

# The current status of marine sciences research in coastal lagoons of Kenya

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## Introduction

Marine science research in Kenya has expanded considerably since the collapse of the East African Marine Fisheries Research Organization. In this report an overview of the current status of marine science in the country is discussed, in particular the research activities at the Kenya Marine and Fisheries Research Institute in Mombasa. Finally the role of Kenyan universities in training marine scientists is examined.

Kenya's coastline of about 630 km has various types of littoral, shallow and deep sea biotopes. The shorelines have many sandy beaches, rocky shores and mangrove forests which grow luxuriantly in creeks with low gradient shores. The shallow water zone supports living coral and sea grass beds. In Kenyan waters less than 10 m deep the total area of sea grass beds and living coral is estimated to be 1,375 km<sup>2</sup> and 125 km<sup>2</sup>. The mangrove forest cover is about 530 km<sup>2</sup>. Like several other countries, Kenya has declared and claimed its Exclusive Economic Zone (EEZ) to the 200 nautical miles limit in line with the UN Law of the Sea.

Kenya puts important emphasis on the sustainable exploitation and conservation of her aquatic resources, both in marine and fresh waters. Such meaningful sustainable exploitation and conservation requires management that is backed by scientific research and training. Apart from KMFRI, marine research in Kenya is also carried out by the National Universities, the Kenya Wildlife Services and the National Museums of Kenya.

# Kenya Marine and Fisheries Research Institute

The Kenya Marine Fisheries and Research Institute (KMFRI) was born in 1979 out of the defunct East African Fisheries Research Organization (EAMFRO) and the East African Freshwater Fisheries Research Organization (EAMFFRO), established in 1948 and 1950 respectively as International Service Organizations to serve the East African countries. The main objective of the Institute is to promote and develop genuine local expertise by way of propagating general research activities in both freshwater and marine ecosystems.

The Institute is a Government parastatal organization and is currently under the Ministry of Research, Science and Technology. It is managed by a Board of Management appointed by the Minister. It has two main divisions, the Marine Science Division housed at the headquarters in Mombasa and the Inland Waters Division with laboratories in Kisumu on the shores of Lake Victoria, at Kalokal on Lake Turkana, at Lake Baringo, at Sangoro on River Miriu, at Kagati and Lake Naivasha, and in Nairobi.

## STAFF

The institute started with only five Kenyan scientists and a few supporting staff. Today, however, KMFRI has 120 scientists half of whom carry out research in fresh-water and the other half in the marine environment. Of all these scientists two have Doctorate degrees, 33 Master of Science degrees and the rest are Bachelor of Science holders. To date the institute has about 1,300 supporting staff.

## Research Programmes

In one programme within fisheries research the goals are to assess the stocks of commercially important fin fish and shell fish and to study the ecology of coral fish. The fact that Kenya's coastline has several sites suitable for rearing of fish means that research oriented to mariculture is very important. Currently research on the culture of prawns, oysters, algae as well as fin fish are under way. There are also attempts to integrate salt mining activities with the rearing of the brine shrimp, Artemisia.

Kenya has a long history of strong interest in the preservation and conservation of wildlife resources and the protection of critical habitats through the creation of parks. Coastal marine

parks in Kenya are also major tourist attractions. Kenya has also gained financially in creating parks as thousands of tourists and local visitors are attracted by the great diversity of life in the parks. As regards health, there is every need to monitor pollution in order to avoid diseases and possible elimination of intolerant species. Thus KMFRI undertakes eager research on environmental aspects.

The environmental programmes range from studies of increased sediment loads from land, sewage and waste disposal from urban areas, over exploitation of reef resources, overcutting of mangroves to oil pollution and industrial waste disposal.

Kenya has many species of marine organisms which could be used as a source of active ingredients with pharmaceutical and nutritional values. These extracts could be beneficial to the country in saving and generating foreign exchange. However, studies on the extraction of active ingredients from marine organisms are scanty and still at the rudimentary stages. Crustacean shells could be used as a source of chitin. They are easily available as waste from crabs, lobsters and prawns. The reef flats support rhodophytes from which agar could be extracted. There are also harvestable quantities of echinoderms and sponges from which active ingredients could be extracted

Another programme on food science and technology deals specifically with the problems of spoilage of fish. The conventional methods of curing fish are under study with a view to finding alternative ways of reducing fish spoilage.

The laboratory is also active in oceanographic research covering the biological, chemical as well as the physical aspects of marine waters.

Finally our marine geologists are also involved in a comprehensive study of the geology of the Kenyan coastal systems, especially the relationship between the distribution of mangrove areas and the oceanographic processes.

### **ATTEMPTS TO MODEL A MANGROVE ECOSYSTEM IN KENYA**

On the Kenyan coast at Gazi Bay various parameters are measured on a monthly basis or at even shorter intervals with a view to understanding the structure and function of this mangrove ecosystem. To achieve this aim research groups studying nutrient and nitrogen fixation, production by phytoplankton and sea grasses, mangrove primary production, their litter fall and decomposition, fisheries productivity and hydrodynamics have been established at the Institute in Mombasa. These teams

are multi-disciplinary and the hope is that when all the data are brought together, a meaningful model for this mangrove ecosystem is produced. This is a collaborative programme and the institutions involved are: KMFRI (Kenya Marine Fisheries and Research Institute); University of Nairobi (Kenya); Free University of Brussels (Belgium); State University of Ghent (Belgium); Delta Institute for Hydrobiological Research (Netherlands); Catholic University of Nijmegen (Netherlands); University of Florence (Italy) and Center for study of Tropical Faunistics and Ecology of the Italian National Research Council (Italy).

## Cooperation in Marine Research

The Kenyan Government encourages bilateral and multilateral cooperation with other countries in marine science research. Cooperation minimizes duplication of efforts and is instrumental in the training of Kenyan scientists in various marine research techniques by experienced experts. This approach has proved really useful and must be encouraged in the region and especially amongst local marine scientists.

One of the oldest and most successful bilateral projects in marine science research is the Kenyan/Belgium Project (KBP). It was started in 1985 and its main objective is to link training, research equipment and marine research literature. In this project research is carried out in the country by Kenyans and visiting Belgian scientists and students. Under the auspices of the project the Belgian Government also provides fellowships for Kenyans to go abroad for specialized training in marine sciences and research. While the initial cooperation started between KMFRI, Free University of Brussels (VUB) and Laboratory of Ecology and Systematics it has expanded to involve other universities and institutions in Belgium, the Netherlands, Italy as well as Nairobi and Kenyatta Universities in Kenya.

The success of the KBP attracted other relevant marine science activities to Kenya. As mentioned earlier the Kenya-EEC Project, whose aim is to describe the structure and function of mangrove ecosystems along the Kenyan coast, came in to action in 1989 as an offshoot of the KBP cooperation in marine science. The project "Regional Cooperation in Scientific Information Exchange in the West Indian Ocean (RECOSCIX-WIO)" was also initiated in 1989 by the IOC with the KMFRI-KBP computer section as the Regional Dispatch Centre (RDC). It is currently funded by the Belgian Government through the University of Limburg. The main objective is to promote communica-

tion between marine scientists in the West Indian Ocean and between them and the international community of marine scientists, institutions and organizations. While elsewhere in these proceedings details on this project are given let it be noted that, in only the first two years of its existence, RECOSCIX-WIO has satisfied the needs of marine scientists by responding to their requests on scientific information. Indeed RECOSCIX-WIO has opened channels of communication which has encouraged exchange of information between scientists in an area geographically so wide that traditional communication becomes slow, difficult and expensive. If these achievements can be seen as a success that will prosper then the RECOSCIX-WIO-experience may offer a model for those who wish to initiate activities along similar lines.

A plan to undertake a Kenya-Dutch Expedition in 1991 has been postponed until April 1992 due to the Gulf war. One part of this expedition will study the effects of the monsoons on coastal ecosystems in Kenya on board the Dutch ship "RV Tyro". The other part will study the mangrove-, seagrass bed- and coral reef ecosystems on the coastal fringes of Kenya from a land-based camp.

Kenya will also participate in the Coastal and Marine Research in Africa (COMARAF) project and will, from 1992 to 1996, undertake research on the ecology of coral reefs along the Kenyan coast. In order to fit in with the objectives of the COMARAF project, the Kenyan research will focus on describing the range of coral reefs with respect to and in comparison with the other coastal ecosystems, the taxonomy of various groups as well as the effects of human and natural aggression on corals and will suggest steps to limit their consequences.

Kenya participates fully in the East African Action Plan which was started as a joint mission by UN agencies in 1991 and directed to the 8 states of the region. KMFRI has received an atomic absorption spectrometer and a gas chromatograph under the auspices of the regional project on Assessment and Control of Pollution in the Coastal and Marine Environment of the East African Action Plan.

At its second session in Arusha, Tanzania, December 1987, the Regional Committee for the Cooperative Investigations in the North and Central Western Indian Ocean (IOCINCWIO) approved a proposal for development of a regional component of Global Sea-level Observing System (GLOSS). Since then four extra sea-level stations have been established which brings the total number of tide gauges installed in the region to 17. A workshop on Causes and Consequences of Sea Level Change in

the West Indian Ocean was held in Mombasa in 1991. The theme of this workshop was to promote the use of sea level data and products in the IOCINCWIO region.

SAREC, the Swedish Agency for Research Cooperation in developing countries has supported the development of marine research in East Africa directly. In 1990 SAREC signed an agreement with IOC for a joint regional programme in whose light SAREC and SAREC/IOC have recently organized seminars, workshops and training courses in which Kenyans have actively participated.

Besides research linkages made at government to government levels or UN bodies, individual researchers who have their research grants and skeletal equipment can be allowed to undertake their research at KMFRI and use its facilities for their research purposes. Some foreign researchers who have already established professional links with their counterparts in Kenya find it cheaper to undertake joint research with their Kenyan counterparts rather than to bring groups from abroad to assist them. This also enhances professional links and it speeds up the building of confidence between local researchers and their foreign counterparts. Cases of affiliations of research individuals to KMFRI are therefore also encouraged. One such current project is the Coral Reef Conservation Project headed by Dr Tim Mc'Clanahan who is sponsored by Wildlife Conservation International. He works with 6 Kenyan researchers drawn from KMFRI, Kenya Wildlife Service and University of Nairobi, some of whom receive academic training.

## Marine Sciences at Kenyan Universities

Earlier in this paper it is said that KMFRI has 120 scientists, half of whom conduct research in fresh water while the other half constitute marine scientists. Undoubtedly this indicates a very rigorous recruitment programme for an institute which started with only 5 scientists in 1979. It is also noted that only 30 % of these have some postgraduate training.

The fact that well over 95 % of these scientists received their undergraduate training in Kenya means that it is important that we examine the contribution these institutions of higher education have made to the development of marine science in the region.

Until 1984, the University of Nairobi was the only university in the country. Today, however, the country has four national universities which, in addition to Nairobi, are Kenyatta University, Egerton University and Moi University. The Faculty of

Science in each of these universities trains scientists who, at completion of their Bachelor of Science (B.Sc.) degree are adequately prepared to contribute in one way or another to research in marine science. The Faculty of Science is made up of departments that train scientists in various disciplines including biochemistry, botany, chemistry, computer science, geology, geography, physics and zoology. The scientists then join a research team in the research institutes and eventually pursue a postgraduate course in a specific area in marine science (Fig. 1). With this kind of training at our universities it is no wonder that KMFRI has expanded its scientific personnel rather rapidly and that future recruitment will not be a problem, now that the output of graduates from the national universities has trebled in recent years.

Some departments offer courses directly related to marine science. One is the Department of Botany which offers a course in marine botany at undergraduate level and marine related courses at postgraduate level. The Zoology Department of University of Nairobi offers two courses in aquatic ecology and also a postgraduate course which leads to a M.Sc. (hydrobiology). This year a Department of Fisheries has been started in the Faculty of Science at Moi University. Initially this department aims to produce a small number of graduates with a degree in fisheries who will participate in fisheries research and management in both fresh-water and marine environments.

While it is obvious that the national universities have played a key role in the development of aquatic sciences in Kenya it must be pointed out that all of them are geographically placed well over 500 km from the Kenyan coast. This factor alone has some problems associated with it. First, many students finish their undergraduate course with an apparent mental picture of the structure and function of a marine ecosystem. Because of the financial constraints it is almost impossible to take students on a field course to the Kenyan coast for anything longer than one week during their three years of study. This lack of proper exposure is probably the reason why most postgraduate students in our hydrobiology course tend to do their thesis reports on fresh-water ecosystems. This disparity, in my opinion, has to be corrected.

University students doing research in marine science find useful facilities and laboratory space at KMFRI. This affiliation of the universities and research institutes must be encouraged and sustained. This calls for the expansion of the existing laboratory space at KMFRI. Let us also recognize that the University of Nairobi has a marine station (MOANA) situated

at Diani beach some 30 km south of Mombasa Island. This could also be developed to cater for the training of marine scientists at undergraduate and postgraduate levels. If developed, MOANA would be an ideal facility for training and for university staff interested in marine science research.

Having shown the role of universities in training it is important to mention that the teaching staff have active research going on at the Kenyan coast. In particular there is research on: the ecology of benthic invertebrates; diversity, dynamics and productivity of phyto- and zooplankton; fisheries and fish biology; physiology, production and regeneration strategies of the mangrove trees; parasites on fish, edible crustaceans and molluscs; ecophysiology of oysters and genetic studies in the handedness of the *Uca* crabs. In addition, research is carried out on: the biology of the black spot snapper (*Lutianus fulviflamma*); the biology of the edible crab (*Scylla serrata*); the influence of nutrients on the zonation and abundance of zooplankton; the regeneration strategies of the mangrove trees; and the photosynthetic activities of mangrove trees in Kenya.

In conclusion the universities have played a truly vital role in the development of marine sciences in Kenya and this should be strengthened. Maybe a good suggestion would be to set up, in one of the universities, a department of Marine Sciences and Oceanography. The training of technicians must also go hand in hand with the training of marine scientists. This has been and is done at Nairobi and Mombasa Polytechnics Schools.

## The Future of Marine Science in Kenya

Given the present institutional framework, research facilities and manpower for undertaking the research, the future of marine science in Kenya shows a promising increase. However, to sustain this trend KMFRI will need cooperation with various countries undertaking marine research for the exchange of expertise, donor agencies for granting scholarships in specialized training, equipment, literature, etc., until the time when Kenya will have enough to sustain itself. Training institutions in the country need valuable help to start or improve and maintain good quality of marine science training programmes which will enable the production of competitive manpower in this competitive field.

The ultimate aim is to create a Centre of Excellence for Marine Science in Kenya. The efforts by various organizations to cooperate with Kenya in the marine sciences is well appreciated. They are, indeed all, playing an important role in the evolution of the marine sciences in Kenya and as such these forms of cooperation are significant and need to continue.



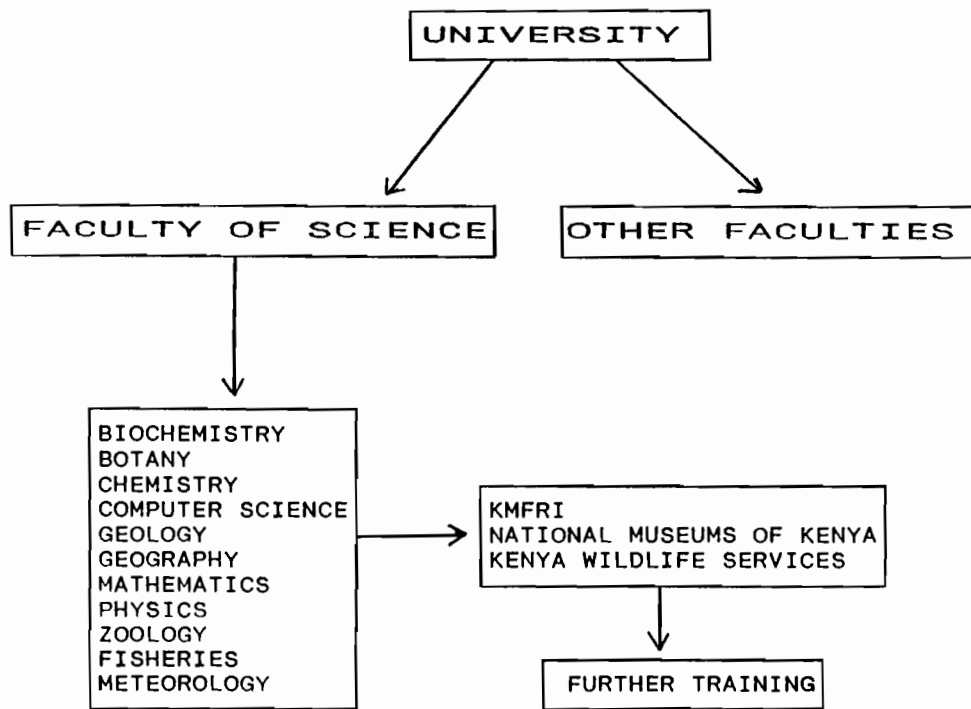


Fig.1 The Faculty of Science in a Kenyan University has several departments which train scientists who can participate in Marine science research.