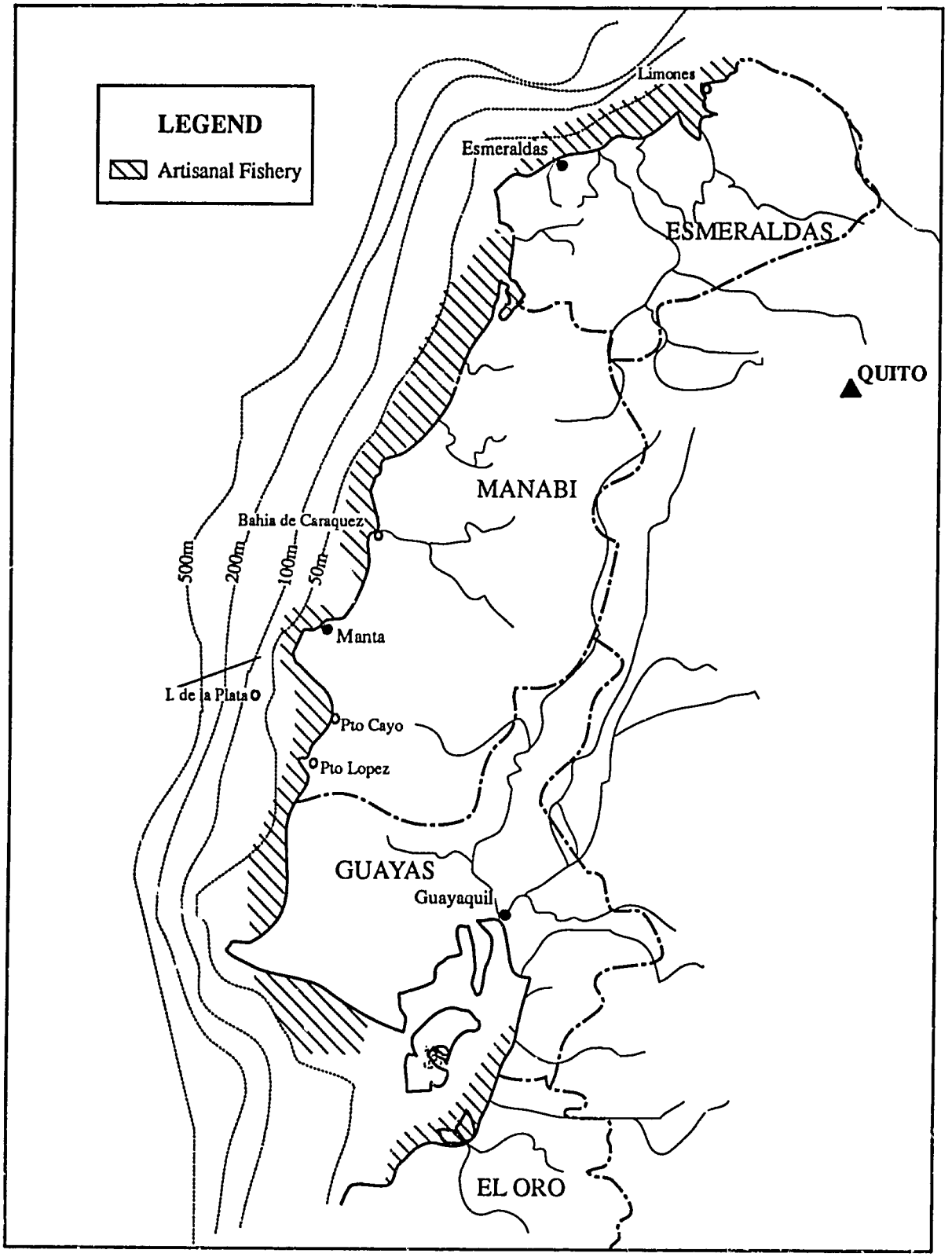


Figure 29. Fishing Zones for the Artisanal Fleet

All studies are in general agreement that infrastructure and services are required to support the sector. In an attempt to improve the situation, effort has been focused on the creation of artisanal fisheries centers and cooperatives, the largest numbers of which are located in the provinces of El Oro and Manabi. According to the INP, there are 50 fishing cooperatives. The majority, however, are not very active, or are in reality nonexistent (FAO/BID, 1986), although a few have been successful in acquiring lanchas, small purse seines, trucks, and market outlets. The principal impediments cited in explaining the low level of success achieved by co-ops are minimal social solidarity, poorly developed entrepreneurial and management capabilities, and a general absence of institutional support. Programs have also been initiated to increase domestic fish consumption, to improve quality and marketing, and to enhance administrative capabilities of co-op managers. Five artisanal fisheries centers in Esmeraldas, Puerto Lopez, Engabao, Santa Rosa, and Puerto Bolivar have reportedly been constructed. Included in the projects are better landing facilities and processing plants. The German Agency for Technical Cooperation (GTZ) funded a project in Esmeraldas province in 1992.

Total Landings and Trends

Total landings for both sectors increased steadily between 1965 and 1976, oscillated from 1978 to 1983, regained their upward trend in 1985, and declined in 1986. Landings in 1985 exceeded those of 1965 by 27-fold, 55,500 mt to 1.5 million mt, and then declined to 390,000 mt in 1990. There were sharp declines, 50 percent in 1983 and 33 percent in 1987, attributed to the El Niño phenomenon, which caused pelagic stocks to disappear or disperse. Figure 30 shows the species composition of landings in the late 1980s. Scott and Torres (1991) point out that variations in annual catch are almost entirely due to fluctuations in the abundance of small pelagic species—such as sardine, mackerel and thread herring—which accounted for 73 percent of total landings in 1988. They go on to warn that the declining trend witnessed over recent years—culminating in extremely low catch levels in 1990—has been put down to overfishing combined with biological and oceanographic factors.

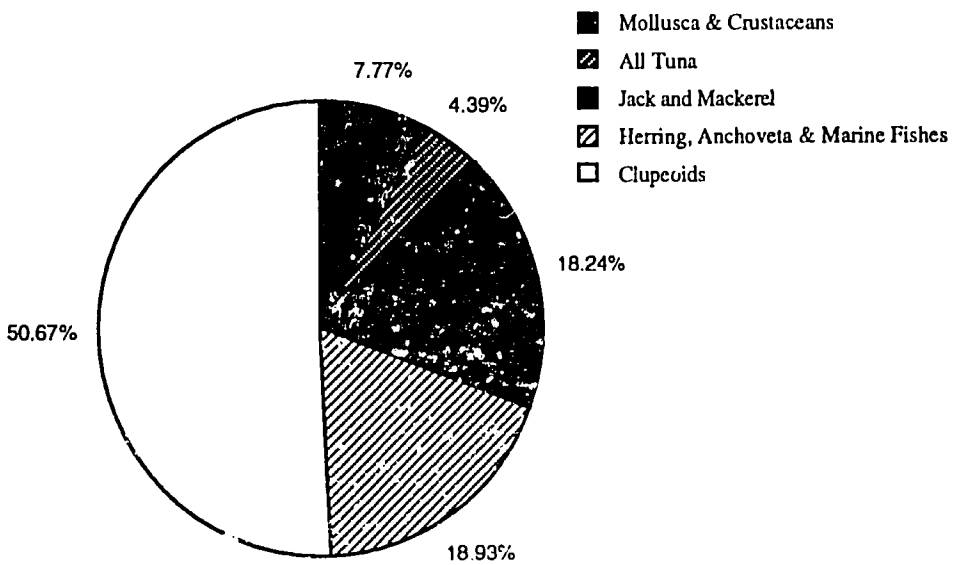


Figure 30. Major Species Groups Composition (by weight) of Fish Landings 1984-1991.
Source: FAO/BID, 1986 and 1991.

Processing

Ecuador's processing sector has modernized to keep pace with increased landings. Scott and Torres (1991) state that the potential for growth in the 1990s will be dependent on resource availability. Their report goes on to mention that there is significant overinvestment in all sectors of the processing industry. Most of the development has been export-oriented, as the domestic market is not well-developed. A description of the industry according to species.groups is presented below. Table 18 summarizes how fish were processed between 1983 and 1990.

Pelagics

Tuna. Most tuna landed in Ecuador is destined to be frozen or canned; less than 10 percent is fresh chilled. Canning plants and cold stores are concentrated in Manta, Posorja, Santa Rosa, and Chanduy. In the 1980s, tuna products did not fare well on the world market. The free on board (FOB) price for canned tuna dropped from U.S. $3,667 per mt in 1981 to U.S. $2,023 per mt in 1990. Over the same period of time the FOB price for frozen tuna fell from U.S. $1,095 mt to U.S. $860 per mt. The trend in tuna utilization is toward freezing rather than canning (Scott and Torres, 1991). Comparing the years 1983 and 1990, the respective proportions of canned to frozen tuna were 51:49 and 26:67. Approximately 20 percent of total production is consumed domestically.

Small Pelagics. The majority of small pelagic species—approximately three-fourths—is converted to fish meal, one fourth is canned, and less than 1 percent is frozen.

Most industrial fish meal plants are found in Posorja, Chanduy, Anconcito, Monteverde, and Salango. Gonzales (1983) states that 33 firms, capable of processing 1 million metric tons of fish into meal, existed in Ecuador in 1981.

Canneries increased their production capacity by 300 percent between 1974 and 1981. Partial closures of regional markets in Colombia and Venezuela and lower prices have hurt the industry in the 1980s. Much of the frozen production is used as bait by long-liners. Smoking and salting is performed at the artisanal level. In 1985, landings of small pelagics exceeded 1.2 million mt, so fish plants were operating at full capacity. In 1990, they employed only 14 percent of installed capacity.

Shrimp. Little information is available on Ecuador's shrimp processing—restricted to heading and freezing raw, shell-on shrimp—and marketing sector. It is known that the number of shrimp freezing and packing facilities grew rapidly during the 1980s to keep pace with the increased production of cultured shrimp. Prior to 1980, the country had fewer than 20 packing firms. By 1985, the number exceeded 40. From 1982 to 1984, 10 percent of the firms exported about 45 percent (by volume and value) of all shrimp. Between 1980 and 1984, Enaca, the largest firm in recent years, had its share of the market drop from 20 to 10 percent (Sutinen et al., 1986). Scott and Torres (1991) write that there were approximately 95 companies that freeze shrimp operating in 1991. Of these, 56 were found in Guayaquil.

Table 18: Processing of Fish Landings (in metric tons): 1983-90

	1983	1984	1985	1986	1987	1988	1989	1990
Total Landings								
TOTAL	331,084	896,182	1,517,606	1,019,304	679,335	871,985	682,872	390,192
Canning	52,726	96,386	96,842	85,134	80,655	63,894	70,410	52,967
Freezing	63,963	83,481	72,672	95,158	122,356	119,454	130,166	136,557
Meal	182,832	692,564	1,315,093	811,337	447,101	654,467	449,314	162,072
Artisanal	31,563	32,411	32,988	27,428	29,191	23,554	20,719	25,765
Fresh/Chilled	N.A.	N.A.	N.A.	N.A.	N.A.	10,580	11,435	12,768
Tuna								
TOTAL	30,136	50,725	54,769	59,204	51,166	49,378	58,470	58,301
Canning	15,317	30,805	23,914	27,098	24,456	21,156	20,466	15,000
Freezing	14,771	28,542	30,802	31,522	26,687	25,559	37,201	38,816
Meal	-	-	-	34	18	2,000	-	-
Artisanal	48	105	53	550	5	10	5	1,171
Fresh/Chilled	N.A.	N.A.	N.A.	N.A.	N.A.	653	798	3,314
Sardine/Herring								
TOTAL	111,607	437,060	722,140	662,714	299,598	422,712	334,391	70,925
Canning	35,523	61,305	67,585	57,090	54,329	39,421	47,586	36,581
Freezing	-	937	25	1,423	1,368	4,996	4,193	1,187
Meal	76,015	374,696	654,512	604,222	243,804	375,300	281,044	32,952
Artisanal	69	122	18	39	97	198	167	123
Fresh/Chilled	N/A	N/A	N/A	N/A	N/A	2,797	1,401	82
Mackerel								
TOTAL	89,293	297,115	534,653	107,711	116,625	180,347	148,112	75,038
Canning	1,886	4,276	5,304	978	1,828	3,317	2,356	1,362
Freezing	3,125	9,090	3,278	6,430	5,131	7,052	6,291	3,118
Meal	84,219	280,956	526,025	100,112	109,507	167,184	136,037	69,959
Artisanal	63	2,793	46	151	157	2,629	2,535	565
Fresh/Chilled	N/A	N/A	N/A	N/A	N/A	165	893	34
Anchovy								
TOTAL	3,346	24,467	3,871	25,877	63,509	32,720	25,868	22,982
Meal	3,346	24,467	3,871	25,877	63,509	32,720	25,868	22,982
Shrimp								
TOTAL	44,600	39,900	36,228	52,794	79,883	82,580	77,073	86,402
Freezing	43,733	39,166	35,548	50,799	78,723	79,052	76,275	84,562
Artisanal	867	734	680	1,995	1,160	3,528	1,428	1,840
Mollusks								
TOTAL	4,500	4,801	5,178	3,513	1,649	1,817	1,916	3,069
Canning	-	-	39	28	42	31	2	20
Freezing	17	-	7	87	72	-	169	630
Artisanal	4,483	4,801	5,119	3,398	1,535	1,772	1,739	2,407

Source: Scott and Torres, 1991

Economic Contributions

Recent estimates of the total ex-vessel value (that received by fishermen) of fish landings in Ecuador* are not available, so export values and sector employment are used as indicators of the industry's economic importance.

The value of fisheries exports, excluding shrimp, rose from less than U.S. $5 million per year in the late 1960s to U.S. $450 million per year between 1988 and 1990. In weight terms, fish meal accounted for 53 percent of exports in the late 1980s. In value terms, shrimp, including farmed shrimp, is the most important, generating about 80 percent of earnings between 1956 and 1990.

Export and trade statistics do not differentiate between captured and cultivated shrimp, but indications are that the export of captured shrimp has oscillated between 5,000 and 8,700 mt per year since the mid-1960s. The export value of trawled shrimp in the 1980s ranged between U.S. $48 million and U.S. $70 million. Between 1976 and 1990, the trade balance for fisheries products remained positive, rising from U.S. $50.7 million to over U.S. $450.7 million. Of the latter, approximately 80 percent was shrimp (Banco Central, 1990).

Employment. Fisheries-related activities, including shrimp mariculture, are an important source of coastal employment. Urriola and Cuvi (1986) estimate that 23,000 worked in various positions connected with the fishery industry in 1986.

Scott and Torres (1991) estimate that total employment in the fisheries sector is in the vicinity of 174,000, of which 77,000 are full-time and the rest part-time. Estimates for 1991 by the Camara de Productores de Camaron state the direct employment generated by the shrimp mariculture industry alone to be 215,772 direct employees and 23,508 indirect employees. Each of these estimates appears to be vastly overstated. For example, they presume there are between 87,000 and 90,000 gatherers of shrimp PL, whereas a recent study of the sector (Gaibor, 1993) finds the number of PL gathers to be 16,000. Scott and Torres (1991) estimate that 29,000 are directly employed in catching, processing and other sectors related to the capture fisheries, a figure that appears reasonable.

Domestic Fish Consumption. Approximately 85 percent of Ecuadorian fish production is exported. The per capita consumption of fish is about 9.5 kg per yr (Scott and Torres, 1991). Poor quality, bad handling, a lack of infrastructure, and poor distribution constrain development. An additional consideration is that fish is more costly than substitute goods such as meats and chicken. Per capita consumption is much higher on the coast than in the Sierra.

Government Fisheries Institutions and Development Incentives

In 1960, the Instituto Nacional de Pesca (INP) was created as the state entity charged with conducting scientific research and promoting activities within the fisheries sector. The commercial development of the industry was assigned to the Empresa Pesquera Nacional (EPNA). Activities of both agencies were placed under the Subsecretaria de Recursos Pesqueros (SRP), located in Guayaquil. SRP was initially formed as part of the Ministerio de Recursos Naturales, but was placed under the Ministerio de Industrias, Comercio, Integración y Pesca in 1984.

Development of marine fisheries has long been supported by the government. In the late 1970s and early 1980s, cheap fuel was a major attraction for foreign investment and

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* FAO (1987) estimated the ex-vessel value of fisheries output to be U.S. $38.2 million in 1975.

vessels. Fish exporters also receive a direct subsidy based on the value of their exports. In August 1986, the subsidy was increased to 20 percent, and exporters were exonerated from paying duties on goods that are later exported or used in the production of exportable goods.

Important financial and credit support schemes have been made available to foster industry growth. Exporters were also allowed to use dollars to import goods duty-free. Abuses of this privilege prompted the government to terminate many of these benefits in 1982, but they are still applicable to equipment used in the fish-canning and processing industries.

Issues for a CRM Program

As is the case with all coastal issues, addressing fisheries management implies consideration of a number of interrelated factors—environmental, biological, social, and economic. Controlling degradation of coastal water quality, preserving nursery and fishery habitat threatened by construction of shrimp mariculture ponds, reversing overfishing of certain species and encouraging exploitation of others, protecting jobs and sources of foreign currency are major considerations when managing fisheries for maximum sustainable benefits. Failure to address them will ultimately lead to fisheries decline, which, in turn, will cost Ecuador millions of dollars in exports, domestic food sources, employment, and possibly irreversible damage to habitat and resources.

Major shortcomings and issues involving proper fisheries utilization and management identified by Reck (1981) are summarized below:

- Ecuador's capture fisheries are primarily dependent on harvesting migratory pelagics that cross international boundaries. Actions by one country can influence the condition of stocks in another. This, combined with limited understanding of the impact of the El Niño on stocks, complicates management and threatens the validity of standard fisheries models.

- The crash of anchoveta stocks off Peru in the early 1970s shows the vulnerability of certain species. Attempts must be made to ensure that the situation does not repeat itself with stocks important to Ecuador.

- The principal demersals harvested are shrimp. The potential to harvest other demersals is limited by the narrow continental shelf and low numbers of areas suitable for trawling, but species such as hake and deep-water shrimp may have potential and should be studied.

- There are no specific programs to monitor and develop the artisanal fisheries sector.

- Fisheries investigation has stagnated. Accurate data on basic biological parameters such as catch per unit effort and species composition of catch are incomplete or unknown. Little experimental trawling, sampling, or monitoring are done.

- There is a need to improve utilization of catch. Most of Ecuador's harvest is converted to fish meal. Many of the species can be better utilized. Value can be added by improving transportation, storage, and marketing.

- The impact of mangrove cutting on marine fish stocks is unknown.

- There are no regulations governing the introduction of exotic species.

- New hydroelectric and irrigation projects have not been thoroughly assessed to determine the impact on water quality, natural ecosystems, and species that rely on periodic flooding at some stage in their life cycles.

- Little attention has been focused on the possibility of developing freshwater fisheries.

- There is a lack of coordination among government agencies responsible for fisheries-related programs. In some instances, tasks are duplicated, and much of the data produced is contradictory.

- Fisheries regulations reflect the period during which the country was concerned with development of its industrial sector, and do not address resource management. In some instances, they promote overexploitation. Laws that regulate resource exploitation often are not supported by enforcement, and are not clear in specifying responsibility among the Ministry, Subsecretaria, and Director General of Fisheries.

- Ecuador's institutional structure is rigid and does not provide the flexibility required to resolve issues related to renewable resources. In some instances, government agencies are assigned contradictory roles, such as simultaneously developing and protecting natural resources. Mandates for institutions to expand their activities are not sufficiently supported by increases in staff and budget allocations.

VI. SHRIMP CULTIVATION

Historical Overview

Indigenous cultures apparently practiced aquaculture along the coast of Ecuador over 5,000 years ago by closing off lagoons when they were seasonally flooded with seawater that carried shrimp larvae and small fish. In 1968, an observant owner of a banana plantation in El Oro noticed abundant quantities of shrimp flourishing in floodwaters trapped behind an embankment (Olsen and Maugle, 1986b). Early cultivation techniques were extensive and involved no supplemental feeding. Little was known about the complexities of raising shrimp. Yields and total production were low. From this meager start sprang an industry that has rapidly transformed Ecuador's coastal fringe and, to a large degree, its economy.

With increasingly positive results, large numbers of investors were lured into the industry. According to Hirono (1983), attraction to the industry made it akin to a gold rush. McPadden (1985) indicates that rapid industry expansion was reliant on the abundance and quality of natural coastal resources—specifically, large tracts of intertidal mangroves and salt flats, which were developed at low cost, and an abundance of postlarvae (PL).

By the early 1980s, shrimp mariculture had emerged as the most important activity in the coastal zone. By 1983, Ecuador could boast that it was the world's number one producer of cultured shrimp, and in 1987 surpassed Mexico as the largest supplier of shrimp to the United States. The value of shrimp exports approached U.S. $500 million in 1991; in terms of foreign currency earnings, shrimp ranks second only to oil, and is the largest single source of foreign earnings for the private sector. The amount invested is over U.S. $1 billion (Olsen and Maugle, 1986). However, the industry failed to keep pace with international competition, principally from Southeast Asian countries, in the late 1980s and, as of 1990, had fallen to fifth place in the production of cultured shrimp.

It is difficult to quantify with any accuracy the various parameters of the industry's physical expansion. Many ponds are located in the intertidal zone, *tierra baja*, which is officially government domain and, consequently, requires government authorization before it can be modified. There is confusion over the area authorized, the area actually in production each year, and the cumulative area altered to construct ponds, since 1) shrimp ponds have been, and continue to be, constructed without authorization; 2) not all the areas authorized have, to date, been utilized; 3) some shrimp ponds have never been in production, or are periodically removed from production for technical, managerial, or economic reasons; and 4) the total area occupied by shrimp growers is not converted to ponds, since a portion of all holdings must be reserved for access roads and facilities.

Area Authorized and Area in Production

Estimates of the cumulative area authorized and area believed to be producing between 1974 and 1991 are presented in Table 19 and Figure 31. Growth was relatively slow and sporadic through the 1970s, began increasing exponentially after 1979, and tended to slow after 1986. The largest concessions were granted in 1981 and 1986. The 1984 increase was, most likely, a response to a dramatic increase in productivity experienced by the industry as a result of the El Niño phenomenon in 1982-83 (El Niños favor shrimp growth). Worry that steps might be taken to preserve intertidal areas by prohibiting the cutting of mangroves may also have prompted some to seek concessions while the getting was good. The salient point is that leases of intertidal areas increased from about 400 ha in 1976 to approximately 157,000 ha by 1991. This represents a 400-fold increase over 16 years.

Table 19. Estimates of the Total Area (in ha) Authorized, in Production, and Converted for Shrimp Cultivation, 1974-91.

	Authorized				In Production		Total Area Converted
	Each Year		Cumulative		Cumulative		Cumulative
Year	DGP	CPC	DGP	CPC	CPC	Others	
1974						600a	
1975		63		63			
1976	439	300	439	363	316		
1977	1,906	1,312	2,345	1,675	1,690		
1978	1,833	1,502	4,178	3,177	3,011		
1979	2,767	2,239	6,945	5,413	5,005	24,000b	
1980	7,762	6,935	14,707	12,351	10,599	30,000c	
1981	20,385	15,600	35,092	27,951	25,291	32,000d	
1982	13,186	12,015	48,278	39,966	34,794	32,500e	
1983	13,969	12,890	62,247	52,856	44,861		89,368h
1984	24,199	23,652	86,446	76,506	62,302	48,000f	
1985	16,041	15,795	102,487	92,303	73,862		75,000i
1986	19,192j		121,679j		87,564	30,000g	60,000k
1987	7,475j		121,154j		92,952		
1988	9,898j		139,052j		100,000		
1989	6,236j		145,284j		104,000		
1990	5,205j		150,489j		121,560		
1991	6,505j		156,994j		131,800l		145,998m

Sources: DGP (Dirección General de Pesca)
CPC (Camara de Productores de Camaron)

a McPadden, 1985
b Calvas, 1980
c NMFS, 1981
d Barniol, 1980
e Banco Central, 1982
f Parodi, 1985
g Olsen and Maugle, 1986
h CLIRSEN, 1985
i LiPuma and Meltzoff, 1986
j Subsecretary of Fisheries, 1992
k Horna, et al., 1986
l CLIRSEN, 1992
m CPC, 1992, personal communication

Estimates of the area actually in production during a given year vary greatly. Depending on the source, up to 37 percent of the ponds were taken out of production during or after 1984. A shortage in the natural abundance of PL, that began to appear in 1984, is generally stated as the rationale for reducing the area in production. In addition to shortages in PL, poor construction techniques, inappropriate siting, poor water quality, a lack of technical expertise required to maintain satisfactory levels of production, cash flow problems, the high cost of capital, and poor management contributed to the decrease in productive capacity. An abundance of PL associated with El Niño events lowers operating cost, causing a greater number of the shrimp ponds to be brought back into production. During the late 1980s and early 1990s, about 20,000 ha of the area authorized was not in production each year.

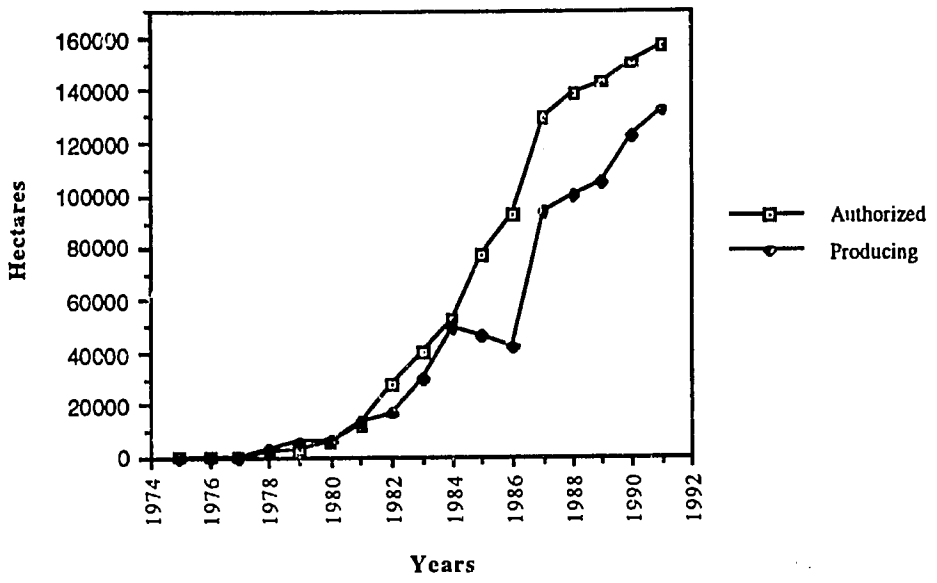

Figure 31. Comparison of Area Authorized and Area Producing Shrimp, 1975-91.
Sources: Camara de Productores de Camaron, 1987 and 1989; Dirección General de Pesca, 1986; Subsecretary of Fisheries, 1992.

Shrimp Ponds and Mangroves

Location and Size. Data on the number, size, and location of shrimp ponds in Ecuador are not available, and therefore government statistics on authorizations have to be used to identify these parameters. Table 20 summarizes the numbers and sizes of leases authorized in each province between 1976 and 1991. Fifty-three percent of the number of concessions and 72 percent of the area authorized for shrimp ponds are located in Guayas. The average size of a concession ranges from 31 ha in Manabi to 97 ha in Guayas, with an overall average of 71 ha. Government data on the number and size of concessions awarded by the end of 1991 indicate that large concessions are held by a few firms. At the time, approximately 90 percent of the total area authorized bordered the Guayas Estuary.

Siting. Four types of land are converted to shrimp ponds: mangroves, salt flats, low-lying agricultural land, and arid areas (the last is primarily on the Santa Elena Peninsula). LiPuma and Meltzoff (1986) estimate that 70 percent of the shrimp ponds are located in mangrove areas, 15 percent on salt flats, and 15 percent on converted farmland, while McPadden (1985), the SRP (1986), and the Camara de Productores de Camaron (1989) report that 38 to 41 percent of the ponds are located below the mean high water mark (Table 21).

Table 20. Cumulative Number of Concessions and Area (in ha) of Shrimp Ponds Authorized by Province by Year, 1976-91.

Year	Total #	Total ha	Guayas #	Guayas ha	El Oro #	El Oro ha	Manabi #	Manabi ha	Esmeraldas #	Esmeraldas ha
1976	6	439	2	300	3	119	1	20	0	0
1977	27	2,345	13	859	8	734	6	752	0	0
1978	52	4,176	25	2,625	9	749	8	804	0	0
1979	84	7,125	50	4,331	14	1,247	20	1,574	0	0
1980	157	14,887	104	10,944	24	2,121	28	1,772	1	50
1981	344	35,272	207	25,887	94	6,526	39	2,403	4	506
1982	460	48,458	278	35,986	123	8,652	53	3,142	6	678
1983	582	62,427	364	47,398	137	9,978	70	4,001	4	1,050
1984	84	86,626	521	67,521	174	12,529	97	5,125	19	1,451
1985	1036	102,667	654	78,933	229	15,587	121	5,906	32	2,241
1986	1,460	121,679	769	87,743	360	21,789	231	8,863	100	3,284
1987	1,608	129,154	855	93,160	388	22,831	259	9,706	106	3,457
1988	1,794	139,052	945	100,625	424	23,990	307	10,754	118	3,683
1989	1,920	145,284	1,021	104,664	439	25,311	332	11,416	128	3,893
1990	2,087	150,489	1,096	108,118	466	25,875	386	12,074	139	4,422
1991	2,212	156,994	1,163	112,681	485	26,661	408	12,666	156	4,986
Avg. size		71		97		55		31		32

Source: SRP, 1992.

Table 21. Shrimp Ponds Situated Above or Below Mean High Water, 1983-87, and 1991.

Year	Below M.H.W (ha)	Above M.H.W. (ha)	Total (ha)	% Below M.H.W.
1983	27,400	33,000	60,400*	45.4
1984	37,388	54,482	92,371**	41.0
1985	36,090	57,289	93,379**	38.6
1986	36,448	57,904	94,352**	38.6
1987	44,439	69,766	114,205***	38.9
1991	86,745	59,253	145,998****	59.4

Sources: * McPadden, 1985
**Subsecretaria de Recursos Pesqueros, 1986.
***Camara de Productores de Camaron, 1989.
****CLIRSEN, 1991.

The most reliable information on shrimp pond siting has been compiled by the Centro de Laventamientos Integrados de Recursos Naturales por Sensores Remotos (CLIRSEN) based on comparison of photographs taken by remote sensors in 1969 and 1991 (Table 22). If one assumes that the total loss of mangrove stands and salt flats identified by CLIRSEN is attributed to construction of shrimp ponds, then 59 percent of the 146,000 ha of shrimp ponds identified by CLIRSEN, 86,744 ha, are located in mangroves and salt flats. These data indicate that, nationwide, 20 percent of the mangroves and 88 percent of the salt flats were lost within 22 years. Manabi fared the worst of any

coastal province, losing 64 percent of its mangroves and 80 percent of its salt flats. Figure 33 portrays the relative change in mangrove and salt flat areas between 1969 and 1991. Overall, 28 percent of ponds have been constructed in areas that were previously mangrove and 31 percent now occupy area that was once salt flats. Consequently, 59 percent of all shrimp ponds (86,745 ha) were constructed in intertidal areas and 41 percent (59,253 ha) are above mean high water.

Table 22. Changes in Intertidal Areas by Province, 1969-91.

Province	Year	Mangroves (ha)	%	Salt Flats (ha)	%	Shrimp Ponds (ha)
Guayas	1969	125,523	100	40,899	100	
	1991	109,928	88	4,520	11	94,124
	Loss	15,595	12	36,379	89	
El Oro	1969	33,654	100	9,782	100	
	1991	20,918	62	1,637	17	33,006
	Loss	12,736	38	8,145	83	
Esmeraldas	1969	32,033	100	0	0	
	1991	26,663	83	0	0	6,289
	Loss	5,370	17	0		
Manabi	1969	12,416	100	815	100	
	1991	4,547	16	164	20	12,579
	Loss	7,869	64	651	80	
Total	1969	203,626	100	51,496	100	
	1991	162,056	80	6,321	12	145,998
	Loss	41,570	20	45,175	88	
Percentage of Shrimp Ponds		28		31		100

Source: CLIRSEN, 1992.

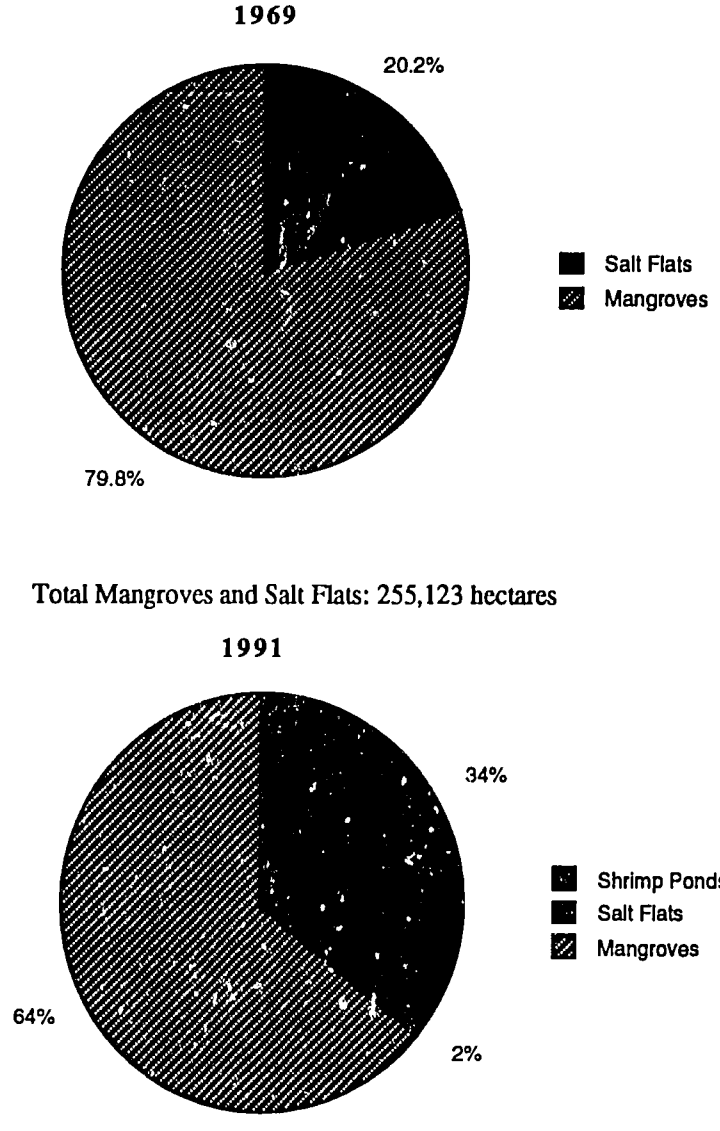

Figure 32. Composition by Area of Intertidal Vegetation in Ecuador, 1969 and 1991.
Source: CLIRSEN, 1992.

In 1986, LiPuma and Meltzoff stated that there had been a shift toward greater utilization of land above the high water mark for shrimp culture. The transition, it was generally believed, was occuring because 1) the cutting of mangroves was legally prohibited; 2) the industry was employing more intensive cultivation techniques, which were more easily conducted from land; 3) financing and credit were more easily secured, since land could be used as collateral, whereas government leases of intertidal land cannot; and 4) the added security derived from retaining title to a property created a more stable business environment, thus encouraging greater investment by prolonging the time horizon over which investments can be recouped.

In addition, LiPuma and Meltzoff (1986) state that "the common wisdom, other factors notwithstanding, is that farmland contains the richest nutrients, followed by acid mangroves, and then barren salt flats." Use of farmland provides an opportunity for owners to more easiiy increase the intensity of culture and, consequently, yield, and to expand the physical area of their operations. There are, presumably, economies of scale associated with each action. Conversion of dry areas is also encouraged by industry spokespersons who fear that further infringement into intertidal areas will reduce the supply of natural PL.

Several of the assumptions made by LiPuma and Meltzoff no longer appear to be valid. Despite a reduction in the annual rate of mangrove loss during the mid-1980s, deforestation accelerated in the late 1980s.

Postlarvae for the Industry

Shrimp growers rely on three sources for PL: 1) fishermen, who harvest natural PL from estuaries and the ocean; 2) hatcheries, and 3) on rare occasions, imports.

PL Fishermen. Wild postlarvae are collected nearshore by fishermen (*larveros*), who use various designs of fine-meshed nets. Of the three most prevalent species—*Penaeus occidentalis, P. stylirostris*, and *P. vannamei*—the last is preferred by shrimp growers, as it is hearty and fast-growing. Catch rates are highest during semimonthly high tides, when shrimp concentrate in lower reaches of creek . Variations in natural abundance occur as one moves north to south along the coast, as well as seasonally (the PL fishery peaks between December and March and bottoms out between May and October) and year to year. The abundance of natural PL increases dramatically during El Niño years.

After capture, PL are stored in containers before being sold to middlemen, who transport them to shrimp farms in tanks and barrels by truck. Mortality at capture is reportedly as high as 50 percent (Horna et al., 1986).

Nursery Ponds/*Precriaderos*. In an attempt to add value to PL, small-scale, independent individuals that capture PL or purchase them from larveros place the PL in nursery ponds or *precriaderos*. After three to four weeks, PL have grown in size and can be sold as higher-valued juveniles. Precriaderos are normally small, less than 50 m^2, shallow, and located adjacent to settlements. There is minimal circulation, and water quality is poor and often contaminated by human waste. Mortality rates of 60 percent are common in precriaderos (residents of Bunche and Atacames, pers. comm.).

Hatcheries. Concern over the instability of supply and of prices of PL prompted construction of hatcheries. The first was established in Guayas in 1980. Subsequent PL shortages resulted in rapid expansion of hatchery capacity. By 1984, four hatcheries were producing PL, and 14 others were in various stages of construction. Production of hatchery PL was less than 300 million PL per year in 1985 (NMFS, 1986). McPadden (1985) subsequently estimated Ecuador's hatchery production potential at 2.4 billion PL per year, although Mark Leslie (pers. comm., 1986) states that actual production in 1985 was in the vicinity of 500 million PL. The SRP stated that by October 1986 it had authorized construction of 105 hatcheries, but lacked information on the number actually constructed. The Camara de Productores de Camaron (1987) reported 43 hatcheries in operation, ranging in size from 4 million to 500 million PL per year and 14 additional hatcheries under construction, with individual production capacities ranging from 25,000 to 198,000. A census conducted by the Instituto Nacional de Pesca, reports that 347 hatcheries had been constructed as of 1991. Of these, 257 were operational and the remainder were either closed or under construction. Theoretically, the combined annual

production capacity of hatcheries approaches ten billion PL*, but there are large gaps between theoretical and actual production.

Hatchery PL are produced by 1) placing gravid—egg bearing—females obtained from the wild in tanks, 2) spawning and the collection of eggs, 3) hatching the eggs to the first larval stage, the nauplii, and 4) rearing the larvae. Efforts are underway to obtain PL by forcing accelerated development of ovaries (maturation), but results have been mixed, and therefore hatcheries remain ultimately dependent on natural stocking. Even if the process is perfected, hatchery production is not immune to environmental changes. Factors such as water temperature, oxygen levels, variations in the presence and levels of bacteria and algae, and water quality will influence production capabilities.

There are unconfirmed reports that Ecuadorian laboratories had begun to export PL to shrimp ponds in neighboring countries in 1991.

Imports. In addition to the supply from fishermen and hatcheries, PL have sporadically been imported from Peru and as far away as the Philippines, Panama, and the United States (Sutinen et al., 1986; Maugle, pers. comm., 1986).

Demand and Supply of PL. The annual demand for PL, for each of 100,000 ha of shrimp ponds in production, has been estimated to be between 9.2 and 22 billion (Table 23). Evidence indicates that the industry is expanding in area and moving toward more intensive culture. Given this trend, demand for PL, even holding the present area in production constant, would at least double if all farms adapted intensive cultivation techniques. It should also be noted that wild and hatchery-reared PL are not exact substitutes, as growers prefer wild PL, which they claim is hardier and faster-growing.

Industry expansion has, and obviously will, continue to be dependent on adequate supplies of PL. Shortfalls in natural production are being offset by hatchery production, but one must question the long-term economic viability of hatchery operations, particularly those not part of an integrated operation. Prices for PL, whether they be from hatcheries or collected in the wild, are determined by the interaction of supply and demand. During El Niño years, when PL are abundant, prices drop and many hatcheries become uneconomical. In this instance, growers who own hatcheries absorb the loss, and independents face the possibility of bankruptcy. Increased hatchery production and efficiency is necessary to keep pressure from becoming too high on natural stocks, but investment in hatcheries is extremely risky. Hatcheries must also prove to growers that their PL are as resilient, fast-growing, and desirable as wild PL.

Table 23. Demand for Postlarvae Required to Stock 100,000 Has.

Source	Average Stocking Density/ha/harvest	Number of Harvests/yr	Survival[1] Factor	PL/ha/yr	Total Demand/ 100,000 ha (in billions)
McPadden (1985)	50,000	2.2	2 (50% surv)	220,000	22
NMFS (1986)	35,000	2.2	2 (50% surv)	154,000	15.4
FAO/BID (1986)	60,000	2.2	1[2]	132,000	13.2
Hirono (1987)*	45,600	2	1[2]	91,200	9.1

[1]Estimated survival between capture and stocking into grow out ponds.

[2]Mortality is not mentioned.

* Hirono (1987) calculates an average yield of 811 lbs per ha comprising 31-35/36 count shrimp, which implies an annual harvest of 28,400 shrimp. Thirty-five percent of the shrimp purchased survive grow-out—50 percent survival in nursery ponds and 70 percent survival from transfer to the grow-out ponds until harvest—which implies that growers purchase an average of 81,200 PL per ha in production. In addition, he assumes 65 percent of the wild postlarvae survive capture, manipulation, and transport (a conservative estimate), and are stocked in nursery ponds. Based on his calculation, 125,000 PL must be captured for each hectare in production.

How the Industry Functions

After harvest, PL are usually placed in precriaderos at stocking densities of 1 million or more per ha for 21 to 45 days. When the larvae reach two to three grams, they are transferred to larger (five to 50 ha) grow-out ponds (LiPuma and Meltzoff, 1986; McPadden, 1985). Stocking densities in grow-out ponds are dependent on which of three production strategies is employed (extensive, semi-extensive, or semi-intensive). Each is differentiated by the type and magnitude of input and, consequently, yield (Table 25). McPadden (1985) reports that the grow-out time under semi-intensive production is between 120 and 140 days, with yields of 3,000 to 5,000 pounds per ha per year, versus 600 pounds per ha per year under extensive culture. There are generally two harvests per year, which are synchronized with the abundance of PL. Grow-out ponds are regularly monitored for primary productivity, oxygen levels, biomass, and growth. Pumps are used to maintain a continuous flow of water.

Table 24. Comparison of Shrimp Cultivation Techniques.

	Water Exchange	Nursery Ponds	Fertili-zation	Supplemental Feeding	Stocking Density/ ha/yr	Yield (lbs/ha/yr)	Avg. Pond Size(ha)
Extensive	Low	No	No	No	10000	600	Small
Semi-extensive	Medium	Yes	Yes	Near End	30,000-35,000	1,000-2,000	100+
Semi-intensive	Highest	Yes	Yes	Throughout	80,000-100,000	2,000-5,000	100+

Source: McPadden, 1985.

LiPuma and Meltzoff (1986) estimate that the extensive method is used in 35 percent of the shrimp ponds, the semi-extensive method in 55 percent, and the semi-intensive in 10 percent. If this distribution is accurate, farms using the extensive method account for only 9 percent of total shrimp production, semi-extensive for 58 percent, and semi-intensive for 33 percent (Sutinen et al., 1986). The CPC (1991) report that, during 1991, 10 percent of the ponds in production employed extensive culture techniques, 40 percent semi-extensive and 50 percent semi-intensive.

Harvesting. Barniol (1980) states that the decision to harvest is determined by the weight and growth rate of the shrimp, by market prices, and by the extent of predation (by crabs, birds, and human thieves). Harvesting is achieved either by partially draining the pond and using a cast net, or by complete draining, then capturing shrimp as they leave the pond. The average size of shrimp harvested is 31 to 35 individuals per pound. Recent changes in the world market have convinced some growers that harvesting smaller shrimp is more profitable.

Processing and Marketing. After harvest, shrimp are iced and transported to packing houses, where they are separated by size, then deheaded and frozen, usually in five-pound boxes. Nearly all production is destined for export, with 96 percent of reported exports marketed in the United States. NMFS (1981) states that three U.S.-based importers purchased over 50 percent of all Ecuadorian shrimp exported to the United States. Larger quantities of shrimp, up to 39 percent, were exported to Europe in 1991 as part of an effort to diversify and expand Ecuador's markets.

In 1989, there were 75 shrimp packers and processors operating in Ecuador.

Economic Contributions

Statistics on the value and quantity of Ecuadorian shrimp exports have historically been understated, since there was economic motivation in taking advantage of discrepancies in exchange rates and export incentives between Ecuador and Peru by illegally selling shrimp to Peru. LiPuma and Meltzoff (1986) state that the sale of shrimp worth U.S. $1,000 would convert to 125,000 sucres under the floating rate (in Peru), but only 95,000 under the official Ecuadorian rate in 1985. Profit-motivated Ecuadorians consequently smuggled shrimp to Peru to obtain the floating rate. Peruvian export incentives, which add 36 percent onto the export value over and above the floating rate, create an additional incentive to smuggle. Ecuadorians also benefit by avoiding income and export taxes. Smuggling has apparently become less prevalent due to less favorable discrepancies in exchange rates, but there are unreported and under-reported sales of Ecuadorian shrimp within the official system, for it is common practice to understate the size category and, consequently, the value per pound.

Even taking these factors into consideration, estimates of the growth in mariculture production, and in the quantity and value of exports have been impressive. Depending on the source, between 1976 and 1991, the volume of cultured shrimp exports jumped from 4,768 mt to 79,407 mt. During the same period, the value of shrimp exports increased 20-fold, from U.S. $24.6 million to U.S. $491.4 million. During 1991, total shrimp accounted for 17 percent of Ecuadorian exports, 29 percent of the total value of private sector exports, and over 80 percent of the value of fisheries exports. (Figure 33).

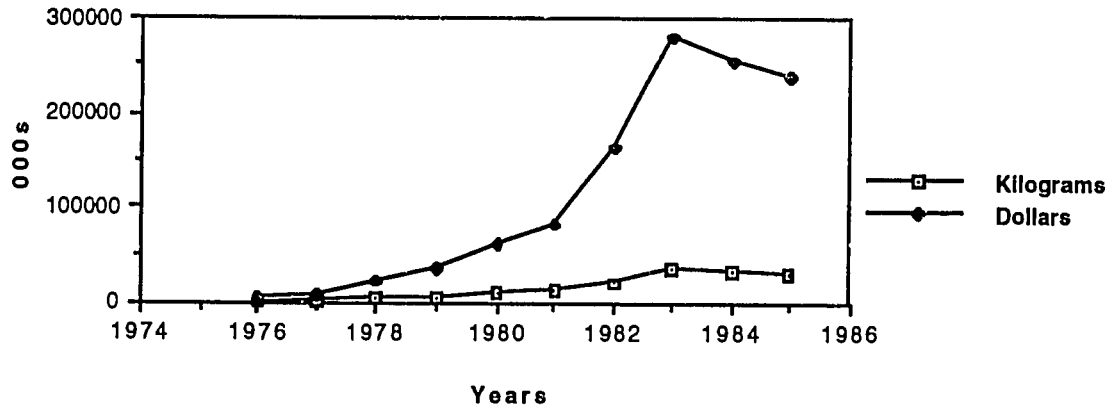

Figure 33. Production and Export Value of Cultivated Shrimp, 1976-85.
Source: Camara de Productores de Camaron, 1987.

Employment. In addition to foreign currency generated by the sale of shrimp, the industry has significantly increased employment along the coast. In 1980 there were an estimated 2,000 to 3,000 larveros collecting PL. Assuming an annual capture that year of 5 billion PL, which sold at 25 sucres per 1,000, an average fisherman's earnings were 41,667 sucres (U.S. $1,700). McPadden (1985) states that up to 90,000 part-time and full-time fishermen had entered the industry by 1983. The value of the PL fishery at the beach had increased from 125 million to 900 million sucres between 1980 and 1983, but the tremendous increase in the number of fishermen caused average yearly earnings to fall to 10,000 sucres (Sutinen et al., 1986). In addition, employment has also been generated on farms, in packing houses, in transport and marketing, in pond construction, on boats

(where gravid females are collected), and in feed mills. Other studies estimate that 25,000 to 40,000 were employed during 1984 in these activities. Total employment generated by the industry cited by LiPuma and Meltzoff (1986) was estimated to be 120,000. There is a wide range of estimates of the number of persons employed by the shrimp industry in 1991. The Camara de Productores de Camaron (1992) estimates that the sector provides direct employment for 215,772 and indirect employment for 23,508 workers (Table 25).

Table 25. Employment Generated by the Shrimp Mariculture Industry: 1991.

Direct	
Artisanal Fishermen	50,000
Industrial Fishermen	2,600
PL Gatherers	86,995
PL Laboratories	5,659
Hatchery/Cultivators	57,778
Processing	12,740
Total (Direct)	215,772
Indirect	23,508

Source: Camara de Productores de Camaron, 1992

These estimates, however, appear to be drastically overstated. It is doubtful that there are 50,000 artisanal fishermen engaged in mariculture-related activities when studies of the sector (Scott and Torres, 1991) indicate that there are a total of 18,000 full-time artisanal fishermen in the country. The number of PL gatherers must also be questioned, as a recent study of the fishery (Gaibor, 1993) estimates the total number of larvaes to be 16,000). There is also no differentiation between full- and part-time employment.

Employment on shrimp farms ranges from less than a dozen full-time laborers on farms smaller than 50 ha, to 70 employees on the largest.

Industry Expansion in the Future

From the perspective of land availability, shrimp mariculture in Ecuador has an almost unlimited ability to expand production. Possible directions involve redemption of ponds constructed but not in use, utilization of more intensive culture to increase yields, and construction of more ponds. McPadden (1985) estimates that between 70,000 and 260,000 ha of land are suitable for conversion to shrimp ponds. If all existing farms were to utilize semi-intensive cultivation, and if yields corresponded to existing upper limits (5,000 pounds per ha per year), Ecuador would theoretically increase production by 250 percent without enlarging the area under production. This may seem optimistic, yet intensive shrimp cultivation in Taiwan is producing 33,000 pounds per ha.

In reality, the industry's growth potential is determined by economic factors such as foreign competition, fluctuations in world prices, changes in the structure of costs, currency exchange rates, and the efficiency of new culture and laboratory technologies, to name a few. The quantity of land utilized for commercial shrimp cultivation will ultimately be determined by the costs and earnings of farms on marginal land (Sutinen et al., 1986).

In addition to perfecting existing culture techniques to meet increased competition in the world market for shrimp, the industry may diversify to alternative species and culture

techniques. Technology, cost structure, and markets are constantly changing. It is not difficult to envision, particularly given the infrastructure and expenditure, that Ecuador may someday employ polyculture, cage or pen culture, raceways, and other methods to cultivate finfish, bivalves, and/or seaweeds.

Issues for a CRM Program

The issues that revolve around shrimp culture in Ecuador are far-ranging, and must be examined within an industrial, economic, and social context. For example, in addition to the benefit of the industry to the national economy, many coastal residents and local economies are heavily dependent on the industry's performance. On the negative side, the industry has provoked controversy and public concern as large areas of coastal mangrove and salt flat habitats are being destroyed. The environmental and economic consequences of these actions have not been fully defined, but there is reason to fear that capture fisheries and natural productivity are being adversely affected.

The mariculture industry itself is being pulled in two directions. On one hand, there are economic incentives and support to continue rapid expansion. On the other hand, industry performance is closely linked to environmental quality—specifically, the relationship between the supply of wild PL and habitat.

In an effort to define and address these issues, CRMP personnel assembled an interdisciplinary team of national and international experts in environmental, biological, economic, technical, and socio-political aspects of shrimp mariculture at a workshop in Guayaquil in August 1986. The following strategies, based on Olsen and Arriaga (1989) were formulated to promote a sustainable mariculture industry after the workshop.

- *Water Quality.* Good water quality is crucial to shrimp cultivation and the maintenance of natural shrimp nurseries and habitats, yet there is increasing evidence that urban growth, industry, mining, and hydroelectric projects, as well as mariculture itself are contributing to declining water quality in Ecuador's rivers, estuaries, and coastal areas. Hatchery operators and growers report occasional mass mortalities, blooms of microscopic algae, and reduced growth rates attributed to low water quality. Such allegations have justifiably heightened public concern that humans are also experiencing health problems related to water quality.

  A top priority should therefore be the establishment of an ongoing collection of baseline data and a monitoring program to assess and prioritize water quality problems. To whatever extent possible, existing analytical capabilities should be expanded, not duplicated. A network of in-country diagnostic laboratories capable of identifying water quality and levels of pollutants is needed. Steps must also be taken to identify and reduce known contaminants.

- *Habitat and the Supply of Postlarvae.* To date, industry performance has been strongly correlated with fluctuations in the natural abundance of PL. During El Niño years, the industry flourishes; in intervening years, the supply of PL determine the area under production.

  Research conducted worldwide has shown strong correlations between the area of coastal wetlands and the size of penaeid shrimp populations. Destruction of habitat, combined with fishing pressure from PL fishermen, leave scientists pondering the status and future of this valuable stock. In addition, mortality between capture and acclimation to pond conditions is high, and many shrimp species unsuitable for mariculture are being killed in the collection process. Measures should be taken to sustain stocks while ensuring that harvests are efficiently used.

  A well-designed program is needed to: 1) quantify mortality rates associated with various handling methods and to reduce PL mortality; 2) encourage effective

enforcement of laws protecting habitat and water quality and stocks; 3) study habitat status and productivity to identify priority areas requiring protection; 4) quantify, to the extent possible, the relationship between various types of fishing effort and PL stocks in order to design management schemes to protect stocks; and 5) develop management strategies for mangroves.

- *Management of Wild Shrimp Stocks.* Wild shrimp stocks are exploited at their adult stage by offshore trawlers, in the juvenile stage by nearshore fishermen, and as PL by larveros. If wild stocks are to be protected at a sustainable level, the needs of each harvesting sector must be considered in formulating an effective management strategy.

  Development of a shrimp management plan is contingent upon expanding the system for collecting catch and effort data, identifying shrimp populations and movements, and correlating trends with environmental and habitat variables.

- *Economic Viability of the Industry.* Ecuador's shrimp industry can anticipate increased competition in the world market. Nations in Southeast Asia have a tradition in mariculture and are rapidly moving to increase shrimp production. Latin American countries—specifically, Brazil, Panama, and Belize—have also entered the industry. Increasing supplies of shrimp, changes in technology, reputation, and the intricacies of international trade and currency exchange will determine the continued economic viability of Ecuador's shrimp mariculture industry.

  Steps should be taken to ensure competitiveness, by gathering information to monitor trends in world markets, and strictly enforcing methods for certifying the quality of exports. Analysis of industry data, economic performance, and the consequences of deterioration of water quality and habitat should be made available to industry organizations and firms to enhance their ability to make informed decisions.

- *Government Involvement.* The existing system for granting concessions in the government-controlled intertidal zone is complex, and a major expense both in time and money. The system fails to secure the real value applicants are willing to pay for concessions, provides no incentive for intensive culture, is unregulated, and fails to establish guidelines for pond construction, or to discourage environmental degradation. Laws and government policies affecting the industry are varied, often not enforced, and they favor large-scale, vertically integrated companies. Incentives to promote hatchery development may be well-founded, but incentives to promote more efficient land use through intensive culture are nonexistent.

  The permit system should be overhauled and simplified to produce and meet defined objectives. An integral part of the new system should be its ability to enforce laws, and ensure adherence to permitting procedures. The evaluation and disposition of permits should be based on criteria designed to minimize impacts on important habitats and to foster good construction practices. Government policies that shape the industry's structure should be scrutinized to ensure that they promote social desires. A more diversified industry may produce greater economic benefits, and may prove more responsive to changes in world markets and technology.

- *Technical Assistance.* The Ecuadorian shrimp culture industry has grown in a gold rush atmosphere. Industry and government spokespersons promote the flow of information, but competition within the industry often impedes the passage of pertinent technical information. An extension program targeting specific industry needs while recognizing social objectives should be designed with industry support.

PL are poorly and inefficiently handled during and after capture. Estimates vary, but between 50 and 85 percent of all PL die before reaching a harvestable size. It is obvious that better treatment will lead to a reduction in the rate of mortality. An

extension program designed to improve handling techniques during capture and transport, in holding centers (*centros de ocopio*), in nursery ponds, and during growout is economically justifiable. Based on 1991 data, export earnings would increase by U.S. $4.9 million for each 1 percent increase in the overall survival rate.

- *Public Education.* In order to gain public support for programs designed to maximize benefits derived from coastal resources, residents must be made aware of the uniqueness and value of these resources. A recurring theme at the 1986 workshop was the need for broad dissemination of information on the conditions and problems affecting the quality of ecosystems. The commitment to public education on environmental matters should be broadened to emphasize the diversity, uses, value, and sustainability of coastal resources.

- *A National Aquaculture Policy.* The shrimp mariculture industry in Ecuador has demonstrated that it can create employment opportunities, promote significant private sector investment, encourage technology innovation and transfer, stimulate economic growth, provide food for local consumption, and generate export earnings. Simultaneously, it has produced large-scale and usually detrimental changes in coastal ecosystems, and has conflicted with traditional activities and raised concern over the socio-economic well-being of poor coastal communities. If the industry is to fulfill its potential in a socially desirable manner, the government of Ecuador should formulate a management policy which, in addition to the issues identified above, addresses the industry's present needs, development potential, conflicts, investment incentives, and research priorities.

- *Undervaluation of Common Property Resources.* The shrimp mariculture industry is primarily sustained by exploiting PL, water, and intertidal areas, each of which is a common property resource. History has repeatedly shown that the failure to charge a fee or assign a value to such resources results in their overexploitation. It is the role of government, as the manager and steward of these resources, to ensure that public resources are used in a manner that optimizes social welfare.

  This is, however, not the case in Ecuador, as no values are assigned to the PL fishery or to water, and fees charged for concessions of mangrove areas assign only minimal values to these resources. Rather than invest in improving the productivity of existing ponds, many shrimp growers find it more profitable to increase production by continually converting mangroves into grow-out ponds. Effort must be made to identify the economic values attributed to mangroves, and concession fees must be established that reflect this value. Cutting will continue unabated and shrimp growers will have less incentive to intensify production in existing ponds until they are forced to pay for the true worth of mangrove ecosystems.

- *Underutilization of Areas Converted to Shrimp Ponds.* Tied to the issue of undervaluation of intertidal areas is the fact that many have been clearcut and abandoned without constructing ponds, and that large areas of ponds sit idle for years and are only put into production when economic and biological conditions—the abundance of cheap PL—increase profitability, thus creating incentive to utilize these areas. In addition, data from the Subsecretaria de Recursos Pesqueros reveal that productivity per ha per year is low when compared to other leading shrimp producing nations, and has tended to decrease, for example, from 1.84 mt per ha in 1980 to .65 mt per ha in 1989.

  Policies are required to ensure that government-owned intertidal areas that have been cleared for shrimp ponds are utilized, that they are efficiently utilized, that the benefits generated exceed those that would accrue had the area been left in mangrove.

Areas that are utilized only for a brief period or that are abandoned should be replanted with mangroves.

- *PL Bycatch.* A recent study (Gaibor, 1993) reveals that only about 18 percent of the organisms captured in the fine-meshed nets used by larveros are desired species of PL, and that the remaining 82 percent are usually killed when they are discarded on the beach. The analysis found that the unwanted bycatch contained 32 species of juvenile fish, half of which were of commercial value, and the larvae of 35 species of fish, 21 of which are of commercial importance. The remainder of the bycatch consisted of large quantities of organisms, crabs in particular, that are important in the food chain.

  It is not possible to assess the overall impact that the harvesting of PL has on the marine ecosystem, yet it is obvious that larveros should be educated and encouraged to treat all species carefully when returning by-catch.

- *Poor and Conflicting Data.* As is often the case in Ecuador and should be obvious by analyzing information presented in this profile, there are numerous, often conflicting, data sets from responsible institutions. It is consequently extremely difficult to formulate resource management policies that are based on dependable data.

VII. MANUFACTURING

Historical Overview

Shipbuilding between 1600 and 1750 was the first important industry in Ecuador. Cigarette manufacturing started in Guayaquil about 1790, and sugar mills were constructed in the Yaquachi-Milagro area in the 1800s.

During the early 1900s, the more important coastal industries included cigarettes, straw hats, chocolate, crackers, hard candy, shoes, matches, beer, soft drinks, and *aguardiente*, a liquor made from sugar cane. The 1930s and 1940s saw development in agricultural industries (rice and sugar mills), and cement and pharmaceutical industries. During this period, the most important industry in the Sierra, and possibly in the country, was textiles.

By 1950, industrial development was still at a meager level. Most industries were small, involved low investments, and relied on manual labor rather than on sophisticated machinery. The artisanal sector produced 90 percent of the country's industrial goods. The first industrial census in 1955 found only 2.3 percent (excluding the artisanal sector) of the working population employed in industry. Industry contribution to GDP was about 9 percent.

Industrial growth, for all practical purposes, has its roots in the 1950s. Capital generated by agricultural expansion on the coast provided funds for investment, while increases in employment and salaries, both of which were related to the banana boom, expanded the size of the domestic market. Increases in state support and credit, along with the passage of laws favorable to industrial growth and import substitution, provided additional stimuli. New industries appeared, producing liquors, foods, soaps, paints, cables, construction material, tin roofing, noodles, margarine and edible vegetable oil, cement, shoes, and furniture. Rice, flour, and saw mills processed raw products for domestic consumption. New textile factories were completed and equipped with British and Swiss machinery (Linke, 1960).

The 1960s saw entry by multinational corporations that provided raw materials and technology transfer. The average annual rate of industrial growth during that decade was 7 percent. Industry contribution to GDP increased to 15 percent, and the sector absorbed 70 percent of the value of all imports.

During the 1970s, revenues generated by Ecuador's oil bonanza benefited the industrial sector, and it experienced its highest rate of growth and diversification. First, the infusion of currency stimulated domestic demand for income-elastic goods rather than agricultural products. Second, the fixed exchange rate ensured that prices of imported goods rose no faster than the dollar price in their country of origin. Laws to provide incentives gave generous profit cushions through import-duty exoneration and high tariffs on competing imported goods (World Bank, 1984).

The domestic market expanded by nearly 93 percent between 1973 and 1982, whereas export expansion, excluding oil products over the same period, accounted for only 6 percent of export growth. The gross domestic value of manufacturing, excluding petroleum and refining, expanded from 6.4 billion sucres in 1970 to 44.4 billion by the end of the decade. Productivity quadrupled. The average rate of industrial growth was 10 percent, according to Junta Nacional de Planificación. Overall, industrial manufacturing was the most important sector in the Ecuadorian economy, accounting for 18 to 21 percent of GDP between 1975 and 1989. Between 1989 and 1992, manufacturing was the fastest growing sector of the economy and accounted for 24.3 percent of GDP in 1991 (BID, 1992). Factories producing consumer goods (food, drink, and tobacco, in particular) accounted for 54 percent of industrial production, 55 percent of the number of industrial enterprises, and 59 percent of the gross value of industrial production. In 1989,

manufacturing generated 10.4 percent of employment (The Economist Intelligence Unit, 1992).

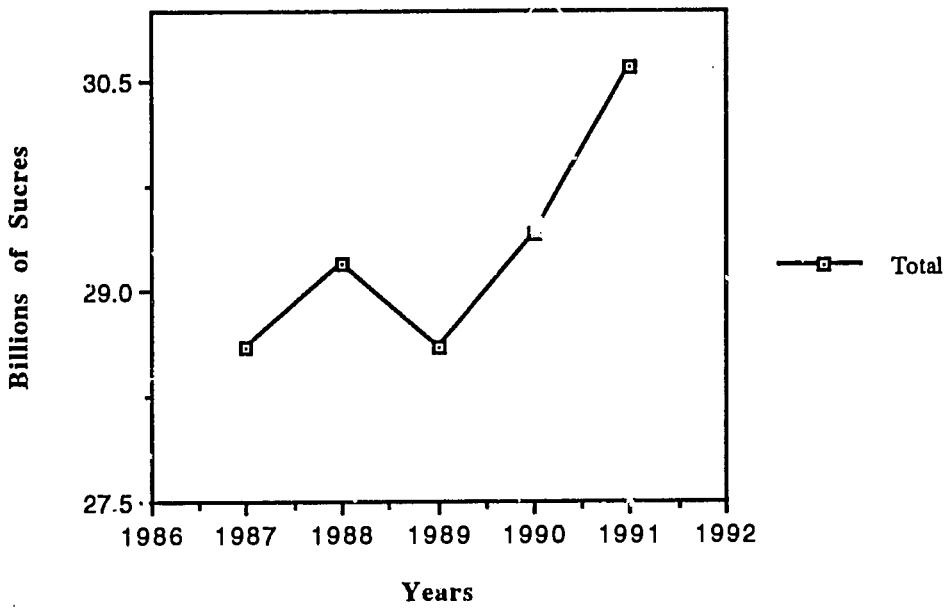

Figure 34. Value of Industrial Production 1987-1991 at Constant 1975 Prices

Hurtado (1983) points out that, despite impressive growth in the manufacturing sector, Ecuador remained dependent on imports of capital and intermediate goods. Data indicate that manufacturing reduced imports via substitution by less than 1 percent. Many domestic industries produced goods that competed with the artisanal sector but not with imports.

Industrial expansion came to an abrupt halt in 1982 and subsequently flattened out. Austerity programs were initiated, devaluation of the sucre caused the costs of imported capital goods and inputs to rise, credit dried up or was expensive, and increases in unemployment and underemployment caused the domestic demand to shrink.

Industry Structure

The manufacturing sector, excluding petroleum refining, can be classified by two types: small-scale artisanal, and large enterprises. Ecuador is particularly rich in small-scale and cottage industries. The success of these small-scale enterprises is dependent on domestic demand and entrepreneurial capabilities. They are generally little affected by government policies.

One of the more interesting facets of the structure of Ecuador's large modern manufacturing sector is that it is concentrated in terms of both location and size. More than 80 percent of manufacturing employment and of manufacturing value added is generated by firms located in either Guayas or Pichincha—more specifically, in Guayaquil and Quito. Guayas accounts for the major share of food, paper, and chemical production, while Pichincha specializes in textiles, wood and metal products, and machinery.

The high degree of geographic concentration is largely attributed to the fact that basic infrastructure, services, and markets are more developed in the country's two urban centers. It also indicates that decentralization incentives have not been effective. Industries

found in other locales—for example, fish processing or fish meal plants in Manta—are located in these areas to facilitate access to inputs.

Industrial incentives have not widened industry ownership and may have even fostered concentration of power and wealth. In many cases, laws have induced investors to build to overcapacity because installed capacity allows them to impose barriers to the entry of potential competitors on the basis that existing domestic industry is capable of meeting national demand. This has encouraged the emergence of oligopolies in major manufacturing subsectors. For example, large firms control 97 percent of fertilizer and pesticide sales, 74 percent of paint, varnish, and liquor production, 90 percent of paper production, and 69 percent of chemical production. Two firms control 60 percent of frozen tuna and 80 percent of canned tuna production (Instituto de Investigaciones Economicas de la Universidad de Guayaquil, n.d.). Similar concentrations are found in the textile and wood products industries. Large industrial groups often have direct links—common directors and major shareholders—with banks and financial institutions. As a result, a relatively small number of families in Guayaquil and Quito control a major part of the country's modern industries (World Bank, 1984).

Coastal Industries

As of 1980, 36 percent of the number of industrial businesses, 43 percent of industrial employment, and 55 percent of the value of industrial production (Table 26) were located on the coast. These data indicate that coastal industries tended to be larger than those in the Sierra. Of the 1,643 large factories registered on the coast, 80 percent were in Guayaquil, 8.5 percent in Manta or Portoviejo, and 11.5 percent in other coastal towns. The majority of the nation's industries are found in Guayas.

Table 26. Number of Industrial Establishments, Employees, and Value of Production (in millions of sucres) by Category for Ecuador and the Coast, 1980.

	Food, Beverages, and Tobacco	Textiles, Garments, and Leather	Wood, Wood Prod. and Furniture	Paper, Printing, & Publishing	Chemicals, Fuels, and Plastics*	Non-metallic and Basic Metal Products	Metallic Prod. Machinery & Equip.	Other Ind. Manufactured Products	Total Products
# of Establishments									
Ecuador	4,006	16,078	6,827	891	448	1,469	3,335	1,092	34.346
Coast	1,480	5,827	2,579	473	187	252	1,273	219	12,290
% on Coast	37	36	38	53	42	15	38	20	36
# of Employees									
Ecuador	46,221	52,074	24,079	9,498	13,459	12,564	24,679	3,292	185,866
Coast	28,177	13,882	9,206	5,564	7,950	4,659	9,458	750	79,646
% on coast	61	57	38	59	59	37	38	23	43
Value of Production									
Ecuador	38,635	13,480	52,223	6,473	12,004	8,664	13,786	1,131	99,396
Coast	25,4332	3,077	3,376	4,338	6,986	020	6,008	130	54,368
% on Coast	66	23	65	67	58	58	44	11	55

*Excludes refined petroleum products.
Source: Censo Economico, 1980; Elaborated upon by Fundación Maldonado, 1987.

Issues for a CRM Program

Over 70 percent of the industrial growth in Ecuador is attributable to small companies that produce foods and beverages, textiles, chemicals, petroleum derivatives, and non-metallic minerals. There are plans for major industrial projects, including petrochemical, ammonia-urea, and steel plants, as well as shipyards and automotive assembly plants. These industries and industrial projects can have significant impacts on ecosystem health:

- Many of these plants discharge directly into the Guayas Estuary, into nearby rivers or streams, or into sewer systems that, in turn, empty into nearby bodies of water.
- Some of the more dangerous effluents come from companies producing metals, batteries, radiators, chemicals, paints, paper, and leather. Many discharge toxic heavy metals such as mercury, copper, lead, and iron. Other companies discharge petrochemicals that are toxic and adversely impact water quality and aquatic species.
- A survey of 43 industries in Guayaquil producing hazardous effluents conducted by Direccion General de la Marina Mercante y del Litoral (DIGMER), revealed that only 20 percent have initiated wastewater treatment.

VIII. TOURISM

The Tourism Industry in Ecuador

A five-year master plan for the development of tourism in Ecuador was prepared by the World Tourism Organization (OMT), the United Nations Development Programme (UNDP), Ecuador's Central Bank, and the Dirección Nacional de Turismo (DITURIS). The plan identifies major zones of interest to tourists, specific sites and/or attractions, domestic and international tourist demand to visit Ecuador, and recommends a strategy to develop the country's tourist facilities (DITURIS, 1983).

The study identifies 260 tourist sites, with 877 attractions. The survey indicates that the majority (58.2 percent) of tourist attractions are classified as natural sites—such as mountains, beaches, and lagoons—while cultural and folklore attractions account for 33.3 percent of the total. By far, the majority of natural sites are located in the Galapagos Islands, which is Ecuador's greatest tourist attraction and one of the most famous tourist destinations on the west coast of South America. Many of the international tourists visiting Ecuador's mainland, as well as sites in Peru, do so as part of an excursion package to the Galapagos. It should also be pointed out that all air traffic to the Galapagos and many of the international flights serving Ecuador make stops in Quito and Guayaquil, so many tourists visit the cities during stopovers.

The studies conclude that cultural and folklore attractions are concentrated in the Sierra, while the coast and the Galapagos have the majority of natural attractions. More notable among the sites in the coastal regions are over 100 beaches.

International Tourism. Between 1973 and 1990, the number of foreign visitors entering Ecuador has grown sporadically. Estimates of the number of international tourists visiting Ecuador are either unavailable or contradicting, but there appears to have been a significant increase. The Fundación Hanns Seidel (1991) writes that, on average, 309,000 tourists per year visited Ecuador in the late 1980s. It is reasonable to assume that bombings and terrorism in Europe during 1985 and early 1986 redirected the flow of American tourists, some of whom visited South America. In addition, the appearance of the revolutionary group The Shining Path has discouraged tourism to Peru and its top attractions Cuzco and Macchu Picchu. Ecuador has presumably attracted some of these tourists. Changes in exchange rates have also drawn tourists, as devaluations have greatly reduced the costs of hotels, food, and tours within Ecuador. However, the outbreak of cholera in early 1990, and more recently, travel advisories warning that it is dangerous to travel within Ecuador have prompted many tourists to cancel visits to the country.

The largest group of visitors to Ecuador (36.6 percent of total) are from Andean Pact Countries (Bolivia, Peru, Colombia, and Venezuela). The number of tourists from Canada and the United States (23.4 percent) is growing at an average annual rate of 6.3 percent, while visitors from Europe (22.9 percent) are increasing at 14.2 percent per year. Asians, particularly Japanese, have recently started visiting Ecuador. The number of Asian visitors is increasing at a rate of 20.3 percent per year.

The largest portion (44 percent) of visitors passing through the country's two international airports, Quito and Guayaquil, are North Americans and Europeans. In order of importance, the reasons given for visits are business (37.6 percent), and tourism or vacations (37.2 percent). The average stay is 20.6 days, and the areas most frequently visited are Quito, Guayaquil, the Galapagos, and the Oriente.

Approximately 45 percent of the visitors, mostly Colombians, enter the country over land (Fundación Hanns Seidel, 1991). Included within this group are an estimated 79,600 tourists who stay an average of 17 days, spending most of their time in either Quito or Guayaquil, or at the beaches.

Domestic Tourism. It is not possible to quantify the various parameters associated with travel by Ecuadorians inside their country. Many high-income residents of larger cities maintain small farms in the country, which they frequent on weekends and holidays. Many residents of Guayaquil spend their weekends, particularly from December to May, at nearby beaches on the Santa Elena Peninsula. Tourist data from the Galapagos Islands indicate that domestic tourism is increasing. In the early 1970s, there were roughly 500 Ecuadorian tourists per year visiting the islands. In 1987, the number was closer to 20,000, and has remained relatively constant.

Economic Importance

In terms of economic contribution, the sector category "Hotels, Bars, and Restaurants" contributed 1.1 percent to Ecuador's GDP in 1985, which is comparable to countries with intermediate levels of development. In terms of national employment generated, tourism ranked third, with 48,419 positions, according to the 1980 economic census. The industry growth rate between 1976 and 1985 was 5.6 percent, as compared to a 4.2 percent per annum rate of growth in GDP. The industry also had a relatively stable pattern of growth during that time.

Fundación Hanns Seidel (1991) indicates that Ecuador had a slightly positive balance of payments for tourism in 1989. Incoming revenues attributed to international tourism that year amounted to U.S. $170.8 million; Ecuadorians spent U.S. $168 million on vacations outside of Ecuador, leaving a surplus of U.S. $2.8 million. The average expenditure per day by an incoming tourist in 1989 was U.S. $56.30.

Industry Accommodations

The greatest concentration of hotels, particularly first-class hotels, is found in Quito and Guayaquil.

Nationwide, 78 percent of all hotels and pensions and 65 percent of rooms are considered second- or third-class accommodations and are run as family businesses.

Most restaurants and bars are concentrated in major cities. The province of Guayas has 50.3 percent of these businesses and Pichincha 17.9 percent, with the remainder scattered throughout the country.

Between 1972 and 1989, the number of hotel rooms increased from 12,977 to between 24,474 and 36,000. Most of this growth coincided with Ecuador's oil boom between 1972 and 1982.

Tourism on the Coast

Tourism is a relatively new industry in coastal Ecuador. Significant coastal tourism was not possible until improved systems of communication and transportation facilitated access to coastal areas in the 1950s. Despite its image as a marginal activity in coastal areas, the industry's growth rate has been impressive. A little over half the country's hotels are now found in the coastal region. There are also large numbers of beach houses and vacation or weekend apartments in coastal resort communities. (For example, there are 2,000 in Salinas and 1,326 in Atacames.) Manabi experienced the largest percentage increase of all coastal provinces (Table 27). Guayas—Guayaquil in particular—has 50 percent of all hotel rooms on the coast, and by far the largest guest capacity.

The most developed beach resort is Salinas, 160 km west of Guayaquil. In addition to protected beaches, Salinas offers all types of water sports (including some of

Table 27. Number of Hotel Rooms by Coastal Province, 1980 and 1987.

Province	1980	1987	% Change
Esmeraldas	2,898	3,400	17.3
Manabi	2,881	4,990	73.2
Guayas	8,250	10,154	23.1
El Oro	2,136	2,437	14.1
TOTAL	16,165	20,986	29.8

Source: Plan DITURIS, 1983-1987.

the world's best marlin fishing), casinos, and numerous first-class restaurants and hotels. In the provinces of Guayas and El Oro, the towns of Manglaralto, Ayangue, Palmar, Ballenita, Chanduy, Playas, Posorja, and Jambeli are also favored by tourists.

Developed coastal tourist areas in Esmeraldas are Las Palmas, Sua, and Atacames. All are accessible by road and have adequate accommodations and long beaches. San Lorenzo, Rio Verde, and Muisne have a small tourist trade; they are considered to have greater potential, but are hindered by difficult access and communications, as well as by a shortage of basic services and infrastructure. The oil refinery at Esmeraldas does not enhance the area's image as a tourist attraction, since its presence has created concern over water and beach contamination.

Tourist areas in Manabi include Bahia de Caraquez, Manta, San Vicente, San Jacinto, Cojimies-Pedernales, Jama, Puerto Cayo, and Puerto Lopez.

Development Trends

The government of Ecuador, in an attempt to assist in the development of its tourist industry, is supporting a wide variety of programs:

- modernization and expansion of small and intermediate tourist facilities
- commercial promotion of Ecuador's tourist attractions to increase domestic and international demand
- training of hotel workers and guides
- a program to increase awareness of the potential for tourism
- improvement of major infrastructure, such as airports and roads
- an increase in public expenditures on tourism
- information on Andean tourist attractions

- a beach development program
- a conservation and development program for tourist resources in the Galapagos Islands
- a conservation and development program for tourist resources in the upper Amazon
- development of national parks and protected areas, particularly in the upper Amazon
- conservation of socio-cultural features

Beach Development Program. Ecuador has over 100 beaches considered to have development potential. The greatest demand is expected to come from local tourists and from neighboring countries. Despite their potential as year-round tourist attractions, these beaches are insufficiently known. Some of the problems that have to be overcome are the following:

- lack of basic services and infrastructure
- difficult and limited access
- a lack of planning and control over beach use
- long distances between tourist destinations
- competition for coastal land by industries that are not compatible with tourism
- unorganized construction of facilities
- land speculation that has limited public access to beaches

If an effort to improve the quality of beaches currently frequented by tourists is initiated, programs are required to:

- construct beach houses with bathrooms and cabañas
- clean litter from beaches
- improve security

In addition, 18 beaches that are currently not frequented by tourists have been recommended for development. The plan calls for orderly development and the creation of tourist centers that will serve as models for future expansion. An example is the NAPA Project which, if implemented, will be oriented toward Ecuadorian and Colombian tourists and will utilize the Manta airport. The project will be located on 150 ha adjacent to a 2,000-meter beach. Construction of two hotels, one apartment hotel, condominiums, camping facilities, lodges, and lots for other uses will be developed, at an anticipated cost of 1.68 million sucres (1983 value), 25 percent of which will come from the public sector. The project, originally due to be completed in 1994, is anticipated to generate 5,400 jobs and have an internal rate of return of 16.4 percent. To date, construction has not begun.

The following are other recommendations of the beach development plan:

- The areas selected as having the most potential for development are the beaches of San Vicente (Napo and Briceno), Puerto Cayo (Los Frailes), and Manta (Boca del Rio and San Mateo).

- The area between the Jama-Tabuga and the Atacames Beach should be declared a national reserve.

- The beaches at San Vicente and Puerto Cayo should be declared zones of tourist interest, and inappropriate construction should be prohibited.

Issues for a CRM Program

Tourism is an emerging industry in coastal Ecuador. It is considered to have considerable potential and is receiving increased support from the government. Continued expansion is contingent on the maintenance of the quality of beaches, protected areas, fishing stocks (which are of special interest to sportsmen), and of cultural and archaeological sites. However, there are problems to be addressed:

- Development in coastal areas is occuring haphazardly. For exampie, shrimp pond construction is conflicting with tourism by destroying archaeological sites, creating barriers that restrict expansion of small beach resorts, and pumping water that increases suspended sediment, and therefore cloudiness, in water off beaches.

- Tourist facilities, particularly in urban areas, are competing with fishermen, industries, and ports for access to beaches and public services.

- There is a lack of planning and control over beach use. Construction is haphazard, and many owners have restricted access in an attempt to "privatize" the beach. Proceedures are needed that will promote orderly growth, to allocate resources among competing user groups, and to ensure that the cultural and ecological integrity of the coastal fringe is maintained.

- To attract international tourists, the quality of human services and accommodations must be enhanced and information on coastal tours and attractions needs to be increased.

- Efforts to advance coastal tourism must be integrated with, and linked to, strategies at the national level. Coastal tourism can complement efforts to promote the Galapagos, the upper Amazon, and the Andes.

IX. PORTS

Historical Overview

Despite Ecuador's traditional dependence on maritime trade, the country did not have a modern port or large pier where seagoing vessels could unload until, in the early 1960s, a mile-long canal was cut to connect the Guayas River with the Estero Salado, which allowed vessels to unload within five miles of central Guayaquil. In its initial stage, the port centered around a 3,000-foot pier, capable of handling five vessels simultaneously and bordered by numerous warehouses. Previously, large vessels had been forced to anchor at the mouth of the Guayas Estuary, where cargo and passengers were transferred to small vessels. Guayaquil handles 75 percent of all maritime cargo, excluding petroleum.

Manta, the country's second busiest port since the 1920s, is where most of the tagua nuts, straw hats, and fish are shipped. Between 1949 and 1958, the number of vessels visiting this port increased from 123 to 321, which is quite remarkable considering the complete lack of infrastructure. Large ships anchored offshore and transferred cargo to launches, which were then unloaded by men who carried boxes and sacks on their backs through the surf. A jetty, which turned into a pier that extended out to sea nearly a mile from the beach, was constructed in the early 1960s to allow vessels to berth.

Other ports of importance are Puerto Bolivar, Manta, and Esmeraldas. Puerto Bolivar's infrastructure was upgraded in the early 1940s, after the war with Peru. The port of Esmeraldas became important for shipping tagua nuts, balsa wood (during World War II), and bananas (in the 1950s). In recent years, changes in the world supply and relocation of banana plantations within Ecuador have severely hurt this port. Construction of an oil terminal to load offshore vessels has improved the situation slightly.

Table 28 summarizes the infrastructure in Ecuador's commercial ports.

Port Activity

The volume, type of cargo, and port infrastructure were drastically changed when Ecuador began exporting large volumes of crude oil from the newly developed oil fields of the Oriente in 1972. The most significant structural changes included construction of the oil terminals in Balao, in the province of Esmeraldas, in the 1970s. Coastal storage capacities for oil derivatives are presented in Table 29.

In 1970, the total amount of maritime cargo passing through Ecuador's ports was about 3.5 million mt. By 1973, the volume reached 13.7 million mt (of which 11.1 million mt, or 80 percent, were petroleum products). With the exception of 1987 when an earthquake damaged the pipeline, cutting oil exports for months, the total weight moving through Ecuadorian ports was consistent, ranging from 12.5 to 14 million mt, during the 1980s (Figure 34). Nearly all petroleum (crude and fuel oil) products, 96.6 percent, were moved through the Balao terminal, with the remainder shipped from La Libertad.

Tables 30 and 31 present the number of vessels and tonnage of maritime cargo (imports and exports, excluding petroleum and petroleum products) passing through Ecuador's main ports. The greatest percentage of exports (bananas) is shipped from Puerto Bolivar. In weight terms, bananas account for 80 percent of all non-petroleum exports. In value terms, shrimp is the chief export.

Guayaquil, the busiest cargo port overall, receives the largest portion of all private sector imports, and ranks second in exports. Common imports include fertilizers, pesticides, cement, petroleum derivatives, iron, steel, wheat, paper, vehicles, machinery, and chemicals.

Table 28. Commercial Port Infrastructure, 1981.

Infrastructure	Guayaquil	Esmeraldas	Puerto Bolivar	Manta
Breakwater				Yes
Length (meters)				1,600
Marginal Pier	Yes		Yes	3
Length (meters)	295			
Number of Berths	5	2	2	
Length/Berth (meters)	185	175		
No. of Covered Berths	3			
Small Vessel Dock	Yes		Yes	
Granel Cargo Berths	2			
Floating Dock		Yes		
Roll On/Roll Off Dock				Yes
Wooden Pier			Yes	Yes
Number of Berths			2	4
Length (meters)			400	200
Service Dock			Yes	
Covered Warehouses	Yes	Yes	Yes	Yes
Area (m^2)	79,498	7,200	14,526	13,800
Container Warehouses	Yes			
Area (# of containers)	4,000			
Refrigerated Container Storage	Yes			
Area (m^2)	2500			
Storage Silos (wheat/sugar)	Yes			
Capacity (tons)	50,000			
Hazardous Cargo Storage				
Uncovered Storage Area (m^2)	147,800	8ha	16,926	88,300
Other				

Sources: Armada del Ecuador, 1981; *Guayas '85.*

Table 29. Coastal Storage Capacities for Oil Derivatives (in millions of gallons), 1985.

Site	Terminal Capacity	% of National Terminal Capacity	Refineries	% of National Refinery Capacity	Under Construction
Pasquales	23	45.4			
Guayaquil	4.3	8.5			
Manta	1.1	2			
Esmeraldas			102.1	70.6	9.2
Libertad			42	28.5	5.6
Subtotal	28.4	55.9	144.5	99.1	14.8

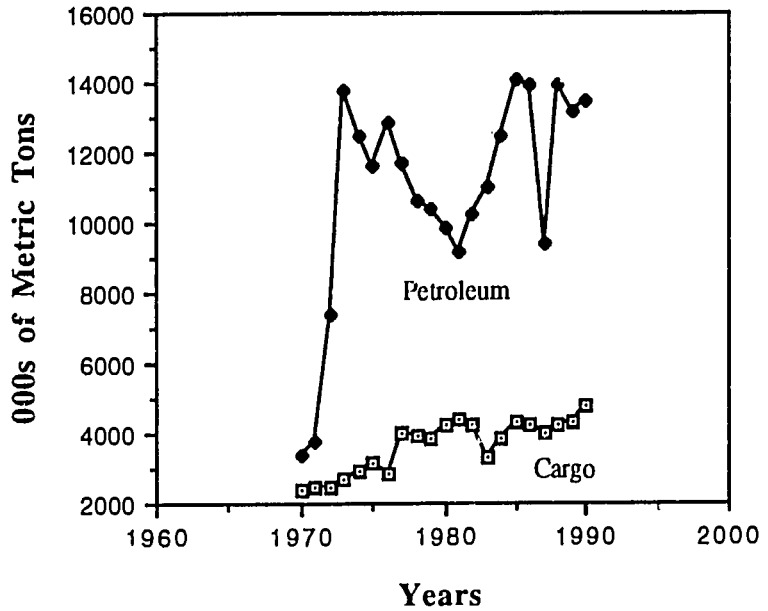

Figure 35. Total Cargo and Petroleum Moved Through Ecuadorian Ports, 1970-90.
Sources: Armada del Ecuador, 1984; Banco Central, 1987; Banco Central, 1991.

During 1990, 2,475 vessels moved through Ecuador's ports. Two hundred and thirty-nine of these vessels transported petroleum products. Guayaquil was the busiest port, loading and/or offloading 1,324 ships and 3,000 mt of cargo. Puerto Bolivar, which handled 559 ships and 1,454 mt of cargo was next in importance. Less than 7 percent of the cargo moved through Esmeraldas and Manta. Roughly 60 percent of non-petroleum cargo moved through Ecuador's ports were agricultural exports. In terms of weight, wheat, fertilizers, and chemicals accounted for about 50 percent of all imports.

Issues for a CRM Program

The volume of cargo and the number of vessels passing through Ecuador's ports increased dramatically with the discovery of oil in the early 1970s. The increase in traffic has had some adverse effects:

- The greater number of large vessels using the navigation channel to the port of Guayaquil are churning up bottom sediments and increasing turbidity and contributing to the sedimentation in that channel and the decline of water quality.
- There is a greater possibility of contamination as more vessels visit Ecuador.
- In Manta, construction of a breakwater changed patterns of water flow, resulting in erosion on a nearby popular beach, and sedimentation in the area used by artisanal fishermen.
- Residents in Esmeraldas believe that offshore tankers are dumping ballast water laden with oil, which is fouling local beaches.

Table 30. Number of Vessels and Cargo Passing Through Ecuadorian Commercial Ports, 1979-90.

Year	Number of Vessels	Total Cargo (mt)	Imports (mt)	Exports (mt)
1979	2,045	3,828,418	1,932,486	1,895,932
1980	1,964	4,256,204	2,422,122	1,834,082
1981	1,939	4,403,485	2,698,715	1,704,770
1982	1,890	4,241,193	2,600,513	1,640,680
1983	1,553	3,322,494	2,265,903	1,056,591
1984	1,636	3,859,486	2,419,789	1,439,697
1985	1,753	4,313,739	2,458,136	1,855,603
1986	1,788	4,244,468	2,330,362	1,914,106
1987	1,824	3,993,148	2,037,768	1,955,380
1988	1,908	4,266,670	2,166,518	2,100,152
1989	1,960	4,269,746	3,053,980	2,215,766
1990	2,236	4,735,760	1,942,758	2,793,002

Note: Data for cargo excludes crude oil.

Source: Armada del Ecuador, 1984; Sistema Portuario Ecuatoriano, n.d.; *Estadisticas 90.*

Table 31. Number of Vessels and Quantity of Cargo (mt) Moved, by Port, 1990.

Ports	Number of Vessels	Cargo (000s of mt)	Percent of Cargo
Guayaquil	1,324	3,003	63.4
Manta	173	115	2.4
Puerto Bolivar	559	1,454	30.7
Esmeraldas	180	164	3.5
Totals	2,236	4,736	100

Note: Data for cargo excludes crude oil and refined products.

Source: Sistema Portuario Ecuatoriano, n.d.; *Estadisticas 90.*

X. MINING

Historical Overview

The Incas are known to have exploited gold in Ecuador before the Colonial period, yet mining has historically contributed little to Ecuador's economy. This does not imply that the country is devoid of minerals, but merely that minerals have not consistently made significant contributions to the economy. There are, however, exceptions. Between 1930 and 1946, exports of gold, copper, and lead accounted for 8 to 24 percent of export earnings. High world prices during World War II stimulated gold, copper, silver, and lead production in Ecuador.

The first large-scale gold-mining venture was started in the southern coastal province of El Oro in the mid-1940s. A U.S.-backed company employed up to 2,000 laborers, but closed in 1950. The government, workers, and local interests purchased the company, but the value of exports fell from 43.7 million sucres in 1950 to 6.8 million in 1951. Quantities extracted continued to be modest, with the price fluctuations reflecting erratic world demand. Between 1952 and 1953, sulphur was mined for export to Brazil and India. During the 1950s and 1960s, minerals (excluding oil) averaged less than 2 percent of export value.

The Ecuadorian Central Bank (1984) estimated that there were 30,000 small mines in Ecuador, employing 15,000 workers during the early 1980s. Changes in laws for mining concessions initiated by the government in 1985 caused a flurry of investment, most of which was international. At least 23 mining companies and consortia, including Cyprus, Wright Engineers, and British Petroleum, have started operations. Nearly U.S. $30 million was invested in 1987. In that year, Edgar Salazar, technical manager in the Ministry of Energy and Mines, stated, "within a decade, only 10 percent of the gold contracts applied for will average a ton a year, and Ecuador will be producing 37 tons annually."

By 1990, gold production had risen to 13 tons annually, from a 1981 production level of 0.8 tons per year, and Ecuador is expected to continue to dramatically increase production and exports (The Economist Intelligence Unit, 1992). Applications for gold mining operations are currently pending for 4.75 million ha, a sixth of the country's land area. While most of the production is coming from mines, gold is also being panned and dredged from rivers and deltas (*Christian Science Monitor*, 1987). While the production of gold is increasingly important, and still promising, most mining activities focus on the production of non-metal construction materials, such as limestone.

The sector is now regulated by a new mining bureau that grants concessions for prospecting, exploration, and exploitation, since mineral resources are owned by the government. By October 1990, 550 concessions has been granted, covering 2.4 million ha (The Economist Intelligence Unit, 1992).

A law passed in 1991 provides much greater protection of the rights of concession holders, but concessions are frequently invaded by squatters, who are estimated to number about 40,000 (The Economist Intelligence Unit, 1992).

Coastal Mining

Mineral exploitation has never been an important activity in Ecuador's coastal plain. During the 1950s, the following coastal mining concessions were granted: iron in Guayas and Loja; titanium in Guayas, Manabi, and Esmeraldas; and manganese in El Oro. Results were marginal, and efforts were soon abandoned. Currently, exploitation is conducted by small-scale enterprises that extract minerals used for building materials—such as sand,

gravel, and marble—from quarries, or along river banks. The only precious metal discovered has been small quantities of gold in rivers and deltas.

Issues for a CRM Program

Policies must be implemented to discourage practices in mining that adversely affect the country's resources:

- The recent flurry of mining activities is increasing erosion in upland areas and along rivers.
- Mercury, used to separate gold from ore, is discarded into waterways, posing a threat to organisms in sediment and in the water column. Mercury contamination has begun to be detected near the discharge of the Rio Siete in El Oro province.

XI. PETROLEUM AND GAS

Historical Overview

Small quantities of high-grade oil were first found on the Santa Elena Peninsula at the end of World War I. Between 1917 and 1918, three oil companies—one Canadian and two British—were granted concessions in coastal Ecuador. Exports of crude oil began in 1925, when U.S. $4 million worth was shipped. Exports quickly jumped to $15.8 million in 1930, and peaked at $28.8 million in 1944. Falling world prices and increasing domestic consumption reduced the value of crude exports during the 1950s. The Canadians, after investing $4 million in 20 wells, left in 1947. Concessions to the first British company, McKay Harmsworth Oil, were turned over to U.S. investors in 1951. They fared better, but coastal production remained low.

Exploration started in the Oriente in the late 1940s. Despite an investment of nearly $44 million, discoveries were not large enough to justify construction of a pipeline across the Andes to transport the crude. At their peak, oil companies employed 5,300 workers. Curtailment of activities abruptly awakened Ecuadorians dreaming of an oil-rich nation, and seriously disrupted labor markets in the 1950s (Linke, 1960).

Ecuador's dream began to materialize when Texaco-Gulf announced a large discovery in the Oriente in 1967. New wells were drilled, and the Trans-Andean pipeline was constructed from Lago Agrio, in the Oriente, up the Andes to 4,100 m and down to the Pacific port of Esmeraldas. Oil first flowed through the 313-mile-long pipeline in 1973, the same year that Ecuador became a member of OPEC.

The contribution of petroleum products to GDP, in 1975 sucres, jumped from 4.9 billion sucres in 1972 to 23.3 billion by 1986 and dropped to 10 billion in 1987 due to an earthquake that destroyed 40 kilometers of pipeline, curtailing oil production and exports for five-and-a-half months. By 1989, however, petroleum's contribution to GDP had recuperated to 23.3 billion. Crude oil production, which had increased from 3,700 barrels per day in 1971 to 208,800 by 1973, stagnated and fell in the 1980s and is anticipated to increase through the mid to late 1990s. The proportion of oil exported also declined in the 1980s. This has been attributed to domestic consumption, which increased from 20 percent of production in 1973 to 46 percent in 1982, and to quotas established by OPEC. Some of the increase in export earnings in the 1970s and early 1980s also reflected rapidly escalating world prices.

In 1991, oil exports, including refined products, amounted to U.S. $1.1 billion which, despite a 4 to 5 percent increase in volume, was 18 percent below that of 1990. In 1991, oil and related products represented only 40 percent of total merchandise exports, the lowest point since Ecuador became a significant oil exporter in the early 1970s (The Economist Intelligent Unit, 1992).

In addition, offshore exploration in the Gulf of Guayaquil, which started in 1968, produced natural gas in three of five wells. This contract and subsequent ones were annulled during the 1970s. Exploration during the 1980s indicates that oil may also be present off the Santa Elena Peninsula and off Manabi. Proven oil reserves estimated in 1991 amount to 1.2 billion to 1.5 billion barrels. The ratio of proven reserves to oil production indicates 13 years of reserves (The Economist Intelligent Unit, 1992). This estimate is conservative, as it does not take into account new discoveries and more efficient technology.

Coastal Production

Since the opening of the Lago Agrio oil fields in 1973, coastal production has contributed only 4 to 5 percent (approximately 420,000 barrels per year) to national

production, yet two-thirds of the country's wells (595 of 900) are located on the coast. The disparity in numbers is attributed to the fact that the average well on the coast produces two barrels per day, versus 300 in the Oriente.

Oil-Related Facilities

While coastal production and oil fields (Figure 35) are small in comparison to the Oriente, large expanses of pipelines, 99.1 percent of refinery capacity, over 80 percent of storage, and all oil terminals are located on the coast. Prior to construction of the Trans-Andean pipeline, the only oil fields, refineries, and pipelines that existed in Ecuador were on the coast. The Trans-Andean pipeline opened with a rated capacity of 245,000 barrels per day. In 1984, the capacity was expanded to 293,000 barrels per day (World Bank, 1984). The Ministry of Energy and Mines (1986) estimated 987 miles (1,649 km) of pipelines in Ecuador, of which 589 miles were dedicated to transporting crude, and the remaining 418 for petroleum derivatives. Plans announced in 1992 indicate that capacity may be further increased to 450,000 barrels per day by 1997.

The expansion in pumping capacity has necessitated an increase in storage facilities for crude oil and derivatives. In 1985, crude storage capacity was 4.7 million barrels, and is expected to increase. Over 95 percent of this is located on the coast.

Three refineries process crude oil in Ecuador. With the exception of a small plant in Lago Agrio, which is oriented solely toward meeting local demand, the remaining plants are found on the coast. The largest refinery and terminal is adjacent to the city of Esmeraldas, while the others are located on the Santa Elena Peninsula.

Of the total refinery capacity, 99.1 percent is located on the coast. Expansion is envisioned to bring the capacity of the Esmeraldas plant to 81,370 barrels per day, and a second proposal would create a new refinery in the Oriente with a capacity of 9,700 barrels per day. All oil exports, as well as imports of processed petroleum derivatives, are moved at coastal ports.

Issues for a CRM Program

The concentration of oil wells, pipelines, refineries, terminals, and offshore loading platforms means that the potential hazard of oil spills is greatest in the coastal areas of Ecuador. Ecuador has worked closely with international organizations in developing methods for the early detection and control of oil spills, including the use of dispersants in cleanup. New issues will arise if proven gas reserves in the Guayas Estuary are exploited, or if exploratory drilling offshore uncovers new crude oil reserves. Aside from those long-term issues, there are more immediate impacts on coastal resources to be addressed:

- Many coastal residents, particularly in Esmeraldas, allege that minor quantities of oil are being spilled and are fouling beaches and rivers.

- Disposal of used motor oils is contributing to the pollution of rivers and estuaries.

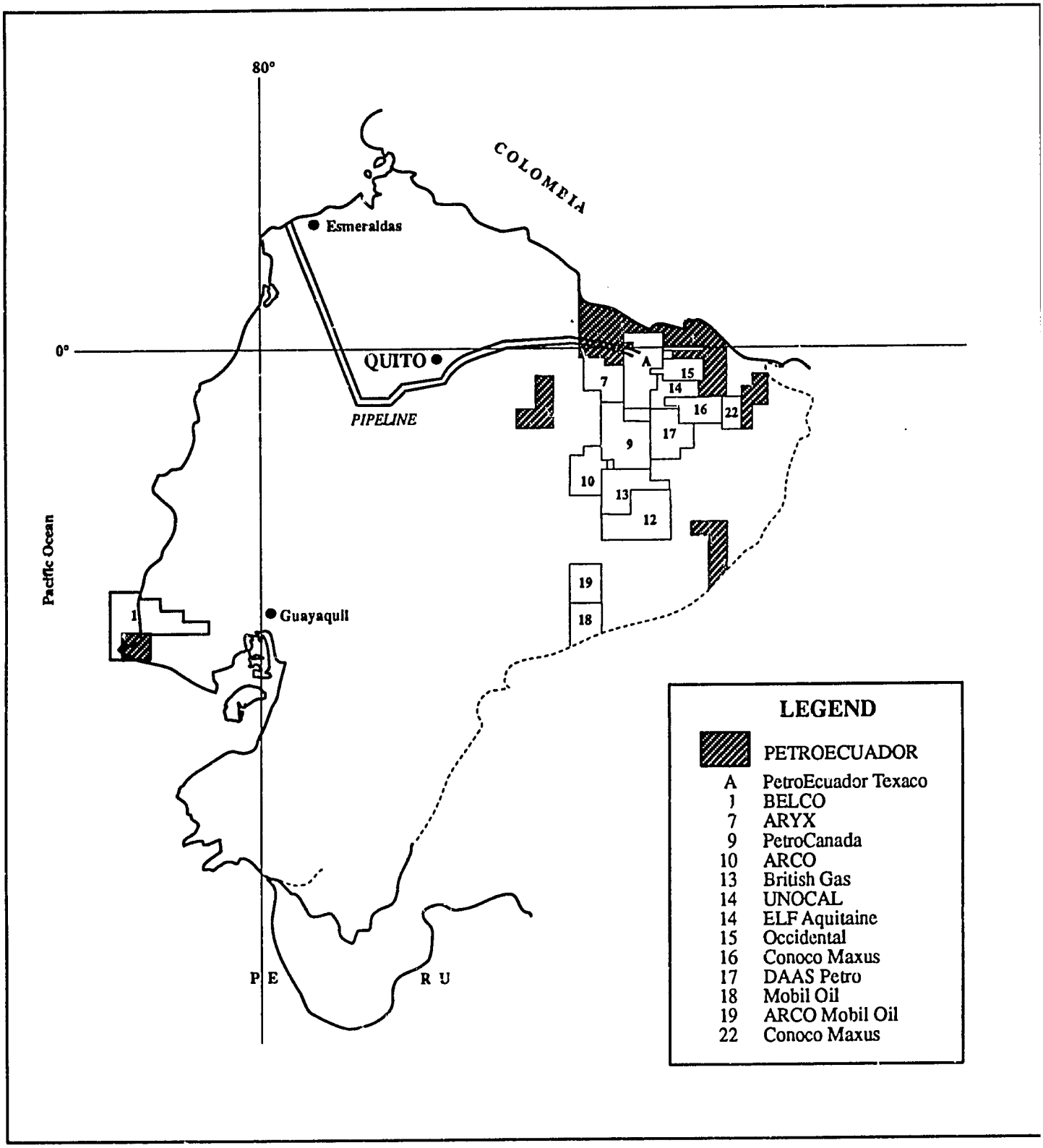

Figure 36. Oil Concessions in Ecuador

Source: Southgate and Ortiz-Crespo, 1992.

XII. THE COASTAL RESOURCES MANAGEMENT PROGRAM*

Historical Overview of the CRM Program in Ecuador

In 1983, the U.S. Agency for International Development (USAID) Office of Forestry, Environment, and Natural Resources, Bureau of Science and Technology, commissioned an assessment of developing nations that had expressed interest in launching pilot programs in integrated coastal resources management. In large part because of the interest generated through a United Nations-sponsored conference (1981) on coastal resources management in, Ecuador was selected by USAID as one of three countries for a pilot program. Sri Lanka and Thailand were the two other countries chosen.

In May 1985, USAID entered into a cooperative agreement with the University of Rhode Island to implement the International CRM project. Project personnel made an initial visit to Ecuador in June of 1985 to discuss the design of the project and to begin drafting a joint project agreement to govern its implementation. Later that year, the government of Ecuador selected the Dirección General del Medio Ambiente (Directorate for the Environment) in the Ministry of Energy and Mines as the lead agency in the program's development, to act as counterpart to the University of Rhode Island for the USAID-sponsored project.

The Coastal Resources Management Project (PMRC) began formally in January 1986 with the signing of the Joint Project Agreement between the Ecuadorian and the U.S. governments, setting forth the objectives and structure of the program. Initially conceived as a three-year effort, the project was extended to 1992, and then again to 1994.

The government of Ecuador asked that the first issue addressed be the shrimp mariculture industry. A decline in 1984-85 in the productivity of shrimp cultivation, on which the economy depended, made it a priority issue. An interdisciplinary group of environmental experts, economists, technicians, and sociologists was assembled to examine the information available on shrimp mariculture at both national and world levels. Based on this information, a strategy to promote the sustainable development of the shrimp industry was presented (Olsen and Figueroa, 1987). A comprehensive report on Ecuador's shrimp mariculture industry, *A Sustainable Shrimp Mariculture Industry for Ecuador*, was later published by the Coastal Resources Center of the University of Rhode Island (Olsen and Arriaga, 1989).

A number of other activities were sponsored between 1986 and 1988. Continued and major efforts were made to assess water quality problems along the coast, to identify shoreline characteristics and processes in order to provide guidelines for construction and activities in the shore zone, and to address the problem of mangrove destruction.

Technical studies focused first on the most important issue—the future of the shrimp mariculture industry—and then broadened to develop knowledge of local coastal issues through a participatory issue-profiling process in the four provinces. At the same time, working groups were established to analyze the legal and institutional framework for CRM, and to gather basic facts about mangrove destruction, water quality, and the uses and problems of shoreline development.The firm of Perez and Associates was hired to examine the legal and institutional aspects of key resource management issues. They produced a computerized catalog of existing legislation as it relates to environmental management topics. Public education and participation were used to gain national attention for these concerns and for designing a workable national coastal management program.

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* This chapter is based in part on a document prepared in conjunction with the original provincial profiles (Matuszeski et al., 1988).

Profiles were prepared for each coastal province by the Fundación Pedro Vicente Maldonado. The profiles summarized findings from technical and legal studies, presented the resource issues in a historical and socio-economic context, and assessed development trends. As the drafts were completed, workshops were held in each province to discuss them. The workshops provided a forum for the discussion of the priorities for a CRM program and led to the identification of the following ten basic principles, which served as a guide in the design of the administrative and institutional framework for the CRM program.

1) The focus of the program must be on issues and conflicts that are truly coastal in nature—that is, on issues related to the sea and to adjacent land areas. Coastal management cannot be expected to deal with all problems on education, health, and infrastructure of the coastal provinces. If it attempts to do so, it will duplicate the missions of other government agencies and become lost in the complexities of other issues.

2) There is no massive critical problem or problems common to all coastal areas. Rather, there are specific issues in each sector of the coast, and there are some identifiable geographic areas where serious conflicts among users are either present or likely to emerge in the near future if no action is taken.

3) There are sufficient laws and authorities already in place to manage coastal resources. New laws are not necessary. What is needed is better coordination and more effective enforcement of existing legislation.

4) There is a general lack of knowledge on the part of public officials about the precise nature and extent of the laws they seek to carry out. Generally, this manifests itself in self-imposed limits on the exercise of enforcement authority. Occasionally, it results in unnecessary duplication of government activity.

5) There is a serious shortage of adequately trained enforcement personnel in nearly all agencies; their salaries and logistical support are also inadequate. The result is a high level of frustration on the part of those attempting to have the laws enforced, and a general attitude on the part of the public that the government does not really expect the laws to be obeyed.

6) There are many overlapping areas of jurisdiction in government agencies. In the case of coastal resources management, it would be more productive to improve coordination among government agencies than to try to reorganize the existing distribution of responsibilities.

7) Apart from the need of specific mechanisms to improve coordination among government agencies in aspects related to coastal resources, management of the different areas will require several administrative levels in order to be effective.

8) The private sector does not have a high level of confidence in the ability of the government to simplify procedures, expedite decisions, or enforce regulations on coastal resources. This attitude cannot be expected to change until real improvements can be shown.

9) An important element of CRM must be an extensive education program at all levels to create a civic consciousness about coastal resources and the critical role they will play in the future of Ecuador.

10) Support for the CRM program must come from presidential, ministerial, and local levels. This support will ensure that 1) the different government agencies improve their cooperation and the enforcement of policies, 2) regional and local entities become more concerned about solving conflicts that affect their areas, and 3) opinions of the public sector and the general public are considered in areas that are important to their interests.

Components of the Program

Building on the insights gained and principles arrived at through research and workshops, a strategy for a national CRM program, accompanied by a manifesto for support from leaders in all four coastal provinces, was drafted in 1988 and circulated to all presidential candidates during the national election. Newly elected president Rodrigo Borja signed Executive Decree 375 in January 1989, which created the legal framework for Ecuador's national Coastal Resources Management program. The 1989 decree called for the creation of special management zones (ZEMs) with separate and executive advisory committees; an executive director and technical secretariat to be based in Guayaquil; a national Coastal Resources Management Commission, within the office of the president, and the establishment of coastal law enforcement coordination units, known as "Ranger Corps." The decree stipulates that management plans should be prepared and approved for each ZEM within two years. A subsequent Executive Decree in 1992 creates a Direccion Ejecutiva as a decentralized governmental unit in Guayaquil responsible for the administration of the program.

Special Management Zones. The six special management zones designated by the 1989 Executive Decree are areas where it is especially important to improve coordination among community government entities in order to deal with current or impending conflicts. Figure 36 shows the five zones in continental Ecuador. Examples are those areas where mangrove deforestation and the associated decline in water quality threaten shrimp farm activities, postlarval hatcheries, and/or tourism; or where large infrastructural works could adversely alter natural processes. These sites were selected as microcosms for combinations of resource management issues found along the coast.

The six special management zones designated by Executive Decree 375 in 1989 are:

- *The Atacames-Sua-Muisne Zone in Esmeraldas.* In this area, regional tourism has the potential to significantly improve the economy of these three small towns. Development, however, is proceeding in an uncontrolled manner, and the potential attractiveness of the area is severely compromised by the absence of wastewater treatment, by inadequate water supply systems, and by the improper siting of shorefront buildings. The local economy is also dependent on artisanal fisheries, but many coastal-dependent stocks are overfished and are suffering from the destruction of their habitats. In the Muisne and Atacames vicinity, shrimp mariculture on an artisanal scale not seen elsewhere in Ecuador is emerging, and offers an interesting test case for a form of mariculture that could benefit poor local inhabitants. A program to define and protect ecosystem health along this stretch of coastline could directly benefit traditional fisheries and enhance the possibilities for growth in tourism.

- *The Bahia de Caraquez Zone in Manabi.* Here, the key issues are to maintain the shrimp mariculture industry in the bay and to deal appropriately with severe erosion along the ocean coast. The great majority of the bay's once-extensive mangrove forests

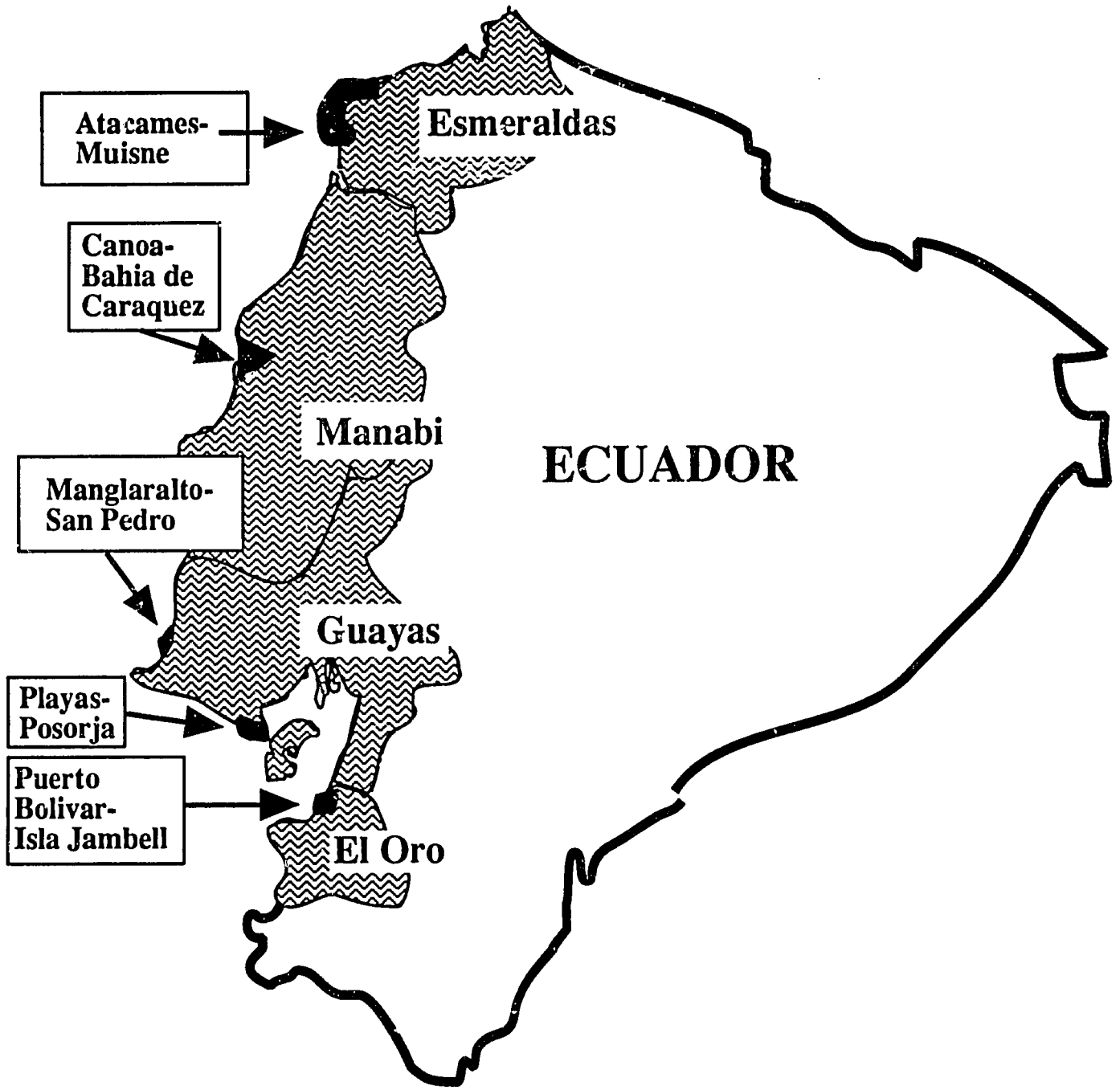

Figure 37. The Five ZEMS in Continental Ecuador

have been converted to shrimp ponds, and pressures to dike off portions of the bay itself—are intense once productive fisheries in the bay have collapsed. Furthermore, dam projects and expanded agriculture in the bay's watershed are likely to bring changes in water quality that may affect the viability of the shrimp mariculture operations. The town of Bahia faces major decisions on the siting of a new fishing port and beachfront facilities for tourism along a coast where processes of erosion and sedimentation have already caused dramatic problems.

- *The Playas-Posorja-Puerto El Morro Zone in Guayas.* In this zone, the conflicts among artisanal and industrial fisheries, tourism, and shrimp mariculture are intense. The infrastructure required for the important fisheries of the zone is inadequate, and fishermen compete directly with tourists for sandy beaches. Problems of waste disposal and inadequate sewage treatment become acute during the tourist season. Declining water quality is of concern to tourists and mariculturists alike. Pressure to convert the remaining mangroves into shrimp ponds is also intense in this area. Land use controls are required to impose some order on development of second homes, on mariculture, and on polluting industries, all of which are expected to expand in the next decade.

- *The San Pedro-Valdivia-Manglaralto Zone in Guayas.* Some of the oldest archaeological sites in the Western Hemisphere have been discovered near Valdivia, yet they have been afforded little protection. Artisanal fisheries are important in the southern portion of the zone, and agriculture dominates in the central and northern portions. An extensive postlarval shrimp fishery has developed in the southern portion of this ZEM. The populations of local communities swell seasonally, reflecting the abundance of postlarvae. Post-harvest mortality is extremely high.

- *The Macahla-Puerto Bolivar Zone in El Oro.* Problems of water quality are most acute in this area. Pesticides, herbicides, and sewage are believed to be affecting human health and have made several shrimp hatcheries inoperable. As in Esmeraldas, the stocks that support artisanal fisheries appear to be declining, and wholesale changes to the ecosystem are being brought by the uncontrolled proliferation of shrimp ponds.

- *The Galapagos Islands.* The Galapagos Islands, with their unique and world renowned ecosystems, were included as the sixth special management area. Despite international support to conserve the rich assemblage of species found in the archipelago and a series of master plans intended to balance economic development and conservation, the human population and activities have increased at an alarming rate. Tourism has increased 10-fold over the last 20 years and the resident population is growing at the unprecedented rate of 6.3 percent per year. The introduction of exotic species is one of several threats to the ecological integrity of the islands.

Although the USAID-sponsored PMRC had focused exclusively on mainland Ecuador, the Borja administration felt that the community-based approach would contribute to addressing and resolving the complex resource management issues that existed within the Galapagos archipelago. The Tinker Foundation generously provided financial support for an initial phase of issue definition involving all governmental units in the islands. A three-day workshop was held to discuss two documents prepared by the PMRC: "An Initial Profile of Resource Management Issues to be Considered Through the ZEM Process in the Galapagos" and "A Proposal to Reactivate the Planning Process for the Galapagos Marine Resources Reserve." There was a consensus that an integrated approach to resource management supported by public participation would contribute to resolving diverse issues within the park, non-park areas, and marine reserve. Given that tourism is the driving force behind change in all areas of the Galapagos, the group recommended that the socio-

economic impacts of tourism in the islands be investigated. The economic analysis of tourism completed by the PMRC in early 1992 provided information that was eventually used to set new visitor and concession fees. Financial constraints prevented the PMRC from establishing a lasting presence in the islands.

Assuring the sustainability and effectiveness of CRM in Ecuador

In 1991, the Interamerican Development Bank provided the Ecuador coastal resources management program with funds to design a larger-scale implementation project incorporating many of the proposed actions in the five special area management plans. The funding was also intended to strengthen national capacity to carry out community-based coastal resources management through public education, information-gathering and analysis, training and technical assistance, and an expanded Ranger Corps. The final design for the four-year program will be determined during 1993.

BIBLIOGRAPHY

Accion Internacional Tecnica. 1976. El Otro Guayaquil. Guayaquil, Ecuador.

Acosta Solis, M. 1977. Ecologia y Fitoecologia. Casa de Cultura. Quito, Ecuador.

AITEC. 1976. El Otro Guayaquil, Servicios Sociales del Suburbio, Intimidades y Perspectives.*

Albornoz, Oswaldo. 1971. Las Luchas Indigenas en el Ecuador.**

Anon. 1983. Ecuador. OPEC Member Country Profile.**

Anon. 1987. World Shrimp Trade. The Fish Boat.**

Arana, P., M. Freire and C. Marin. 1978. Consideraciones sobre la Actividad Camaronera: Desarrollada en el Ecuador 1976. Boletin Cientifico y Tecnico, Instituto Nacional de Pesca, 1-27. Guayaquil, Ecuador.

Arellano, E., et al. 1989. Role of Hatcheries in the Shrimp Pond Culture Industry in A Sustainable Shrimp Mariculture Industry in Ecuador. University of Rhode Island, Kingston, R.I.

Arias, Hugo, et al. 1987. Transferencia de Technologia en el Ecuador (resumen).*

Armada del Ecuador. 1984. Puertos y Marina Mercante, No. 13. Guayaquil, Ecuador.

Arriaga, L. 1986. The Daule-Peripa Dam Project, Urban Development of Guayaquil and Their Impact on Shrimp Aquaculture. Unpublished document.

--------. and P. Vasconez. 1987. Los Manglares y Los Recursos Costeros del Ecuador y su Manejo Ambiental. Primer Congreso Ecuatoriano del Medio Ambiente, Documento U.I. Quito, Ecuador.

Ayon, Hector. 1987. Geologia de la Linea de Costa del Ecuador (informe preparado dentro del PMRC). Guayaquil, Ecuador.

Bailey, C. 1989. Shrimp Mariculture Development and Coastal Resources Management: Lessons Learned from Asia and Latin America. In: S. Olsen and L. Arriaga, eds. Establishing a Sustainable Shrimp Mariculture Industry in Ecuador. Coastal Resources Center, University of Rhode Island. Kingston, R.I.

Banco Central del Ecuador. 1920. Cronica Comercial e Industrial de Guayaquil en el Primer Siglo de la Independencia, 1820-1920. Quito, Ecuador.

--------. 1956. Memoria del Gerente General 1955. Quito, Ecuador.

--------. 1981. El Ecuador en la OPEP. Quito, Ecuador.

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* Cited in: Fundacion Maldonado. 1987. Perfil de Sus Recursos Costeros.

** Further publication information unavailable.

--------. 1982. La Actividad Camaronera en el Ecuador. Guencia de la Division Tecnica. Quito, Ecuador.

--------. 1984. Memoria de 1983. Quito, Ecuador.

--------. 1986a. Boletin Anuario No. 9. Quito, Ecuador.

--------. 1986b. Boletin Estadistico de la Provincia del Guayas. No. 9. Junio-Diciembre de 1985. Quito, Ecuador.

--------. 1986c. Memoria Anual. Quito, Ecuador.

--------. 1986d. Cuentas Nacionales del Ecuador No. 8, 1976-1986. Quito, Ecuador.

--------. 1987. Informacion Estadistica Mensual. No. 1.601. Quito, Ecuador.

--------. Division Technica. 1987. Cuentas Nacionales del Ecuador: 1977-1986. Quito, Ecuador.

--------. 1987a. Boletin-Anuario. No. 10. Quito, Ecuador.

--------. 1987b. Boletin Estadistico de la Provincia de El Oro. No. 3. Enero-Diciembre de 1986. Quito, Ecuador.

--------. 1988. Informacion Estadistica Mensual. No. 1616. Quito, Ecuador.

--------. 1990. Memoria Anual. Quito, Ecuador.

--------. 1991. Boletin Anuario, No. 13. Quito, Ecuador.

--------. 1991. Boletin Estadistico de la Provincia del Guayas, No. 17. Quito, Ecuador.

--------. 1991. Informacion Estadistica Quincenal, No. 1.665. Quito, Ecuador.

--------. n.d. Information Estadistica Quincenal. Quito, Ecuador.

BID. 1987. Progreso Economico y Social en America Latina. Washington, D.C.

--------. 1992. Datos Basicos Socioeconomicos. Washington, D.C.

Barniol, R. 1980. Diagnostico y recomendaciones sobre el recurso de camarones marions. Subsecretaria de Recursos Pesqueros. Guayaquil, Ecuador.

Baumann, Peter. 1985. Valdivia: El Descubrimiento de la mas Antigua Cultura de America. Editorial Planeto. Barcelona, Espana.

Baus, Samuel. 1977. Integracion Estadistica de los Puertos Ecuatorianos. Tesis de grado Universidad de Guayaquil (Facultad de Economia). Guayaquil, Ecuador.

Bird, E.C., and M.L. Schwartz. 1985. Ecuador. In: The World's Coastline. Van Nostrand Reinhold Co., New York.

Blandin. 1977. Publication unavailable.

Cabezas, Gabriel. 1987. CEDEGE debe Hacer la Revolucion Verde, en Revista Dialogo No. 6. Abril de 1987.*

Calvas, J. 1980. Situacion de la Cria de Camarones en el Ecuador. French Aquaculture Mission, Centre Oceanologique.

Camara de Productores del Camaron. 1992. Guia del Sector Camaronero. Guayaquil, Ecuador.

Camara de Productores del Camaron. 1987. El Cultivo del Camaron en el Ecuador. Revista No. 3. Aquacultura del Ecuador. Guayaquil, Ecuador.

Camara Nacional de Pesqueria. 1990. Mundo Pesquero, Año #1, No. 1. Guayaquil, Ecuador.

Cañadas, Luis. 1983. El Mapa Bioclimatico y Ecologico del Ecuador. Editores Asociados. Quito, Ecuador.

Carbo, Luis Alberto. 1978. Historia Monetaria y Cambiaria del Ecuador. Quito, Ecuador.*

Cardenas, J. and K.M. Greiner. 1988. Walking the Beaches of Ecuador. Empresa Editora Porvenia. Quito, Ecuador.

Cardoso, Ciro. 1981. Introduccion al Trabajo de la Investigacion Historica.**

Carrera, Luis. 1987. Lineamientos hacia una Politica y Estrategia para Manejo del Medio Ambiental en el Ecuador. En Documento del Primer Congreso Ecuatoriano del Medio Ambiente. Quito, Ecuador.

CEDEGE. 1970. Investigacion de las Oportunidades de Desarrollo Economico de la Cuenca del Rio Guayas, Ecuador. Comision de estudios para el desarrollo de la cuenca del Rio Guayas. Quito, Ecuador.

---------. 1983. Plan de Conservacion Ambiental del Proyecto de Proposito Multiple Jaime Roldos Aguilera. Unidad de Estudios Agrologicos, Departamento Tecnico. Noviembre. Quito, Ecuador.

---------. 1984. Trasvase de Aguas del Rio Daule a la Peninsula de Santa Elena-memoria general. Centro de Estudios Hidrograficos. Junio. Quito, Ecuador.

---------. 1985. Programa de Desarrollo Forestal de la Cuenca Alta de la Represa Daule-Peripa del Proyecto Jaime Roldos Aguilera. Unidad de Estudios Agroecologicos, Dirección Tecnico. Noviembre. Quito, Ecuador.

---------. n.d. Plan Regional de Desarrollo, CRM, Atlas Regional de Desarrollo. Quito, Ecuador.

CEDIG. 1986. Mapa de Distribucion de la Poblacion Ecuatoriana, 1982. Quito, Ecuador.

CEDIG. 1986. Reparticion Geografica de la Poblacion Ecuatoriana segun el Ultimo Censo de Poblacion (Noviembre de 1982). Quito, Ecuador.

CENDES. 1984. Cultivo y Procesamiento de Balsa para Exportacion. Quito, Ecuador.

CEPAR. 1985. Boletin Sociodemografico Manabi. Guayaquil, Ecuador.

---------. 1986. Boletin Sociodemografico. Guayas, Ecuador.

CEPAR-ICDS. 1985. Poblacion y Desarrollo Socio-Economico en el Ecuador.

CEPE. n.d. 1983. Informe Estadistico. Quito, Ecuador.

Cevallos, Rodrigo. n.d. Industrializacion y Empleo en Ecuador.**

Chauvin, W.D. 1983. Ecuador: Shrimp moves to second largest export. The Fish Boat. August. 41-70.

Chiriboga, Manuel. 1980. Jornaleros y Gran Propietarios en 135 años de Exportacion Cacaotera (1790-1925). Quito, Ecuador.**

Christian Science Monitor. 1987. Vol. 79, p. 12.

CLIRSEN. 1983. Situacion Historica y Actual de los Manglars en un Area Piloto de la Costa Ecuatoriana. Quito, Ecuador.

---------. 1984. Aplicacion de Sensores Remotos en el Estudio del Ecosistema del Manglar. Quito, Ecuador.

---------. 1985. Estudio Multitemporal de Manglares, Camaroneras y Areas Salinas de la Costa Ecuatoriana Mediante Informacion de Sensores Remotos. Quito, Ecuador.

---------. 1986. Estudio Multitemporal de Manglares, Camaroneras y Areas Salinas de la Costa Ecuatoriana Mediante Informacion de Sensores Remotos, 1969-1984. Quito, Ecuador.

---------. 1987. Estudio Multitemporal de Manglares, Camaroneras y Areas Salinas de la Costa Ecuatoriana Mediante Informacion de Sensores Remotos. Quito, Ecuador.

--------. 1992. Estudio Multitemporal de Manglares, Camaroneras y Areas Salinas de la Costa Ecuatoriana, Mediante el Empleo de la Informacion de Sensores Remotos Actualizado a 1991. Quito, Ecuador.

Coe, Edward, and Chuck Gee. 1986. Strategic Tourism Market Plan for Ecuador. USAID. Quito, Ecuador.

Colegio de Ingenieros Agronomos del Guayas. 1986. Memorias del Primer Seminario Internacional de Actualizacion en el Uso y Manejo de Pesticidas en Cultivos Tropicales. Guayaquil, Ecuador.

Compania Guia del Ecuador. 1909. Guia Comercial Agricola e Industrial de la Republica. Guayaquil, Ecuador.

CONADE. 1974. Ecuador, Plan Nacional de Desarrollo. Quito, Ecuador.

---------. 1980. Plan Nacional de Desarrollo, 1980-1984. Quito, Ecuador.

---------. 1980. El Estrato Popular Urbano de Esmeraldas. Quito, Ecuador.

---------. 1982. Indicadores Socio-Economicos. Quito, Ecuador.

---------. 1985. Plan Nacional de Desarrollo, 1985-1988. Quito, Ecuador.

---------. 1986. Previsiones Economicas para 1986. Quito, Ecuador.

---------. 1987. Poblacion y Cambios Sociales: 1950-1962. Diagnostico Sociodemografico del Ecuador. Quito, Ecuador.

---------. 1988. Informe del Presidente del Consejo Nacional de Desarrollo al H. Congreso Nacional: Anexo. Quito, Ecuador.

CONADE, Secretaria General de Planification. 1988. Ecuador: Hechos y Cifras. Quito, Ecuador.

CONADE ILDIS. 1982. Situacion Socioeconomica de la Artesania Ecuatoriana. Quito, Ecuador.

CONADE-UNFPA. 1987. Poblacion y Cambios Sociales. Biblioteca de Ciencias Sociales. Vol. 13. Corporacion Editora Nacional. Quito, Ecuador.

Conniff, R. 1991. RAP: On the Fast Track in Ecuador's Tropical Forests. Smithsonian. 22(3):36-48.

Cobo, M., and H. Loesch. 1966. Estudio Estadistico de la Pesca Camaron en el Ecuador y Algunas Caracteristicas Biologicas de las Especies Explotadas. Boletin Cientifico y Tecnico, Instituto Nacional de Pesca, 1(6):1-25. Guayaquil, Ecuador.

Coulter, J. 1983. Diagnostico del Mercado Interno para Pescado y Productos Pesqueros. Instituto Nacional de Pesca. Guayaquil, Ecuador.

Cribb, J. 1986. Subtidal Galapagos. Camden House Publishing, Ltd., Ontario, Canada.

CRM. 1981. Atlas Regional de Manabi. MAG. Quito, Ecuador.

--------. 1982. Plan Regional de Desarrollo, Manabi, 1983-1987. Tomo 1 y 2. Quito, Ecuador.

---------. 1987a. Manabi en Cifras, Departamento de Planificacion. Quito, Ecuador.

---------. 1987b. Mapa Geografico de la Provincia de Manabi. IGM. Quito, Ecuador.

Cun, M., and C. Marin. 1982. Estudio sobre los desembarques del Camaron en el Golfo de Guayaquil (1965-1979). Boletin Cientifico y Tecnico, Instituto Nacional de Pesca, 5(8):1-32. Guayaquil, Ecuador.

Deler, Jean Paul, et al. 1983. El Manejo del Espacio en el Ecuador. Etapas Claves.

DIGMER. 1985. Estadisticas Portuarias. Quito, Ecuador.

Dillon, Luis. 1985. La Crisis Economico-Financiera del Ecuador. Quito, Ecuador.**

Dirección General de Pesca. 1985. Empresas Pesqueras Clasificadas (estadisticas). Guayaquil, Ecuador.

---------. 1986. Estadisticas Pesqueras. Guayaquil, Ecuador.

---------. 1987. Cria de Camaron (estadisticas). Guayaquil, Ecuador.

---------. 1988. Estadisticas Pesqueras, 1987. Guayaquil, Ecuador.

Dirección Nacional Forestal. n.d. Depto de Areas Naturales y Vida Silvestre. Quito, Ecuador.

DITURIS. 1983. Plan Maestro de Desarrollo Turistico del Ecuador, 1983-1987. Quito, Ecuador.

Dodson, C.H., A.H. Gentry, and F. Sarmiento. n.d. Biological Extinction in Western Ecuador. Draft for the Annuals of the Missouri Botanical Garden. Quito, Ecuador.

Duenas, de Anhalzer Carmen. 1986. Historia economica y social del norte de Manabi. Ediciones Abya Yala. Quito, Ecuador.

The Economist Intelligence Unit. 1992. Ecuador: Country Profile, 1992-93. Business International Limited. London.

The Economist Intelligence Unit. 1988. Ecuador: Country Profile. London.

El Universo. 1992. Se Ampliara el Oleoducto, November 12. Guayaquil, Ecuador.

Espinoza, Jorge. 1987. La Red Vial en el Litoral Ecuatoriano (informe para el seminario sobre planificacion de playas, DITURIS, OMT).*

---------. 1987. La Infraestructura Basica (Agua Potable y Alcantarillado) en el Litoral Ecuatoriano (informe para seminario sobre planificacion de playas, DITURIS, OMT, Mayo).*

Estrada, Julio. 1973. El Puerto de Guayaquil. 2 Cronica Portuaria. Quito, Ecuador.

Estrada, Victor Emilio. 1934. El Problem Economico del Ecuador en 1934. Quito, Ecuador.**

Estupinan, Julio. 1984. Geografia de Esmeraldas. Quito, Ecuador.*

Facultad de Ciencias Economicas de la Universidad de Guayaquil. 1978. El Capitalismo Ecuatoriano Contemporaneo, su Funcionamiento. Guayaquil, Ecuador.

Fallows, J. and S. Contreras. 1992. Estudio de Linea Base de la Pesqueria Artesenal del Ecuador. INP, Informe Internal. Guayaquil, Ecuador.

FAO. 1970. Ecuador Country Profile. Rome.

--------. 1985. Yearbook of Fishery Statistics, Vols. I and II. Rome.

FAO/BID. 1986. Ecuador, Informe Sobre el Sector Pesquero. Internal document.

Flores, Luis. 1985. Estudio Socioeconomico e Institucional del Sector Productor de Granaderia en el Litoral. Guayaquil, Ecuador.

French, S., and A. Menz. 1983. La Pesqueria para Peces Pelagicos en el Ecuador y la Distribucion de las Capturas en Relacion con Factores Ambientales. Ponencia presentada en el seminario regional de la CPPS, Guayaquil, 1982. Revista No. 13.

Fundación Hanns Seidel. 1991. Ecuador: Datos e Indicadores Basicas. CONADE. Quito, Ecuador.

Fundación Natura. 1981. Diagnostico de la Situacion del Medio Ambiente en el Ecuador. Tomo 1 y Tomo 2. Quito, Ecuador.

---------. 1985. Los Plaguicidas en el Ecuador. Quito, Ecuador.

---------. 1986. Medio Ambiente Humano, Medio Ambiente Natural y Recursos Naturales. Quito, Ecuador.

---------. 1987. Vision Global. Unpublished document.

Gaibor, N. 1993. Post Larvas son Base de la Industria Camaronera, published in El Universo.

Gentry, A.H. 1977. Endangered Plant Species and Habitats of Ecuador and Amazonian Peru. In: Extinction is Forever. G.T. Prance and T. S. Elias, eds. New York Botanical Garden, New York.

Gilbert, R. J., and T. R. Roberts. 1972. A Preliminary Survey of the Freshwater Food Fishes of Ecuador. USAID. Quito, Ecuador.

Gonzales. 1983. Publication not known.

Hamerly, Michael. 1973. Historia Social y Economica de la Antigua Provincia de Guayaquil, 1763-1842.*

Harding, G. n.d. The Vegetation Types of Ecuador—A Brief Survey. Publication not known.

Herdson, D., T. Rodriquez, and J. Martinez. 1982. Las Pesqueras Artesanales de la Costa del Ecuador y Sus Capturas en 1982. INP. Guayaquil, Ecuador.

Hernandez, Arturo. 1986. Memo 482-86-DIGEMA (documento interno). Quito, Ecuador.*

Hirono, Yosuke. 1983. Preliminary Report on Shrimp Culture Activities in Ecuador. Cited in Aquaculture Digest (8.8.6).

Holdridge, L.R. 1967. Life Zone Ecology. Tropical Science Center. San Jose, Costa Rica.

Horna, R., et al. 1986. La Exportacion de Camarones, II Congreso Mundial de Aquacultura. Guayaquil, Ecuador.

Hurtado, Osvaldo. 1983. Dos Mundos Superpuestos.**

Icaza, G.R., and E.P. Arana. 1978. Criaderos de Camarones: Diagnostica y Recomendaciones. Serie Informes Pesqueros. Instituto Nacional de Pesca. No. 9/78. Guayaquil, Ecuador.

IDB. 1992. Datos Basicos Socioeconomicos, Resume Ejecutivo. Washington, D.C.

IGM. 1979. Mapa Geografico del Ecuador. Quito, Ecuador.

INEC. 1950, 1962, and 1974. Censo Nacional de Poblacion. Quito, Ecuador.

---------. 1975. Encuesta Anual de Manufactura y Mineria. Quito, Ecuador.

---------. 1979. Encuesta Anual de Manufactura y Mineria. Quito, Ecuador.

---------. 1979. Proyeccion de la Poblacion del Ecuador. Quito, Ecuador.

---------. 1980. Censo Economicos y Encuesta de Manufactura, 1984. Quito, Ecuador.

---------. 1981. Areas de las Provincias. Quito, Ecuador.

---------. 1982. IV Censo de Poblacion, 1982. Quito, Ecuador.

---------. 1984. Encuesta Anual de Manufactura y Mineria. Tomo 1. Quito, Ecuador.

---------. 1985. Proyecciones de la Poblacion Ecuatoriana por Provincias, Cantones, Areas y Grupos de Edad (1982-1995). Quito, Ecuador.

---------. 1985. Anuario de Estadisticas Hospitalarias. Quito, Ecuador.

---------. 1986. Encuesta Anual de Restaurantes, Hoteles y Servicios. Quito, Ecuador.

---------. 1986. Anuario de Estadisticas Vitales: Nacimientos y Defunciones. Quito, Ecuador.

---------. 1987. Division Politico-Administrativa de la Republica del Ecuador. Quito, Ecuador.

--------. 1990. Anuario de Estadisticas Vitales: Nacimientos y Defunciones. Quito, Ecuador.

--------. 1990. V Censo de Poblacion y IV de Vivienda: 1990. Quito, Ecuador.

INEC and MAG. 1986. Encuesta de Superficie y Produccion pur Muestreo de Areas. Quito, Ecuador.

INEMIN. 1986. Castastro Minero de la Republica del Ecuador. Quito, Ecuador.

INERHI. n.d. Evaluacion de los Recursos Hidricos. Tomo 1. Quito, Ecuador.

INERHI-CONADE-OEZ. Plan de Desarrollo Region 1. Quito, Ecuador.

Instituto Nacional de Pesca. 1987. Informe de los Resultados Obtenidos del Crucero de Investigacion Oceanografico-Pesquera 87/04/2. Guayaquil, Ecuador.

International Institute for Environment and Development. 1986. World Resources 1986. Basil Books, New York.

International Union for Conservation of Nature and Natural Resources. Tropical Forest Program. 1988. Ecuador (with Emphasis on Western Ecuador): Conservation of Biological Diversity and Forest Ecosystems. Draft document.

Jaramillo, Marco. 1980-1981. Diagnostico Socio-Economico de la Provincia de Esmeraldas. 1, 2, 3, 4 Tomos (Estudios de OIPE). Quito, Ecuador.

Jenkins, D.W. 1979. Estudio del Impacto Ambiental del Proyecto de Proposito Multiple Daule-Peripa del Ecuador. Comision de estudios para el desarrollo de la cuenca del Rio Guayas. Banco Interamericano de Desarrollo. Washington, D.C.

JUNAPLA. n.d. Estructura Espacial de la Industria Ecuatoriana. Quito, Ecuador.

---------. n.d. Alguno Aspectos de la Economica Ecuatoriana, la Decada del Sesenta. Quito, Ecuador.

---------. 1972. Filosofia y Plan de Accion del Gobierno Revolucionario y Nacionalista del Ecuador. Lineamientos Generales. Quito, Ecuador.

---------. 1973. Plan Integral de Transformacion y Desarrollo, 1973-1977. Quito, Ecuador.

---------. 1976. El Estrato Popular Urbano. No. 2. Informe de Investigacion sobre Machala y Puerto Bolivar. Quito, Ecuador.

---------. 1979a. La Industria Lactea en el Ecuador (Situacion Actual y Perspectivas). Quito, Ecuador.

---------. 1979b. Ecuador, Estrategia de Desarrollo (Dimension Rural). Quito, Ecuador.

---------. 1979c. Distribucion del Ganado Vacuno Segun Cantones, 1974. Quito, Ecuador.

Junta de Recursos Hidraulicos, Fometo y Desarrollo de Jipijapa y Pajan. 1981. Evaluacion Costera del Canton Jipijapa (documento interno). Quito, Ecuador.

Kasza, G.J. 1981. Regional Conflict in Ecuador: Quito and Guayaquil. Inter-American Economic Affairs. p. 3.**

Klima, E. 1989. Review of Ecuadorian Offshore Shrimp Fisheries and Suggestions for Management and Research. In: Olsen and Arriaga, eds. A Sustainable Shrimp Mariculture Industry for Ecuador. Coastal Resources Center, University of Rhode Island. Kingston, R.I.

Linke, Lilo. 1960. Ecuador, Country of Contrast. Oxford University Press, New York.

LiPuma, E., and S.K. Meltzoff. 1986. The Social and Political Economy of CZM: Shrimp Mariculture in Ecuador. Coastal Zone Management Journal 14:349-380.

Loesch, H., and Q. Avila. 1965. Identificacion de las Camarones (penaeidae) Juveniles de los Esteros del Ecuador. Boletin Cientifico y Tecnico. Instituto Nacional de Pesca 1(3):1-24. Guayaquil, Ecuador.

---------. 1966. Observaciones sobre la presencia de camarones joveniles en dos esteros de la costa de Ecuador. Boletin Cientifico y Tecnico, Instituto Nacional de Pesca 1:1-30. Guayaquil, Ecuador.

Loor, Macias. 1987. El Problema de la Garrapata en la Costa Ecuatoriana.**

Macias, Washington. 1983. Problemas Socioeconomicos del Ecuador. Guayaquil, Ecuador.**

MAG. 1984. Estimacion de la Superficia Cosechada. Quito, Ecuador.

---------. 1985a. Estimacion de la Superficia Cosechada y de la Produccion Agricola del Ecuador. Quito, Ecuador.

---------. 1985b. Informe Estadistico: 1980-1984. Quito, Ecuador.

---------. 1986. Programa Nacional Forestal. Informe Estadistico: 1980-84. Quito, Ecuador.

--------. 1990. Forestal Informativo. Boletin No. 8. Quito, Ecuador.

MAG-ORSTOM-ILDIS. 1987. Diagnostico Socioeconomico del Medio Rural Ecuatoriano, Descomposicion de la Mano de Obra Ecuatoriana. Quito, Ecuador.

Maldonado, Arturo. 1985. La Actividad Economica del Hombre del Suburbio. Quito, Ecuador.*

Maldonado, Luis. 1953. Una Teapa Historica en la Vida Nacional. Quito, Ecuador.**

Marcos, Jorge. 1985. Los Campos Elevados de la Cuenca del Guayas, Ecuador: El Proyecto Piñon del Rio, 45th International Congress of Americanists.*

---------. 1986. Personal communication.

---------. 1987. El Manejo de Recursos Costeros en el Antiguo Ecuador. Epoca Prehispanica. Quito, Ecuador.**

Martinez, Carlos. 1987. La Pesqueria Pelagica de la Zona Norte y su Relacion con los Fenomenos de El Nino 1982, 1983 and 1987. Segundo Congreso Latinoamericano de Ciencias del Mar, Peru.

Massay, S. 1983. Revision de la Lista de los Peces Marinos del Ecuador. Boletin Cientifico y Tecnico, Instituto Nacional de Pesca 6(1). Guayaquil, Ecuador.

Matusezki,W., E. Perez, and S. Olsen. 1988. Structure and Objectives of a Coastal Resources Management Program for Ecuador and a Manifesto in Support of the Program. Coastal Resources Center, University of Rhode Island. Kingston, R.I.

Maugle, Paul. 1986. Personal communication.

McCredie, W.H. 1982. AID Forest Project in Ecuador: The Forest Industry and Project Recommendations. National Forest Products Association. Washington, D.C.

McPadden, C.A. 1984. A Brief Review of the Ecuadorian Shrimp Industry. Instituto Nacional de Pesca. Guayaquil, Ecuador.

--------. 1985. The Ecuadorian Shrimp Trawl Fishery, 1974-1985. Guayaquil, Ecuador.

Meggers, J.B. 1966. Ecuador. Frederick A. Praeger, New York.

Meltzoff, S.K., and E. LiPuma. 1986. The Social and Political Economy of Coastal Zone Management: Shrimp Mariculture in Ecuador. Coastal Zone Management Journal 14(4).

Ministerio de Finanzas. 1987. Presupuesto del Estado. Registro Oficial. Quito, Ecuador.

---------. n.d. Estadisticas Fiscales, No. 2. Quito, Ecuador.

Molina, F. 1978. Doscientas Millas Mar Territorial. Instituto Geografico Militar, Direccion General de Pesca. Guayaquil, Ecuador.

Montano, Galo. 1976. Vision sobre la Industria Ecuatoriana.**

Naranjo, Marcelo. 1980. Etnicidad, Estructura Social y Poder en Manta: Occidente Ecuatoriano. Coleccion Pendoneros, ed. Gallo Capitan.*

National Marine Fisheries Service, U.S. Department of Commerce. 1981. Ecuadorian Shrimp Fishery, 1980-81. Division of Foreign Fisheries Analysis, IFR-81/91F. Washington, D.C.

---------. 1984. Ecuadorian Shrimp Hatcheries. Office of International Fisheries. IFR-84.

---------. 1984. Shrimp situation and outlook, June 1984. Fisheries Development Analysis Branch. St. Petersburg, Florida.

---------. 1985a. Ecuadorian Shrimp Culture and Exports. Office of International Fisheries. IFR-85/50. Washington, D.C.

---------. 1985b. Shrimp aquaculture in Asia. F/M321:GH/MF, IFR-85/13B. April. Washington, D.C.

---------. 1985c. Ecuadorian Shrimp Hatcheries. Office of International Fisheries. IFR-85/3-B. Washington, D.C.

---------. 1985d. The Latest Developments in Latin American Fisheries. F/321:dw, IFR-85/55. August. Washington, D.C.

---------. 1985e. Fishery Market News Report, T-64. Southwest Fisheries Center. Terminal Island, California.

---------. 1986. Ecuadorian Shrimp Update. 2-12. Washington, D.C.

Odum, H.T. 1991. personal communication.

Oficina de Agricultura y Desarrollo Rural-USAID/E. 1986. Reorientacion del Sector Agricola. Quito, Ecuador.

Olsen, S., and L. Arriaga, eds. 1989. A Sustainable Shrimp Mariculture Industry for Ecuador. Coastal Resources Center, University of Rhode Island. Kingston, R.I.

Olsen, S., and E. Figueroa. 1987. Summario: Una Estrategia Integrada Para el Desarrollo de Maricultura de Camarron. PMRC. Guayaquil, Ecuador.

Olsen, S., and P. Maugle. 1986a. Status and Prospects for Shrimp Mariculture in Ecuador. Proceedings of the International Workshop on the Management of Wetlands, Charleston, S.C.

---------. 1986b. An Integrated Strategy to Promote a Sustainable Shrimp Mariculture Industry in Ecuador. Coastal Resources Center, University of Rhode Island. Kingston, R.I.

Orlando, Alfredo. 1987. Sector Agricola y Forestal: Caracteristicas Actuales y Potencialidad (informe preparado para el PMRC). Guayaquil, Ecuador.

Ortiz, Gonzalo. 1981. La Incorporacion del Ecuador al Mercado Mundial. La Coyuntura Socio-Economica, 1975-1995.

Palacios, Patricia. 1987. Determinacion del Prisma de Marea y Tiempo de Renovacion de Aguas en el Guayas. Tesis para Oceanografa, ESPOL. Guayaquil, Ecuador.

Parodi, E. 1985. Langostinos Del Golfo. Written statement before the United States International Trade Commission. New Orleans, March 21, 1985.

Paucar, Angel. 1986. Plan de Emergencia para la Reserva Ecologica Manglares Churute.*

Paz, L.T. and Mino. 1942. La Poblacion del Ecuador. Quito, Ecuador.**

Perez, Efrain. 1987. Elementos Legales y Administrativos del Manejo de Recursos Costeros de la Provincia de Esmeraldas (borrador de trabajo preparado para el PMRC).

Perez, Efrain, et al. 1987. Prevencion y Control de la Contaminacion de las Aguas Costeras y Estuarinas del Ecuador (estudio realizado dentro del PMRC).

PREDESUR. 1985. Plan de Desarrollo.

PRONAREG, ORSTOM, ILDIS. n.d. Diagnostico Socioeconomico del Medio Rural Ecuatoriano, las Zonas Socioeconomicas Actualmente Homogeneas en la Costa. Quito, Ecuador.

---------. 1982. Diagnostico Socioeconomico del Medio Rural Ecuatoriano, Descomposicion de la Mano de Obra Agropecuaria. Quito, Ecuador.

Quevedo, Carlos and Jorge Medina. 1987. La Contaminacion en las Actividades Hidrocarburiferas en el Ecuador. Ponencia para el Primer Congreso Ecuatoriano del Medio Ambiente. Quito, Ecuador.

Rasmusson, E. 1984. El Niño: The Ocean/Atmosphere Connection. Oceanus 27(2): 5-12.

Reck, G. 1981. Recursos Pesqueros y Costeros. In: Diagnostico de la Situacion de Medio Ambiente en el Ecuador. Fundación Natura. Quito, Ecuador.

Rengel, Jorge. 1985. Desarrollo Nacional de la Mineria Ecuatoriana. ESPOL. Guayaquil, Ecuador.

Reyes, Oscal Efren. n.d. Los Ultimos Siete Años. En: Proceso de la Dominacion Politica en el Ecuador. Quito, Ecuador.**

Rosenberry, Robert, ed. 1991. Directory: Shrimp Farming in the Western Hemisphere. San Diego, CA.

Rosero, Luis. 1986. Las Microempresas de Produccion y Empleo en Guayaquil. En: Informativo Comercial Economico, No. 143.

Salgado, G.P. and G. Acosta. 1991. El Ecuador del Mañana. Corporacion de Estudios para el Desarrollo. Quito, Ecuador.

Scott, I. and L. Torres. 1991. An Economic Review of the Ecuadorian Sea Fishing Industry and Implications for Resource Management. INP. Guayaquil, Ecüador.

Servicio de Economia y Tecnologia Oceanicas del Departamento de Asuntos Sociales y Economicos Internacionales de las Naciones Unidas. 1981. Informacion Preliminar Sobre los Recursos, Usos y Problemas de la Zona Costera Ecuatoriana. New York.

Sistema Portuario Ecuatoriana. n.d. Estadisticas 90.

Smith, C. 1985. Ecuador. In: South America, Central America and the Caribbean Islands. Europa Publications. London.

Snedaker, S.C., et al. 1986. Shrimp Pond Siting and Management Alternatives in Mangrove Ecosystems in Ecuador. Final report to the Office of the Science Advisor, USAID. Quito, Ecuador.

Solis, R. 1985. Situacion de la Ganaderia en el Litoral Ecuatoriano.**

Solorzano, L. 1986. Status of Coastal Water Quality in Ecuador. Guayaquil, Ecuador.**

Southgate, D. and F. Ortiz Crespo. 1992. Development and the Environment: Ecuador's Policy Crisis. Instituto de Estrategias Agropecuarias. Quito, Ecuador.

Southgate, D. 1991. Shrimp Mariculture Development in Ecuador: Some Resource Policy Issues. Fundacion IDEA. (Instituto de Estrategies Agropecuarios.) Quito, Ecuador.

Stevenson, M.R. 1981. Seasonal Variations in the Gulf of Guayaquil, a Tropical Estuary. Boletin Cientifico y Tecnico. Instituto Nacional de Pesca 4:1-133. Guayaquil, Ecuador.

Strong, S. 1987. Ecuador Gold Lures Big Mining Stakes. Christian Science Monitor, November 18.

Subsecretaria de Recursos Pesqueros. 1984. Landings by Species by Year. Unpublished data. Guayaquil, Ecuador.

--------. 1987. Characteristics of the Industrial Fleet. Unpublished data.

--------. 1991. Criaderos de Camaron 1976-1990 (Acumulado): Concesiones y Autorizaciones por Provincial y Tipos de Zonas, Segun Años. Unpublished data.

--------. 1992. Characteristics of the Industrial Fleet. Unpublished data.

Sutinen, S., J. Boradus, and W. Spurrier. 1989. An Economic Analysis of Trends in the Shrimp Cultivation Industry of Ecuador. In: Olsen and Arriaga, eds. A Sustainable Shrimp Mariculture Industry in Ecuador. Coastal Resources Center, University of Rhode Island. Kingston, R.I.

Terburgh, J., and B. Winter. 1983. A Method for Siting Parks and Reserves with Special Reference to Colombia and Ecuador. Biological Conservation 0606-3207/83.

Trabucco, Federico. 1968. Sintesis Historica de la Republica del Ecuador.**

Turner, R.E. 1989. Factors Affecting the Relative Abundance of Shrimp in Ecuador. In: Olsen and Arriaga, eds. A Sustainable Shrimp Mariculture Industry for Ecuador. Coastal Resources Center, University of Rhode Island. Kingston, R.I.

Twilley, R. 1989. Ecosystem Analysis of the Guayas River Estuary in Ecuador: Implications for the Management of Mangroves and Shrimp Culture. In: Olsen and Arriaga, eds. A Sustainable Shrimp Mariculture Industry for Ecuador. Coastal Resources Center, University of Rhode Island. Kingston, R.I.

Ulloa, Antonio de, and Jorge Juan. 1960. En: El Ecuador Visto por los Extranjeros.**

UNESCO. 1985. Ecuador, Educacion Primaria y Media General.

UNFPA-CONADE. 1985. La Poblacion del Ecuador: Tendencias, Perspectivas y Medidas Iniciales de Politica (version preliminar).

United Nations Department of International Economic and Social Affairs. 1982. Coastal Area Management and Development. Pergamon Press. England.

Urriola and Cuvi. 1986. La Agricultura Alimentaira en el Ecuador en los años 80.**

USAID. 1982. Ecuador: Forestry Sector Development.. Project No. 518-0023, AID/LAC/P-097. Washington, D.C.

U.S. Department of State. 1982. Ecuador. Background notes. Bureau of Public Affairs. Washington, D.C.

U.S. Science and Technology Division, Library of Congress. 1979. Draft Environmental Report on Ecuador. AID/DS/ST Contract No. SA/TAO/1-77 with U.S. Man and the Biosphere Secretariat. U.S. Department of State. Washington, D.C.

Vallejo, S.M.A. 1987. Seminar on Integrated Development and Management of Coastal Areas: A Pilot Experience. Coastal Management. Vol. 15, pp. 89-96.

Velasco, Fernando. 1978. El Modelo Agroexportador. Unpublished document.

Velasco, Fernando. 1975. La Estructura Economica de la Real Audiencia de Quito. Notas para su analisis. En Ecuador: Pasado y Presente.**

Velasco, Francisco. 1973. La Circunstancia Actual, 1977. Unpublished document.

Velasquez, Sigifredo. 1987. Realidad y Perspectivas del Desarrollo de Manabi (version preliminar).

Villacrés, Jorge. 1984. Fundamentos Cientificos y Juridicos de la Amplificacion de la Plataforma Continental. Guayaquil.**

Whitaker, M.D. and J. Alzamora. 1990. Production Agriculture: Nature and Characteristics. In: Whitaker, M. and D. Colyer, eds. Agriculture and Economic Survival: The Role of Agriculture in Ecuador's Survival, Westview Press, Inc. Boulder, Colorado.

Whitaker, M.D. and D. Colyer, eds. 1990. Agriculture and Economic Survival: The Role of Agriculture in Ecuador's Survival. Westview Press, Inc. Boulder, Colorado.

Whitaker, M.D., and J. Alzamora. 1988. Characteristics and Indicators of Ecuador's Population. USAID. Quito, Ecuador.

Whitaker, M.D., and J. Alzamora. 1988. Sources of Growth in Crop Production. USAID. Quito, Ecuador.

Whitaker, M.D. 1988. Low Productivity in Ecuadorian Agriculture. USAID. Quito, Ecuador.

Wolf, Teodoro. 1975. Geografia y Geologia del Ecuador. Quito, Ecuador.*

World Bank. 1984. Ecuador: An Agenda for Recovery and Sustained Growth. Washington, D.C.

World Resources Institute and the International Institute for Environment and Development. 1988. World Resources, 1986. Basic Books, Inc. New York.

Zapata, B. and M. Fierro. 1986. Informe sobre el Sector Pesquero y Camaronero. Prepared for PMRC.