ENVIRONMENTAL MONITORING IN THE COASTAL ZONE

NYALI BEACH HOTEL, MOMBASA: Wednesday 23rd - Friday 25th April 1997

A contribution to the UK Overseas Development Administration (ODA) Land-Ocean Contamination Study (LOCS) in East Africa.

Organised by the British Geological Survey and Kenya Marine and Fisheries Research Institute.

BGS 1835

KMFRI

ODA

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Bibliographic reference:

Rawlins, B. G. and Williams, T. M. 1997. Abstracts of the ODA / LOCS Workshop-Environmental Monitoring in the Coastal Zone, Mombasa, Kenya, 23rd-25th April, 1997. British Geological Survey, Keyworth, Nottingham, U. K.

WORKSHOP PROGRAMME

WEDNESDAY 23RD APRIL

Introduction and Coastal Zone Management

9-00	Registration	
9-45	Martin Williams (BGS)	Introduction: background to the ODA LOCS project
10-30	**Coffee**	
11-00	Martin Williams and John Rees (BGS)	Contaminant monitoring in estuarine and nearshore marine systems. 1: Survey framework, design and sample collection
12-30	**Lunch**	

Chemical oceanography and pollution

14-00	Abdalla C Yobe (KMFRI)	Assessment of land based sources of pollution along the Kenya coast
14-20	Peter J Shunula (IMS)	Considerations on sources and control of pollution of the coastal zone in Tanzania
14-40	Alfred Muzuka (IMS)	1. Methods of dating coastal sediments and corals.
15-00	Alfred Muzuka (IMS)	2. Can stable isotope compositions of tropical East African flora be used as source indicators of organic matter in coastal marine sediments?
15-20	R. B. Owen (Dept. of Geog., Hong-Kong)	Heavy metals in Hong Kong coastal sediments
15-40	C. Z. Kaaya (Dept of Geology, Dar-es-Salaam)	Sources of Chemical Pollution in Dar-es-Salaam Coastal Waters
16-00	**Coffee**	

Remote sensing in Coastal Zone Management

16-20	Peter Mumby (CTCMS, U. K.)	Practical remote sensing of coral reefs and seagrass beds: a cost benefit assessment.
16-40	Edmund Green (CTCMS, U. K.)	A Comparative Assessment of Mangrove Areas using Remotely Sensed Data from Satellites and Airborne Sensors.

THURSDAY 24TH APRIL

Interpretation of marine pollution data

9-00	Martin Williams (BGS)	Contaminant monitoring in estuarine and nearshore marine systems. 2: Analysis, interpretation and integration of chemical data.
9-45	John Rees (BGS)	Estimation of residence time of sediment-hosted contaminants, based on interpretation of sedimentological and oceanographic data
10-30	**Coffee**	
11-00	Barry Rawlins (BGS)	Obtaining pollution chronologies in marine sediments
11-30	Jason Weeks (ITE)	Biomarkers in marine pollution monitoring
12-30	**Lunch**	

Biological / Ecological studies

14-00	Nyawira Muthiga (Kenya Wildlife Service)	Coral reef monitoring within protected areas in Kenya
14-20	Johnson Kazungu (KMFRI)	Nitrogen transformational processes in a mangrove ecosystem
14-40	Jacqueline N Uku (KMFRI)	Submerged marine flora as indicators of environmental health
15-00	**Coffee**	
15-30	Omondi Wawiye (KMFRI)	Phytoplankton as bio-indicators of environmental stress: comparison between a polluted and a pristine environment along the Kenyan coastline
15-50	Patrick Gwada (KMFRI)	Regeneration structure of Kenyan mangroves after human perturbation: case study of Mida creek
16-10	Helida Oyieke (National Museums of Kenya)	Coastal zone environmental quality vs biological diversity

FRIDAY 25TH APRIL

Physical oceanography

9-00	Mika Odido (KMFRI)	Tidal flushing of the creeks around Mombasa Island
9-20	Michael Mutua Nguli (KMFRI)	Water exchange and mixing in tropical inlets - a case study of Tudor inlet, Mombasa
9-40	Johnson Kitheka (KMFRI)	Coastal water-circulation, groundwater flux and salinity anomalies at Mida Creek, Kenya

10-20 Coffee

Coastal zone management and GIS

11-00	Dirk Van Speybroeck (UNEP)	UNEP's eastern African Coastal and Marine environment resources database and atlas project
11-20	Dixon Waruinge (UNEP)	Integrated coastal area management in Eastern Africa
11-40	B. A. J. Mwandotto (Coastal Development Authority)	Kenya integrated coastal area management (ICAM) Pilot project
12-00	Prof. J. Bauer (ECO-TERRA)	Holistic coastal zone protection in areas of conflict (the case of Somalia's coast during the last 10 years)

12-30 Lunch

Beach erosion

14-00	Jeremiah Daffa (NEMC)	Oil spills and marine contingency planning in Tanzania
14-20	N. Nyandwi (IMS)	Man induced coastal erosion and its management in Tanzania
14-40	A. M. Dubi (IMS)	Beach erosion and the role of coastal structures in beach protection
15-00	Yohannah Shagude (IMS)	Sediment distribution and transport off the western coast of Zanzibar
15-20	Pamela Aboudha (KMFRI)	Beach erosion and its management strategies in Kenya

Acronyms:

KMFRI:	Kenya Marine Research Fisheries Institute
IMS:	Institute of Marine Sciences (Tanzania)
UNEP:	United Nations Environment Programme
NEMC:	National Environment Management Council (Tanzania)
BGS:	British Geological Survey (U.K.)
ITE:	Institute of Terrestrial Ecology (U.K.)

THE LINKAGE BETWEEN COASTAL WATER CIRCULATION DYNAMICS AND GROUND-WATER FLOW IN A TROPICAL MANGROVE CREEK IN KENYA

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The hydrologic research on coastal water circulation and ground-water flow was undertaken for the period 1996-1997 in a 35 km^2 tropical Creek in Kenya. The research involved measurement and coupling of the hydrodynamic parameters (salinity, temperature, current velocity, tidal elevation) with meteorological data (air temperature, rainfall, evaporation and solar radiation influx) and hydrogeologic data (ground water flow, ground water level variability and permeability).

The rate of water-exchange is high at the front water-zone of the creek. Three methods used to calculate the exchange rate provided agreeing results (volume-conservation model: 3970 m3.sec-1; Cross-sectional-Area-Velocity method: 3780 m3.sec-1; Tidal cycle-Area-Tidal Range method; 3920 m3.sec-1). The differences between these methods were insignificant. The residence time of water in the Creek is short at the front-water zone (approx 12 hrs), but longer (>24 hrs) in the middle and backwater zones. The turbid water and pollutants are trapped for longer periods in these zones as compared to the front-water zone. In spring tide, at least 60% of the Creek water is exchanged with the shelf waters in each tidal cycle. In neap tides, only 40% is exchanged. As with tidal water exchange, the rates of tidal flushing are considerably high at the front-water zones (current velocity up to 2.5 m/s), but lower in the backwaters (<0.3 m/s current speed). There is only minor, but no major seasonal fluctuations in water salinity (29-38 PSU) and temperature (24-29%C). But there are spatial differences, influenced by evaporation, solar radiation influx and tides. The backwater zone is a region of low energy (current speed <0.30 m/s, high temperature (>29%C), high evaporation rates (8 mm/day) and high salinity maxima (38 PSU). The front-water zone experience the reverse of conditions in the back-water zone. The spatial salinity-temperature differences between front-water and backwater zone reach 0.80 PSU/Km and 0.45%C/Km respectively.

Freshwater input is essentially via two main sources: rainfall and ground water seepage. The supply of freshwater by rainfall is seasonally variable and in most cases is often <3.0% of the total Creek volume. The volume of freshwater supplied through rainfall is only high during the South-East monsoon rainy season (April-May-June). The highest volume is in May (6.5%) with April and June having 3.1% and 3.2% respectively. In the North-East monsoon, the supply is often <2.0% in over 80% of the time. The ground water storage in the surrounding sandy aquifers is enormous (105 x 106m3), with a permeability rate of 1.25 m/day. The rate of ground water seepage, calculated using Glovers method is 10.0 m3/sec, but it varies seasonally in response to fluctuating climatic conditions. The inflowing brackish ground water causes low salinity in ebb tide as compared to flood tide. The flood-ebb tide salinity difference range from 0.04 to 1.06 PSU. The replacement time of the supplied freshwater and nutrients is 14.6 days (approx 2 weeks).

Modelling research was focussed on the simulation of water temperature and salinity, using multi-variate statistical methods. Simulation was found to be complex and depended on many independent hydrodynamic factors. In the front-waters, salinity was simulated quite well (R-sq: 0.77; df: 35), with water temperature and conductivity being independent of physical factors. The

relationship between the simulated and measured salinity was good (r=0.89; R-Sq; 0.77). Temperature simulation was also good (R-Sq: 0.75; df: 35.0) with water column depth, salinity and conductivity been independent factors. The correlation coefficient for measured and simulated temperature is 0.89 with R-Square of 0.77.

The research provided important information on the hydrologic linkage between coastal hydrography and ground water flow. It also provides important information of potential application in pollution control and abatement, as well as in the sustainable management of coastal and marine ecological systems in tropical areas.