

importance of conserving biodiversity for the sustainable use of living aquatic resources.

Acknowledgements

We thank the European Commission, Directorate General for Development, especially Dr. C. Nauen, for their untiring support, which was instrumental in the eventual realization of this project.

References

- Anon. 1995. ACP-EU Fisheries Research Initiative. Proceedings of the first Dialogue Meeting, Eastern and Southern Africa, Indian Ocean and the European Union. Swakopmund, Namibia, 5-8 July 1995. Brussels, ACP-EU Fish. Res. Rep. 1, 144 p.
- Froese, R. and D. Pauly, Editors. 1996. FishBase 96: concepts, design and data sources. ICLARM, Manila, Philippines. 179 p.
- Pitcher, A. 1996. Reinventing fisheries management. Naga, ICLARM Q. 19(3):15-17.
- Sutton, M. 1996. The Marine Stewardship Council: new hope for fisheries. Naga, ICLARM Q. 19(3):10-12.
- J.M. VAKILY is Training Coordinator, ACP-EU Project; R. FROESE is Project Leader, ACP-EU Project; M.L.D. PALOMARES is Software Developer and Database Scientist; and D. PAULY is Principal Science Advisor, all from ICLARM.
- ICLARM Contribution No. 1349.

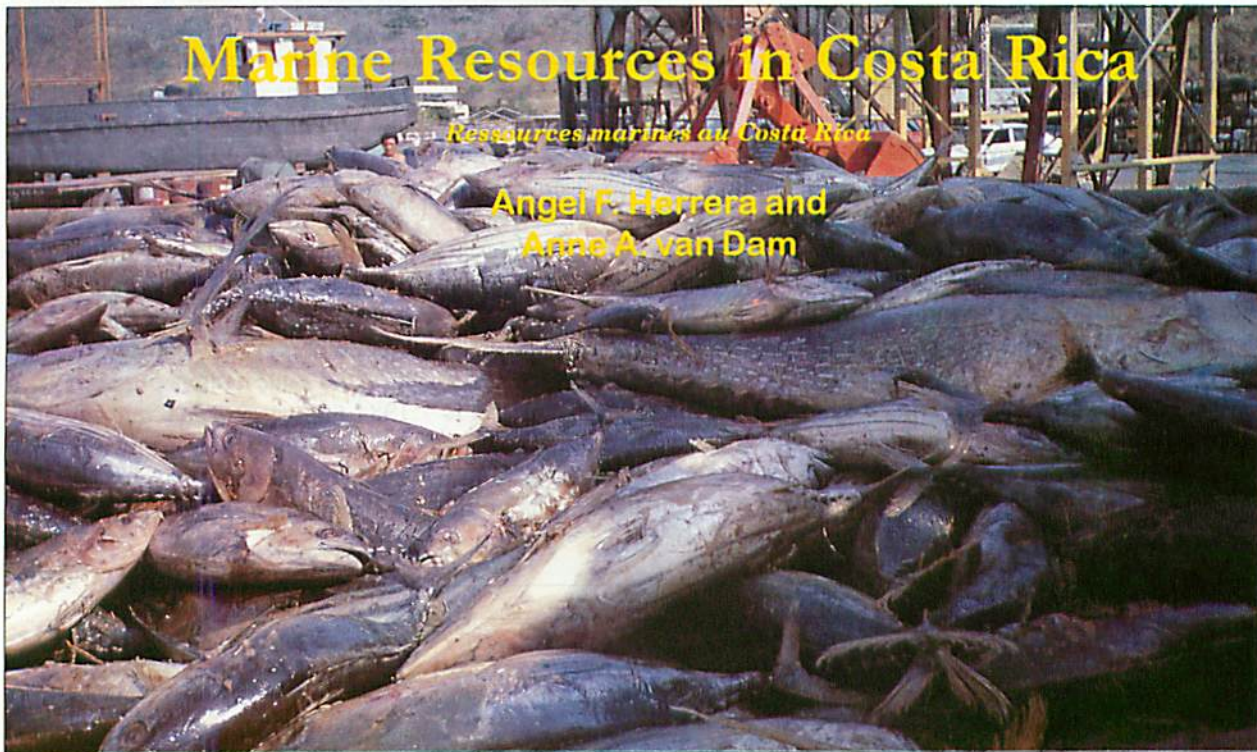


Photo by A.A. van Dam

Tuna at processing plant in Puntarenas. More than 15 000 persons are involved in fishery activities in Costa Rica. Local fishers use artisanal boats with long lines to catch tuna, shark, sailfish and dolphin. However, most of the tuna landings are by foreign vessels.

Blessed with beautiful beaches, mangroves and coral reefs, fisheries in Costa Rica developed without a basic resources management plan until the mid-1980s when protected areas were developed and integrated into the National System of Conservation Areas. With the boom in tourism as well as a decrease in fish landings due to overfishing, and an increase in pollution threatening the coastal areas, there is now a need for integrated management of marine resources. Costa Rica has made a deliberate choice for sustainable development. There has been a significant growth in scientific research, development of human resources at the technical and scientific level, stronger environmental legislation, and joint national and regional projects. What is needed for the future is good coordination and collaboration between the various institutions involved, namely the government, research and the resource users. Only then can Costa Rica continue to enjoy the "rich coast" that Christopher Columbus saw in 1502.

Bien que les pêcheries du Costa Rica comptent parmi leurs atouts de superbes plages, mangroves et récifs coralliens, elles se sont développées sans qu'aucun plan élémentaire de gestion des ressources ait été mis en place. C'est seulement vers la moitié des années 1980 qu'un système national de conservation prévoyant la protection de certaines zones a été institué. Étant donné l'essor du tourisme, la baisse enregistrée dans les quantités de poissons débarquées due à la surexploitation, et l'élevation de la pollution menaçant les zones côtières, la gestion intégrée des ressources marines devient à présent impérative. Le Costa Rica a délibérément opté pour le développement durable. Parmi les développements récents, on observe une évolution très nette dans les efforts consentis au niveau de la recherche scientifique, un accroissement des ressources humaines au niveau scientifique et technique, un renforcement de la législation environnementale, et la multiplication des projets conjoints nationaux et régionaux. Pour garantir la continuité de ces développements, une bonne coordination et une collaboration étroite entre les diverses institutions intervenantes sont à présent nécessaires, notamment le gouvernement, la recherche et les utilisateurs des ressources. C'est uniquement dans ces conditions que le Costa Rica pourra continuer à profiter de cette "Riche côte" que Christophe Colomb contempla en 1502.

Introduction

When Christopher Columbus made his fourth voyage to the "New World" in 1502 he is reported to have said "Qué costa tan rica!"; thus, the name of Costa Rica was born. Notwithstanding the "richness" of their coasts, Costaricans have always been oriented toward the highlands. The country did not have large amounts of gold, and the Spanish colonists were generally farmers who settled in the central valley, far away from the sea. The development of the coastal area, and in particular of the marine resources, was neglected. The area known today as Costa Rica was characterized by great natural riches but had little anthropological importance compared with the Maya, Inca or Aztec kingdoms. Without gold, Costa Rica remained outside the main conflicts, which mitigated to a certain extent the impact of colonization and the associated persecution of the indigenous population and exploitation of the natural resources.

Costa Rica has enjoyed a stable democracy for more than 100 years. In 1948, it abolished its armed forces which enabled the country to utilize

its resources for the improvement of education and health services. Thus, despite being a developing country in economic terms, for several years Costa Rica has ranked among the top 35 countries in terms of the Human Development Index formulated by the World Bank (World Development Report 1992).

The Coastal Zone

Costa Rica is small. The total surface area is 50 000 km² and it has 1 380 km of coastline (1 164 km on the Pacific, and 216 km on the Caribbean coast) characterized by beaches, mangroves and coral reefs. The Exclusive Economic Zone (EEZ) covers approximately 500 000 km², almost 10 times the land territory (Figs. 1 and 2). All along the coast, an area of 200 m inland from the high tide mark is designated public zone. About 5% of Costa Rica's population (of a total of 3.37 million in 1996) lives in coastal areas.

The EEZ in the Caribbean zone is only about 10% of the Pacific EEZ. The Caribbean zone has a tropical humid climate with inundated forests in the

north. Sportfishing is prominent, as are ecotourism and the development of protected areas. Inland, there is cattle husbandry and the timber industry. In the south the coral reefs are important with the majority located in protected areas. Both "sun and beach" tourism and ecotourism are being developed. All along the inland Atlantic zone lies the major banana producing area.

The northern part of the Pacific zone has a tropical dry climate and a coastline with many beaches. During the last years, tourism has boomed, especially "sun and beach" tourism. More inland, the cattle industry is important. The Gulf of Nicoya, an estuary which produces about 30% of Costa Rica's fish landings, is an important feature of this part of the country. The southern part of the Pacific zone has a tropical humid climate, with a mixed development of "sun and beach" tourism and ecotourism. Inland, there is cattle industry, rice culture and some banana production. In 1984, the major banana company withdrew its operations from this area, leading to more pressure on other resources, including fishery. Recently,

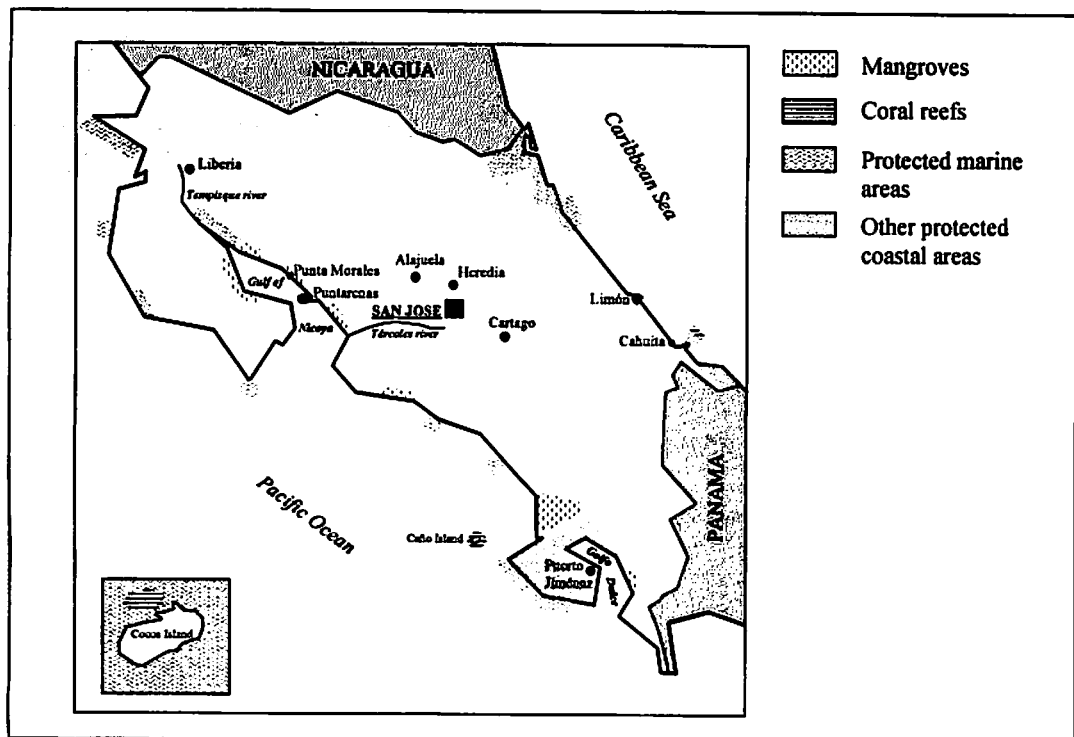


Fig. 1. Schematic map of Costa Rica with marine resources.

tree plantations for reforestation purposes have been actively established. Protected areas exist along the whole Pacific coastline.

The major marine resources are located in the permanent upwelling area of Domo Termico de Costa Rica, with a productivity comparable with that produced by the Humboldt current. An estimated 41 000 hectares on the Pacific coast are covered with mangroves (Jiménez 1994) with a few coral reef areas. One reef, located in the Caribbean near Cahuita, was severely damaged during the 1991 earthquake that hit the east coast of Costa Rica. The other coral reefs are located at the Caño Island on the Pacific coast and around Cocos Island.

Characteristics of Fish Production

More than 15 000 persons are involved in fisheries activities in Costa Rica, of which about 7 000 are fishers. Fish landings increased from 8 200 tonnes in 1971 to 25 000 tonnes in

1986, but decreased to about 13 500 tonnes in 1995 (see Fig. 3). The semi-industrial fleet consists of 57 trawlers that concentrate on shrimp and sardines. Most of the tuna landings in Costa Rica are caught by foreign vessels. The artisanal fleet (boats with outboard motors and a crew of two men)

consists of some 100 advanced artisanal boats with a maximum capacity of 20 tonnes using longlines to capture tuna, sharks, sailfish (*Istiophorus platypterus* or *Pez vela*) and dolphinfish (*Coryphaena hippurus*, dorado or mahi-mahi), and several hundred smaller boats, most with out-

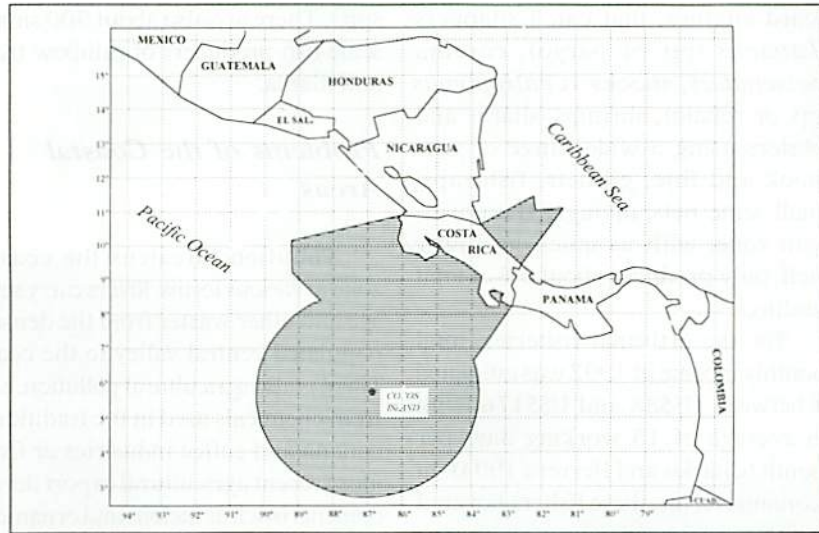


Fig. 2. Schematic map of Costa Rica's Exclusive Economic Zone.



Photo by A.A. van Dam

Mangrove forests in the Gulf of Nicoya. The Gulf of Nicoya is an important estuary which produces about 30% of the country's fish landings. Costa Rica's fish consumption is quite low and most of the fish landings are exported.

board engines, that catch snappers (*Lutjanus* spp. or pargo), corvina (*Sciaenidae*), snooks (*Centropomus* spp. or róbalo), shrimps, sharks and lobsters using a wide range of gear (hook and line, gillnets, fishtraps, small seine nets, diving). The Caribbean zone, with its much narrower shelf, only produces about 5% of total landings.

For the artisanal fisheries, total monthly income in 1992 was estimated at between US\$88 and US\$176, with an average of 15 working days per month (Charles and Herrera 1994). In economic terms, these fishers hovered between severe and extreme poverty.

Most of the fish landing is exported. Costaricans are not big fish eaters with an annual per capita fish consumption of only about 4 kg (1986). Aquaculture production has shown a significant growth, increasing by 60% in the last ten years. In 1990, aquaculture production amounted to US\$50 million (Charles et al. 1996). Four large companies on the Pacific coast grow mainly marine shrimp (*Penaeus* spp.). In freshwater aquaculture, there are several large companies that produce prawns (*Macrobrachium rosenbergii*) and tilapia (*Oreochromis*

spp.). There are also about 500 small-scale fish producers of rainbow trout and tilapia.

Problems of the Coastal Areas

Pollution threatens the coastal zone in various forms. Rivers carry sewage and other wastes from the densely populated central valley to the coast. There is also agricultural pollution, e.g., from chemicals used in the traditional banana and coffee industries or from more recent agricultural export developments (such as melons and ornamental flowers). Industries, ranging from saddleries to plastic factories, contribute to the pollution.

Degradation of the natural environment is caused by various forms of infrastructure development. Deforestation has led to increased rates of river sedimentation. Urban and tourism areas are affected by unplanned development. On a smaller scale, beaches and forests are affected by the excavation of sand, vehicle movements and extraction of wood and pollution. The 200 meter public zone is not always respected. Between 1952 and 1988, 5 640 hectares of mangroves were lost,

mainly as a result of agricultural activities. In the Gulf of Nicoya, about 1 000 hectares of mangroves were lost to shrimp and salt pond development and urban growth (Jimenez 1994). Tourism has risen dramatically, from over 500 000 arrivals in 1991 to almost 800 000 in 1995 (INICEM 1996) increasing the pressure on the coastal zone.

Most of Costa Rica's fish stocks are considered to be fully or overexploited (Gumy et al. 1992). Fishing effort continually increases but landings are decreasing. Expansion of artisanal exploitation, both in numbers and in terms of technology used, has been stimulated by government incentives for export industries. Policies change every time the government changes with little government control over the sea, resulting in piracy by foreign vessels, drug trafficking, disrespect for marine borders and the absence of a development policy.

Recent Developments

The attitude towards the coastal zone and the ocean has gradually changed in several ways since the middle of the 1980s. The number of protected marine areas has grown, especially on the Pacific coast and there are now nine protected marine areas totalling 317 000 hectares, of which two are marine parks. Protected marine areas have been integrated into the National System of Conservation Areas and play an important role in the management of the whole Caribbean and, to a lesser extent, the Pacific zone. These areas range from National Parks, where fishing is prohibited, to Wildlife Reserves, where fishing is regulated.

In the Caribbean, the effects of this system of protected areas are most obvious in the development structures for management of the exploitation of the green turtle (*Eretmochelys imbricata*) and the spiny lobster (*Panulirus argus*). It is only permitted to fish these species outside the National Parks. In the Pacific zone, effects are felt most strongly in the bivalve mollusc fishery in the mangrove areas, in the regulation of tree felling in the mangroves,

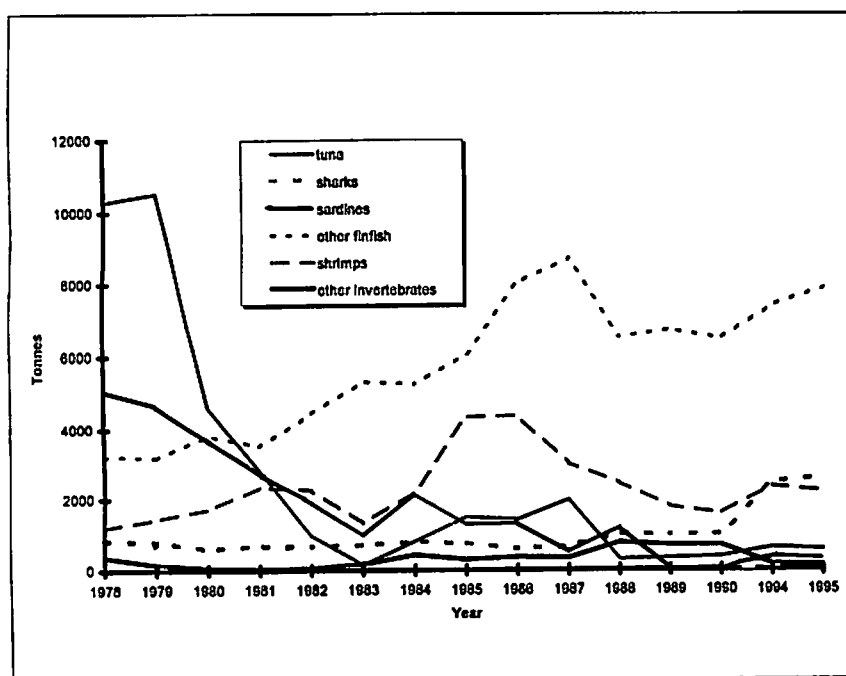


Fig. 3. Fish landings in Costa Rica, 1978-1995 (Source: Gumy et al. 1992; INCOPECA 1996).

in the ban on the capture of wild animals in the mangroves (such as the big parrot, *Ara macao*), and the fishing ban in the vicinity of National Parks.

There has been a steady growth in the amount of scientific research and in the development of human resources at a technical and scientific level to such an extent that Costa Rica now has a leading role in Central America in this respect. Environmental legislation has developed strongly, leading, for example, to compulsory environmental impact studies. Non-governmental environmental organizations have been strengthened. Enterprise development is encouraged in the coastal zone, both by the establishment of Free Zones and through growth in the tourism sector, but at the same time, there is a strong campaign by both the government and private sector groups to reduce pollution and improve waste management. The Costarican Institute of Fisheries and Aquaculture (INCOPECA), an autonomous government body, was formed to support and regulate the sustainable development of fisheries and aquaculture.

Costa Rica has been developing its research base in the marine sector since 1970. In the early seventies, the focus was on marine coastal resources, morphology, mangroves, coral reefs and the intertidal rocky areas. A second wave of development occurred in the eighties, which included fisheries research. Students were sent abroad for higher degree training in areas related to plankton, red tides and pollution. In the middle of the 1980s, the Universidad Nacional Autónoma (UNA) in Heredia initiated its programs in aquaculture and coastal zone management and the Universidad de Costa Rica (UCR) established programs of basic aquatic ecological research through its Centro de Investigación en Ciencias del Mar y Limnología (Center for Research in Marine Science and Limnology, CIMAR).

Costa Rica is currently entering a third phase of research and development in the marine sector, stimulated by the requirements of the United Nations Environmental Program (UNEP). Costa Rica now has the opportunity to

centralize and coordinate joint national and regional projects for marine coastal management, information systems, and development of human resources.

Scientific investigation has produced a steady flow of scientific articles, theses (from undergraduate to doctoral), reports, and books. Between 1984 and 1994, 700 publications on biology appeared on the subject of coastal marine resources and 285 publications on biology (Herrera et al., in press; Fig. 4). Research has been carried out by about 50 scientists, the majority of whom belong to the two largest universities in Costa Rica namely the UNA and the UCR. Recent projects in marine coastal development include both national projects and projects in collaboration with foreign institutions, such as the collaborative project in applied aquatic sciences between Wageningen Agricultural University in the Netherlands and the UNA (Günther and Kleijn 1993); the integrated rural development project DRIP (Desarrollo Rural Integral Peninsular), funded by The Netherlands and with a strong marine/coastal component; and projects with the Japanese International Cooperation Agency (JICA), the Government of Taiwan, and the International Union for the Conservation of Nature. Significant recent developments include the construction of a new Marine Biology Station in the Pacific port city of Puntarenas and the refurbishing of



Photo by A.A. van Dam

Crab fisher lifting his traps.

the Research Station for Marine Biology in Punta Morales, at the Gulf of Nicoya, both being carried out by the UNA.

Challenges for Marine Resource Management in Costa Rica

Like in many other countries, the fishery in Costa Rica developed without a basic management plan. Several years ago Costa Rica made a deliberate choice for sustainable development. All sectors involved in the marine coastal zone

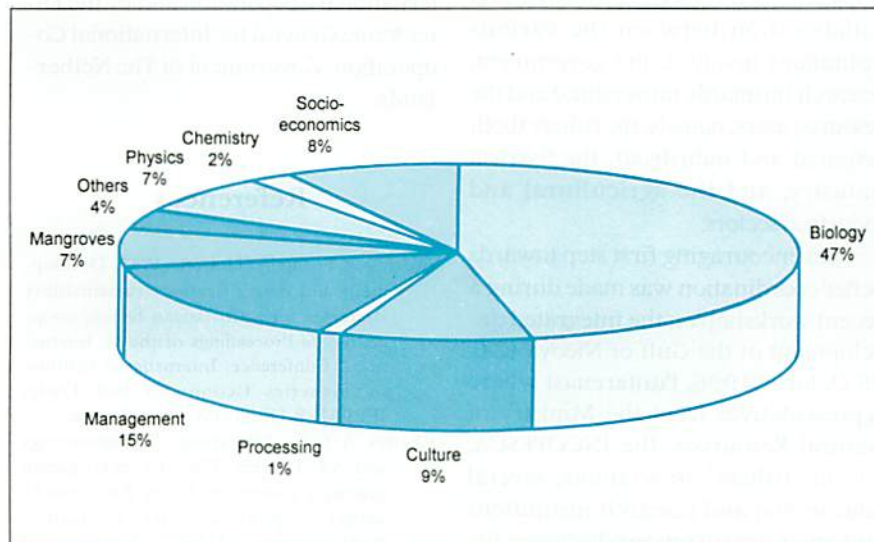


Fig. 4. Publications on marine resources in Costa Rica, 1984-1994 (Herrera et al. 1996).

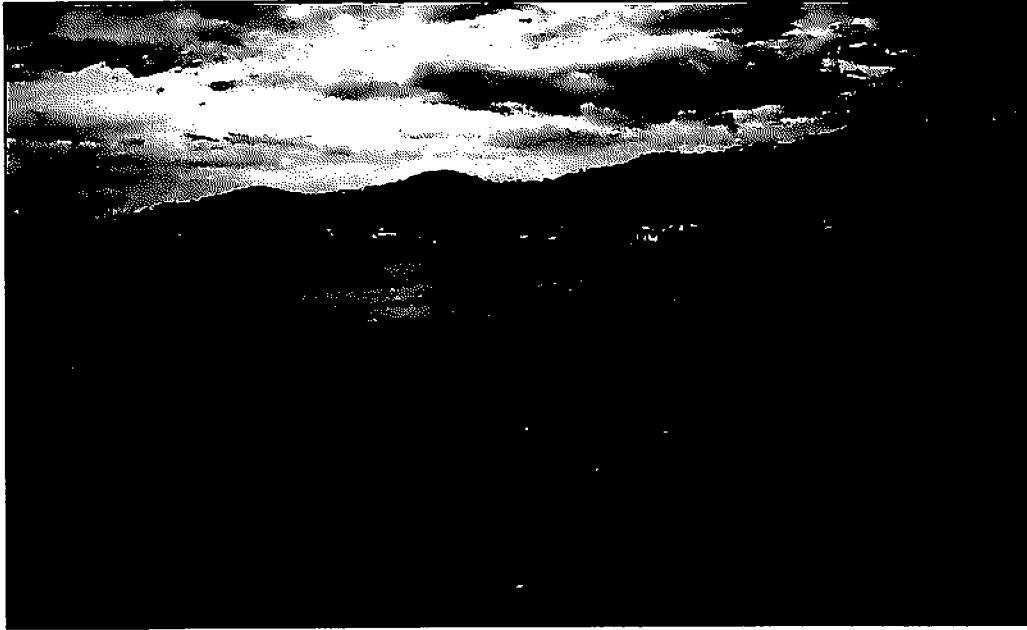


Photo by A.A. van Dam

Typical beach on the Pacific coast of Costa Rica. Tourism along the more than 1 000 km of beaches has boomed in recent years and protected areas exist along the whole Pacific coastline.

should move from the current disorderly development to a form of integrated management, which minimizes negative impacts on the environment and stimulates the restoration of deteriorated coastal zones resulting in a better quality of life for the inhabitants. Costa Rica has the opportunity to build a good system of marine resources management. It has the professionals to design and implement management plans for marine areas. It will have the facilities and staff needed to conduct necessary research. The country could even play a regional leading role in research and training. What is needed is good coordination and collaboration between the various institutions involved: the government, research (primarily universities) and the resource users; namely, the fishers (both artisanal and industrial), the tourism industry, and the agricultural and industrial sectors.

An encouraging first step towards better coordination was made during a recent workshop on the integrated development of the Gulf of Nicoya (24-25 October 1996, Puntarenas) where representatives from the Ministry of Natural Resources, the INCOPECSA, various fishers' associations, several educational and research institutions and other organizations discussed the future management of the Gulf and the

role each organization could play. Only through a coordinated effort will it be possible to reduce pollution, enforce protection where necessary and achieve sustainable forms of exploitation. Only then can Costa Rica continue to enjoy the "rich coast" that Columbus saw in 1502.

Acknowledgements

A.A. van Dam is seconded to the Universidad Nacional, Heredia through a program funded by the Netherlands Universities Foundation for International Cooperation and by the Directorate General for International Cooperation, Government of The Netherlands.

References

Charles, A.T. and A. Herrera. 1994. Development and diversification: sustainability strategies for a Costarican fishing cooperative. *In* Proceedings of the 6th International Conference, International Institute of Fisheries Economics and Trade, IFREMER-ORSTOM, Paris, France.

Charles, A.T., C. Amaratunga, T. Amaratunga and A.F. Herrera. 1996. La investigación marina y costera en Costa Rica: estado actual y políticas para el futuro. Publicaciones UNA, Universidad Nacional, Heredia, Costa Rica.

Gumy, A., J. Csirke, E. Ruckes and M. Giudicelli. 1992. Programa de Asesoramiento en Ordenación y Legislación Pesquera. GCP/INT/466/NOR, Field Report 92/13. Food and Agriculture Organization, Rome.

Günther, J. and K. Kleijn, Editors. 1993. Actas del Simposio "Investigación acuícola en Centroamérica". Escuela de Ciencias Biológicas, Universidad Nacional, Heredia. 181 p.

Herrera, A., A. Charles and C. Amaratunga. Análisis de las referencias en ciencias marinas y costeras en Costa Rica, 1984-1994. Uniciencia. (In press).

INCOPECSA. 1996. Estadísticas pesqueras de Costa Rica, período 1995. Instituto Costarricense de Pesca y Acuicultura, Puntarenas, Costa Rica.

INICEM. 1996. Costa Rica: datos e indicadores básicos (Costa Rica at a glance). Sexta edición. INICEM, San José. 39 p.

Jiménez, J.A. 1994. Los manglares del Pacífico de Centroamérica. Editorial Fundación UNA, Heredia, Costa Rica. 352 p.

World Development Report. 1992. Development and the environment. Oxford University Press, New York.

A.F. HERRERA and A.A. VAN DAM are with the Programa UNA-LUW, a collaboration between the Universidad Nacional in Heredia, Costa Rica and Wageningen Agricultural University, The Netherlands. Address: Programa UNA-LUW, Escuela de Ciencias Biológicas, Universidad Nacional, Ap. 86 - 3000 Heredia, Costa Rica.