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Marine and coastal ecosystems management in Latin America and the Caribbean: Problems and research capacity

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SUMMARY

This document evaluates the Latin America and Caribbean research capacity in the area of marine and coastal ecosystems, focusing on the problems the region confronts. For this task, a review was made of the most relevant and updated literature including some existent directories (FAO/IOC/UN, RIDALC, DECA) and the available information of the ongoing projects in the area. Biodiversity and global changes on the coastal zone and the management of the marine coastal areas are discussed from the point of view of the actual scientific capacities in the area. The level of the individuals capacities was evaluated through the DECA information, relative to the academic degree of scientists. Fifteen leader institutions were identified for the Latin American and Caribbean region, and a list of the major institutions is given: 17 for the Caribbean area, 8 for the Pacific coast of Central and Meso America, 10 for the Atlantic coast of South America and 11 for the Pacific coast of South America.

The most important problems identified are: the lack of continuity of the research efforts which reflects in the lack of long term information on physical and biological parameters; the need of increasing the academic formation of the concerned scientists by means of postgraduate programs and well defined short term training; the lack of a true, real time and efficient network which encourages the institutions to cooperate.

Research topics to be strengthened and around which efforts can be organized, to be developed on long terms studies, are suggested: coastal productivity, integrated research river basins-coastal areas, biodiversity and coastal management.

Ideas of how research can be improved are discussed and a scheme is proposed, focusing on the need of strengthening the human and infrastructure resources in the area, building a Regional Network of Cooperation and orienting the extra-Regional help always fortifying the existing institutions. If new centers have to be established it needs to be done after and exhaustive analysis of the existing capacities avoiding to overlap efforts.

RESUMEN

El siguiente documento evalúa la capacidad de investigación en el area de las ciencias marinas y ecosistemas costeros, de América Latina y el Caribe en relación a los problemas que esta región encara. Se realizó una revisión de la bibliografía más reciente y relevante, incluyendo algunos reconocidos directorios (FAO/IOC/UN, RIDLAC, DECA) y la información disponible acerca de los proyectos que actualmente operan en el area. Se discuten los cambios en la biodiversidad y en clima mundial, y el manejo de la zona costera, desde el punto de vista de la capacidad existente en el area. De igual manera se evaluó la capacidad de los investigadores en relación a su nivel académico, por medio de la información suministrada por el DECA. Se identificaron 15 instituciones líderes de la región, a partir de una lista de las instituciones más importantes de la misma (17 de la región del Mar Caribe; 8 de la región de Meso y Centroamérica; 10 de la región Atlántica de Suramérica y 11 de la región Pacífica de Suramérica).

Los problemas identificados de mayor relevancia fueron los siguientes: falta de continuidad en los esfuerzos de investigación, lo cual se refleja a su vez en la carencia de información de parámetros físicos y biológicos de largo plazo; la necesidad de incrementar la formación académica de los científicos, a través de programas de post-grado y de entrenamiento a corto plazo; la falta de una Red de Cooperación real e inmediata entre las diferentes instituciones del area.

Se sugieren algunos tópicos de investigación a ser fortalecidos y alrededor de los cuales deberían concentrarse los esfuerzos a largo plazo. Entre ellos cabe mencionar la productividad de las zonas costeras, la investigación integrada de las cuencas fluviales y las areas costeras, el manejo de las mismas y los estudios de biodiversidad.

Se propone un esquema en el cual se discuten algunas ideas para el mejoramiento de la capacidad de investigación, tomando en cuenta la necesidad de fortalecer los recursos humanos y la infraestructura del area, a través del establecimiento de una Red Regional de Cooperación, orientando la ayuda extra-Regional hacia el fortalecimiento de las instituciones existentes. Con el fin de no repetir esfuerzos, se recomienda realizar un análisis exhaustivo antes de crear nuevos centros de investigación.

1 INTRODUCTION

Due to the expansion of industry, tourism, urban growth and other developments, coastal and marine ecosystems in Latin America and the Caribbean (LA & C) appear to be degrading in many localities. The most important causes are the explosive population growth and the anthropogenically driven changes in the coastal zone and adjacent waters. Under the pressure of increasing demands for resources, the coastal zone is also the focus of intense development. Increasing pollution from industrial and urban centers and agricultural activities adds to the cumulative impact. Increasing tourism developments and harbor activities on the coastal zone are also dramatically affecting the ecosystem. Distinguishing the effect of human impacts from natural events is generally very difficult, and there is also evidence of synergistic interactions between both. As some LA & C areas are facing the increasing population growth rate and are being cleared and developed at an ever-increasing rate, damage and destruction of coastal habitats in the next decade are expected to reduce the quality of the coastal waters.

Even when LA & C. have made an extraordinary effort to conserve representative examples of its natural ecosystems and its biodiversity, creating a system of protected areas (parks, reserves and sanctuaries) which cover a total of 81 million hectares, the damage is increasing and almost irreversible (LACCDE, 1990).

Among the major problems the LA & C region faces are the lack of continuity of the research effort, which is reflected in the lack of long-term information on physical and biological parameters. This is a common tendency resulting in punctual research, both in time and space, as well as on the thematic. There are practically no time series analysis of environment data in any place in the region. Permanent monitoring of physical and biological parameters is something unknown in the area. This fact does imprint a serious handicap to the research on coastal zone, which is specially concerned by many factors, by far more vulnerable than an open ocean mass of water.

Discontinuity of the research effort is also a consequence of the lack of a perseverance policy in the concerned countries in relation to science development; an area which is (and was!!!) severely punished in some countries by politics, which leaded in the past 30 years to several waves of emigration and exile of entire scientific teams.

The economic crisis of the LA & C countries also is responsible for the lack of continuity of many programs, and specially those concerning increasing formation efforts and the strength of the regional research infrastructure.

Isolation of the scientific communities of the differents countries of the region, within the countries and between the countries, is also one of the major causes of the lack of interrelation. Most of these are a result of the economical situation, but also because selfishness and narrow optics of the administration.

One of the main efforts fighting this tendency was the

establishment of the Asociación Latinoamericana de Investigadores en Ciencias del Mar, founded in 1977, which organizes periodical meetings in different countries of the region. This is the only continuous effort with success as a common forum for the Marine Sciences in LA, and one of the goals of the scientific community, non governmental organization and no contaminated by politics. This was the most important vehicle for communication in the region during the past 15 years.

Recently, much attention has been directed to the increase of greenhouse effects in the atmosphere and the probability of global warming as a direct effect of sea level rise. Considering that the Third World Countries cover approximately three fourth of the terrestrial world and that many of them are situated in the tropical region, these countries will have to spend rapidly increasing fractions of their national resources on environment related activities in the years to come. Furthermore, it is inferred from models that in a matter of 10 to 20 years, the frequency of events as cyclonic sea surges and coastal inundations may become much more frequent than nowadays (IGBP, 1989, 1990a, 1990b).

The main question is therefore what can be done in the region to face all these problems.

For instance, the lack of information in a long-term basis even the most basic physical parameters, such as seawater temperature in coastal areas did not allow the scientific community to be conclusive with the relation of the elevation of water temperature and coral bleaching in the Caribbean, being nevertheless the parameter the most suspected as causing this phenomenon

As has been suggested this question could be faced as follows:

- What research capacity the LA & C countries have to engage in increased efforts on these topics?
- How can increased international/regional cooperation be effectively organized in this field?
- What are the main topics around which research efforts can be organized?

2 PROBLEMS OF COASTAL AND MARINE ZONES IN LA & C

2.1 Biodiversity, Global Change and Coastal and Marine Areas

2.1.1 Global Climatic Change and Biodiversity

The projected global warming will cause sea-level rise, will modify ocean circulation, and will cause fundamental changes to marine ecosystems. Rapid sea-level rise would change coastal ecology and threaten many important fisheries, producing changes in the heat balance, shifts in ocean circulation which will affect the capacity of the ocean to absorb heat and CO_2, changes in upwelling

zones, decreasing the biological diversity and shifting marine organisms and productive zones (IPCC, 1990b).

2.1.1.1 Sea Level Rise

Coastal ecology is affected by the rate of sea-level rise. Too rapid a rise could reduce or eliminated many coastal ecosystems, drown coral reefs, reduce biological diversity and disrupt the life cycles of many economically and culturally important species (IPCC, 1990b).

Upwellings of nutrient-rich waters associated with major fisheries are also expected to change, causing a decrease in primary production in open ocean upwelling zones and an increase in primary production in coastal upwellings zones (IPCC, 1990b).

Adverse ecological and biological consequences will vary by geographic zones of the world's oceans. The loss of habitat will cause changes in biological diversity, redistribution of marine organisms and a shift in the ocean production zones (IPCC, 1990b).

Coastal embayments surrounded by low-lying wetlands areas may be expected to increase in extent with consequent increase in available habitats for sub-tidal communities such as seagrasses. Salt and freshwater marsh plants are susceptible to change. As a consequence of relative rises in sea level the distribution of ecotones shifts in a landward direction (Pernetta & Elder, 1990).

On the basis of geomorphological and paleobotanical evidence it has been suggested that when rates of sea level rise were rapid in the early Holocene, expansive mangrove systems did not exists, but that such mangrove communities developed only following the stabilization of sea levels in the mid-holocene (Pernetta & Elder, 1990).

In low island environments and areas with low inputs of terrigenous sediments, mangrove ecosystems may be able to keep up with a rise of 8 cm./century but at rates in excess of 12 cm./century such communities may not persist. The survival of mangrove ecosystems in low island environments is therefore threatened by the current projected rates of sea level rise (Pernetta & Elder, 1990).

The potential destruction of coral reefs is the most significant, because these areas serve important ecological habitats with high biodiversity (IPCC, 1990b). In the case of these organisms it has been suggested that the currently projected rates of sea-level rise pose no major threat in themselves to the continued survival of these ecosystems. One problem in interpreting the current views of possible coral reef responses, arises from some confusion between the capacity for upward growth of individual coral colonies and that of entire reef communities. Simplistic interpretations follow the line that if individual colonies can growth upwards sufficiently fast to keep pace with projected sea-level rises, whole reefs will do likewise. A second problem stems from a failure to consider changes in physical parameters other than sea level, as we will see briefly in the next part (Pernetta

& Elder, 1990).

2.1.1.2 Raising Temperatures

Since all species exist within a complex web of interactions between their habitats and other species, climate changes which affect any part of the web, will have direct or indirect effects on the entire ecosystem and on the individuals within it. The most direct effect will be physiological, involving temperature or moisture changes. Different species have different mechanism to help them react to changes in either of these two factors (Anonymous, 1990).

Increase of the air temperature will increase sea surface temperatures, which will affect saw the growth and productivity of a wide variety of marine organisms, particularly those which are currently growing at or near their limits of thermal tolerance (Anonymous, 1990).

A rise in temperature can affect the reproductive cycle of many species, as can affect larvae stages of fish and invertebrates. It is also widely known that among sea turtles, the sex of the young is determined by the temperature of sand where the eggs are laid (Anonymous, 1990).

The temperature anomalies that could cause mass mortalities of marine organism are of the same order of magnitude as those predicted to occur within the next thirty to forty years under the greenhouse models of climate change (Pernetta & Elder, 1990).

The implications of such information may be of considerable importance (Anonymous, 1990).

For instance with respect to the issue of coral reef "bleaching", the workshop on Coral Reef Ecosystems and Globe Change, held in June 18-21, 1991, in Miami, concluded that recent increasing in reported events were indicative of increasing ecosystems stress, and that many of the events appear to be associated with local high temperatures. However, other stresses are also known to cause bleaching, and our knowledge of both coral stress responses and the detailed nature of climate change make it impossible at present to claim that coral bleaching is an early indicator of the global greenhouse effect. This detailed finding was seen as strong reinforcement of the perceiving need for systematic monitoring as a basis for research (D'Elia, 1991).

Nevertheless, coral reefs can not survive in waters that are $30^{0}C$ or above for extended periods. Many of the world's reefs are already established in waters which are very close to the upper level of temperature tolerance for the reef (Anonymous, 1990). Heat stress can cause the coral to die. Thus, if sea temperatures increase the predicted $2\text{-}3^{0}C$, most of the world's reefs will die, depriving the earth of this rich source of biological diversity, which are second only to tropical forests, in the variety of species.

In addition to their inability to adapt to higher temperatures, coral reefs are also threatened by more frequent

tropical storms predicted by scientist in their global warming models. Coral reefs takes as much as 10-20 years to recover from just one storm. The branching corals such as elkhorn and staghorn will be particularly threatened.

Coral reef growth is dependent not merely on the upward growth rate of the corals themselves but also on the growth rate of sand producing algae, such as *Halimeda*, which provide in many reefs systems the bioclastic materials for infilling the reef matrix formed by frame-building corals. Changed water temperatures, if they reduced either the growth rates of the frame-building corals themselves or the sand-producing algae, or both, may result in coral reef systems failing to "keep-up" with rising sea level (Anonymous, 1990).

2.1.1.3 Impacts on the world oceans

Ecosystem processes, such as photosynthesis and respiration, are dependent on climatic factors and carbon dioxide concentration in the short term. In the longer term, climate and carbon dioxide are among the factors which control species composition (IPCC, 1990a).

Global climate warming and increase in UV-b radiation can change the physical, chemical and biological processes in the oceans, and affect productivity of the oceans and fisheries. Effective CO_2 doubling could lead to an increase of sea-surface temperature by 0.2°C and to change heat balance components (IPCC, 1990b).

Marine plankton in the sunlit upper portion of the ocean extract inorganic carbon from water through the process of photosynthesis. Perhaps 90% of this carbon is respired during its transfer through the food web in open ocean layer. The rest with inorganic components of the skeleton of the organisms settle to greater depths. A small fraction is ultimately committed to long term burial in deep sediments. In turn this carbon content in the ocean is replenished by the CO_2 in the atmosphere. The reservoir of organic and inorganic carbon in deep sea sediments is more than 100 times those presently circulating in the atmosphere, terrestrial biosphere and ocean. It is also inferred that, perhaps about half of all fossil fuel burnt since the industrial revolution, has been absorbed in the ocean. Furthermore, while the seasonal CO_2 in the atmosphere is dominated by terrestrial processes, the annually average trend in atmospheric CO_2 is a function of marine processes. This complex cycle is also influenced by changes in the rates of oceanic production and species composition of the plankton, by the availability of iron in sea water for regulating the rate of marine primary production and by the impact of rate of sea level rise from global warming on estuarine and coastal environment (IGBP, 1989, 1990b).

A change in heat balance and the circulation systems in the oceans will produce a direct effect on the productivity of marine ecosystems. Taking into consideration the fact that 45% of the

total production is in the zones of oceanic and coastal upwellings and subpolar regions, a change in these regions would determine the future productivity of the oceans (IPCC, 1990a).

The global warming would be accompanied by a weakening of the intensity of oceanic upwelling because of a decrease in the meridional temperature gradient. This process will involve a decrease in productivity of these ecosystems. Some increase in the intensity of coastal upwellings as a result of increasing temperature difference between land and water surface, would partially compensate the reduction of the oceanic upwellings. Besides, an increase in the temperature at high altitudes will be accompanied by an increase in their productivity. As a result of the above changes, a redistribution of productive zones will probably occur. This could led to disturbances in the trophic structure of marine ecosystems and to a change in the conditions of the formation of the stocks of commercial fishes (IPCC, 1990b).

An increase in the zone of the area of warm equatorial and tropical waters would cause migration of pelagic and displacement of benthic communities of these areas to the boreal and temperate regions. This circumstance might significantly affect the structure of world fisheries (IPCC, 1990b).

Climatic effects, for instance on the Galapagos Islands, could come from more frequent and massive El Niño torrential rainfall. If, in the next century, global patterns of wind circulation change, then the upwellings along the west coast of Isabela and Fernandina islands may diminish, threatening the Galapagos penguin and the flightless cormorant. Both of these species need the cold and productive ecosystems provided by the current levels of upwelling in order to reproduce. In fact, during the 1982-83 El Nino, many species of seabirds, including these two, did not breed (Anonymous, 1990).

2.1.2 Sea and Coastal Resources and Contamination

Marine contamination, caused by the dumping of toxic wastes and similar materials into the sea, the runoff of contaminated waters from the land and the decomposition of the atmosphere continue to increase, not only in LA & C, but around the world (LACCDE, 1990).

Coastal contamination is a serious problem in many regions. Together with overfishing, it is leading to the decline of many regions fishing grounds.

The principal problems associated with these resources are overexploitation, contamination by petroleum and other components, and the degradation of coastal, beach and river ecosystems (LACCDE, 1990).

Coastal zones and marine-estuarine species are continually being damaged by discharge of wastes and contaminants from urban and industrial areas. This discharge is concentrated in specific zones where the volume of the discharge overwhelms the recycling ability of nature. For lack of planning, to provide employment and for general economic reasons, industrial plants and tourist resorts

have been established in coastal areas (LACCDE, 1990).

Many countries discard toxic wastes into the sea, either raw or after incineration. The practice of discarding radioactive wastes in the sea stopped in 1983; however, only the accumulation of radioactive wastes discarded into the sea between 1967 and 1985 by all of the OECD member countries totalled 90,000 tons, with a radioactivity of one million curies (LACCDE, 1990).

As in oceans generally, at least 85 percent of the ocean contaminated in LA & C is caused by human activity on the land, and 90 percent of these contaminants remain in coastal waters and ecosystems (mangrove swamps, underwater meadows, coral reefs and the like). The Caribbean has characteristics similar to the Mediterranean Sea as to the concentration of population along its coast, the heavy amount of maritime traffic (cargo and petroleum), the importance of tourism and high levels of contamination (LACCDE, 1990).

An important cause of contamination and deterioration of the marine and coastal environment in the Caribbean, is the petroleum industry, specifically the loading, unloading and transportation of petroleum products, and the cleaning of tanks, as well as the accidents, spills and fires that often accompany these activities. An improvement has been made in oil spills which have declined worldwide in recent years. Nevertheless, the estimated spills of hydrocarbons in the seas and oceans of LA & C total more than 500,000 tons a year and marine transport is responsible for more than 28 percent of these incidents. This is relatively small compared with the six million tons a year of petroleum dumped into the world's oceans, but it does not fail to be worrisome (LACCDE, 1990).

The oceans represent a dynamic system which is closely linked both physically and chemically with the atmosphere, a fact of great importance as it relates to global warming. All the waters of the oceans, even the deepest of them, eventually mix although it may take centuries to occur. Contaminants dilute in the sea, but they are dispersed throughout the world on the currents. This gives the problem a global character (LACCDE, 1990).

2.2 Coastal Management

This section has been performed mainly selecting updated information as case examples on coastal problems in LA & C.

The exponential growth in human populations, particularly in the tropics and sub-tropics has increased the pressures on coastal zones and their resources both living and non-living. The high concentration of people in coastal areas has resulted in increasing volumes of municipal wastes including raw human sewage being poured into the marine environment. Together with increased use of fertilizers in agriculture and consequent high rates of nutrient loss through leaching and run-off, this has contributed to marked changes in nutrient levels in coastal waters, leading to changes in primary and secondary productivity (Pernetta and Elder, 1990)

Biologically coastal systems may include species resident for

their entire life-span in the coastal zone, and others that spend only part of their life-cycle there and part, either in the open ocean, such as penaeid prawns; or part in freshwater such as anadromous or catadromous fishes.Coastal wetlands under the influence of the marine environment are also important transitory habitats for many migratory species of birds. Managing the living resources of the coastal zone therefore often involves management actions at considerable distance of the coastal zone itself. In addition processes and activities occurring at considerable distance from the shore may have major impacts on the scale and direction of processes occurring in coastal environments (Pernetta & Elder, 1990).

The coastal ecosystems of the Caribbean region do not escape from this gradual human degradation, and the potential impacts of global climatic change will not only accentuate current coastal problems but will also add new and severe constraints to sustainable use and development of coastal zones.

2.2.1 Coastal Zone Management and Sea Level Rise

Little attention is given to adopting the comprehensive and integrated approaches that are needed to manage the multiple use which characterizes the coastal zone. In addition, it takes places an added constraint managing coastal environments and resources at a time when global changes may affect their viability. Although coastal management studies regarding global changes are not so abundant in LA & C literature, the sea level rise topic is one of the most world wide focused.

For instance, the coastline of Recife, Brazil, has shown a trend of erosion during the past decades. Comparison between ortophotocharts from 1975 and 1984 indicates a retrogradation of some coastal segments ranging from a few meters up to 25 m; in Olinda, the shore has receded 80 m from 1915 to 1950, and there are bulkheads where there used to be sandy beaches. According to Neves et al. (1991) the present situation results from a combination of causes, mainly: the deficit in sediment supply from rivers due to construction of dams and dredging to the harbor; the beach rock obstructing sediments to be moved either from the inner shelf to the shore or along the coast; sand mining at inlets; extensive coastal engineering works built since 1915. Local tectonism and eustatic sea level variation, either amounting to a relative sea level rise, would bring serious concern to the region, mainly because most of the downtown areas are located below 5 m elevation (Neves, et al., 1991).

The gradual expansion of the city toward areas formerly occupied by mangroves, along the margins of the estuarines and lagoons, poses already a serious problem during the rainy season. These areas have been occupied mostly by low income population, but also have been reclaimed for building shopping centers.

Because of frequent flooding in the business district, dams have been built, upstream from Recife; with a rise in sea level,levees and gates should also be needed. Even though

topographic surveys are already available for the downtown area, it may become necessary to verify the design of the drainage system.

Considering a rise of 1.0 m in main sea level, shore recession values of 24 m and 7 m were computed for different surrounding beaches as Boa Viagem and Piedade.

According to the same author, in relation to the sea level rise, even though one might think that beach rocks could serve as natural breakwaters, there are several considerations to take into account: first, wave transmission over the beach rock would be enhanced; second, wave set-up past the beach rock should also change, and so would the pattern of circulation between the shore and the beach rock; third, fine sediment on the beach could be easily removed by an increase of wave action or current; fourth, once the beach rock is exposed, it behaves as a groin, trapping sediment in one side and causing erosion on the downdrift side. On the other hand, beach nourishment should be feasible solution and the beach rocks might also be used for support of perched beaches.

At this state, the approval and enforcement of strict zoning codes preventing the occupation of risk areas in case of sea level rise should bring significant savings for future city's management (Neves, et al., 1991).

As in Brazil, the Argentina coast exhibits a variety of environmental settings, including estuarine and deltaic areas, marshes, sandy and pebbly shores, and cliff exposures.

Although erosion typifies the 5,000 kilometers coastline, problems are particularly severe in the Province of Buenos Aires, with 40% of the country total population and one third of its coastline. The main urban developments, harbors, industrial complexes, and tourist resorts are located in this province. Floods are very dramatic on the Rio de La Plata shores, which have the highest population density. In the latter case, more than a half a million inhabitants were affected in differents ways (Lanfredi & Pousa, 1991).

Coastal plain flooding is also critical in areas such as the Rio Salado Basin, where topographic gradients are extremely low and the phreatic surface is very shallow. In addition, salt intrusion of coastal aquifers can be predicted as a combined result of sea level rise and coastal retreat. Overpumping has already created this kind of problem in the city of Mar del Plata.

Urban development on the sandy coastline of the northern Buenos Aires Province has caused the elimination of extensive sands and dunes, which are the only available storage bodies for groundwater. Beach erosion in this area is partly due to the restriction in sediment supply from the sand dunes. Undoubtedly, the accelerated rate in sea level rise predicted for the next century will exacerbated the described process (Lanfredi & Pousa, 1991).

2.2.2 Raising Temperatures in the Coastal Zone

As a result of eight years of study on the effects of a thermoelectric facility (Planta Centro, Venezuela), Penchaszadeh

and Bone (1991), and Penchaszadeh et al. (1991) reported some changes in the surrounding marine communities. From the ecological study they found that a sea grass bed of *Thalassia testudinum* suffered a reduction on productivity rates and on total leaf length, while its annual turnover rate stabilized at 13.3 times its standing crop biomass. On sandy bottoms 0-10 m depth a high species-replacement rate was recorded; only 40% of the total macrofauna original species were still present at the end of the study.

It was possible to find a direct relation between the number of electric generators operating at a time and the extension of the thermal plume (170.000 m^2 with 1 unit, 230.000 m^2 with 2 units and more than 300.000 m^2 with 3 or more units). Environmental physical factors such as wave action, wind and currents, determined the shape and direction of the thermal plume. However, this relation varied on a monthly basis. Nevertheless the effluent mostly affects surface waters, since its vertical penetration is in average about 3 m deep, and it decreases with the distance to the discharge channel (<0.5 m deep), reaching a temperature increase up to 6^0C. These results suggested that the impact of the discharge on the sandy bottom is reduced, since it is located 7 m deep.

2.2.3 Coastal Zone Contamination and Water Quality

The history of coastal resource management is sectorally based and as a consequence national policies are fragmented with few linkages between decisions and policies in different sectors. At the present time decision making processes remain fragmented and reactive, frequently focussing on the symptoms (eg. monitoring pollution) rather than on the causes of a particular problem (eg. poor waste management practices) (Annibal, et al., 1991).

Nevertheless, a great attention has been dedicated to the pollution monitoring, by some LA & C countries, where according to Lavrado, et al. (1991) regarding to Brazil, stated that "sometimes the construction of a water-supply system, seems to have priority over water treatment plants in as much as one construction of sewer systems which involved higher costs".

Recently, Guanabara Bay, in Brazil, has become the subject of many discussions in order to try to reverse the present situation of anthropogenic degradation. Guanabara Bay is an estuarine complex in the state of Rio the Janeiro with 12 cities including Rio de Janeiro and Niteroi on its shores. It has a hydrographic basin of 4000 km^2 with 35 major tributaries and 43 km^2 of mangroves (Kosawa de Costa, 1991). Urban areas, which surround the bay, have about 6,000 industries, 2 oil refineries, 16 oil terminals, 2 ports and 12 shipyards. Despite its advance state of degradation, it still is a life resource area of great ecological and socio-economic importance. Water quality parameters are not uniform, due to the complexity of this ecosystem, establishing regions with different hydrological conditions (Villac, et al.,1991). Under the basis of oxygen and ammonia levels, Lavrado, et al. (1991) stated that a

very small area of the bay is responsible for the overall downward trend in water quality parameters.

Out of the 6,000 industries mentioned above, only 52 are responsible for 80% of the total industrial pollution which includes 6.9 tons/day of oil besides toxic compounds and organic matter. Domestic discharges are one of the main sources of water pollution and they contribute with 470 tons/day of organic discharge of which only 64 tons/day receive adequate treatment. Moreover, about 7,000 tons/day of garbage is thrown at city dumps often located at the shores of the bay. Therefore, during the last 20 years, man has caused serious damage to this ecosystem: the fauna has changed with impact on fishing activities, 53 beaches of the bay are now unfit for bathing, destruction of original vegetation (rainforest) on surrounding slopes and alteration in the course of rivers drastically increasing natural sedimentation rates, and constant landfills of an extensive area, mainly along the western shores, have cause irreversible damage to the patterns of tidal induced currents and to water renewal. Moreover, most of the domestic sewage of about 8.7 million people, and an additional burden of some industrial wastes, enter these waters with no treatment. Polluting materials enter the bays and lagoons mostly in rivers and streams that have turned into open sewers, and most of the sewage from the South Zone of Rio de Janeiro enters the ocean through the Ipanema submarine sewer outfall about 3 km. off Leblon beach. When there is a failure in the sewer system or heavy rains fall, considerable amounts of sewage enter directly on the ocean beaches resulting dark regions of beach sand (Araujo, et al.,1991).

In spite of these pollution problems Guanabara Bay produces 260 tons of fish and 20 tons of mussels per month, sustaining about 6000 fishermen. Mussels are harvested by primitive means along much of the bay shore and from small rocky islands and sold directly without depuration. Whole mussels concentrated coliforms about 100 times the level in lightly polluted and 10 times that in more polluted waters, and heterotrophic bacterial population of the mussel intestine was more than 10,000 times of that water (Kosawa da Costa, et al., 1991).

Agriculture, although a dominant land use activity in the adjacent coastal lands of LA & C, has contributed significantly to the incident of non-point source pollution in the marine zone. Pesticides and fertilizers originating from the adjacent coastal lands and outside of this area have been transported into the marine zone where they have had significant deleterious effects on marine ecosystems. Fish kills and coral reef stress are typical examples of the impact from agricultural areas in several Eastern Caribbean countries (Lewsey, 1991).

The prognosis of this phenomena is that agricultural chemicals will continue to accumulate throughout the marine environment, and will impact heavily on the artisanal fishing industry, the food chain, and coral reefs. Furthermore, these events will impact on the stability of the beaches and the well being of coastal user groups such as recreational bathers, tourist and artesanal fishermen (Lewsey, 1991).

The cumulative impact of these multi porpoise land/water use activities have had a significant impact on the water quality of some areas. That is the case of the Gulf of Paria, Venezuela-Trinidad. This water body simulates and estuarine type environment and is very shallow, measuring 70 fathoms at its deepest point. The environmental legacy of intense development activity on the west coast area of Trinidad has resulted in periodic fish kills, the elimination of shell fish beds, the pollution of recreational bathing beaches, and the high toxic residues found in the remaining shell and fin fish populations (Lewsey, 1991).

In other countries, as Ecuador, a group of technicians is trying to develop a coastal Water Quality Working Group (WQWG) management strategy, order to improve and strengthen the institutional capabilities and commitment to deal with water quality issues. It comprised a group of Ecuadorian technicians trained in different areas of chemistry and engineering, and employed by various institutions with interest and responsibilities related to water quality. Nevertheless, this group is facing some problems as lack of financial resources; infrequent communication between experts and the WQWG, thereby delaying results/conclusions and diminishing the scientific weight of the work; the tendency of the Ecuadorian technicians to take "shotgun" approaches in sampling and designing strategies, without clearly identifying issues and objectives, resulting in inefficiency and waste of resources; training in technical areas before training in policy, producing a narrow vision of problems and delay in their solutions, and, its Coordinator and all other members are employed at one or more jobs in addition to volunteering their time to WQWG (Montano & Foer, 1991).

2.2.4 Use of Land and boundaries in the Coastal Zone

Historically, the coastal zone has been designated by using ecological, geographical or political guidelines. In continental maritime countries the use of watersheds to delineated the landward limits of coastal zone boundaries have met with extensive criticisms from public and private interest groups because of the probable impact of proposed boundaries on growth and development activities. For instance, in the eastern Caribbean archipelago, boundary determination is of paramount importance because of the limited geographic area of these islands, along with the close and interrelated nature of the marine and adjacent coastal lands. To date, coastal zone boundary designation in the Caribbean, with regard to landward limit, has been arbitrary based on local and/or sectorial circumstances (Lewsey, 1991). So, as it has been stated by Pernetta & Elder (1990), the first problem encountered in planing and management of human activities and resource use in the coastal zone is met in defining boundaries, of the system under consideration. Different definitions are used by different individuals or groups concerned with coastal processes and resource use. One of the most dramatical examples of the latter is the case of Ecuador and its mangrove areas.

In developing countries, the rate of mangrove destruction to provide sites for mariculture, sources of fuel-wood and agricultural land to feed growing populations has accelerated in recent years. This kind of exploitation, besides an indiscriminate waste disposal and sediment inputs from construction activities on land, can led to extensive coastal and near-shore habitats loss and irreversible modification (LACCDE, 1990).

The breeding and growth zones (the mangrove forest) of the economically most important species (shrimp, mullet, bass) are being cleared and converted to other activities (tourism, ports and the like). Thus more than 50 percent of the mangrove swamps of Latin America (60,000 square kilometers) are exploited, converted or degraded in some manner. The productivity of this system may exceed 1.000 g.C./m^2/year (Parsons, 1991).

According to Landazuri (1986), the prawning farms-mangrove is a very important issue to solve for Ecuador. Prawning is considered a highly profitable activity from an economic point of view and, for this reason, there is a hard competition over the use of lands, some of them of agricultural potential in the ecuadorian coastline. In fact, some agriculturally adequate soils have been displaced to give room for the prawning pools. Once mangrove is removed, as is the case with the extensive prawning pools that have been constructed to the present in Ecuador, it rarely returns. The particular characteristics that give mangrove its special adaptations to saline mediums and to fluctuations of water salinity do not appear in other ecosystems. The functions of mangrove cannot be adequately replaced by any other kind of species, introduced or managed. It is impossible to reproduce its role as a basic and multiplying element of marine fauna, as well as of habitat and sustenance of avian fauna associated to coastal fringe sectors.

The creation of extensive zones of prawning pools has had two main effects; first, it created saline environments in places where they didn't exist before, and second, when water evaporated in these shallow trenches, it produced an increasing concentration of salt which salinized the soil making it inadequate for future agricultural uses. This phenomenon, occurring over great extensions of the Ecuadorian coast, constitutes one of the most preoccupying effects of the industrial activity above mentioned (Landazuri, 1986).

More recently, agriculture has had to compete with other activities such as coastal tourism, port facilities, industrial development, air-ports, urbanization and local recreational activities. However, as the competition for coastal land intensified, agricultural activity has had to share, and in some cases relinquish land to tourism activities and urban development. Similarly, the competition for beach and adjacent coastal lands between tourism, artisanal fisheries and local recreation has skewed land use in favor of tourism related activities, being Barbados a typical example of this phenomenon (Lewsey, 1991).

The problem is well illustrated by reference to recent applications to develop lands along the northern coast of Barbados.

The proposition was to expand a hotel complex and subdivide adjacent lands for real estate. The only pocket beach along the North Point coastline would have been eliminated from public use. If the proposal were approved, the only means of public access would have been via a sheer 20.0m high cliff, or alternatively by boat from the two nearest beaches at River Bay and Archer's Bay, some 3.0 km to the southeast and 2.0 km to the southwest respectively (Atherley, et al.,1991).

According to Freestone (1991) the number of beaches and the beauty of the coastal areas of Antigua and Barbuda have been the basis for a steep rise in tourism in the last decade, which has resulted in a commensurate acceleration of development in the coastal zone. The building of hotels and tourism related facilities has resulted in the draining of important saltpond and mangrove areas, and the need for deep water access for cruise ships has necessitated the dredging of harbor areas. Such developments threaten the possible long term environmental damage. Because of the priority which has been given to the development of tourism and its wealth generating importance, it is only recently that attention has started to be given to the co-ordination of the activities which put considerable stress on the coastal zone, and to the establishment of institutions which would permit an informed and long term view of the future development of the coastal zone.

Since 1989, one Caribbean area that is being studied in order to provide adequate knowledge for a rational management is the Archipielago Sabana-Camaguey which stretches about 400 km along the Central North part of the mainland of Cuba. This archipelago is being the object of extensive tourism development projects, and in the most western part, to oil exploitation (Alcolado, et al., 1991).

The smaller Eastern Caribbean Islands, which form a chain from Grenada in the South to the Virgin Islands in the North, are heavily dependent upon coastal tourism. In addition the coastal zone is often the only area where there is flat land. As a result the coastal zones are intensely used for tourism, manufacturing, harbors, fishing, residential and commercial development and communications. Despite this heavy dependence on the coastal zone, natural and man induced changes in the coastal zone have been largely ignored. However, as the degree of development increases, and as tourism grows in importance to the local economies, it is no longer possible to ignore this changes (Lewsey, 1991).

Against this background there was no in house expertise within these islands to advise Governments as to how to deal with these problems.

This apparent indifference to the coastal zone is related to the low level of government and public awareness of the importance of this area and its contributions to national physical development. This problem is compounded by the traditional approach to development planning which presumes that economic growth and development is always beneficial for a region or country, and the

role of the planner is to organize space to accommodate this growth. It is not sufficient for plans to only accommodate growth demands, but in the process they must evaluated the ability of the environment to accommodate proposed growth. The traditional planning process needs to be altered to reflect the sensitivity of the coastal zone to withstand the intensive demands of multiple use activities (Lewsey, 1991).

3 REGIONAL AND INTERNATIONAL PROGRAMS FACING PROBLEMS OF COASTAL AND MARINE AREAS IN LA & C

Of all the subareas considered here, the wide Caribbean has been for years the scenery for many cooperation programs, in different aspects of the marine sciences and related subjects. It is by the other hand, one of the areas of the world with more research infrastructure for sea studies though it still lacks an efficient network between laboratories, been the common situation, the isolation.

Some programs are actually trying to develop a better degree of cooperation, and among them we must cite the "CARIBBEAN COASTAL MARINE PRODUCTIVITY" (Jordan, et al., 1989). This is a regional scientific program to study land-sea interaction processes. The program focuses on understanding productivity, structure and function of the three main coastal ecosystems in the Caribbean; mangroves, seagrasses and coral reefs. The CARICOMP program, under the frame of the COMAR-COSAL of UNESCO, succeeded in starting in 1991 with a grant of the NSF (US$175,000) and the Mac Arthur Foundation (US$350,000). Since the establishment of a Steering Committee in 1985, several activities were conducted; among them the preparation of a manual of methods for mapping and monitoring physical and biological parameters in the coastal zone of the Caribbean. The main goal of this program is to establish a network among marine laboratories that could cooperate at the same level of commitment and precision obtaining their data with a standard methodology and on the basis of a time series. This effort could change, if successful, the tendency of isolated data in time and space with none comparable methodologies.

The need of cooperation in the Caribbean is seen perhaps more clearly than in other of the subareas here considered. In the last years, some wide spread events occurred in the area and only some speculations were offered as scientific response, as in the case of the disappearance of the black urchin *Diadema antillarum* and the coral bleaching phenomena. Nearly 30 laboratories of the Caribbean will be interconnected trough the CARICOMP program. A data management center for CARICOMP was already constituted, located at the Center for Marine Sciences of the University of the West Indies, Mona Campus, Jamaica.

The anglophone Caribbean, integrated at CARICOM has a Regional Center of Ocean Studies at the Institute of Marine Affairs in Trinidad, as well as a Fish Resources and Management Program (CFRAMP) in Belize city, with projects in St. Vincent and Trinidad

(granted Can$15 million).

Another regional structure operating in the Caribbean is IOCARIBE, the Intergovernmental Oceanographic Commission for the Caribbean; with a secretariat in Cartagena, Colombia and in UNESCO, Paris. Their more successful program is CARIPOL, dealing mainly with cooperative research in oil pollution. IOCARIBE as an IOC Subcommission, runs also as a medium term plan (1990-1995) which includes all major projects on Ocean Sciences (Ocean Dynamics and Climate; Ocean Sciences in Relation to Living Resources; Ocean Sciences in Relation to Non Living Resources; Research, Monitoring, Control and Abatement of Marine Pollution; Ocean Mapping and Bathymetric Chart of the Caribbean Sea and Gulf of Mexico), Ocean Services (Sea-level Observing System, International Oceanographic Data Exchange), Training and Educational Mutual Assistance (IOCARIBE MEDIUM TERM PLAN: 1990 - 1995, 1990)(ANNEX I).

The Center for Resource Management and Environmental Studies of the Eastern Caribbean, is located at the Barbados Campus of the West Indies University; they deal mainly with **sedimentology** and erosion in the small islands. Environmental Sciences has also a place at the Center for Nuclear Sciences in Mona, Jamaica (budget US$1 million).

The regional Co-ordinating Unit of the UNEP Caribbean Environment Programme, has initiated, among others, the CEPPOL programme (Marine Pollution Assessment and Control Programme for the Wider Caribbean Region), with, for instance the "Site-Specific Studies of Damaged Ecosystems and Development of Proposals for Remedial Action" and "Studies on the Impact of Marine Pollution on Coral Reefs in the Wider Caribbean Region".

UNESCO's COMAR-COSALC runs a special program for the temperate Coastal systems in South America, focused mainly on the Climatic or blooming ecosystems (e.g. short term effects, red tides, long term effects, EL Niño), and on the so called permanent ecosystems as rocky shores, sandy beaches, upwelling areas, estuaries, coastal lagoons, saltmarshes, wetlands, fjords and archipelago zones of estuarine type.

The study of long term climatic efforts upon the coastal sign environment such as El Niño have determined many of the National and International efforts of the past 20 years in the South Eastern Pacific.

Intertidal ecology of rocky shores from a modern point of view has been largely developed in Chile, in relation to the exploitation of natural resources as mollusks and algae, whereas sandy beaches ecology, which are predominant in the Atlantic side of South America have seen studied mainly regarding the population dynamics of economically important bivalves (Argentina, Uruguay and southern Brazil).

Coastal lagoons, which are very important in the Caribbean and Atlantic side of South America are also included in the COMAR-COSALC Program.

The COMAR-COSALC program had nevertheless little success in attaining funds and therefore it is not as active as their organizers would like it be.

4 RESEARCH CAPACITY OF THE REGION: INSTITUTIONAL AND HUMAN RESOURCE

Research capacity is a widely used term that sometimes is difficult to measure: it is possible to find a very well equipped institution which a null scientific production, and it is also possible to find a good single scientist producing useful information in a scarce equipped center. It is obvious that the economic level of the countries can determine the kind of available research technology, which is the limitation factor for the accuracy of data, for the speed to obtain it and for the capability to get some new and specific information, but not for the quality of the scientific information produced. In the same way, human capacity is measured in relation to the professional level. In LA & C the main tendency of the composition of professional levels of scientists from the differents countries is strongly skewed to the "Licenciado" level (Fig. 1).

It is a reasonable point of view to think that an improvement of the professional level, at the PhD. or post-PhD levels, will assure the improvement of scientific research. Nevertheless, it is interesting to think about the causes of this skewness, regarding to economic pressures on our young people. It is difficult to answer this question, but it is possible to point out that the stimuli to young people to become a PhD, in a research area, is almost scarce, both in professional recognition as in economic retribution. It is not a difficult problem to a well prepared "Licenciado" in our LA & C region to realize that with a lesser effort he would get more goods doing other activities than science, with less worries and frustration.

Regarding the institutional capacities (ANNEX II), in LA & C some of them have been identified due to their scientific productivity and some for their relevant role in selected LA & C countries. Those that have been tagged with the (*) keep the best conditions to be considered the fifteen Leader-Institutions in the region. Under this point of view, for the Caribbean Region, the following are the most important scientific Institutions dealing with coastal and marine ecosystems.

Bermuda Biological Station.
CARMABI, Curacao.
CIBIMA, Santo Domingo, Rep. Dominicana.
CINVESTAV, Mérida, México.
EPOMEX, Campeche, México.
ICML, UNAM, Puerto Morelos, Ciudad de México, México.
Caribbean Environment Health Institute St. Lucía.
Instituto de Oceanología, Cuba.(*)
Universidad de La Habana, Cuba.
INVEMAR, Santa Marta, Colombia.
INTECMAR, Univ. Simón Bolívar, Venezuela.(*)
EDIMAR, La Salle Foundation, Venezuela.
Instituto Oceanográfico, UDO, Cumana, Venezuela.(*)
Universidad Nacional, Heredia, Costa Rica.

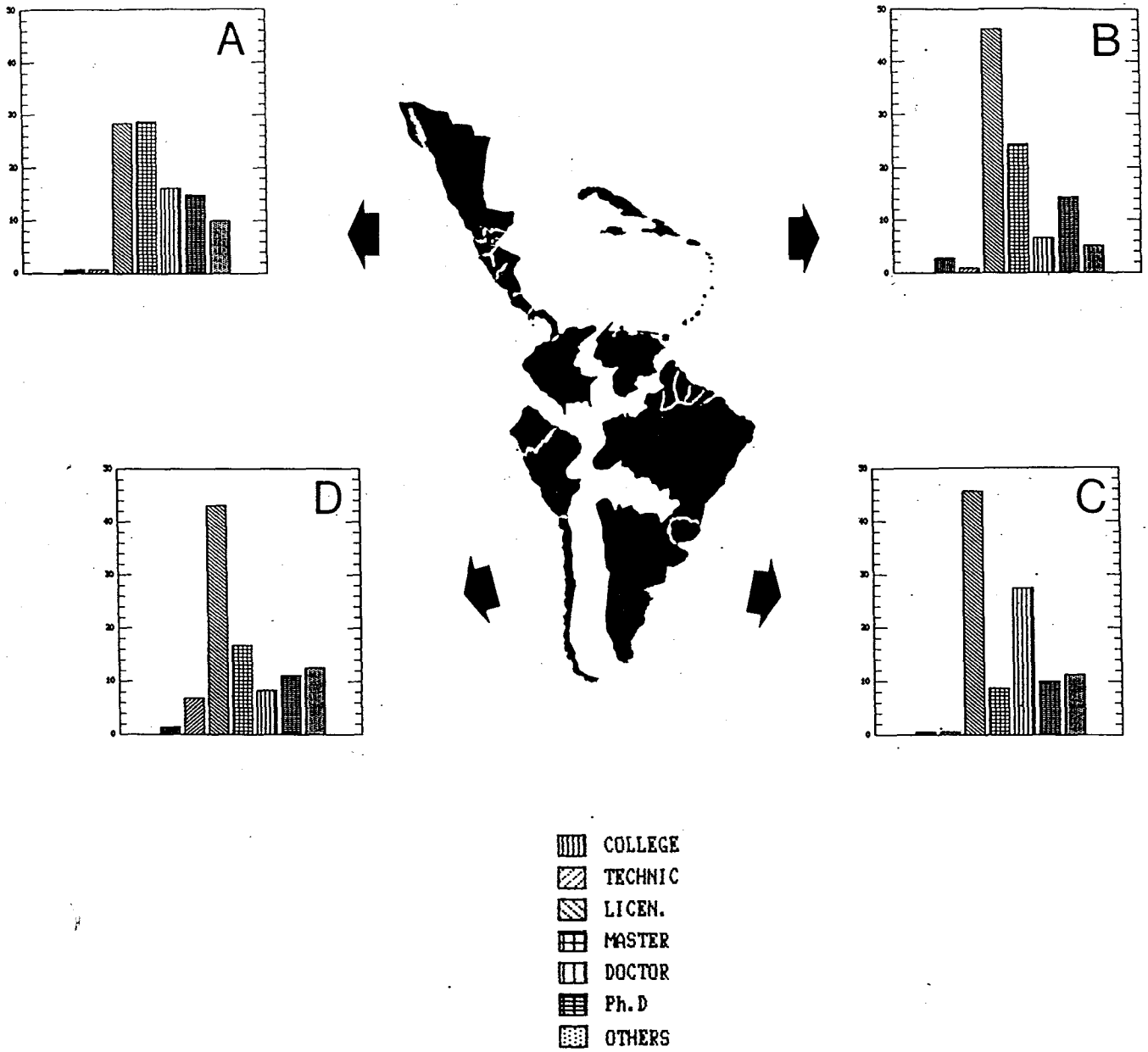

FIGURE 1: This figure shows schematically the professional capacity of the LA & C scientists, considering four different areas. A: Central and Meso America (N=247 scientists), B: Caribbean Sea (N=217 scientists); C: Atlantic Coast of South America (N=160 scientists) and D: Pacific Coast of South America (N=72 scientists). Seven categoires are considered. Vertical axis are the percentages calculated in each area. Percentage of scientists in each country: A: Mexico = 68.8%; Colombia = 11.7%. B: Venezuela = 55.3%; Cuba = 31.3. C: Argentina = 65%; Brasil = 30.6%. D: Chile = 75%; Peru = 13.9; Ecuador = 11.1%. The remaining countries contribute with a number of scientist less than 10% of the total in each area. Data obtained from DECA (1991).

University of Puerto Rico, Mayaguez, Puerto Rico.(*)
University of West Indies, Jamaica.
Smithonian Tropical Research Institute, Balboa, Panama.

On the Pacific coast of Central and Meso America:

CICESE, Ensenada, México.
CICIMAR, La Paz, México.
Instituto Politécnico Nacional, México.
ICLM, UNAM, Mazatlán y Ciudad de México, México.(*)
Universidad de Costa Rica, San José, Costa Rica.
Smithonian Institute, Panama.(*)
Universidad Nacional, Heredia, Costa Rica.
Universidad de Panamá, Panamá.

On the Atlantic coast of South America:

Instituto Oceanografico Sao Paulo, Brazil.(*)
FURG, Rio Grande, Brazil.(*)
Univ. Federal de Rio de Janeiro, Brazil.
INIDEP, Mar del Plata, Argentina.(*)
Facultad de Ciencias Universidad de Mar del Plata, Argentina.(*)
INAPE, Montevideo, Uruguay.
Facultad de Ciencias Universidad de La República, Uruguay.(*)
CADIC, CONICET, Ushuaia, Argentina.
CENPAT, Puerto Madryn, Argentina.
Universidad de Buenos Aires, Argentina.

On the Pacific Coast of South America, chileans have a very diversified capacity, but the main institutions are:

Universidad Católica de Valparaíso.
Universidad Católica de Talcahuano.
Universidad Católica de Santiago.(*)
Universidad Católica de Chile.
Universidad Católica del Norte, Coquimbo.
Universidad Austral, Valdivia.
Universidad de Concepción, Concepción.(*)
Universidad de Chile, Santiago y Vina del Mar.(*)

Peru and Ecuador:
IMARPE, El Callao, Perú.(*)
Universidad de Guayaquil, Ecuador.
Universidad Nacional Mayor de San Marcos, Perú.

5 RESEARCH TOPICS TO BE STRENGTHENED AND AROUND WHICH EFFORTS CAN BE ORGANIZED

The following suggested areas have been identified in order to be developed on long term studies, using the actual human and physical infrastructure in the LA & C countries.

5.1 Coastal productivity. Mangrove wetlands, seagrass meadows and coral reefs which dominate the land-sea margins in the tropics. Studies on productivity, structure and functions and the interrelation and linkages between the systems. The upwelling phenomena which imprint a very important pattern to productivity in some areas of LA & C. (i.e. Paraguana Peninsula, Venezuela.; Eastern coast of Venezuela.; Cabo Frio, Brazil; El Nino, Peru, Chile, Ecuador; Southern Atlantic Subtropical Convergence.)

5.2 Integrated research, River Basins-Coastal areas. The integrated study of the influence of river basins on the coastal areas has been identified as a major need in LA & C countries. The successful cooperative italian-chilean project on the Bio-bio basin is and stimulating example for other similar studies in the area.

5.3 Studies on biodiversity in marine-coastal environment focusing on the knowledge and the updating of biogeographical problems of the evolved communities as a cooperative all-area effort.

5.4 Coastal management of the marine environment focused in how to prevent the effects of the actual environmental anthropogenic degradation and those related to the global change.

6 HOW RESEARCH CAN BE IMPROVED IN THE AREA

The multidisciplinary approach that characterizes in the best cases the actual phase of the L.A. & C. research need to go into a true interdisciplinary and issue-oriented nature of work with a strong emphasis on time and space scales and on environmental interactions.

There are few examples of institutional integrated research in the Coastal Marine areas of LA & C. One of them, and probably the oldest, is the Cuban effort, leaderized by Academy of Sciences and University of Havana focused on different areas of their coastal and marine environment, and in some cases with the "Instituto del Transporte" (Contamination of the Bay of Havana UNDP Program 1980 - 1984).

The more recent EULA programs, if succeed, will multiplicate and enrich the Chilean experience in several other countries, like Argentina, Chile, Uruguay, Brazil and Venezuela.

Other examples of integrated research in LA & C is the Program of Ecology, Fisheries and Oceanography of the Gulf of México (EPOMEX), leaderized by Universidad Autonoma de Campeche with joining efforts of CINVESTAV - Merida, and the State University of Louisiana US. The program includes, the oceanographic processes, ecology and management of coastal ecosystems, coastal geology processes, tropicals fisheries resources, pollution and environmental impact.

A starting point for the development of a international and interdisciplinary research effort in the LA & C coastal and marine

zones could be to complete a severe, precise and updated accurate diagnosis of the research capacity of the region and the identification of the needs both institutional and of human resources.

A second phase will be to organize a regional and international cooperation program and a network to ensure the data taken and exchange of these data, information, research results, techniques, management solutions and experiences. A major chapter of this network need to be training and formation of human resources.

From the analysis provided, there is a strong need of academic improvement of the scientific community dealing with coastal and marine problems in LA & C. But training and formation of human resources alone is not enough to ensure the strengthening and enhancening of the research capacity of the area. We do need to build also a communication infrastructure, taking the best profit of what is already done and also by constructing new structures.

A proposed scheme of how research can be improved in LA & C is:

Phase one; proper updated diagnosis of capacities and weakness of the area.

This will be done with a special program designed to obtain specific and accurate information from each institution involved. Time: one year.

Procedure:

a) Elaboration of a form to be filled by the concerned institutions focusing mainly on what they could offer as expertise and what are their needs.

b) Sending and receiving the forms.

c) Processing the obtained information in a matrix of capacity-weakness for the region.

d) Validation of the scheme in point "c" with a short consultancy trip to the countries of the area, with emphasis on the quality of the scientific production.

Phase two: building a Regional Network of Cooperation.

a) Training and formation

a.1) Taking into account the best opportunities for graduated formation in the area; orienting the candidates to those excellency centers.

a.2) Short term training in specific techniques and subjects, orienting the candidates to those identified excellency laboratories in their field.

b) To build a communication system for the area. A more realistic, usable, efficient way to:

b.1) Obtain information (reprints) in a real time-scale.

b.2) To communicate with laboratories facing similar problems in real-time.

b.3) A data-base center, (perhaps expanding one of the existing centers in the area, such as the CARICOMP one at West Indies University).

Phase three: Focus extra-regional cooperation to those

identified crucial aspects lacking expertise in the region.

After phase one and two will going on, the needs for oriented extra-regional help will be evidently pointed out; for instance with a program of visiting professors in special topics or sending scientist for the LA & C area to centers in Europe or USA and Canada.

This scheme will optimize the use of founds of many concerned agencies, which are willing to have a frame of needs in the area.

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ANNEX I

PROJECTS RELEVANT TO THE IOCARIBE (INTERGOVERNMENTAL OCEANOGRAPHIC SUB-COMMISSION FOR THE CARIBBEAN) MEDIUM TERM PLAN (1990-1995).

PROJECTS RELEVANT TO THE IOCARIBE MEDIUM TERM PLAN

PROGRAMME	NAME OF PROJECT	RESPONSIBLE	IMPLEMENTATION	BUDGET US$
PHYSICAL OCEANOGRAPHY	1. Ocean circulation in the Caribbean Sea and Adjacent Regions: An Intergovernmental Oceanographic Commission Proposal to the European Space Agency for ERS-1 Science, Aplication, and Validation.	IOC/IOCARIBE	1990-1993	180,000
	2. Climatic and other Environmental Changes - Establishment of a Regional Monitoring Network.	IOC/IOCARIBE	1990-1992	166,000
	3. Climatic Change Impacts and Ocean Physical Processes.	IOC/IOCARIBE and Regional Institution bodies	1990-1995	1.382,000
OCEAN SCIENCE IN RELATION TO LIVING RESOURCES	1. Satellite Ocean Analysis for Recruitment (SOAR).	USB, Texas A&M Univ.	1990-1991	156,000
	2. Fish Estuarine Deltaic Recruitment (FEDERP).	USA, Mexico, Colombia, Venezuela, Brazil.	1990-1995	2.500,000
	3. Peneids Recruitment (PREP).	USA, Mexico, Colombia, Venezuela, Brazil.	1990-1995	5.000,000
	4. Coral Reef Demersal Recruitment (CORDEP).	USA, Cuba, Venezuela.	1990-1991	95,000
OCEAN SCIENCE IN RELATION TO NON-LIVING RESOURCES	1. Substrate mapping, sample collecting and analysis. 2. Preparation of geomorphological maps of the coastal areas. 3. Beach dynamics and monitoring 4. Quaternary Palaeo-oceanography studies. 5. Geotectonic, morphostructural and geodynamic studies of deep trenches. 6. Water and continental material fluxes towards the sea. 7. Evolution of coastal fringe in the beach zone. 8. Management of coastal ecosystems including legal aspects.	(An Ad-hoc Group of Experts has been charged with the task to finalize a project on Impacts of Sea-Level Changes on the Coastal Zone - Effects on Erosion and Sedimentation)		

PROGRAMME	NAME OF PROJECT	RESPONSIBLE	IMPLEMENTATION	BUDGET US$
MARINE POLLUTION RESEARCH, CONTROL AND ABATEMENT.	1. Control of domestic, industrial and agricultural land-based sources of pollution.	IOC/UNEP and nat. inst. under supervision of CEP POL focal points	Mar 1990-May 1991	238,000
	2. Baseline studies on pesticide contamination.	IOC/UNEP, UNAM, EQ-UCR Univ. of W. Ind. Jamaica, CEHI, CIOH, NOAA.	Mar 1990-Oct 1991	265,000
	3. Monitoring and control of the sanitary quality of bathing and shellfish growing water.	IOC/UNEP, WHO/PAHO, Nat. inst.	Mar 1990-Sep 1991	190,000
	4. Monitoring and control of pollution by oil and marine debris.	IOC/UNEP, IMO, ARPEL	Mar 1990-Sep 1991	221,000
	5. Site-specific studies of damaged ecosystems and development of proposals for remedial action.	IOC/UNEP, Nat. inst.	Mar 1990-Sep 1991	212,000
	6. Development of environmental quality criteria.	IOC/UNEP, WHO/PAHO FAO (etc) Nat. inst.	Mar 1990-Oct 1991	238,000
	7. Research on the significance of organo-tin as pollutant of the Wider Caribbean Region.	UPR, CEHI	Mar 1990-Aug 1991	65,000
	8. Co-ordination of CEP POL.	IOC/UNEP	Mar 1990-Oct 1991	155,000
OCEAN MAPPING	IBCCA	IOC	on going - 1995	

From: IOCARIBE Medium Term Plan "1990-1995". 1990.

ANNEX II.

LIST OF INSTITUTIONS RELATED WITH MARINE AND COASTAL STUDIES IN LATIN - AMERICA AND THE CARIBBEAN AND THEIR FIELD OF EXPERTISE.

COUNTRY / INSTITUTION	ACTIVITIES
ANTIGUA.	
Chemistry and Food Technology:	Environmental education with environmental Awareness Group.
Museum of Antigua and Barbuda:	Awareness of history and natural history to citizen of our new nation; Antigua and Barbuda history: prehistory of the Caribbean, naval history (British), military history, uses of plants.
Ministry of Agriculture:	Environmental education and agroforestry development in Antigua and Barbuda; Developing TFAP programas and project development.
ARGENTINA:	
ALUAR, Aluminio Argentino, S.A.:	Environmental Impact.
Asociación Austral para la Vida Silvestre:	Pollution.
Centro Austral de Investigaciones Científicas (CADIC):	Ecology of algae; Physiology; Ecophysiology; Marine ecology, mammals; Paleoecology; Ichthyology.
Centro de Estudios Parasitológicos y de Vectores (CEPAVE):	Parasitology.
Centro de Investigaciones de Biología Marina:	Marine biology; Marine chemistry; Ecology; Biostatistics.
Centro de Investigación de Genética Básica y Aplicada (CIGEBA):	Toxicology.
Centro Nacional Patagónico (CENPAT):	Marine mammal ecology; Fisheries ecology; Fishery; Population dynamics; Physiology; Mathematical models; Statistics; Pollution; Biotechnology.
Comisión Nacional de Estudios Geoheliofísicos:	Geology; Mineralogy; Economic geology; Physical oceanography; Hydrodynamics.

Dirección General de Pesca y Recursos Pesqueros:	Fishery Biology; Aquaculture; Benthos.
Estación Hidrobiológica de Puerto Quequén:	Biological oceanography; Phytoplankton.
Instituto Antártico Argentino:	Chemical Oceanography; Phytoplankton; Primary Production; Marine Geology; Paleontoloy; Physical Oceanography; Currents; Copepods; Antarctic Fauna.
Instituto Argentino de Oceanografía (IADO):	Marine Chemistry; Marine Biology; Phytoplankton; Sedimentology; Computer Science; Primary Productivity; Electronics; Marine Geophysics; Marine Geology; Pollution; Geophysics; Lipid analysis; Physical oceanography; Population dynamics; Pollution; Environmental Impact.
Instituto de Biología Marina y Pesquera "Almirante Segundo Storni":	Aquaculture; Fishery biology; Reproduction of mollusks; Marine ecology; Aquaculture; Ichthyology; Fishery.
Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP):	Marine geology; Biochemistry of marine organisms; Fish culture; Fishery resources, biology; Benthos; Natural resources; Fishery Economics; Fishery biology of comercial crustaceans; Population dynamics; Stock assesment; Biological fouling; Research vessels; Fishing technology; Biology of illex argentinus; Technology of fishery products; Fish ecology; Sea water chemistry; Physical oceanography; Biological sciences; Hystology; Ichthyology; Ichthyoplankton; Trophic ecology of marine fish; Microbiology; Physiology; Crustacean culture; Experimental culture of comercial crustaceans; Mathematic models; Zoology (Fish); Ecology of marine phytoplankton; Hydrocarbons in the marine environment; Continental waters; Fouling; Coelenterates; Benthic communities; Bioenergetics of demersal fishes; Sand beach ecology; Trophic ecology; Environmental Impact; Population dynamics; Lagoon ecology; Taxonomy; Systematics; Aquaculture; Heavy metals.
Instituto Tecnológico de Buenos Aires:	Geophysics.

Instituto Universitario Trelew:	Marine Geophysics.
Laboratorio de Ensayo de Materiales e Investigaciones Tecnológicas:	Geology and Geophysics.
Ministerio de Recursos Naturales, Provincia de río Negro:	Marine mammal behavior.
Museo Argentino de Ciencias Naturales 'Bernardino Rivadavia' e Instituto Nacional de Investigaciones de las Ciencias Naturales:	Marine Biology; Antartic Fish; Echinoderms; Plankton; Foraminifera; Crustaceans; Microbiology; Ichthyology; Cetacea; Echinoderms; Pinnipeds; Pteropods; Ocean birds; Algae (taxonomy + botany); Marine geology; Sedimentology; Water chemistry and pollution; Marine biology (Chaetognatos and Cocolitoforids); Pollution; Benthic ecology; Phytoplankton.
Museo Provincial de Ciencias Naturales 'Florentino Ameghino':	Fishery biology; Pisciculture; Ecology.
Reserva Ecológica Costanera Sur:	Geography.
Servicio de Hidrografía Naval:	Chemical oceanography; Hydrography; Marine ecology; Physical and biological oceanography; Marine meteorology; Cartography; Coastal dynamics; Marine geology; Acoustics; Chemistry; Geology; Geophysics; Magnetism; Meteorology (Air-Sea interaction).
Servicio Meteorológico Nacional:	Meteorology.
Universidad de Buenos Aires:	Physical and biological Oceanography; Zooplankton; Fishery biology; Carcinology; Aquaculture; Zooplankton (radiolaria); Diatoms; Euphasiids; Antartic Fauna; Echinoderms; Ecology of crustacea; Penguin ecology; Mollusc ecology; Pollution.
Facultad de Ciencias Geológicas:	Fossil foraminifera; Paleomagnetism.
Facultad de Meteorología:	Physical oceanography.

Departamento de Química Orgánica:	Chemistry of algae.
Universidad Nacional del Comahue:	Global climatic change.
Universidad Nacional de Luján:	Population dynamics.
Universidad Nacional de Mar del Plata:	Sand beach dynamics; Physiology; Fishery; Benthic marine and Antartic ecology; Fouling; Pollution; Zoogeography; Marine birds ecology.
Universidad Nacional de la Patagonia:	Marine ecology; Population genetic in crustaceans; Environmental impact.
Universidad Nacional del Sur:	Pollution.

BARBADOS.

Bellairs Research Institute:	Effects of eutrophication on coral reefs.
McGill University, Bellairs Research Institute:	Tropical marine ecology, Primary and secondary production.
University of West Indies:	Sea turtle conservation; Insecticide resistance of ***Platella xylostela.***

BELIZE.

The Belize Zoo:	Conservation and wildlife education; Zoo programs and rural outreach.

BERMUDA.

Bermuda Biological Station for Research:	Marine biochemistry; Pollution; Chemical oceanography; Benthic invertebrates; Ecology of nearshore soft-bottom communities; Coral population dynamics on Bermuda Reefs; Recolonization and succession on disturbe coral reefs.
Department of Agriculture and Fisheries:	Fisheries Administration, Biological and Conservation of Fish, Sea Birds, Water Pollution, Habitat Management.

Palisades Geophysical Institute:	Underwater Acoustics, General Oceanography, Systems Analysis, Computer Analysis, Physical Oceanography, Electronic Systems.

BRAZIL.

Base de Pesquisa Cananeia, Instituto de Pesca:	Biological oceanography; Sea culture; Fisheries biology.
Centro Nacional de Conservaçao e manejo de Sir:	Ecology; Geology (coastal).
Companhia de Pesquisa de Recursos Minerais (CPRM):	Physical oceanography; Mineral resources; Marine geology; Geophysics; Sedimentology.
Conselho Nacional de Desenvolvimento Cientifico e Tecnológico (CNPQ):	Physical oceanography; Marine geophysics; Geology and geophysics; Marine geology; Biological oceanography; Zooplankton; Aquaculture; Biological oceanography; Nekton.
Departamento Nacional de Obras contra as segas (DNOCS):	Fisheries science; Limnology, fisheries; Technology, fisheries, biology; Ichthyoplankton, Fisheries taxonomy; Pisciculture intensive; Pisciculture fish nutrition.
Directoria de Hidrografia e Navegacao:	Physical oceanography; Meteorology.
Empresa Brasileira de Pesquisa Agropecuaria:	Environmental impact.
Empresa Brasileira de Pesquisa Agropecuaria do Rio Grande do Norte:	Resource management.
Fundao Brasileira para a Conservaçao da Naturaleza:	Resource management.
Fundao Estadual de Engenharia do Meio Ambiente:	Ecology.
Fundao Joaquin Nabuco:	Lagoon community.
Fundao Protamar:	Sea turtle.
Fundao Rio Zoo:	Coastal management.
Fundo de Desenvolvimento Florestal:	Resource management.

Fundaçao Zoobotanica do Rio Grande do Sul:	Biological oceanography; Phytoplankton; Littoral Benthos.
Instituto de Pesca:	Fishery economics.
Instituto de Pesquisas e Extensao da Pesca; Secretaria de Agricultura de Santa Catarina:	Fishery biological, Fisheries; Aquaculture; Experimental fishery.
Instituto de Pesquisas Espaciais; Departamento de Sensoramiento Remoto /Oceanografía:	Physical oceanography; Remote sensing; Hydrography.
Instituto Nacional de Pesquisas da Amazonia:	Ecology of marine mammals.
LARQ Arquitectura LTDA:	Environmental impact.
Museu de Historia Natural "Capao Da Imbuia":	Ecology of marine mammals.
Museu Nacional da UFRJ; Departamento de Biología:	Fisheries science; Ichthyology.
Museu Nacional da UFRJ; Departamento de Ictiología:	Fisheries science; Ichthyology.
Museu Paraense Emilio Goeldi:	Population dynamics.
Pontificia Universidade Catolica Do RS. Museu de Ciencias:	Fisheries science; Phylum mollusca; Biological oceanography; Aquaculture; Tetraodontiformes; Sinopse choudrichtyes; Marine ichthyology fauna; Echinoderms; Ichthyoplankton.
Programa de Pesqueria e Desenvolvimento Pesqueiro do Brasil:	Fisheries science; Fish production statistics; Marine fish production statistics; Biology of ***Sardinella brasiliensis,*** Shrimp biology; Fish commercialization and distribution; Biometry.
Projeto Remac:	Geology and geophysics; Marine geology; Geomathemathics; Coelenterate biology; Regional geology geotectonic.
Secretaria da Agricultura do Rio Grande do Norte - Projeto Camarao:	Aquaculture, Biological oceanography; Plankton; Pollution; Ecology; Carcinology; Algae; Benthos.
Secretaria Agricultura / Departamento de Pesca:	Biological oceanography.

Secretaria Agricultura e Abastecimiento / Instituto de Pesca:	Aquaculture; Biological and chemistry oceanography; Hydrography; Fisheries research; Statistical research; Populations dynamics.
Shrimp Farming:	Biological oceanography; Penaeidae shrimp culture.
Sociedade Brasileira de Proteçao Ambiental:	Cetacean fishery.
Superintendencia do Desenvolvimiento do Nordeste (SUDENE) / Departamento de Recursos Naturais (DRN) / Divisao de Recursos Pesqueros:	Aquaculture; Hydrography; Physical and chemical oceanography; Fisheries research; Naval engineering; Marine geology.
Universidade de Brasilia:	Ecology of birds.
Universidade Federal Fluminense:	Toxic waste in mangroves.
Universidade de Sao Paulo:	Physiology.
Universidad de Sao Paulo / Departamento de Botanica / Instituto de Biociencias:	Marine botanics; Marine algae; Biology; Ecology; Taxonomy.
Universidad de Sao Paulo / Departamento de Zoología del Instituto de Biociencias:	Biological oceanography; Marine biology; Malacology; Littoral benthos; Zooplankton; Littoral macro and meiobenthos; Carcinology; Taxonomy of ascidians.
Universidad Federal de Alagoas:	Fishery biology; Biological oceanography.
Universidad Federal de Bahía / Instituto de Biología:	Biological oceanography; Aquaculture; Carcinology; Littoral benthos; Ecology of marine algae; Phytoplankton; Citogenetics.
Monosowskl Consultores:	Environmental impact.
Universidade Catolica de Rio de Janeiro:	Heavy metals.
Universidade de Cear:	Ecology of crustaceans; Ecology of fishes
Universidade Catolica de Pelotas / Instituto de Pesquisas Maritimas Fluviales e Lacustres:	Biological oceanography; Marine biology; Population dynamics; Fisheries technology.
Universidad Estadual de Campina':	Chemistry; Industry waste.

Universidade Estadual de Maring:	Zoobentos.
Universidad Federal de Bahía / Programa de Investigación y Posgraduación en Geofísica:	Marine geology; Sedimentology.
Universidad Federal do Paraná / Curso de Pos-Graduaçao em Zoología:	Fishery biology; Biological oceanography.
Universidade de Londrina:	Aquaculture; Fresh water shrimps.
Universidade de Sao Paulo:	Biological, Chemical and physical Oceanography; Benthic ecology; Primary production; Bio-geochemical cycles; Fisheries science; Marine products technology; Fisheries geography; Remote sensing; Crustacean biology; Ichthyoplankton; Surface circulation; Circulation in estuaries; Benthic fauna and flora; Ecology and Biology of demersal fish; Dissolved oxygen; Inshore fisheries; Phytoplankton; Benthic ecology mollusks; Biochemistry; Marine meteorology; Marine sedimentology; Biogeography; Marine pollution; Physiology and diversification; Bioeconomics and life of marine fish; Fisheries in general; Sea water organic composition.
Universidade de Maranhao / Laboratorio Hidrobiología:	Food technology; Population dynamics; Fisheries science; Fisheries biology; Marine botany and algae; Marine histology; Phyto and zooplankton; Chemical oceanography; Ichthyology and pisciculture; Microbiology.
Universidade do Estado do Rio de Janeiro:	Ecology of benthic algae; Environmental impact;
Universidade do Rio Grande / Departamento de Física:	Physical oceanography.
Universidade do Rio Grande / Departamento de Oceanografía:	Marine pollution, algae, botany, geology, physiology; Biological and chemical oceanography; Hydro- chemistry; Aquaculture; Fisheries science, technology, biology; Geology and geophysics; Phytoplankton; Ichthyoplankton, Demersal fishes; Diving research; Estuarine systems; Systematic malacology, ichthyology.

Universidade do Rio Grande / Departamento de Quimica:	Marine pollution; Chemical oceanography.
Universidade Federal de Pernambuco / Departamento de Oceanografía:	Fisheries Science; Ichthyoplankton, Fish, crustacean culture; Ichthyology, stomach contents; Pathology and fish parasites; Celenterates; Crustaceans, larvae development; Bio-geography; Malacology; Chemical and Biological Oceanography; Aquatic plants; Geology and Geophysics; Marine Geology; Zooplankton.
Universidade Federal de Santa Catarina:	Ecosystem ecology (mangrove, lagoons).
Universidade Federal do Ceara / Laboratorio de Ciencias do Mar:	Fisheries Science, biology, technology, statistics; Fish Taxonomy; Population dynamics; Sedimentology; Biological and Chemical Oceanography; Marine geology and hydraulics; Bio- chemistry.
Universidade Federal do Rio de Janeiro / Departamento de Biología Marina:	Fish larval; Fisheries Science; Algal bioessay, Aquaculture; Macrobrachium culture; Benthic invertebrates; Systematics; Hydromedusas distribution; Marine resources; Radioactive tagging for population dynamics studies; Fouling organisms; Thermal impact of power plants; Radionuclids concentration in marine bivalves; Radiobiology; Heavy metals; Contamination in fish.
Universidade Federal do Rio Grande do Sul / Centro de Estudios de Geología Costeira y Oceánica - CECO:	Physical oceanography; Marine geology and geophysics, sedimentation; Geochemistry; Mineralogy; Coastal sedimentation, plain geology, geology; Computer science; Shallow water sedimentation; Sea mineral resources; Ecology of cephalopods; Population dynamics in fishes; Heavy metals; Environmental impact.
Universidade Nacional Estadual Paulista:	Sand beach ecology; Taxonomy of decapods; Pollution; Aquaculture; Ecology; Physiology; Ecology of algae; Geochemistry of soils; Ecology of crustacea.

CHILE.

Armada de Chile / Servicio Meteorológico de la Armada:	Marine meteorology; Wave forecasting; Oceanography.

Comité Oceanográfico Nacional (CONA):	Fisheries engineering.
Corporación de Investigaciones Económicas para Latinoamerica (CIEPLAN):	Economy; Bioeconomics models.
Empresa Nacional del Petróleo (ENAP) / Geología Submarina:	Marine geology, biology; Pollution.
Instituto Antártico Chileno:	
Instituto de Fomento Pesquero / Departamento de Recursos:	Fisheries biology, engineering; Mollusks; Algae; Zooplankton; Aquaculture; Marine biology, Oceanography; Acoustics.
Instituto de la Patagonia / Departamento de Hidrobiología:	Decapod crustaceans, crustaceans larvae culture; Biological monitoring; Marine mammals; Phytoplankton; Oil Pollution.
Instituto de Salud Pública:	Pollution.
Instituto de Investigación Pesquera, VIII Region:	Environmental impact.
Instituto Hidrográfico de la Armada / Departamento de Oceanografía:	Physical Oceanography; Marine acoustics. geology; Waves, Tides, Currents, Bathymetry, Ocean engineering.
Ministerio de Economía, Fomento y Reconstrucción / Subsecretaría de Pesca:	Fishery Biology.
Ministerio de Salud Pública / Departamento Programas sobre el Medio Ambiente:	Marine Pollution.
Museo Nacional de Historia Natural:	Taxonomy; Taxonomy and ecology of molluscs.
Museo Nacional de Historia Natural /Sección Hidrobiología:	Parasitic copepods, Zooplankton, Echinoderms, Mollusks, Decapod crustaceans; Biological Oceanography.
Pontificia Universidad Católica de Chile:	Marine ecology; Biogeography; Evolution; Coastal ecology; Algae ecology; Taxonomy and ecology of algae.
Pontificia Universidad Católica / Departamento de Biología y Tecnología del Mar, Química y Física:	Coastal hydrography; Seafood contamination by coliform bacteria; Fishery biology; Marine and Freshwater aquaculture, Algal culture, Polysaccharides

	extraction from algae; Population genetics; Marine equipment, chemistry, parasitology; Population studies (crustaceans); Fishing gear; Physiological ecology of marine invertebrates; Biology, Ecology.
Pontificia Universidad de Chile / Departamento de Biología Ambiental y Poblaciones:	Marine parasitology, biology, biogeography, invertebrate taxonomy; Littoral ecology; Coastal pollution; Shell fishery; Polychaeta taxonomy; Sand macrofauna, Ecology, Taxonomy; Culture of benthic algae; Invertebrate larvae.
Universidad Arturo Prat:	Environmental impact.
Universidad Austral de Chile / Instituto de Ecología:	Marine bioenergy, ecology; Ecology; Ichthyology; Benthos polychaeta.
Universidad Austral de Chile / Instituto de Zoología:	Ichthyology; Malacology; Larval development; Sandy beaches invertebrates; Physiological ecology; Fish taxonomy; Phytoplankton ecology; Marine birds; Pelecypods biology; Elasmobranchs; Marine aquaculture; Physiology.
Universidad Católica del Norte, Sede Coquimbo:	Coastal ecology; Coastal zone management; Aquaculture; Ichthyology; Zooplankton; Heavy metals; Pollution; Ichthyoplankton.
Universidad Católica de Valparaiso / Centro de Investigaciones del Mar y de los Alimentos:	Fisheries biology, technology; Population dynamics; Sharks and rays taxonomy; Fishing gear and methods; Fisheries, Fish taxonomy; Design and behaviour; Stock assesment; Ichthyopathology; Marine Biology; Hydrobiology; Chemical Oceanography; Submarine geology; Primary production.
Universidad de Chile / Departamento de Oceanología:	Zooplankton, Bentos, Ecology littoral, Marine geology, bacteriology; Limnology, Heat flow; Echinoderms, Malacology, Phytoplankton ecology, Algae, Carcinology, Molluscs, Ichthyology; Aquaculture; Population dynamics; Chemical, Littoral Oceanography.
Universidad de Chile / Facultad de Ciencias:	Carcinology, Ichthyoplankton, Phytoplankton, Botany; Ecology; Aquaculture; Animal physiology; Cellular biology; Biology; Zoology; Microbiology, Primary production; Limnology; Chemical

	engineering; Chemistry; Biological oceanography; Oceanography; Molluscs ecology.
Universidad de Chile de Valparaiso / Departamento de Oceanología:	Population dynamics; Marine pollution; Benthos; Zooplankton; Birds; Phytoplankton; Fisheries biology; Mollusks; Algae; Crustaceans; Climatology; Physical and chemical oceanography.
Universidad de Chile de Valparaiso / Laboratorio de Contaminación Ambiental:	Chemistry; Pharmacology.
Universidad de Valparaiso:	Pollution hydrocarbons.
Universidad de Antofagasta.	Invertebrate ecology; Aquaculture; Ichthyology; Bioenergetics.
Universidad de Concepción / Departamento de Oceanología y Pesquerías:	Algology; Taxonomy and ecology; Ecology of littoral and sublittoral communities; Plankton and taxonomy; Zooplankton; Fisheries biology; Polychaeta; Decapod crustacean taxonomy; Chemical and biological oceanography; Pollution; Benthic ecology; Antartic equinodermata; Marine ecology; Population genetic in gastropods; Fish behavior; Fishery.
Universidad del Norte / Centro de Investigaciones Marinas:	Ichthyology; Algae; Phytoplankton; Zooplankton; Mollusks; Coastal Fish; Intertidal ecology.
Universidad del Norte / Centro de Investigaciones Submarinas:	Fisheries, Physical and Chemical Oceanography; Marine Botany, Biology, Cultures; Algae; Bathymetric measurements; Underwater engineering; Coastal engineering; Ecology of coastal environments; Hystology of marine mollusks; Hyperbaric medicine; Microbiology pollution.
Universidad del Norte / Departamento de Pesquerías:	Physical and Applied oceanography; Sea food bacteriology; Oceanography; Pollution; Bathymetry; Marine ecology, culture (Mollusks); Stock assesment; Ichthyology; Fish reproduction; Fishing vessels; Commercial fisheries; Fisheries management; Fishing gear and methods; Sea food technology; Echosounding; Fluid mechanics.

COLOMBIA.

Fuerza Naval del Atlántico:	Oceanography and Hydrography.
Armada Nacional / Centro Investigaciones Oceanográficas e Hidrográficas:	Marine biology, pollution: Oceanography; Chemistry; Physical Oceanography; Sedimentology; Hydrography.
Armada Nacional / División Oceanografía:	Marine biology; Oceanography; Physical Oceanography; Oceanographic data processing; Hydrography.
Centro de Investigaciones Oceanográficas e Hidrográficas:	Estudio de ecosistemas y praderas marinas deterioradas; Calidad del agua; Deposición de carbonatos por electrólisis.
Centro de Investigaciones Pesqueras del INDERENA:	Physical, Chemical and Biological Oceanography; Fishery biology, technology; Ecology of estuaries; Water pollution; Biology; Aquaculture; Phytoplankton; Zooplankton; Ichthyoplankton; Primary production; Population dynamics; Artificial reproduction.
Colombian Oceanographic Commission:	Hydrography; Marine Biology; Ecological caracterization: function and estructural soft bottom.
Escuela Superior de Guerra:	Hydrography.
Fundación Universidad de Bogotá "Jorge Tadeo Lozano":	Marine botany, geology and ecology; Systematics of invertebrates; Plankton; Carcinology; Benthos; Ecosistema litoral rocoso.
Instituto de Investigaciones Marinas José Benito Vives de Andreis:	Ecosistemas marinos costeros; Caricomp; Artisanal fisheries; Estudio batimétrico y caracterización sedimentológica de plataforma.
Instituto de Investigaciones Marinas de Punta Betín:	Lagoon community.
Instituto Nacional de Investigaciones Geológico - Mineras:	Geology; Palinology; Micro- paleontology; Foraminifera.

Instituto Nacional de los Recursos Naturales Renovables y del Ambiente:	Fishery biology, technology, reproduction; Ichthyology; Zooplankton; Phytoplankton; Aquaculture; Biology, Ecology; Biological and Chemical Oceanography; Marine pollution; Fisheries populations.
Laboratorio de ensayos hidráulicos:	Marine Sedimentology.
Universidad de Antioquía:	Ordenación territorial de las cuencas de los ríos Duda, Guayabero, Guaviare, Plan de desarrollo; Estudio de impacto ambiental por minería en el bajo Cauca y Nordeste antioqueño; Inventario de recursos vegetales; Banco de germoplasma; botany.
Universidad de Caldas:	Controladores biológicos; Ecopetrol; Limnology.
Universidad de Cartagena:	Pharmaceutical chemistry; Administration.
Universidad de Magdalena:	Taxonomía y ecología de macroalgas; Environmental impact; Limnology; Aquaculture.
Universidad del Atlántico:	Ambiental Education.
Universidad del Valle / Departamento de Biología:	Population dynamics; Malacology; Aquaculture; Shrimp cultivation; Zooplankton; Fishery biology; Biological Oceanography; Oceanography; Limnology; Pond development; Biogeography of fishes; Ecology of fishes; Estudio de fauna asociada a ecosistemas marinos y costeros; Taxonomía, descripción, distribución, abundancia y ecología de peces.
Universidad Nacional:	Palaeontology; Mollusks; Esquemas y tendencias en la ocupación de espacio en arrecifes coralinos, taxonomía de esponjas.
Universidad Nacional / Departamento Geociencias:	Sedimentology; Submarine geology.
Universidad Tecnológica del Magdalena / Facultad Ingeniería Pesquera:	Biological oceanography; Systematic phycology; Ecology; Marine meteorology; Fishery technology, biology.
Vikingos de Colombia S.A.:	Fisheries biology.

COSTA RICA.

Universidad de Costa Rica:	Competencia entre reintas residentes y migratorias; Dispersión de frutos por aves y fenología de las especies de plantas más utilizadas; Ecología de ***Sebania emerus (Papilio naceae)*** leguminosal, incluye demografia de la planta y semilla, fenología, biomasa (asignación), análisis químico (los nutrientes) en plantas, suelo y agua.
Universidad Nacional:	Biología de moluscos de interés para la pesquería y acuicultura; Comportamiento del Domo Tymico de Costa Rica en presencia del fenómeno ENSO; Caracterización de las masas de agua de la plataforma pacífica de Centro América; Caracterización del fitoplancton en áreas de caladeros de camarón blanco en el Golfo de Nicoya; Dinoglagelados tóxicos del Golfo de Nicoya y las mareas rojas; Manejo de recursos forestales asociados a bosques de manglar; Programa de ecología y manejo de manglares; Evaluación de alternativas tecnológicas en reproducción controlada de camarones Peneidos; Clupeiformes de la Costa Pacífica de Costa Rica.
Universidad para la Paz:	Diferentes sistemas agroforestales; Manejo de bosques tropicales para productos y servicios.

CUBA.

Academia de Ciencias / Instituto de Oceanología:	Benthic ecology; Sponges; Marine biology, ecology, meteorology; geophysics; Gorgonians; Physical Oceanography; Pollution; Coastal geomorphology; Geodynamics; Data processing; Coastal tides; Chemistry (pesticides); Microbiology; Fish ecology (age and growth), reproduction, nutrition; Physiology; Zooplankton; Copepods; Holothurians; Ichthyology; Ichthyoplankton; Polychaeta; Corals; Ecology of fishes; Biodegradation; Resource management; Ecology; Coastal zone management; Ecology & systematics of molluscs; Ecology & systematics of

	echinodermata; Population dynamics; Productivity; Plankton; Sandy beach dynamics; Population genetics; Ecology of lagoons; Coastal dynamics; Environmental impact.
Centro de Investigación Cayo Coco:	Sand beach dynamics.
Centro de Investigaciones Pesqueras:	Fishery; Pollution; Aquaculture.
Instituto de Oceanología:	Systematics; Hydrocarbons; Heavy metals; Coastal zone management.
Instituto de Investigaciones del Transporte:	Heavy metals.
Instituto Superior Pedagógico Felix Varela:	Systematics of molluscs.
Instituto Superior Pedagógico del Pinar del Río:	Coastal zone management.
Ministerio de la Industria Pesquera:	Ecology of crustaceans; Coastal zone management.
Universidad de La Habana / Centro de Investigaciones Marinas:	Marine ecology; Phytoplankton; Zooplankton; Fisheries biology biology; Fish biology and culture; Crustaceans physiology; algae cultivation; Invertebrates; Benthos decapods; Ichthyology; Ecology; Protection and cultivation of fauna; Plankton; Prawn culture; Benthos ecology and systematics; Crustaceans genetics; Aquaculture; Ecophysiology; Physiology; Coastal zone management.

CURAÇAO.

Carmabi Foundation:	Marine benthic community description.

ECUADOR.

Ecuambiente S.A:	Estudio de impacto ambiental para el sector hidrocarbur/ferro y minero, energético, acuacultura y turismo; Investigaciones

	ecológicas en el Amazonia Ecuatoriana: clima, suelos, aguas, flora y fauna, componente socio económico y cultural.
Fundación Charles Darwin para las Islas Galápagos:	Conservación y educación marino costera; Conservación e investigación de tortugas.
Instituto Oceanográfico de la Armada (INOCAR):	Biological, Chemical and Physical Oceanography; Marine ecology, geology, biochemistry; Geomorphology; Geochemistry; Pollution; Photogeology; Zooplankton; Benthos; Chaetognatns; Foraminifera; Phytoplankton; Dinoflagellata.
Instituto Nacional de Pesca:	Fisheries biology, technology; Crustaceans; Mollusks.
Ministerio de Agricultura y Ganadería / Laboratorio de Sanidad Vegetal:	Entomology; Toxicology; Phytopathology.
Ministerio de Educación y Cultura:	Incorporación de la temática ambiental en la educación.
Sociedad Protectora del Medio Ambiente del Ecuador (SOPROMA):	Derrame de petróleo en la zona costera ecuatoriana; Diagnosis de los problemas ambientales del Ecuador.
Universidad de Guayaquil / Facultad de Ciencias Naturales / Departamento de Ciencias del Mar:	Biological, Physical, Chemical, Coastal Oceanography; Invertebrates; Echinoderms; Mollusks; Carcinology; Malacology; Zooplankton; Algae; Phytoplankton; Shrimps; Benthos; Polychaeta; Fish culture; Fishery biology; Aquaculture; Hydrobiology; Marine ecology; Pollution.

EL SALVADOR.

Asociación Salvadoreña de Conservación del Medio Ambiente:	Dirección de comunicaciones, elaboración de proyectos (no efectuados aún) y asesor.
Universidad de El Salvador:	Salud Pública y ambiental del Lago de Ilopango y su cuenca; Saneamiento ambiental de la cuenca y el reservorio de agua a través del manejo adecuado de los diferentes recursos; Hábitat y taxonomía de cangrejos (Crustacea, Decapoda) de la playa los Cubanos, El Salvador; Aportes biológicos

	y taxonomía al conocimiento de los invertebrados marinos de la zona de la marea en el Salvador.

GUYANA BRITANICA.

Guyana Natural Resource Agency:	Planning natural resources (forestry, minerals, petroleum, hydro power and energy); Development / Exploitation; Sustainable development of natural resources in tropical / Amazonian Environment.

GUYANA FRANCESA.

University des Antilles et de la Guyane:	Reproduction of mangrove and seagrass bed bivalves; Studies on bivalve, bacteria symbiosys in Lucinid clams.

GUATEMALA.

Comisión Nacional del Medio Ambiente (COMANA):	Proyección y mejoramiento del Medio Ambiente.

HONDURAS.

Asociación Hondureña de Ecología:	Resource management.
Universidad Nacional Autónoma de Honduras:	Heavy metals; Ichthyology.

JAMAICA.

Discovery Bay Marine Laboratory:	Coral reef ecology; Echinoderms.
Institute of Jamaica:	Administration, with limited input relating to the environment and natural history.
Jamaica Conservation and Development trust:	Establishment of national parks in Jamaica; Use of biological methods for pest control.

Ministry of Agriculture / Fisheries Division:	Marine biology; Fisheries biology, management, conservation; Bio- statistics; Crustacean biology (lobsters); Artificial reef ecology; General fishery management; Avifauna.
Natural Resources Conservation:	Water chemistry; Estuarine biology; Oceanography; Technology; Marine ecology; Ecology.
Natural Resources Conservation Division:	***Andus stolidus*** and ***Sterna fuscate,*** conservation project; Effects of seawage disposal on iverand productivim; Coastal zone management; Environmental planning and environmental impact assessment; Effect of seawages disposal on wetland productivity.
Portland Environment Protection Association:	Environmental preservation, protected areas; Public education on environmental matters, Port Antonio Marine Park.
University of the West Indies:	Analysis of levels of petroleum hydrocarbons on beaches, in water columnn, sea surfaces sediment and oyster tissue; Mangal ecology; Marine science information database on Jamaica; Biology and ecology of Caribbean Ascideacea (Tunicata); Documentation of the historical development, present status and production of management guidelines for the Port Royal mangal, Kingstom, Jamaica; Caribbean Wetlands inventory and management; Investigation of levels of fishing efforts using community based methods to produce an integrated management plan for reef fishery; Use of phytoplankton as environmental indicators; Island forest and watershed management; Constructed wetlands for pollution control and wastewater treatment; Benthic macroalgae and seagrasses in relation to coastal pollution.
University of the West Indies / Port Royal Marine Laboratory:	Oyster culture; Bivalve biology; Marine invertebrate biology; Fisheries biology; Environmental control; Coastal management; Larval reef fish.

MEXICO.

Centro de Ecología de Sonora:	Ichthyology; Fish dynamics.
Centro de Investigaciones Biológicas de Baja California Sur:	Ecology of birds.
Centro de Investigación Científica y Educación Superior de Ensenada:	Environmental impact; Population dynamics of fishes; Hydrocarbon degradation with bacteria; Phytoplankton; Resource management & modelling; Coastal ecology; Ecology; Biological of seagrasses.
Centro de Investigaciones de Quintana Roo:	Ecology of phytoplankton; Benthic ecology; Taxonomy; Resource management of fisheries; Fishery; Reproduction in fishes; Fishery & Aquaculture; Ichthyoplankton; Ecology of fisheries.
Cemtro de Investigaciones Ecológicas del Sureste:	Taxonomy of molluscs.
Centro de Investigación y de Estudios Avanzados:	Environmental impact; Hydrocarbon & Heavy metal pollution.
Centro Interdisciplinario de Ciencias Marinas:	Ichthyoplankton, ecology & taxonomy.
Centro Regional de Investigación Pesquera:	Ecology of coral reefs; Fisheries & benthic ecology.
Departamento de Preservación y Mejoramiento del Medio Ecológico de la SCAOP:	Environmental impact.
Dirección General de Prevención y Control de la Contaminación Ambiental:	Pollution.
Dirección General de Usos de Agua y Prevención de la Contaminación:	Marine biology, bacteriology; Plankton; Benthos; Environmental engineering; Quality control of estuarine and marine water; Aquatic biology.
Escuela Nacional de Ciencias Biológicas / Instituto Politécnico Nacional:	Marine biology, ecology; Periphyton; Taxonomy of mollusks; Coral reefs; Ichthyology; Benthonic communities; Fisheries biology; Taxonomy of Foraminifera; Plankton microbenthos;

	Benthonic mollusks; Plankton; Botany; Taxonomy of algae; Aquaculture; Ecology; Benthic ecology.
Escuela Superior de Ciencias Marítimas y Tecnología de Alimentos / Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM):	Biological Oceanography; Fisheries sciences; Chemical oceanography.
Fundación Chiapanecs Miguel Alvarez del Toro para la Protección de la Naturaleza, A.C:	Resource management.
Grupo ESAME, Estudios Ambientales Especializados:	Environmental impact.
Instituto de Ciencias del Mar y Limnología:	Ecology of fisheries, of echinodermata; coral reefs; Coastal ecosystem; Surgency productivity; Heavy metals; Thermal impact; Productivity; Red tide; Aquaculture of ***Artemia;*** Benthic ecology; Hydrocarbon degradation; Genetics; Population dynamics.
Instituto Mexicano de Tecnología del Agua:	Eutrophication control; Resource management; Pollution.
Instituto Nacional de Pesca:	Sea turtle protection.
Instituto Nacional de Pesca / Guayanas:	Fishery biology; Crustaceans.
Instituto Nacional de Pesca / Antigua Escuela de Pesca:	Fisheries biology, technology; Crustaceans; Mollusks.
Instituto Nacional de Pesca / Ciudad del Carmen.	Fisheries biology, technology; Fishing gear, methods; Shrimps.
Instituto Nacional de Pesca / Mazatlan:	Fisheries biology, Oceanography; Oceanography; Shrimps; Sardines.
Instituto Nacional de Pesca / Isla de Mujeres:	Fishing gear, methods, technology.
Instituto Nacional de Pesca / Progreso:	Fisheries biology; Ichthyology.
Instituto Nacional de Pesca / Salina Cruz:	Fishing gear, methods; Shrimp fishing; Fisheries biology; Ichthyology.

Instituto Nacional de Pesca / Ensenada:	Fishery biology, technology, ocanography; Anchovy; Fishing nets, methods; Lobsters; Industrial processing; Abalone; Echo-sounding.
Instituto Nacional de Pesca / Campeche:	Fisheries biology, technology; Fishing gear, methods; Shrimps.
Instituto Nacional de Pesca / Centro de Investigación Científica y Tecnológica:	Fishery biology; Chemical oceanography; Biochemistry; Bacteriology; Parasitology; Biology.
Instituto Nacional de Pesca / Veracruz:	Fishing gear, methods; Midwater trawis; Trap nets; Trap nets not visible; Not visible nets for mackerel fishing; Aquaculture.
Instituto Nacional de Pesca / Tampico:	Fisheries biology; Shrimp; Oyster culture; Industrial processing.
Instituto Nacional de Pesca / Chiapas:	Fisheries biology, dynamics, economic; Population dynamics; Marine turtles, fish, mollusks, food technology, food processedon board, processing marine food; Histology (fish); Shrimps; Ichthyology; Survey; Food; Methods and Laboratory technics data processing; Administration of the data processing systems; System operator hp 2000e; Game fish; Echo-sounding; Planktology; Ichthyoplankton; Algae and benthos of Mexico; Analysis of marina products; Fishing nets and methods; Physical Oceanography; Midwater trawls; Acoustic data; Sampling.
Instituto Politécnico Nacional.	Ecology of crustaceans; Populations dynamics of fisheries; Coral reefs; Ecology of lagoons; Fish dynamics; Modelling of oceanic circulation; Resource management; Environment impact; Fisheries; Chemistry water; Benthic ecology; Taxonomy of coral reefs; Ecology of fisheries, of coral reefs; Coastal ecology; Hydrocarbon pollution; Taxonomy; Ichthyoplankton; Ichthyoplankton ecology; Aquaculture; Physiology of invertebrates; Physiology; Aquaculture (reproduction); Plankton dynamics.

Instituto Tecnológico y de Estudios Superiores de Monterrey:	Marine mammals.
Secretaria de Ecología del Gobierno de Yucatán, México:	Resources management; Sea turtle protection.
Secretaria de Pesca:	Fishery; Sea turtle protection; Shrimp fishery; Fishery of octopus.
Universidad Autónoma de Baja California (UABC) / Unidad de Ciencias Marinas:	Oceanology; Physical Oceanography; Chemistry; Hydrology; Biology; Fishery; Ecology; Plankton; Marine botany, pollution, ecology, aquaculture; Organic chemistry; Biochemistry; Oyster culture; Geology; Coastal processes; Ichthyology; Computation; Chemistry; Fish culture; Genetics of Penaeids; Benthic ecology; Ecology of phytoplankton; Algae cythology; Aquaculture; Aquaculture of Penaeids, of algae, of molluscs; Fishery of Ellasmobranchia; Phytoplankton; Ecology of marine birds.
Universidad Autónoma de Baja California Sur:	Productivity in Benthic communities.
Universidad Autónoma de Chapingo:	Ecology of lagoons.
Universidad Autónoma de Nuevo León:	Ichthyology; Environmental impact.
Universidad Autónoma Metropolitana:	Aquaculture of ***Artemia;*** Fishery & ecology of coral reefs; Resource management mangroves; Phytoplankton; Pollution; Productivity; Meterology; Fishery; Aquaculture.
Universidad Autónoma de Sinaloa:	Ecology of ichthyofauna; Fisheries.
Universidad de Sonora / Centro de Investigaciones Científicas y Tecnológicas (CICTUS):	Shrimp pathology; Capture of mature females; Shrimp culture; Estuarine ecology; Coastal Lagoon; Shrimp stocking in estuaries; Production of algae; Food technology; Nutrition and Feeding behaviour of shrimp; Shrimp sexual maturity; Productivity; Ecology of lagoons; of mangroves; Geochemistry.

Universidad Nacional Autónoma de México (UNAM):	Ecology; Physiology; Resource management; Dynamics of fisheries; Fisheries; Molluscs genetics; Ecophysiology; Ecophysiology of decapoda; Ecology of Penaeias; Coastal zone management; Ecology of crustaceans; Taxonomy & Ecology of Marine invertebrates; Lagoon ecology; Mangrove ecology; Plankton; Lagoon chemistry; Marine birds behaviour; Productivity of lagoons; Plant ecology.
Universidad Nacional Autónoma de México (UNAM) / Centro de Ciencias del Mar y Limnología:	Biological, Chemical and Physical Oceanography; Marine geology; Fisheries biology.
Universidad Nacional Autónoma de México (UNAM) / Centro de Pre-clasificación Oceánica de México:	Biological Oceanography; Marine biology; Carcinology; Zooplankton.
Universidad Nacional Autónoma de México (UNAM) / Estación de Investigaciones Marinas 'El Carmen':	Biological Oceanography.
Universidad Nacional Autónoma de México (UNAM) / Instituto de Biología:	Marine chemistry, biology; Carcinology; Plankton; Algae; Ichthyology.
Universidad Nacional Autónoma de México (UNAM) / Instituto Geophysica:	Physical Oceanography; Marine geophysics.

NETHERLANDS ANTILLES.

Caribbean Marine Biological Institute (CARMABI):	Reef ecology; Marine biology; Conservation.
Dienst Landbouw, Veeteett en Visserji Kelin Kwartier:	Marine biology; Primary production; Hydrobiology.

NICARAGUA.

Asociación de Biólogos y Ecólogos de Nicaragua:	Coordinación de proyectos: Forestal, educación ambiental, protección, etc; Educación ambiental curricular; Saneamiento ambiental.

Asociación de Biólogos y Ecólogos:	Participación de asesoría a diferentes proyectos de conservación y protección de RRNN.

PANAMA.

Asociación Nacional para la Conservación de la Naturaleza (ANCON):	Proyecto de reforestación cuenca hidrográfica del canal de Panamá; Proyecto agroforestal demostrativo río Caruya; Recopilación y sistematización de la información existente de anfibios y réptiles endémicos, raros y en peligro de extinción; Proyecto de desarrollo y creación de reas silvestres protegidas; monitoreo e inventario de anfibios, réptiles y mamíferos; Diagnóstico de plagas forestales en zonas de amortiguamiento; Recopilación y sistematización de infomación entomofauna de reas protegidas; Centro de datos para la conservación de Panamá; Actualización de la base de datos sobre la diversidad biológica de Panamá; inventarios biológicos en tres reas protegidas.
Autoridad Portuaria Nacional:	Mecanismos de sedimentación en puertos y canales de acceso.
Instituto Nacional de Recursos Naturales Renovables (INRENARE):	Recolección, manejo, beneficiamiento y comercialización de semillas forestales tropicales de Panamá.
Ministerio de Comercio e Industrias / Departamento de Recursos Marinos:	Planktology; Ichthyology; Zoology; Marine biology; Fisheries biology; Biology; Chemistry.
Oficina de Control de Contaminación:	Chemistry; Analysis; Water quality.
Smithsonian Tropical Research Institute:	Marine ecology, biology; Plant systematics; Reproduction ecology; Insect socio-biology; Evolutionary and Ecological Theory; Human ecology; Vertebrate behavioural theory; Animal behaviour and evolution; Reef fish behavioural ecology; Behaviour of cephalopods; Evolution and Ecology of marine organisms; Sistemática de camarones del género ***Alpheus*** y sistemática de corales; Depredación del coral ***Acropora cervicornis***; Bosques de mangle como parte del Proyecto de derrame de petróleo. Study of long term

	effect of the refinery Panam Oil Spill (1986) on mangrove forest of Bahia Las Minas; Peces: electroforesis (laboratorio) y buzo de monitoreo en el campo; Ecología de peces de arrecifes de corales; Mating systems, sexual selection and mechanisms of mate choice in fiddler crabs, genus ***Uca***; Reproductive biology, cycles of egg production and hatching and larval dispersal ecology of intertidal and estuarine brachyuran crabs; Studies of the evolution of social and signal systems, birds, other vertebrates, cephalopds; Molecular population genetics and historical biogeography of tropical marine fishes and invertebrates; Molecular population genetics and evolutionary relationships of Amerindians; Molecular evolution of marine organisms separated by the isthmes of Panam; Role of sea urchins in Caribbean coral reef communities; Long term monitoring of physical factors and plants and animal populations on coral reefs; Effects of oil spills on marine benthos; Efectos de un derrame de petróleo sobre ambientes costeros de Panamá; Efectos biológicos de la formación del istmo de Panamá sobre la biota; Overall responsability for studies of effects of a major oil spill on Caribbean mangroves, reefs, and seagrass communities.
Universidad de Panamá:	Variación entre poblaciones, cariotipo de bandas y sistemas aloenzimáticos; Historia natural de las aves de Panamá, nidos, huevos, pollos, alimentación, parásitos, distribución y migración; Gasterópodos del Pacífico de Panamá, distribución geográfica, ecología y taxonomía; Biología pesquera del pargo rojo del Golfo de Panamá, análisis de crecimiento en longitud y peso, ciclo reproductivo y factores de condición en el ciclo anual.
Universidad de Panamá / Centro de Ciencias del Mar y Limnología:	Zooplankton, Ichthyology; Estuarine ichthyology; Phytoplankton; Food Technology; Marine ecology; Oceanography; Fisheries biology.

PERU.

Asociación Amazonia:	Environmental impact.
Dirección de Saneamiento Ambiental:	Chemical. Sanitary engineering; Biology.
Fundación Peruana para la Conservación de la Naturaleza:	Reproduction of penguins; penguins.
Instituto del Mar del Perú (IMARPE):	Fishery biology, technology, surveys, management; Fish physiology, reproduction, age and growth, Commercial fishery, Demersal fishery; Feeding of fish larvae; Ichthyoplankton; Reproduction of pelagic Fish; Marine biology, ecology, geology, pollution, productivity, Marine fish, birds, ornithology and mammals; Chemical and physical oceanography; Population dynamics; Subpopulations studies; Migration and tagging; Mortality; Hydroacoustics; Geochemistry; Sedimentology; Bathymetry; Data processing; Coastal upwelling; Ocean-air interaction; Surface currents; Remote sensing; Water masses circulation; Primary and Marine productivity; Nutrients; Phytoplankton; Aquaculture; Carcinology; Benthos; Hake monitoring and age determination; Biological Investigation; Stock assessment of guano birds; Benthic communities.
Ministerio de Pesquería:	Aquaculture; Hatchery, pond and fishery construction; Fishery biology, development; Evaluation and population dynamics; Fishing technology; Fish eggs and larvae; Fish diseases, endocrinology; Trouts; Pisciculture; Biology; Resources conservation; Limnology; Administration.
Museo de Historia Natural 'Javier Prado':	Aquaculture, Biological oceanography; Phytoplankton; Phycology; Macroscopic algae; Macroscopic algae; Primary production; Ecologu; Ichthyology; Ichthyogeography.
Universidad Nacional 'San Luis Gonzaga' de ICA:	Biology; Aquaculture; Microbiology.

Universidad Nacional Agraria 'La Molina':	Fish technology; Fisheries; Fishery biology; Aquaculture; Biological and physical oceanography; Marine meteorology; Navigation.
Universidad Nacional de San Agustín Arequipa:	Marine crustaceans; Aquaculture; Biology; Ecology; Fishery biology; Hydrography; Biological and physical oceanography.
Universidad Nacional de Tacna Tacna:	Fishery technology, reproduction and biological; Aquaculture; Carcinology; Physiology; Biological oceanography.
Universidad Nacional de Trujillo:	Aquaculture; Molluscs and crustacean culture; Biological oceanography; Marine phytoplankton; Fishery biology; Marine ichthyology, biology, algae; Zooplankton; Littoral benthos; Environmental impact (rivers); Parasitology & sicknesses of crustaceans.
Universidad Nacional 'Federico Villareal':	Fishery technology, biology; Fisheries; Ichthyology; Plankton; Aquaculture; Chemical, biological and physical oceanography; Marine meteorology, geology; Oceanographical technology; Sedimentology.
Universidad Nacional Mayor de San Marcos:	Marine algae, benthos; Histology; Ichthyology; Biochemistry; Fishing.

REPUBLICA DOMINICANA.

Centro de Investigación de Biología Marina:	Biodiversidad, ecosistemas costeros y marinos de la República Dominicana.
Dirección Nacional de Parques:	Capacitación de Guardaparques.
Universidad Autónoma de Santo Domingo:	Biology; Mangrove ecology; Microbiology; Conservation of marine fauna; Marine biology; Chemistry; Water analysis.

URUGUAY.

Instituto de Investigaciones Pesqueras:	Ecology.
Instituto Nacional de Pesca:	Fisheries biology; Oceanography; Artisanal fisheries; Trawl fisheries.

Industria Lovera y Pesquera del Estado:	Fishery biology, technology; Fisheries.
Hospital de Clínicas:	Toxic waste.
Ministerio de Agricultura y Pesca:	Fishery science; Populations dynamics; Acoustics; Marine biology; Plankton; Statistics; Aquaculture; Parasitology; Ichthyology.
Museo Nacional de Historia Natural:	Fishery biology; Biology oceanography; Taxonomy of molluscs.
Armada (SOHMA):	Hydrography; Chemical and physical oceanography; Marine geology, geophysics, meteorology.
Universidad de la República:	Biological oceanography; Embriology; Fishery biology; Birds and marine mammals; Genetics; Citogenetics; Ecology; Marine geology, meteorology; Hydrography; Hydrology; Coastal geomorphology, lagoons; Littoral benthos, geodynamics; Biophysics; Biomathematics; Sedimentology; Resource management; Paleocology.

VENEZUELA.

Aguamarina de la Costa:	Aquaculture.
Centro Nacional para el Mejoramiento de la Enseñanza:	Productivity.
Comando de Guardacostas de la Armada de Venezuela:	Pollution; Environmental impact; Marine ecology.
Departamento de Información, Investigación y Conservación de Suelos, Agua y Vegetación:	Lagoon fishery.
Fondo Nacional de Investigaciones Agropecuarias (FONAIAP):	Fisheries population dynamics; Aquaculture; Resource management; Sand beach ecology; Fisheries; Red tide.
FUNDACETACEA:	Ecology; Cetacean protection.
Fundación Científica Los Roques (FCLR):	Marine ecology.
Instituto de Ciencias de la Tierra:	Geochemistry.

Instituto de Tecnología de Carupano:	Resource management.
Fundación La Salle de Ciencias Naturales (FLASA):	Marine geology, culture, biology; Oceanography; Meteorology; Zooplanktology; Food technology; Chemical oceanography, engineering; Fishery biology; Phycology; Biochemistry.
Instituto Nacional de Parques (INPARQUES):	Resource management.
Fundación para la Defensa de la Naturaleza (FUDENA):	Ecology; Sea turtle.
Instituto Oceanográfico de Venezuela:	Pollution; Coastal ecology; Ecology of mangroves.
Instituto Universitario de Tecnología de Cumaná:	Ichthyology.
Instituto Venezolano de Investigaciones Científicas (IVIC):	Aquaculture; Biological oceanography; Littoral benthos; Ecology; Marine geology; Physiology; Paleobiology; Biohistory; Paleoecology.
Ministerio del Ambiente y de los Recursos Naturales Renovables:	Resource management.
Smithsonian Institute:	Ecology.
Sociedad Conservacionista Audubón de Venezuela:	Coastal birds.
Universidad Central de Venezuela:	Geology; Ichthyology; Taxonomy of algae; Meteorology; Pollution; Coastal ecology.
Universidad de Los Andes:	Mangrove ecophysiology; Ecophysiology of coast plants.
Universidad de Oriente:	Cultivation molluscs; Physical and chemical oceanography; Fish parasites; Hydrochemistry; Chemical aspects of sediments; Marine geology, bacteriology, radio- chemistry, culture; Food technology; Biochemistry; Fisherie biology; Phytoplankton; Trace elements; Algae; Pigments; Aquaculture; Crustaceans; Echinoderms; Zooplankton ecology; Foraminifera; Currents; Environmental impact; Marine bird ecology; Parasitology; Lagoon ecology; Pollution; Fisheries;

	Physiology: Taxonomy; Communities; Ecology of fishes; Population dynamics; Ichthyology; Plankton; Ecophysiology.
Universidad Nacional Experimental Francisco de Miranda:	Ecology of crustacea; Aquaculture; Population dynamics.
Universidad Santa María:	Biotechnology; Taxonomy of algae.
Universidad Simón Bolívar:	Chemistry; Pollution; Benthic ecology; Physiology; Sand beach ecology; Fisheries; Aquaculture; Heavy metals; Environmental impact; Mangrove ecosystem; Coastal ecology; Physiology of gastropods.
Universidad del Zulia:	Phycology; Ichthyo-biology; Vertebrates; Marine biology; Aquaculture; Ichthyoplankton; Animal ecology; Marine ecology; Heavy metals; Pollution.

FROM:

- DECA. 1991.
- FAO/IOC/UN (OETB). 1983
- RIDLAC. 1990.