Intergovernmental Oceanographic Commission
Training Course Reports

8

IOC Regional Training Course on Marine Living Resources in the Western Indian Ocean

Mombasa, Kenya
27 August - 22 September 1984

Unesco

IOC Training Course Reports

No.	Title	Language versions
1.	IOC Indian Ocean Region Training Course in Petroleum Monitoring, Perth, 18 February-1 March 1980	English
2.	IOC Regional Training Course for Marine Science, Technicians, Cape Ferguson, Queensland, 1-28 June 1980	English
3.	ROPME-IOC-UNEP Training Workshop on Oceanographic Sampling, Analysis, Data Handling and Care of Equipment, Doha, Qatar, 3-15 December 1983	English
4.	Stage COI d'initiation à la gestion et au traitement de l'information scientifique et technique pour l'océanologie, Brest, France, 28 novembre - 9 décembre 1983	French
5.	Curso mixto COI-OMM de formación sobre el Sistema Global Integrado de Servicios Océnicos (SGISO), Buenos Aires, Argentina, 15 - 26 de octubre de 1984	Spanish
6.	Unesco-IOC-NBO Training Course on Tidal Observations and Data Processing, Tianjin, China, 27 August - 22 September 1984	English
7.	Stage COI sur la connaissance et la gestion de la zone côtière et du proche plateau continental, Talence, France, 18 septembre - 4 octobre 1984	French
8.	IOC Regional Training Course on Marine Living Resources in the Western Indian Ocean Mombasa, Kenya, 27 August - 22 September 1984	English

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SC.86/WS/36

Unesco

PREFACE

As part of its programme of Training, Education and Mutual Assistance in the Marine Sciences (TEMA), the Intergovernmental Oceanographic Commission (IOC) of Unesco organizes from time to time, through one or more of its Member States, training courses in one or other field of marine science, with a view to enhancing the capacity and capability of its Member States, especially the developing ones, to participate effectively in the IOC's global and regional programmes.

The IOC Regional Training Course on Marine Living Resources in the Western Indian Ocean, organized with the support of the Governments of the Federal Republic of Germany and of the Republic of Kenya, was held at the Kenya Marine and Fisheries Research Institute, Mombasa, Kenya, from 27 August to 22 September 1984. The Course was conducted by four German professors from the Universities of Kiel and Hamburg, one professor from the University of Karachi, Pakistan, then a visiting scientist at the Institut fur Meeresforschung, Bremerhaven, F.R.G., who were assisted by six scientists from the countries of the region. Nineteen participants, mostly biologists, came from Kenya, Madagascar, Mauritius, Somalia, and Tanzania.

The purpose of the Course was to provide training in biological oceanography and early life history of fish to some marine scientists from institutions engaged in marine science and/or fishery research in the developing Member States of the region, with a view to acquainting them with basic oceanographic techniques and methods used in the study of the spatial and temporal distribution of marine living resources, as a basis for a planned development of a regional component of the IOC-FAO Programme on Ocean Science in Relation to Living Resources (OSLR).

The Report, prepared by Professor W. Nellen (Course Director), in collaboration with Drs. J. Ali-Khan, H. Rumohr, H. Thiel, and B. Zeitzschel (Course Principal Instructors), describes the arrangements for the Training Course, and gives an outline of the Course which included lectures, field work and scientific discussions, as well as a discussion on promotion of future co-operation in marine sciences in the region. It also includes an evaluation of the Course based on the assessments made by the participants and instructors at the end of the Course, and a set of recommendations for the improvement of future courses of this type.

CONTENTS

1. BACKGROUND AND OBJECTIVES

The IOC Programme Group for the Co-operative Investigation in the North and Central Western Indian Ocean (IOCINCWIO), at its First Session (ROSTA, Nairobi, Kenya, October 1982), stressed the importance of improving the understanding of the relationship between the marine environment in the region and the living resources in this environment. This led the IOC to consider developing plans for a Training Course on Biological Oceanography and Early Life History of Fish, to be conducted in the region. Earlier in 1982, the Government of the Federal Republic of Germany had offered to sponsor such an activity by contributing to the IOC Trust Fund, in support of an oceanographic training course in the East African region.

Early in 1983, details of the programme were discussed at the Institut fur Meereskunde Kiel (IfMK) between a representative of the IOC, Dr. S.M. Haq, and scientists who were expected to give the Course (Prof. Nellen, Drs. Thiel and Zeitzschel). It was agreed that the Course should be of one-month duration and that it should be held preferably in November 1983. A course programme was proposed which took into consideration the likelihood that marine biologists in the region would be the potential beneficiaries of the training. It was further agreed that, apart from theoretical lectures, practical training in the laboratory and in the field should form an essential component of the course. Therefore, it was felt absolutely necessary to have the Course organized in Africa so as to ensure that the lecturers and the trainees would gain a better understanding of the special problems biological oceanography has to face in the IOCINCWIO region.

The objectives of the programme that was decided upon were to provide training in biological oceanography and early life history of fish to some marine scientists from institutions engaged in marine science and/or fishery research in the developing Member States of the region, with a view to acquainting them with basic oceanographic techniques and methods used in the study of the spatial and temporal distribution of marine living resources, as a basis for a planned development of a regional component of the IOC-FAO Programme on Ocean Science in Relation to Living Resources (OSLR).

Kenya had been identified as a country which was willing to host the proposed course, and the Kenya Marine and Fisheries Research Institute (KMFRI), Mombasa, had kindly offered its facilities to house it. In order to ascertain the existence of the necessary facilities at the KMFRI, Prof. W. Nellen (IfMK) undertook a mission to Kenya from 9 to 14 May 1983 to explore the logistics and financial situation regarding the planned IOC Course. On completion of the mission, Prof. Nellen supplied IOC with a written report on his findings which described the local situation, revealing a number of questions which had to be settled between IOC and KMFRI before the course could be held. These included the shortage or lack of certain essential facilities at KMFRI (e.g., fishing gear, laboratory equipment and chemicals) without which the Course could not be conducted. To overcome these difficulties, the IOC agreed to supplement the KMFRI's facilities and arranged, through IFMK, for the purchase and shipment of the lacking items, worth DM 15,000, to Kenya. A list of the equipment so provided is given in Annex I.

2. OPENING

After a brief introductory speech by the Director of the Institute, Mr. S.O. Allela, in which he welcomed participants and guests to the Institute, the Course was officially opened by the Minister of Tourism and Wildlife, Mr. M. Wanjigi, M.P., at 11.00 on Thursday 30 September 1984 (i.e., 3 days after the course had actually started). Welcoming the participants and instructors to Kenya, the Honorable Mr. Wanjigi stressed the importance Kenya attaches to marine biological research for the rational management of marine living resources, and called upon the KMFRI to give priority to research projects which could lead to increased utilization of these resources. He regretted the apparent lack of contacts and closer co-operation between the fishing companies and the national fishery institutions, and hoped that remedial measures would be taken by those concerned.

Speaking on behalf of the Director of the Unesco Regional Office of Science and Technology (ROSTA), Dr. D.A. Bekoe, who was not able to attend the opening ceremony, the IOC Assistant Secretary, Mr. G. Kitaka, conveyed to the guests and participants greetings from the Director General of Unesco, Mr. A.M. M'Bow, from the Chairman of the Intergovernmental Oceanographic Commission, Professor I. Ronquillo, and from the Secretary, Dr. M. Ruivo. He outlined the roles of the IOC and the Division of Marine Sciences of Unesco in the promotion and development of marine scientific research and infrastructure, and conveyed the Commission's appreciation of the Governments of the Federal Republic of Germany and the Republic of Kenya, including the KMFRI, for their generous contributions to the realization of the Course.

Speaking on behalf ot the Government of the Federal Republic of Germany and the German institutions concerned, Dr. Thiel referred to the longstanding interest of marine scientists in the Federal Republic of Germany in having a training course of this kind given in the IOCINCWIO region, adding that the Federal Republic of Germany had been particularly willing to support IOC by organizing this activity. He pointed out that the pertinent oceanographic questions for the region are to increase the knowledge of the ocean through research and research development, to increase the use of marine food sources, and to minimize adverse effects of pollution, as well as negative developments in the coastal zone, which would affect sea life. He also underlined the need for co-operation between marine scientists on an international scale, since this is an absolute necessity to progress in our knowledge about the structure and functioning of marine systems, and stressed that promotion of this aspect would be one of the targets of the Course. He also stressed the importance of biological oceanography as a basis for fisheries.

3. COURSE ARRANGEMENTS

During Prof. Nellen's mission to Mombasa in 1983, it had been agreed between him and the Director of the Institute, Mr. Allela, that, for ease of contacts and transport to and from the hotel, all participants and instructors should be accommodated together in a single hotel which was identified, and whose management agreed to charge the participants and instructors subsidized rates because of the length of the period (6 weeks) they were expected to stay there. However, these arrangements were confronted with difficulties so that the instructors and participants found their own accommodation in different hotels.

3.1 ARRANGEMENTS MADE BY THE HOST INSTITUTE

The Director put two full-time officers at the disposal of the Course, namely Mrs. Oyjeke and Mr. Ngala, who assisted in the co-ordination of the various activities relating to the Course.

The Institute's research launch MAUMBA, which was used for the field trips, was in a relatively good shape and its readiness for service was always assured.

The Institute provided transport between airport and hotels, as well as daily transport between the hotels and the Institute, and for excursions to places of interest.

3.2 PARTICIPANTS

All developing countries of the IOCINCWIO region, with the exception of Mozambique, nominated candidates. However, the two candidates nominated by the Seychelles were later withdrawn when it was realized that the Course would not meet their expectations. The 19 participants came from Kenya (7), Madagascar (4), Mauritius (2), Somali (1) and Tanzania (5).

Due to adverse flight connections the participants from Madagascar had to leave Mombasa 4 days before the Course ended, and the participants from Mauritius had to do so 3 days before.

The trainees were supplied with a questionnaire at the beginning of the Course to put down their names, the address of their home institute, their academic degrees, their field of specialization and their current research work at their home institutions.

It appeared that most of the trainees were engaged in some kind of work linked to problems of fishery biology. As such, most of them had some background knowledge of the scientific subjects treated during the Course.

Names, addresses and fields of scientific interest of the trainees are given in Annex II.

3.3 INSTRUCTORS

The principal instructors were biological oceanographers; all of them came from the Federal Republic of Germany, one of them, Dr. J. Ali Khan, was a visiting scientist from Pakistan working at that time at the Institut fur Meeresforschung in Bremerhaven. These were assisted by six scientists from the region. Their names and addresses are given in Annex III.

3.4 COURSE OUTLINE

The Course programme consisted of: (i) theoretical lectures with discussions; (ii) laboratory work; (iii) field trips on the KMFRI research launch MAUMBA, for the collection of biological material to demonstrate the use of different gear, and to train the students in gear handling, as well as in recording the data; and (iv) excursions to coastal sites of ecological interest and to aquaculture stations.

Three lectures were normally given in the morning from 9 to 12.30, interrupted by a 30-minute tea break. After the lunch break of about one and a half hours, the programme was continued until 17.00, with practical work. During these practicals, the students were divided into different rotating groups as the laboratory facilities did not allow all the students to work on one subject at the same time. Field work with the research boat and excursions usually took the full day.

During the last days of the Course, the students were shown some films brought from Germany on sea-going marine research and deep-sea fisheries in Germany. This was organized through the assistance of the "German Classes", Mombasa, a branch of the Goethe Institute in Nairobi.

The main subjects covered by the Course were as follows:

- Marine benthos communities and their ecological importance
- Fish nutrition and interaction of fish with other animals in their environment
- Primary and secondary production in the epipelagic zone
- Early life history of marine fish and recruitment

Most of the lectures dealt with specific aspects of the subjects. In addition, lectures were given by local experts on such topics as fisheries, fishery management and fishery research in the East African region.

4. COURSE DETAILS

4.1 GENERAL INTRODUCTION

The Course was developed and conducted with a view to developing a better understanding of the marine ecosystem research, whereby the importance of biological oceanography as a basis for the rational management of fisheries was emphasized.

The first two weeks of the Course were conducted by Drs Thiel and Rumohr, assisted by Dr. Kokwaro, and the rest of the Course, by Prof. Nellen and Drs. Ali Khan and Zeitschel, with the assistance of Dr. Mshigeni, Mr. Nzioka and Mr. Ruwa. Other invited speakers gave information talks on various aspects of fisheries (see Annex III).

4.2 MARINE BENTHOS

The Course, having been arranged in the context of biological oceanography and fishery problems, the benthos programme was established on the concept of benthos as fish food and as components of the ecosystems. These goals were achieved during the Course through lectures, excursions and practicals. The list of lectures given by Dr. Thiel on benthos included:

- Marine benthos and its ecological importance
- Sampling methods of marine benthos
- Systematic groups of benthic animals and plants as food sources for fish
- Benthic productivity
- Benthic meiofauna
- Distribution of benthos according to environmental parameters.

Other topics referred to in lesser detail covered a broad field of oceanographic information (See Annex IV).

Most of the information was based on tables and figures copied for each participant. For the six lectures referred to above, each student received a total of 27 tables and 91 graphs or figures. These outprints were used as the guidelines for the lectures; they contained the basic information, and together with the personal notes made during the lectures, they may serve as a valuable record for later use at home. In addition, for all the tables and figures, references were given so that the interested student may trace them back for detailed studies. The references included general text books on the benthos.

This type of presentation gives a permanent source of information for the students, a source which may be used again after a long time, which helps them to remember the course and whom to ask, if specific questions arise months or even years later.

The lectures were supplemented by excursions and practical work in the laboratory. Two excursions were made with the research boat MAUMBA into Tudor Harbour, Port Reitz and Kilindini Harbour, as the sea outside the reef was too rough. Benthic organisms obtained from different types of sediment and sampling were demonstrated; subsampling, sieving and preservation were demonstrated and the inherent problems discussed. Back in the laboratory, macro- and meio-fauna were sorted from the samples.

One excursion was arranged to visit the Malindi Marine Park with its magnificent coral reefs. Two glass-bottomed boats were rented for the group. Unfortunately only a few students used the chance to swim and directly observe the coral reef with its many species. For those who swam, it was a fascinating experience to see such an abundance of life, especially when compared to touristically over-exploited regions near the large hotels. After the boat tour, the warden of the

park reported on the development and aims of this marine reserve. On the way back to Mombasa the group stopped at Watamu Marine Park to see the different types of coastline. Whereas Malindi has a sandy beach, the Watamu coast is strongly subdivided by uplifted fossil coral reefs giving rise to narrow sandy coves. The fossil reefs initiated an explanation and discussion of the oceans and of plate tectonics.

Under the guidance of Prof. Kokwaro of the University of Nairobi, one day was totally dedicated to mangrove ecology. This day began with an excursion to the mangrove forests near Gazi. Mangrove species and ecology were demonstrated and explained and emphasis was laid on the commercial use of the mangrove woods. Back in the institute a lecture with slides on the same topics was presented. All students received a paper which summarized those subjects.

Mr. Ruwa, a Research Officer at the Kenya Marine and Fisheries Research Institute, gave a lecture on:
- Coral reef ecology of the rocky interdidal zone
- Commercial and tourist impact on coral reef species

Although Mr. Ruwa had only a few days to prepare his lectures, he presented interesting results; the information was summarized in copies for the participants and he guided an excursion to the rocky intertidal area. In this respect, it should be pointed out that Mr. Ruwa participated in all the other excursions and was of great help because of his good knowledge of shallow-water species.

Mr. Ruwa's contributions were much appreciated by the other participants since not only did he talk on the ecological problems of coral reefs, but also included much information on endangered species from commercial and tourist impacts, demonstrated with the gastropod genus Cypraea, the cowry shells.

From a didactic point of view, Mr. Ruwa's ecological lecture was well presented, since it was embedded into the large-scale oceanographic setting of the IOCINCWIO region, from which he deduced the necessity of scientific co-operation in the western Indian Ocean. It was stimulating and promising for all participants that these suggestions were brought up by a local scientist. This contribution led to a general discussion on the possibilities of how to establish scientific co-operation in the IOCINCWIO region (see below).

4.3 FISH NUTRITION

The general aim of this part of the Course was to develop a better understanding of the coupling of the benthic system and that of demersal fish. For this reason, six lectures and practicals together with two cruises with R.V. MAUMBA were carried out.

The question of what are the special features of tropical ecosystems compared with temperate or boreal systems in higher latitudes, led to several views on the systems characteristic of different latitutes. The discussion started with the abiotic environmental parameters: temperature, solar radiation and subsequently the seasonal cycle in which climatic perturbations play a minor role in tropical environments. The participants learned that spatial heterogeneity (structural diversity) is much higher in tropical habitats than in boreal waters, due to a variety of structure-building species.

The lectures given on fish-nutrition studies by Dr. H. Rumohr were as folows:

- Fish-nutrition studies in tropical environments
- Fish-sampling methods from boats and from the beach
- Feeding types in fishes and corresponding morphological features
- Quantitative fish-stomach analysis
- In situ experiments and their significance to predator/prey investigations
- The benthic food webs (conclusions)

During two boat excursions with the R.V. MAUMBA the students were trained in using the Van Veen Grab and in processing the samples on board. This included washing the samples on a 1000- m screen, transferring them carefully to the sample vessel, staining with rose bengal and fixing with formaldehyde. To most of the students, the standard techniques were new because they had never had the chance to employ a bottom grab. Several stations were sampled in the two creeks surrounding the city of Mombasa: the Tudor creek, a relatively unpolluted water with mud and coralline gravel sediments on one side; and Kilindini Harbour and Port Reitz on the other side of the town, which is a relatively heavily polluted water due to the harbour activities and an oil pier. Muddy and soft sediments were always found here. The comparison of the two transects from two different waters revealed some basic differences in faunal composition that could be demonstrated even without a sound taxonomic knowledge of the local fauna, and gave the students an idea of how basic environmental studies could be done. In each of the creeks a 1-h bottom trawl haul was made with an otter trawl. The two catches were sorted, and length-frequencies of the most abundant species were measured by the students. The taxonomic knowledge of two employees of KMFRI was very helpful in these exercises.

In the lab, basic measurements of feeding morphology were taken; i.e., dentition of fishes, mouth form and gape, structure of intestines, gut length compared to body length, and stomach content. The intended comparison between stomach content and benthic fauna in the fishing area could only be done qualitatively. It would have needed much more sampling time and taxonomic expertise to do more.

By means of this fish material plus special fishes bought from fishermen ashore, it was possible to demonstrate the basic feeding types in fishes (herbivorous, carnivorous, mixed, zooplankton feeders, predators and specialists (coral fish)) and their corresponding morphological features.

After having had a concluding lecture on the benthic food web, the energy flow in tropical lagoon systems was discussed, covering mangrove systems, seagrass beds and coral reefs, with stress being placed on aspects of nature conservation connected with the endangered mangrove stands in the East African area, due to increased sedimentation from the Tana river, which in turn is a consequence of land erosion due to the removal of natural forests and vegetation far away from the ocean.

The aim of this part of the course, which was carried out in close connection with the marine benthos communities part, was to reach an understanding of the nature of marine ecosystems and the linkage of their subsystems.

4.4 PRIMARY AND SECONDARY PRODUCTION

The emphasis in this part of the Course was to make the participants familiar with the unique features of the Indian Ocean with respect to coastal and offshore primary and secondary production.

Due to the changing monsoon regime and the fact that this ocean is closed to the north, the circulation system and specific hydrographic features are fundamentally different from those of the Atlantic and Pacific Oceans.

Production of organic matter as food for fish larvae and fish in relation to the physical environment was discussed in great detail, particularly the relationship between production and light, temperature and nutrient concentration. Methods to measure these parameters were demonstrated and relevant findings were reported.

During the boat trips, the principal hydrographic methods were demonstrated; the participants had the opportunity to get acquainted with the use of reversing thermometers, bathythermographs, water samplers and plankton nets for studies of phyto- and small zoo-plankton.

Water samples were taken to the laboratory and were used to estimate the salinity and the oxygen content of the water. The particulate matter was concentrated by vacuum filtration. The filters were used to measure the amount of total particulate matter (seston). The trichromatic chlorophyll 'a' method, as a measure of the phytoplankton standing stock, was demonstrated. Phytoplankton identification was tried using compound microscopes.

The topic was complemented by the lecture of Prof. Mshigeni:

- Primary production and ecology of marine algae

In the discussion, the importance of macroalgae research and its implication for commercial use was stressed.

The following lectures were given by Dr. B. Zeitzschel:

- Introduction to plankton with special emphasis on ecology
- Nutrients in the sea and primary production
- Dominating systematiç groups of phyto- and zoo-plankton
- Methods of phytoplankton standing stock and primary production measurements
- Vertical distribution and migration of plankton
- Phytoplankton-zooplankton interrelationship
- Basic concepts of ecosystem modelling

4.5 EARLY LIFE HISTORY OF MARINE FISH

This subject was treated from the standpoint of its importance to the studies of stock assessment, fish population dynamics and aquaculture enterprises. Regarding the first two topics the special difficulties, which have to be faced in tropical areas where the typical phenomena are the extended spawning season and portion spawning by the individual female fish over a long time period, were emphasized.

The physiological as well as the morphological and the ethnological factors of fish reproduction were discussed; i.e., the role different hormones play in the ripening of the gonads, fecundity as a function of fish size and species, spawning migration and behaviour, fish-egg development and distribution of eggs in the sea. Questions on the life capacity of fish larvae, their ecology and taxonomy were examined. The current methods of collecting fish eggs and larvae from the sea were dealt with in their qualitative as well as quantitative aspects. Here the different types of nets in use and how these are handled, including light trapping of ichthyo- and zoo-plankton, were subjects of specific lectures. Net avoidance, filtration efficiency and plankton extrusion as a function of larva size, mesh aperture and towing speed were pointed out. Sampling strategies for plankton collection during research cruises were demonstrated.

Methods and complications of fish-fry production and larvae rearing for aquaculture purposes were described, in view of the special ecological demands which are typical of the early life stages of fish.

Last but not least, the students were confronted with several hypotheses on the reasons for the high variability in the recruitment process which is observed in so many fish stocks. New findings about species associated with coral reef systems, and about general fish larvae research work in the IOCINCWIO region were presented specifically.

Lectures given on ichthyoplankton topics included:

- The study of early life history of fish as part of marine fisheries research. (Nellen)
- Fish eggs and larvae taxonomy with reference to the western Indian Ocean. (Ali Khan)
- Reproduction biology of marine fishes. (Nellen)
- Maturation cycle, reproduction and fecundity of Benthosema species from the western Indian Ocean. (Ali Khan)
- Spawning season and spawning areas of marine fish. (Nellen)
- Reproduction and spawning habits of fish. (Ali Khan)
- Morphological and functional aspects of marine fish larvae. (Ali Khan)
- Fish larvae ecology I + II. (W. Nellen)
- Fish larvae ecology III (with special reference to the western Indian Ocean). (Ali Khan)
- Methods of ichthyoplankton investigation. (Nellen)
- Why are bony fish so fecund and for which reasons may recruitment processes vary? (Nellen)

During two boat excursions in the Mombasa creek area, the students were trained in handling ichthyoplankton gear; i.e., Bongo and Neuston net (oblique and horizontal hauls), how to calibrate flow meters and process plankton samples on board the ship for further treatment in the laboratory; protocol sheet design and the importance of good sampling-protocol records were also subjects of the training on board.

The laboratory work dealt with quantitative calculations of biomass concentration in the sea, methods and accuracy of plankton sample splitting, sorting of ichthyoplankton under the microscope, ichthyoplankton and zooplankton taxonomy and ichthyoplankton preparation (clearing and staining) for taxonomical purposes.

On two excursions, the group were able to receive visual instructions about aquaculture work in the Mombasa region. One of these was especially informative in that it showed how a thorough knowledge of the biological peculiarities of a fish species can lead to an extremely successful production of fingerlings and full-sized fish (in this case Tilapia). The methods and techniques involved were demonstrated by Mr. R. Haller, Managing Director of the BAMBURI Tilapia Farm which produces 30 t of fish per year on a relatively small area.

A second excursion took the students to a region north of Malindi where the FAO conducts a farm for big-scale production of penaeid shrimps in a low coastal area. Though the leading scientist was not available to supply the visiting group with information on details of the pond and stock management and of the production capacity of the farm, it was quite impressive to note that the huge and well kept earth ponds are regularly flushed with sea water by the tidal current, and are equipped with specific floodgates working in such a way that escapement of the shrimps from the ponds at high tide is prevented. The shrimps grow to the natural production size in the ponds without supplemental feeding, and at a high rate, allowing a harvest of considerable size. Some of the ponds are, however, fertilized to increase the production.

The students will be provided with a compilation of lecture notes on all different aspects of early life stage biology of fish including research goals and methods. These will be distributed to all of the participants as soon as they are ready.

4.6 REVIEW OF FISHERY RESEARCH AND MANAGEMENT IN THE REGION

Some lectures were given to cover several topics of general interest dealing with current marine and fisheries research in the countries of IOCINCWIO region as well as in other parts of the western Indian Ocean. The biological oceanography and fisheries aspects were covered by Dr. Zeitzschel and Prof. Nellen. Mr. Allela discussed briefly the change in the scientific attitude in East Africa from fish biology to fishery science. Mr. N. Odero, Director of the Fisheries Department, Nairobi, reported comprehensively and very informatively about the fishing situation off the Kenyan coast. Mr. R. Nzioka gave a lecture on the pelagic resources in the western Indian Ocean in which he explained the migration pattern of the different species, mainly those belonging to the family Scombridae, and how their accessibility to the fishing boats is linked to the seasonal appearance of single species in the coastal waters off East Africa. The students also showed great interest in an informative talk by Dr. D. A. Bekoe, Director of the Unesco Regional Office of Science and Technology for Africa, Nairobi, in which he explained the different tasks and problems Unesco faces in Africa, with particular reference to the present Course.

The lectures given under general topics were as follows:
- Fishery science activities in East African states (S. Allela)
- Activities and concepts of the Unesco development programme in East Africa (D. Bekoe)
- Biological oceanography and fisheries in the western Indian Ocean (W. Nellen, B. Zeitzschel)
- Resources of pelagic fish in the western Indian Ocean and seasonal migration patterns of species (R. Nzioka)
- Marine living resources in the East African region (N. Odero)

Through the kind assistance of FAO, each participant was provided with a copy of:
- E. SMITH and S.L. RICHARDSON, 1977: Standard techniques for pelagic fish eggs and larva surveys. FAO Fish. Techn. Paper No. 175, 100 p.
- C. NEDELEC, 1982: Definition and classification of fishing gear categories. FAO Fish. Techn. Paper No. 222, 51 p.

5. COURSE ASSESSMENT

5.1 FACILITIES AT THE KMFRI

Most of the facilities provided by the Institute have been alluded to in section 3.1. However, it may be useful to point out some arrangements that would facilitate future courses at the KMFRI:

The library of the institute was used as a lecture room. It is desirable, however, that the course students should have full access to library holdings to supplement the information they get through the lectures. Overhead projection in the library was possible, but a full range of projection facilities for the presentation of slides for instruction purposes is also desirable.

Laboratory facilities were adequate as far as space, water supply, and lab tables were concerned, but for a course of this type a photometer is required, as well as a sufficient number of microscopes in good working condition, so that all the trainees can do microscopical studies at the same time.

Although the Captain of the research vessel was extremely helpful and encouraging, it was sometimes complicated to operate the different plankton gears from the vessel, since the winch and towing wire facilities were not functioning satisfactorily. Owing to the small size of the vessel, offshore sampling was extremely difficult to perform, and could only be done under calm weather conditions which were more or less lacking throughout the Course.

5.2 ASSESSMENT BY PARTICIPANTS

From answers to a questionnaire distributed at the beginning of the Course, most of the participants considered the theoretical lectures as being of a good standard. Nevertheless, it was also felt that, probably because of the different academic levels of the

participants, too much time was spent in providing basic information on the topics covered. In view of the fact that, in their own institutions, most of the participants were engaged in some kind of fishery research, themes related to fishery biology proved of particular interest to them, but, in general, the participants also appreciated the broad ecological aspect of the whole Course.

The practical work at sea and in the laboratory included demonstration of a number of methods about which many of the participants had only read in books, if at all. The participants welcomed the opportunity to learn such methods. They regretted, however, that the practical work, including data-processing methods, had not covered the greater part of the Course.

It was generally felt that the duration of the Course was too short to allow a sufficiently detailed treatment of the various scientific problems that were discussed. The limited number of microscopes and basic laboratory equipment, the absence of a good reference library and continuous duplicating facilities to make copies of important available reprints and papers referred to in the Course, as well as adequate secretariat assistance during the Course (e.g., for the typing of the lecturers' notes for distribution to the participants), were regarded as being the main shortcoming.

5.2.1 Suggestions by Participants

Several proposals were made regarding improvement of marine research in the region, the promotion of closer contacts and co-operation among the marine scientists in the region, as well as the improvement of the effectiveness of future training courses; the most important proposals are as follow:

(i) The importance of having a suitable research vessel jointly operated on a co-operative basis by the coastal countries of the region was recognized and highly recommended.

(ii) It was considered desirable that scientists from the countries should have opportunities for exchange of views on subjects of mutual interest. In this context the following activities were considered particularly important: establishment of an IOCINCWIO Newsletter; a regularly updated comprehensive directory of marine research centres and scientists in the region; the exchange of Annual Reports among institutions and the provision of relevant literature to the institutions (e.g., reprints from the International Indian Ocean Expedition); the revival of the African Journal of Tropical Hydrobiology and Fisheries, with the possible assistance of the IOC and Unesco; and the organization of regular seminars and symposia in the IOCINCWIO region. However, it was recognized that the success of a Newsletter would depend on a regular supply to the Editor of relevant information by the countries concerned, and that the revival of the African Journal of Tropical Hydrobiology and Fisheries should not deter local scientists from publishing some of their results in other international journals.

(iii) Training courses of this kind, but devoted to a few, if not one, specific topic, with participants of similar academic background, should be organized in the region more regularly, since this would also contribute to maintainance of personal contacts and co-operation among the scientists in the region.

(iv) In order to facilitate the task of the participants and instructors and to make such courses more effective, lecture notes should be prepared and distributed to the prospective participants well in advance of the beginning of the course.

(v) If appropriate hotel arrangements can be made, the instructors and participants should be accommodated in one hotel for ease of transport arrangements and personal contacts, including the enhancement of scientific discussions after course hours.

5.3 ASSESSMENT BY PRINCIPAL INSTRUCTORS

All the participants had a B.Sc. degree or its equivqlent but in different subjects, and several had an M.Sc. degree as well. As a result of this, the scientific background was somewhat heterogeneous and so were the trainees interests in the subjects of the Course, their experience and their engagements. The majority was able to follow the programme without difficulty, but some had difficulties with spoken English, so that they hardly participated in the discussions. It was disappointing to learn from most of the participants that their chances of doing the kind of research work and scientific programmes the Course had aimed at were very limited. In almost all the countries concerned, adequate gear and equipment seem to be lacking,

The Course programme was actually too extensive for the period of the Course. The practical training should have received more time, but in view of the limited laboratory facilities at the Institute for such a large number of participants, it was not a disadvantage that the theoretical part of the course was relatively broad.

5.3.1 Suggestions by Instructors

(i) In order to ensure a certain amount of uniformity in the scientific background and interests of the participants in relation to the envisaged Course programme, the Course, including the anticipated programme, should be announced well in advance of the scheduled dates of the Course. It should draw the attention of the heads of Institutions when nominating candidates to giving due consideration to the importance of adequate scientific background and interests relevant to the proposed Course programme. This would enable the Course organizers to get in touch with the nominated candidates as early as possible so as to give them the necessary information on the basis of which they could decide, in consultation with their respective Directors, whether or not they would benefit from the proposed Course, or to enable the instructors to revise the Course programme so as to suit the scientific interests of the prospective participants.

(ii) It should be ensured that the selected participants have a good command of the language in which the course is to be conducted, which, for regional courses in the IOCINCWIO region, would be English.

(iii) A comprehensive Curriculum Vitae should be submitted for each nominated candidate so as to facilitate the rational selection of the participants, taking into account the available facilities at the home institute for the trained participants to put into practice the knowledge so gained.

(iv) Ideally, it would be very helpful if the institutes/governments concerned took care of the travel costs, so that the funds so saved by the IOC could be used to provide these institutes with some of the badly needed research equipment and gear, with a view to enabling the participants in such courses to undertake thereafter scientific research in which the knowledge gained from the Course is relevant.

(v) Promising participants and institutions should receive follow-up encouragement and assistance on a long-term basis through provision of further training, expertise, scientific equipment and literature.

(vi) If reliable arrangements can be made, including, if possible, subsidized rates, it would be useful to have the instructors and participants accommodated in the same hotel.

(vii) Before an offer to host a course can be accepted, the IOC must ensure that the institute making the offer has the necessary facilities and equipment for the proper conduct of the Course.

6. CONCLUSIONS

The IOC Regional Training Course on Marine Living Resources in the Western Indian Ocean, held at the Kenya Marine and Fisheries Research Institute, Mombasa, Kenya, from 27 August to 22 September 1984, was successfully completed but it was only one of the many needed in the region in a wide variety of fields if the marine scientific capabilities of the region are to be noticeably enhanced, at least to the extent necessary to increase participation of countries of the region in IOC programmes and activities.

While it would appear to be useful to conduct such courses in the region, adequate physical and logistic conditions must be ensured; nevertheless, the objectives of the courses must be matched to the possibilities for its successful completion, and a certain homogeneity of candidates must also be ensured.

Appropriate follow-up training activities should be promoted in the region.

ANNEX I

LIST OF GEAR PURCHASED FOR THE COURSE WITH IOC FUNDS

- Bongo plankton sampler equipped with depressor and two pairs of nets
- double neuston net
- phytoplankton closing net
- 3 flow-through meters
- Van Veen grab
- 4 benthos sieves
- 2 water samplers
- messengers
- 2 stempel pipettes
- 2 stopwatches
- 3 settling chambers for inverted microscope
- fully equipped tool box
- 5 bogarow-dishes
- plankton splitter
- 2 vacuum pumps
- plankton filtration unit
- 20 oxygen bottles
- 9 burettes
- clinometer
- Secchi disk
- oceanographic surface thermometer
- scales for fish-length measurements
- stainless steel forceps and needles
- pipettes, different minor glassware, sampling bottles, diverse chemicals for water and plankton analyses.

ANNEX II

LIST OF PARTICIPANTS

KENYA

Abiya Ignatius, B.Sc.
Kenya Marine and Fisheries Research Institute
Kisumu Laboratory
P.O. Box 1881
Kisumu
(field of specialization: biochemistry and zoology; current research activity: nutritive values of freshwater fishes and fish quality control)

Mrs. Kimaro Mercy Mghoi, B.Sc.
Kenya Marine and Fisheries Research Institute
P.O. Box 81651
Mombasa
(field of specialization: biological oceanography, marine zooplankton; current research activity: marine zooplankton ecology in the waters around Mombasa)

Maithya Jacob M., B.Sc.
Kenya Marine and Fisheries Research Institute
Kisumu Laboratory
P.O. Box 1881
Kisumu
(field of specialization: zoology, botany; current research activity: endoparasite infestation of Tilapia in Lake Victoria)

Radull Odero John, B.Sc.
Kenya Marine and Fisheries Research Institute
Kisumu Laboratory
P.O. Box 1881
Kisumu
(field of specialization: zoology, botany; current research activity: biology and ecology of Clarias mossambicus in Lake Victoria)

Okemwa Ezekiel, B.Sc., M.Sc.
Kenya Marine and Fisheries Research Institute
P.O. Box 81651
Mombasa
(field of specialization: fish-stock assessment, plankton, oyster culture; current research activity: marine plankton production, assessment of oyster culture)

Mainga Osbourne Mwalo, B.Sc., M.Sc.
Kenya Marine and Fisheries Research Institute
P.O. Box 58187
Nairobi
(field of specialization: hydrobiology, fisheries; current research activity: catch assessment of artisanal fisheries in inland lakes)

KENYA (Cont'd)

Thongoro Dishon K., B.Sc.
Kenya Marine and Fisheries Research Institute
P.O. Box 81651
Mombasa
(field of specialization: mathematics, statistics, fish biology; current research work: biometry, growth and feeding habits of rabbit fish, Siganus)

MADAGASCAR

Randriambololona Chrysante
Maitrise de Recherche en Oceanologie Appliquee (MROA)
Preparing D.E.A. en O.A.
Station Marine Tulear
Universite de Madagascar
B.P. 141
Tulear (601)
(field of specialization: marine food chains; current research work: culture of phytoplankton)

Randriamiarisoa
Student MROA
Station Marine Tulear
Universite de Madagascar
B.P. 141
Tulear (601)
(field of specialization: fish systematics; current research work: inventory of fishes of Tulear)

M. Rasolonjanahary Henri
D.E.A. en O.A.
Station Marine Tulear
Universite de Madagascar
B,P, 141
Tulear (601)
(field of specialization: marine biology, primary production, phytoplankton; current research work; ichthyoplankton research)

M. Razafindrakoto Herimamy
D.E.A en O.A.
Station Marine Tulear
Universite de Madagascar
B.P. 141
Tulear (601)
(field of specialization: marine biology, fisheries management and dynamics of exploited marine populations; current research work: selectivity of fishing gear used in shrimp fisheries, study of shrimp recruitment)

MAURITIUS

Chooramun Veenay Mitre, M.Sc.
Ministry of Agriculture, Fisheries and Natural Resources,
Albio Fisheries Research Centre
Remy Ollier Road
Phoenix
(field of specialization: technology of fish processing;
current research work: larval rearing of Macrobrachium and other
crustacean species; biology of juvenile prawn)

Jehangeer Mohammed Ismet, B.Sc.
Dip.Ed., Master of Marine Affairs
Ministry of Agriculture
Fisheries and Natural Resources
Albion Fisheries Research Centre
55, Etienne Pellerean St.
Port-Louis
(field of specialization: fisheries biology; current research
work: biological studies of commercially important fishes of the
lagoons, age, growth, breeding cycles)

SOMALIA

Yusuf Abdi Ibrahim, B.Sc.
Ministry of Fisheries
P.O. Box 438
438 Mogadishu
(field of specialization: biochemistry; current research work:
Rumanian and Japanese trawler activities)

TANZANIA

Miss Kulekana Joyce J., B.Sc.
Tanzania Fisheries Research Institute
P.O. Box 9750
Dar-es-Salaam
(field of specialization: aquaculture, especially growth of
Tilapia; current research work: fishery biology, fish processing
and quality control, fishery statistics and population dynamics)

Salim Mzee Mohammed, B.Sc.; M.Sc.
Institute of Marine Sciences
University of Dar-es-Salaam
P.O. Box 668
Zanzibar
(field of specialization: chemical oceanography, marine pollution;
current research work: nutrients in the Zanzibar inshore
waters, algal ecology and primary production, aquaculture, fish stock
assessment)

TANZANIA (Cont'd)

Miss Mumghamba Salome William, B.Sc.
Tanzania Fisheries Research Institute
P.O. Box 9750
Dar-es-Salaam
(field of specialization: stock assessment; current research work: fisheries biology and stock assessment)

Miss Jiddawi Narriman, B.Sc.
Institute of Marine Sciences
University of Dar-es-Salaam
P.O. Box 668
Zanzibar
(field of specialization: fishery biology; current research work: biology of Hemipterus)

Miss Shushu Esther David, B.Sc.
Tanzania Fisheries Research Institute
P.O. Box 9750
Dar-es-Salaam
(field of specialization: aquaculture of prawns; current research work: fishery biology, stock assessment, fish processing, quality control).

ANNEX III

LIST OF INSTRUCTORS

Dr. J. Ali Khan
Institut fur Meeresforschung
2850 Bremerhaven, F.R.G.

Home Institute:
Centre of Excellence in Marine Biology
University of Karachi
Karachi - 32, Pakistan
(field of scientific interest: fish larvae taxonomy and ecology)

Prof. W. Nellen
Institut fur Meereskunde an der Universitat Kiel
2300 Kiel
Federal Republic of Germany
(field of scientific interest: fish recruitment, aquaculture)

Dr. H. Rumohr
Institut fur Meereskunde an der Universitat Kiel
2300 Kiel
Federal Republic of Germany
(field of scientific interest: feeding of fish, benthic ecology)

Dr. H. Thiel
Institut fur Hydrobiologie und Fischereiwissenschaft
der Universitat Hamburg
Zeiseweg 9
2000 Hamburg 50
Federal Republic of Germany
(field of scientific interest: benthic ecology and production)

Dr. B. Zeitzschel
Institut fur Meereskunde an der Universitat Kiel
2300 Kiel
Federal Republic of Germany
(field of scientific interest: planktonology, primary and secondary production)

The following lecturers from the region supported the principal instructors:

Mr. S. Allela, B.Sc.
Director
Kenya Marine and Fisheries Research Institute
P.O. Box 81651
Mombasa, Kenya
(fishery biology)

Dr. J.O. Kokwaro
University of Nairobi
Department of Zoology
Chiromo
P.O. Box 30197
Nairobi, Kenya
(coral reef and mangrove ecology)

Dr. K.E. Mshigeni
University of Dar-es-Salaam
Institute of Marine Science
Dar-es-Salaam, Tanzania
(primary production, macro-algal research)

Mr. R. Nzioka, B.Sc., M.Sc.
Kenya Marine and Fisheries Research Institute
P.O. Box 81651
Mombasa, Kenya
(pelagic fish resources)

Mr. N. Odero
Director of Fisheries
Ministry of Tourism and Wildlife
Nairobi, Kenya
(fisheries management)

Mr. R. Ruwa, B.Sc.
Kenya Marine and Fisheries Research Institute
P.O. Box 81651
Mombasa, Kenya
(coral reef ecology)

IOC SECRETARIAT

Mr. G. Kitaka
Assistant Secretary
Intergovernmental Oceanographic Commission
Unesco
7 Place de Fontenoy
75700 Paris, France

ANNEX IV

TOPICS REFERRED TO IN LESSER DETAIL DURING THE COURSE

- Benthos in its relation to fish
- Benthos definition, size groups and their significance
- Food webs and energy transfer in the marine system
- Total benthos community structure; i.e., including bacteria to megafauna
- Sampling methods with grabs and dredges
- Small-scale distribution of organisms on and in the sea bed
- Benthos surveys with cameras
- Acoustic equipment aiding in benthos sampling
- Evaluation of plant and animal groups as fish food
- Energy budget
- Plant production, micro- and macro-flora
- Production assessment, demographic method
- Ecological importance of benthos size groups
- Meiofauna
- Meiofauna sampling and sorting
- Environmental factors
- Grain size
- Sinking of particulate matter
- Deposition and erosion
- Sediment transport
- Sediment percolation
- Organic matter
- Use of grains for tubes by orgnisms
- Water content
- Sediment-organism relationship
- Bioturbation
- Light
- Tidal rhythms
- Tidal pools
- Pressure
- Water movement and transport
- Sediment characteristics (O_2, Eh, pH, H_2S)
- Animal distribution in the sediment
- Sulphur cycle
- Organism dependence on O_2 and H_2S
- Shore zonation of organisms
- Thoughts on benthos and pollution

ANNEX V

GRADUATION CERTIFICATE

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of Unesco)

This is to certify that

attended and successfully completed the IOC Regional Training Course on Marine Living Resources in the Western Indian Ocean organized with the support of the Government of the Federal Republic of Germany and of the Government of Kenya, at the Kenya Marine and Fisheries Research Institute, Mombasa, Kenya, 27 August - 22 september 1984.

SIGNED:
Dr Mario RUIVO
Secretary of the Intergovernmental Oceanographic Commission
Unesco

SIGNED:
Prof. Dr Walter NELLEN
(Course Director)
Institut für Meereskunde an der Universitat Kiel
Federal Republic of Germany

SIGNED:
Mr Samuel O. ALLELA
(Course Co-director)
Director, Kenya Marine and Fisheries Research Institute, Kenya

ANNEX VI

QUESTIONNAIRE FOR ASSESSMENT BY THE TRAINEES

Note: The purpose of this questionnaire is to collect information for overall assessment of the course and to assist in the follow-up of future action to be taken to strengthen marine science capability of scientists in various disciplines of marine sciences in the IOCINCWIO region.

1. Name of trainee

2. Academic qualifications

3. Field of specialization

4. Name of employer/institute

5. Type of research being undertaken in home institute

6. Any other past research experience

7. State which part of the Course is of direct relevance to your main field of interest.

8. State which part of the Course was particularly interesting to you and in what way it will be useful to you in your future work.

9. Do you think that the theoretical information was too advanced, or just adequate for you to embark upon planning future research in your field of main interest? Please check relevant column and give your comments.

   _____ too advanced, _____ adequate, _____low

   Comments.

10. Was the demonstration of research techniques and methodology on various aspects of the Course sufficient for you to plan future research in your field of interest? If so, please suggest how you propose to start your future plans in your home institute.

11. Do you have adequate facilities in terms of laboratory and field studies, including equipment, literature etc.? Please describe briefly.

12. If you do not have adequate facilities, what type of requirements do you think would be essential for you to embark upon future research work in your field of interest?

13. Apart from the field of your main interest, what other aspects of the Course do you find important and complementary to your future research in your field of main interest?

14. Please provide your general impression of the Course.

15. Please state your future professional plans as well as how you propose to use this training in your professional work.

16. Please give your comments on the arrangements made in respect of accommodation, transport, food and social events, if any, during the Course.

17. What recommendations do you propose by way of improving the conduct of similar training courses, and the facilities thereof?

ANNEX VII

QUESTIONNAIRE FOR ASSESSMENT BY THE INSTRUCTORS

1. Please state the general level of the trainees, taking into account their fields of interest.

2. What proportion of the trainees, in your view, had sufficient background knowledge to benefit from the Course?

3. Do you think the Course was of a sufficiently high level to enhance their initial capability for research? Was it too broadly based or should it have been narrowed down to more specific aspects?

4. Do you think there is a need to repeat the Course with appropriate phasing to allow gradual development of research potentials in specific fields?

5. Please state which of the trainees showed high potential for research and in what fields (please give names of trainees) so as to allow us to consider future training opportunities for such promising scientists.

6. In regions where marine science infrastructures are relatively poorly developed, short-term training courses may not prove to be effective. In such cases, long-term individual training of scientists in foreign institutions might prove useful. Please give your opinion.

7. What are your suggestions to the IOC to take into consideration for future planning and assessment of regional training courses?

8. Please comment on the arrangements made by the host institution with regard to accommodation, transport, food, etc., during the Course.

9. Please give your recommendations on future action to be taken by the IOC in the conduct of regional training courses.