

**PROGRESS REPORT : SEPTEMBER 1991 - APRIL 1992**

**Semestrial report of the C.E.C. project  
"Dynamics and Assessment of Kenyan  
Mangrove Ecosystems"  
n° TS2-0240-C (GDF)**

**Participating laboratories :**

**Kenya :**

Nairobi University : Dept. Zoology (Dr. Ntiba)  
Kenyatta University : Dept. Botany (Dr. Muthuri)

**Belgium :**

V.U.B. - ANCH (Dr. Dehairs)  
R.U.G. - Marine Biology (Dr. Vincx)  
R.U.G. - Botany (Dr. Coppejans)

**The Netherlands :**

Delta Institute for Hydrobiological Research (Dr. Hemminga)  
Catholic University Nijmegen : Aquatic Ecology (Prof. den Hertog)

**Coordinating laboratory :**

V.U.B.- ECOL : Prof. Polk  
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## NEWSLETTER

### "DYNAMICS AND ASSESSMENT OF KENYAN MANGROVE ECOSYSTEMS"

C.E.C. Project  
n° TS 2-0240-C (GDF)

N° 3, May 1992

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## INTRODUCTION

We are now in the final stage of our CEC STD2 Project on "Dynamics and Assessment of Kenyan Mangrove Ecosystems". This issue of the newsletter will be the last one in the framework of the STD2 programme and we are already thinking of the final report. However, we submitted, last December 2 new STD3 proposals, to the European Community. At this moment we have been informed that probably, at least one of these two programmes will be funded by the CEC. We will thus be able to continue partially our scientific cooperation.

A major complementary research effort this year in the Indian Ocean will be the 1-year lasting expedition organised by the Netherlands Marine Research Foundation. As we have set out in a previous newsletter both, offshore research in Kenyan waters, carried out with the oceanographic research vessel "Tyro", and coastal research in Gazi Bay, will be part of the expedition programme. The coastal programme in Gazi Bay lasts from June 15<sup>th</sup> to July 15<sup>th</sup>, and involves a group of 20 African and European scientists. We expect that concentrating the research work of the STD-2 project and the coastal programme in Gazi Bay will be scientifically highly profitable, as the data resulting from the 2 projects can be connected to give a more thorough understanding of the functioning of a tropical coastal area.

The Kenyan Belgium Cooperation in Marine Science (KBP) is still going on for another year under the management of Y. Vermeulen, facilitating the organisation and complementarity of the research carried out in the CEC Mangrove Ecosystem Project. But we would like to draw your attention to the fact that the actual KBP will terminate in August 1993. Also the KBP budget will decrease drastically during 1993. Therefore new sponsors have to be searched to continue the present research topics. A new VLIR Project on the biology of oysters, under the supervision of Prof. P. Polk, will start soon. We want to thank RECOSCIX-WIO for the

computing and literature assistance at KMFRI and congratulate Mr. P. Pissierssens, father of RECOSCIX-WIO, for his new appointment at UNESCO in Paris. We also welcome P. Reyniers as the new RECOSCIX manager at KMFRI. Our acknowledgements are also going to Prof. P. Polk, general coordinator of this STD 2 project, Dr. E. Okemwa, co-director of the project and director of KMFRI for having given us the impulse, the opportunity and the infrastructure, to realise this very effective scientific collaboration. And last but not least, we would like to thank the Directorate General XII of the European Community for their financial support of the Kenyan Mangrove Ecosystem Project.

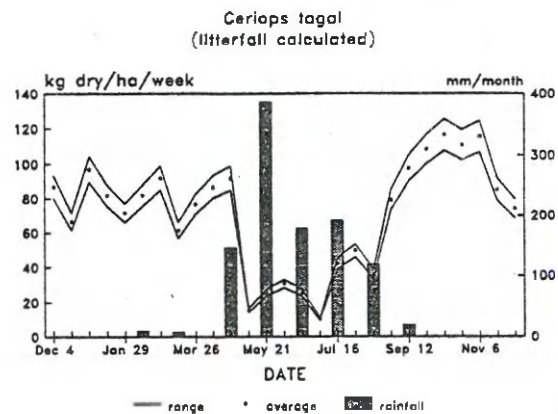
This may be the last newsletter of the STD-2 project, but, as we indicated above, scientific cooperation will continue, and we hope to inform you on its progress in the near future.

#### Litterfall and rainfall

### Litterfall

The research in the *Ceriops tagal* plot continued. It is possible to calculate the litterfall by combining the results of the phenology study and the biomass estimation of the standing crop. The underneath graph shows a time series including last years rain period. It is clear that there is a seasonality in the litterfall coinciding with the rainfall pattern.

In the *Rhizophora mucronata* plot, a direct method for measuring the litterfall is used. Twenty littertraps of 0.44 m<sup>2</sup> each with nylon netting # 1mm are placed at random above the high water level. The traps are emptied each fortnight and the litter is sorted out in the laboratory at KMFRI. The number of leaves, flowers, budscapes and propagules are recorded. Also fresh and dry weight of the litter is measured. Samples of the litter are grinded and sent to The Netherlands Institute for Ecology for analyzing C:P:N content. The litterfall in the *Rhizophora* vegetation is almost 4 times more than in the *Ceriops* vegetation.



F.J. Slim, P. Gwada; Netherlands Institute for Ecology, Vierstraat 28, 4401 EA Yerseke, The Netherlands; and Kenya Marine and Fisheries Research Institute, P.O.Box 81651, Mombasa, Kenya.

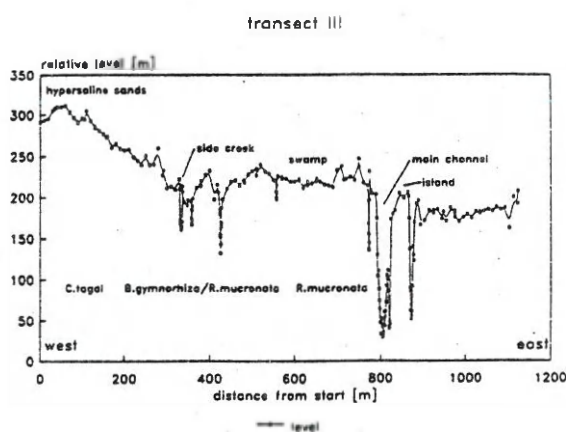
### Elevation, leveling

To describe the morphology of the swamp in more detail, the relative elevation of three transects perpendicular to the western creek were measured. With these measurements it becomes possible to estimate the exchanging water volumes between the swamp and the ocean. But they can also be used for botanical or zoological research, e.g. zonation patterns or inundation period related topics.



Due to the thick vegetation it was a struggle to get the measurements done. Climbing over the propoots could facilitate the job but most of the time the roots were to high to step over or were to weak to stand on. To express the relative elevation in height above datum it is necessary to have a benchmark with known elevation above datum. At this moment tidal curves are measured to establish such a point.

Transect indicating creek and main channel



F.J. Slim, P. Gwada; Netherlands Institute for Ecology, Vierstraat 28, 4401 EA Yerseke, The Netherlands; and Kenya Marine and Fisheries Research Institute, P.O.Box 81651, Mombasa, Kenya.

## Regeneration, reforestation

New to the project is the work done on reforestation and regeneration of mangroves that is done by a MSc. student J.G. Kairo under the supervision of Dr. D. Van Speybroeck and Dr. J.I. Kinyamario (University of Nairobi).

The study has been adopted by our project and the Kenya Belgium Project in Marine Sciences. Involved planting techniques are those developed in Malaysia, Indonesia, Florida and other Indo-Pacific countries. Propagules and saplings of the dominant mangrove

species are collected and transplanted in stands of

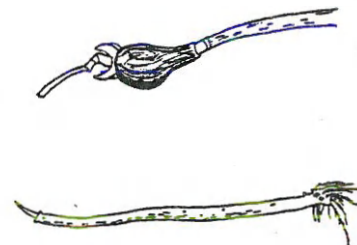
- a) degraded shorelines
- b) denuded mudflats
- c) disturbed forests

Propagules and saplings are being transplanted at a spacing distance of 0.6 and 1.0 meter respectively. At 14 days intervals during 10 months, data on height, number of leaves, number and length of nodes, presence and severity of herbivory and extend of rooting, will be recorded. Along with this study, germination and airlayering experiments will be conducted for selected species. The whole project is envisaged to :

- a) provide a suitable way of collecting, storing and germinating seeds/propagules for a future reforestation.
  - b) provide information and techniques for the reforestation.
- Over 2000 propagules and saplings are already planted and their performance recorded.

This study implies a close collaboration in the field between the University of Nairobi and our project by P.Gwada and J.Kairo.

Figure of Propagule Rooting and one set of leaves



J. Kairo, D. van Speybroeck, J.I. Kinyamario:  
Dep. Botany, University of Nairobi, P.O.Box 30197, Nairobi, Kenya.

## Mangroves on a computer wire

Thanks to P. Pissierssens of RECOSCIX, the project was already able to use the communication options of the global computer network GREENNET. Recently we organized our own account number and you can write to us with electronic mail. Our address is DIHOMEPSLIM. For the moment, ideas and reports are running from continent to continent in seconds of time and the European counterparts are discussing the most recent developments in the field with their Kenyan colleagues.

F.J. Slim, Netherlands Institute for Ecology,  
Vierstraat 28, 4401 EA Yerseke, The Netherlands.

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## Visitors from The Netherlands

Cooperation with the State University of Utrecht will bring K. Kruit, a physical geographer to Kenya, for a preliminary water budget study. During a fieldwork period of 6 weeks, current velocities, seston and nutrient concentrations, conductivity and tidal curves will be measured. For this study a permanent station at the border of the mangrove swamp/intertidal flat and one mobile station at the embayment in front of the mangrove swamp will be used. The permanent station will be situated in the mangrove trees above the high water level. The work of K. Kruit will be coupled to a Kenyan counterpart.

Barbara Schoute is a student in Environmental Sciences and as part of her study she will join the mangrove project. During her fieldwork she will focus on litterfall removal by crabs. Sets of thethered mangrove leaves will be left in the

field for the crabs to eat. After several ebb tides the leaves will be recovered and the eaten leaf area will be estimated. Also the percentage of leaves attacked by crabs will be scored. Besides this work she will set up field experiments in a study of the concentration of lignin compounds in decomposing leaves. Lignin can be used as tracer for mangrove matter.

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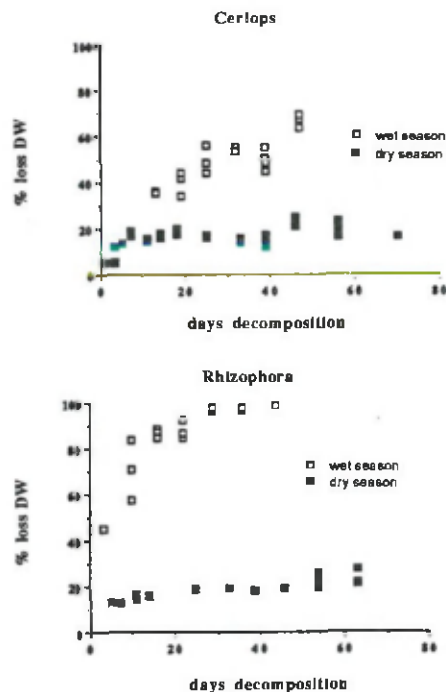
## Mangrove litter as nutritive source in the mangrove ecosystem

Our objective is to investigate the nutritive value of mangrove litter as potential source of energy to secondary and tertiary producers of the mangrove ecosystem of Gazi bay. Our first step was to analyse the C and N composition of fresh and senescent leaves of the main species of mangroves. We reported on this topic in the second newsletter. A second step was to conduct in situ litterbags decomposition experiments of senescent leaves of mangroves, one during the rainy season (1991) and one during the dry season (1992), in 2 experimental plots selected as representative of the mangrove vegetation of Gazi bay (Ceriops tagal plot and Rhizophora mucronata plot). In the next phase we will study the transfer of C and N from primary to secondary and tertiary producers using the natural stable isotopic ratios. The importance of biological nitrogen fixation as a possible way of nitrogen enrichment of leaves during

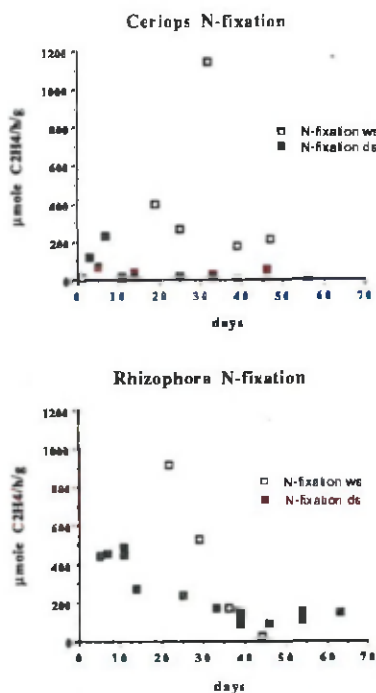
decomposition was assessed by the acetylene reduction technique.

Some results are presented in the graphs below.

weight loss (%DW) during decomposition



N<sub>2</sub>-fixation during decomposition



The rate of leaf decomposition and N<sub>2</sub>-fixation associated with leaves, are higher during the rainy

season (1991) than in the dry season (1992) and are also higher in the *Rhizophora* plot than in the *Ceriops* plot. Our calculation suggest that biological nitrogen fixation can explain 60% of the observed increase of nitrogen during the rainy season.

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J. Kazungu from KMFRI will come for a 3 months period of training in the laboratory of Analytical Chemistry, Free University Brussels in September 1992.

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A.F Woitchik, B. Ohowa & F. Dehairs, Lab. Analytical Chemistry, Free University of Brussels, B-1050 Brussels, Belgium & KMFRI, P.O.Box 81651 Mombasa, Kenya.

## The vegetation of seagrasses and macro-algae of the two creeks of the mangrove ecosystem of Gazi Bay, Kenya.

From September until November 1991, the Catholic University of Nijmegen carried out a survey of the macro-algae and seagrasses of the east and west creek of the mangrove forest of Gazi Bay. The aim of the study was to produce a combined depth-vegetation map and to estimate the biomass of the dominant macro-algae and seagrasses of the two creeks. For that purpose an adapted line intercept method was used. At fixed distances, cross sections were made. In the east creek each 50 m, a cross section was made. Due to time limitation, cross sections in the west creek was made at 100 m intervals. Within a cross section, at every 5 m, samples were taken to assess the species composition and estimate the biomass of the vegetation. In this way, the vegetation and biomass of the creeks were described in patches



with an area of 250 m<sup>2</sup> (east creek) or 500 m<sup>2</sup> (west creek).

At this moment these data are analysed. The results will be published as soon as possible.

P. van Avesaath, Lab. Aquatic Ecology, Catholic University Nijmegen, Toernooiveld 1, 6525 ED Nijmegen, The Netherlands.

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## The microphytobenthos of the intertidal communities

The subject of this work is the study of the microphytobenthos of the intertidal zone of Gazi Bay; this includes the mangrove as well as the midlittoral seagrassbeds. Samples were taken in as much varied biotopes as possible (different mangrove zones, different seagrass vegetations, exposed areas at low tide, in pools, etc.). In a few cases samples were taken along transects perpendicular to the tidal range. Sampling was done by pushing a plexiglass tube (diameter 2.2 cm) in the soil and collecting the upper 1 cm. These samples were then preserved with formaldehyde (4%) for analysis in Ghent. Another sample was taken at the same place for particle size analysis. A description of the profile was also done. Temperature and conductivity of the water were measured on the spot. Using E. Slim's canoe we had the opportunity to take samples upstream along the mangrove creek of the Kidogoweni river. Salinity gradually dropped from 35 ‰ to 2 ‰.

The aim of the study is :

- identification and inventarization of the microphytobenthic organisms (partim diatoms - Bacillariophyceae)
- study their relative abundance and distribution over different biotopes

- seek correlations between this distribution and some abiotic factors such as particle size of the sediment, salinity, level above low water mark.

Preliminary results show that the microphytobenthos in this area is very species-rich, with a dominance of the genera *Amphora*, *Navicula* and *Nitzschia*, but there are also numerous *Mastogloea* spp.

Some samples of periphyton have also been taken as well as phytoplankton samples in the Kidogoweni creek. The last has been done with a phytoplankton net (mesh width 25 µm) at high tide, close to the fishermen's harbour and at low tide, high stream upward in the Kidogoweni creek.

M. Van Zele & E. Coppejans, University of Gent, Lab. Morfologie, Systematiek en Ekologie van de Planten, K.L. Ledeganckstraat 35, B-9000 Gent, Belgium.

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## Benthic research in mangroves in Gazi Bay

Two research items were studied during our one month stay in Kenya : (1) the influence of epifaunal activities on the infaunal distribution in mangrove sediments; (2) the vertical migration of the meiobenthos in mangrove sediments during a tidal cycle.

### (1) Epifaunal influence on infaunal communities in mangroves

The effects of heavy consumers on the infauna in mangrove sediments will be examined in an integrated research plan with teamwork on meiobenthos, epibenthos, mangrove productivity and soil ecology (cf. CEC project). The 'heavy' consumers are the



crabs (Sesarmidae, Gecarcinidae, Portunidae and Ocypodidae), Gastropods (especially *Terebralia palustris*), fish and shrimp larvae and several shore birds. These organisms are important for : (1) litter and leaf removal and degradation by animals mostly or totally depending on mangrove leaves; (2) direct predation on infauna; (3) ground mixing by digging activity of all the crabs and some Thalassinid species. Burrowing effect on root respiration, soil oxidation and meiofauna distribution is unknown but presumably very relevant. Species of crabs and/or molluscs can be removed (or increased) for more or less long periods, and the effect on soil, infauna and mangrove trees can be analysed. Numerous studies have explored the phenomena of biological interactions between infaunal assemblages and, generally larger, epifaunal groups. Many efforts have been aimed at elucidating the effect of predation and bioturbation on infaunal (meiofauna and macrofauna) communities either by introducing or excluding the epifauna.

Cages with screenes of various mesh sizes have been used to both exclude and include large predators such as fish, shrimp and crabs and subsequently monitor infaunal abundance and composition in cage treatments compared to treatments with no alteration of epifaunal activity (uncaged areas = controls). Especially in mangrove sediments, the bioturbating activities of the epifaunal organisms on the structure and the composition of the infauna seem to be very important. The actual research program aims at the quantification of the importance of this bioturbation.

With the samples of February, the effect of the epifauna on the infauna will be investigated in 4 different mangrove vegetation types, i.e. *Avicennia*, *Ceriops*, *Rhizophora* and *Sonneratia* in Gazi Bay. The cages are made of Al-profiles and PVC-plates pushed into the sediment and the walls are made of a nylon with 2 mm mesh. They have a surface of 1 m<sup>2</sup> and are installed in the beginning of February 1992 and the first experiment on the effect of exclusion of epifauna takes two weeks. Within this period, the construction of the cage is tested as well as the short term influence of the exclusion of the epifauna on the infauna. The construction is found to be stable enough to last for several weeks. We have only failed with the *Sonneratia* cage which is fallen down because of the height, the extreme spring tide and the strong currents at that time.

After settling the cages, the epifauna has to be taken away. This is easily done for Gastropoda but is more difficult for the Decapoda. Different methods (life-traps with or without glue, mouse traps, removal by hand) have been tried. Especially for the *Rhizophora* and *Sonneratia* zones the right method has not yet been established. For the other zones, the methods mentioned above seem to be efficient.

In the beginning of February and after two weeks, samples of macrofauna and of meiofauna are taken within the cages and outside the cages (i.e. blanco). A PVC-core of 8.8 cm diameter is used for the macrobenthos and each core is separated in two slices (0-2, 4-r cm). The minimum depth is always 10 cm (especially nematodes are living in the deeper layers). Both slices are brought into a plastic bag and coded. For the meiobenthos, a PVC-core of 3.5 cm diameter is cut

## Visiting scientists

- Dr. E. Coppejans : Belgian, Laboratory of Botany, Lecturer at University of Ghent, Belgium. From 2/09/91 to 27/09/1991. Purpose of the visit : supervision and guidance of the fieldwork of 2 students from University of Ghent and training of Mr. Wakibya(KMFRI) in identification, zonation and succession of seaweeds and seagrasses.

- Dr. A. Zwaenepoel : Belgian, Laboratory of Botany, Lecturer at University of Ghent, Belgium. From 2/09/91 to 27/09/91. Purpose of the visit : guidance of the fieldwork of Mr. Provoost (Univ. Ghent) and Mr. Wakibya on methodology of transect method for vegetation studies.

- Mr. M. Van Zele : Belgian, Laboratory of Botany, M.Sc. student at University of Ghent. From 2/09/91 to 27/09/91. Purpose of the visit : research on microphytobenthos of the intertidal zone of Gazi Bay.

- Mr. S. Provoost : Belgian, Laboratory of Botany, M.Sc. student at University of Ghent. From 2/09/91 to 27/09/91. Purpose of the visit : produce a vegetation map of the intertidal vegetation of Bamburi bay, Mombasa.

- Prof. Dr. E. Schockaert : Belgian, Professeur at the Limburgs University Centre, Belgium. From 22/09/91 to 12/10/91. Purpose of the visit : work on tropical marine Turbellaria along the Kenyan Coast.

- Dr. J. Moens : Belgian, Lecturer at University of Limburg, Belgium. From 22/09/91 to 12/10/91. Purpose of the visit : work on parasitological study of marine fish species of the Kenyan Coast and training of Mrs. M. Mitoko and Kimani (KMFRI) in parasitology.

- Dr. M. Vincx : Belgian, Marine Biology Section, Lecturer at University of Ghent. From 3/02/92 to 13/02/92. Purpose of the visit : start the marine benthos section at KMFRI.

-Prof. Dr. A. Coomans : Belgian, Professor at University of Ghent and Director of the Laboratory of Zoology. From 14/02/92 to 28/02/92. Purpose of the visit : visit of KMFRI and work on benthos.

## **Workshop organized by the research project**

A meeting was organized by Free University of Brussels, Belgium on October 10 and 11 1991 at "Universitaire Stichting - Fondation Universitaire", D'Egmont street 11, 1050 Brussels, Belgium. On the first day, an overview of the results obtained in the CEC STD2 programme "Dynamics and Assessment of Kenyan Mangrove Ecosystems" was presented. The second day was a discussion on future research and cooperation within the CEC STD3 programme. The theme proposed was "Biotic and Abiotic relations between tropical coastal ecosystems (interlinkages between mangroves, seagrass beds and coral reef)". This meeting was sponsored by the CEC DG XII.

### **Agenda of the meeting of October 10 and 11, 1991, Brussels**

#### **October 10 :**

**The research on the Mangrove Ecosystem of Gazi Bay (CEC Project/STD2) : State of the Art**

**Chairman : F. Dehairs**

- 9h30 - Welcome and opening : P. Polk
- 9h45 - Structure of the mangrove forest : E. Slim
- 10h05 - Structure of seagrass beds : E. Coppejans
- 10h25 - Physico-chemical characteristics : J. Kazungu

10h45 - 11h15 : tea/coffee break

- 11h15 - Phytoplankton and zooplankton communities:  
E. Okemwa
- 11h35 - Benthos communities : M. Vincx
- 11h55 - Fish communities : M. Ntiba

12h15 - 13h30 : Lunch

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- 13h30 - Production of the mangrove forest, litter fall : E. Slim
  - 13h50 - Litter decomposition, N<sub>2</sub>-fixation : A.F. Woitchik

- 14h10 - Production of phytoplankton and zooplankton :  
E. Okemwa
- 14h30 - Modelling of data : P. Herman
- 14h50 - Research proposed by University of Florence :  
M.Vannini
- 15h10 - 15h40 Synthesis and future research : F. Dehairs
- 15h40 - 16h00 : tea/coffee break

### **The STD 3 Programme 1991-1994**

Chairman : M. Hemminga

- 16h00 - 16h30 - Introduction : Outline of a joint research  
proposal : M. Hemminga
- 16h30 - 17h30 - Discussion of the proposal (part 1) :  
modification, extension, etc. : all participants

**October 11, 1991 :**

### **The STD 3 Programme (continued)**

- 9h30 - 12h30 - Discussion of the proposal (part 2)
- 12h30 - 13h30 : Lunch
- 13h30 - 17h00 - Definition of the final proposal, assignment  
of tasks and formation of the steering committee.

### **List of scientists attended the meeting**

- Dr. M. Best, National Museum of Natural History, Leiden, The Netherlands
- Dr. E. Coppejans, University of Ghent, Belgium
- Dr. N. Daro, Free University of Brussels, Belgium
- Dr. F. Dehairs, Free University of Brussels, Belgium
- Dr. K. Delbeke, Free University of Brussels, Belgium
- Prof. Dr. Den Hartog, Catholic University of Nijmegen, The Netherlands
- Dr. C. Heip, DIHO (NIOO), The Netherlands
- Dr. M. Hemminga, DIHO (NIOO), The Netherlands
- Dr. P. Herman, DIHO (NIOO), The Netherlands
- Dr. R. Johnstone, SAREC, University of Stokholm, Sweden
- Mr. J. Kazungu, KMFRI, Kenya
- Dr. O. Linden, SAREC, University of Stokholm, Sweden
- Dr. M. Ntiba, University of Nairobi, Kenya
- Dr. E. Okemwa, KMFRI, Kenya



- Prof. P. Polk, Free University of Brussels, Belgium
- Mr. F. Slim, DIHO (NIOO), The Netherlands
- Dr. G. van der Velde, Catholic University of Nijmegen, The Netherlands
- Prof. M. Vannini, University of Florence, Italy
- Dr. M. Vincx, University of Ghent, Belgium
- Ms. A. Woitchik, Free University of Brussels, Belgium

### **Training**

Mr. J. Kazungu, Kenyan research officer at KMFRI, came for a 3 months training period (September 91 to December 91) in nitrogen-15 and natural isotopic variation techniques, at the laboratory of Analytical Chemistry, Free University of Brussels, Belgium, with a fellowship from ABOS (Ministry of Cooperation and Development, Belgium).