

MANGROVE REGENERATION

J. G. Kairo ¹ & P. O. Gwada

INTRODUCTION

The scientific rationale and significance of mangrove research in the on-going KWS-KMFRI Mida Creek biodiversity survey have been well articulated in the project proposal and the first quarter report. As a continuation of these earlier initiatives, this report will in addition to amplifying earlier findings, focus on new results and future directions for the mangrove sub-project.

PRODUCTIVITY STUDIES

In a mangrove ecosystem trees are both the dominant constituent of the standing crop (biomass) and the primary producers. One important characteristic of mangroves is the production of a great deal of litter. The Mida Creek mangrove forest productivity is currently being assessed at one *Rhizophora mucronata* site to estimate the level of the production to litter. Sampling has been conducted and will continue fortnightly to generate time scale-series data.

RESULTS AND DISCUSSION

Three months of litterfall collection and analysis only reveal limited information so far. Apparently, litterfall production has been high from this forest (Fig 1 & 2). Leaf litter has been, quantitatively, the major part of this litterfall. The reproductive units have remained minimal in numbers and in their overall mass contribution to litter, perhaps an indication that these units are out of season. In an earlier productivity survey, Gwada (1991, 1993), has reported that the litter production from Gazi Bay mangroves can be as high as over 1000 g dry wt/m²/yr. This high return rate brings about a high production of marine biota through some extended trophodynamic interactions. It also forms the material base for beach silting.

Recently, scientists have been building more predictive models for site-specific coastal biotopes. In this scenario, mangrove models will benefit greatly from site-specific empirical information of which productivity data will play an overriding role. This will have strong predictive powers for system managers faced with conflicting user demands.

WORK AHEAD

Mangrove litterfall and productivity

1. Continuation with fortnightly litterfall surveys.

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2. Sedimentological analysis.

These two factors (1 & 2) will provide information on the systems storage capacity.

3. Upscaling the data for a mass balance carbon budget for the system.

REFERENCES

- Gwada P. & Slim, E. 1991. Primary production in mangroves assessed by biomass increments and litterfall. KBP - CEC Project Report No. TS2 - 0240 - C (GBF). General Editor Dr. K Delbeke. June 1991: 22 - 28pp.
- Gwada P & Slim F. J. (1993). The mangrove vegetation of Gazi bay. In Dynamics and Assessment of Kenyan Mangrove Ecosystems. No. TS2- 0240- C (GDF). Final Report. April, 1993. General Editor A. F. Woitchik, 6 - 34 pp.

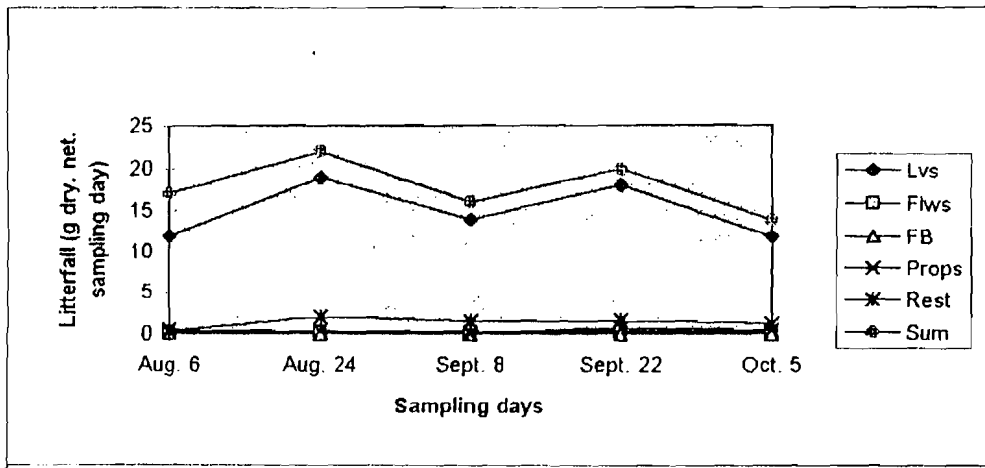


Fig. 1: Litter fall in *R. mucronata* plot

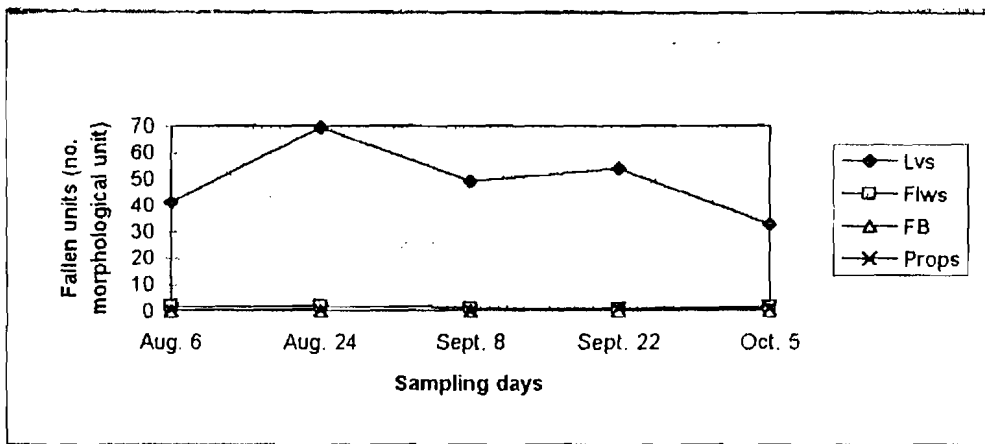


Fig. 2: Fall of morphological units from *R. mucronata* plot

Keys:

LVS - Leaves

Flws - Flowers

FB - Flower buds

Props - Propagules

Rest - All other units 'unidentifiable' or broken off from main morphological units

Sum - All the units together

APPENDIX

FINANCIAL REPORT

VOTE A: PERSONAL ALLOWANCES

DATE	AMOUNT (KSHS)	SUB-PROJECT
3-2/8/96	15,000.00	Regeneration/Phenology
16/8/96	5,000.00	Macroalgae/Fisheries
23-27/8/96	17,000.00	Mangroves
26/8/96	2,000.00	Birds
27/8/96	2,000.00	Birds
28/8/96	5,000.00	Macroalgae/Fisheries
28-29/8/96	13,000.00	Nutrients/Plankton/Hydrology
29/8/96	3,500.00	Birds/Benthos
2/9/96	7,000.00	Macroalgae/Fisheries
9/9/96	18,000.00	Mangroves
16/9/96	5,500.00	Macroalgae/Fisheries
20/9/96	13,000.00	Mangroves
26/9/96	4,000.00	Birds
27/9/96	4,000.00	Birds/Benthos
30/9/96-1/10/96	13,500.00	Nutrients/Plankton/Hydrology
4/10/96	4,800.00	Mangroves
12/10/96	2,000.00	Gwada Gazi Trip
14/10/96	13,000.00	Nutrients/Plankton/Hydrology
24/10/96	6,000.00	Birds/Benthos
25/10/96	4,000.00	Birds/Hydrology
26/10/96	2,500.00	Regeneration
28/10/96	13,000.00	Nutrients/Hydrology/Plankton
30/10/96	7,000.00	Macroalgae/Fisheries
TOTAL	180,400.00	

VOTE B: FUEL (CAR AND BOAT)

FOLIO NO.	PURCHASE DATE	AMOUNT (KSHS)	PLACE OF PURCHASE	PROJECT
1	6/8/96	320.00	Gede Esso # 13509	Mangroves-Boat
1	6/8/96	300.00	Mkomani Total # 154008	Mangroves-Car
2	16/8/96	640.00	KWS #91651	Macroalgae-Boat
2	16/8/96	700.00	Mkomani Total # 153319	Macroalgae-Car
3	24/8/96	2,152.00	Mkomani Total # 155174	Mangroves-Car
3	24/8/96	800.00	Mukem Total # 300	Mangroves-Car
4	25/8/96	300.00	Mkomani Total # 155133	Birds-Car
5	27/8/96	1,000.00	N. Nyali Bridge Shell 24765	Birds-Boat
5	27/8/96	960.00	New Ocean BP # 29001	Nutrients-Car
5	27/8/96	644.00	Gede ESSO # 17055	Nutrients-Car
6	28/8/96	640.00	Gede ESSO # 17125	Nutrients-Car
6	28/8/96	600.00	Mkomani Total # 153022	Birds-Car
6	29/8/96	500.00	Mkomani Total # 153125	Macroalgae-Car
7	29/8/96	700.00	Mkomani Total # 153146	Macroalgae-Boat
8	30/8/96	700.00	Mkomani Total # 153815	Macroalgae-Car
8	30/8/96	645.00	Gede ESSO #13917	Macroalgae-Boat
9	2/9/96	750.00	Gede ESSO #152128	Macroalgae-Car
9	2/9/96	483.00	Gede ESSO # 13078	Macroalgae-Boat
10	6/9/96	300.00	Mkomani Total # 1152820	Mangroves-Car
11	9/9/96	500.00	Gede ESSO # 002913	Mangroves-Car
11	5/9/96	1,950.00	Wakiney Caltex # 29012	Mangroves-Car
12	16/9/96	800.00	Mkomani Total # 40300	Macroalgae-Car
12	16/9/96	656.00	Gede ESSO # 003351	Macroalgae-Boat
13	20/9/96	1,830.00	Nyali ESSO # 5418	Mangroves-Car
13	22/9/96	600.00	Gede ESSO # 416	Mangroves-Car
14	26/9/96	952.00	Mkomani Total # 41233	Birds-Car

14	26/9/96	680.00	Gede ESSO # 495	Birds-Boat
14	27/9/96	851.00	Mkomani Total # 41635	Birds-Car
15	28/9/96	200.00	Kenyatta Avenue Total	Mangroves-Car
16	30/9/96	1,500.00	Gede ESSO # 1133	Nutrients-Boat
17	1/10/96	600.00	Mkomani Total # 41970	Nutrients-Car
17	1/10/96	600.00	Mkomani Total # 41750	Nutrients-Car
17	1/10/96	560.00	New Nyali Shell # 128989	Nutrients-Car
18	4/10/96	1,850.00	Nyali ESSO # 6969	Mangroves-Car
19	6/10/96	800.00	Gede ESSO # 002615	Mangroves-Boat
20	14/10/96	760.00	Salama BP # 42826	Nutrients-Car
20	15/10/96	1,665.00	Gede ESSO # 001990	Nutrients-Boat
21	24/10/96	800.00	Mkomani Total	Birds/Benthos
21	25/10/26	1,000.00	Mkomani Total	Birds-Car
21	25/10/96	700.00	Gede ESSO	Birds-Boat
22	26/10/96	800.00	Mkomani Total	Mangroves
23	26/10/96	600.00	Gede ESSO	Mangroves
24	27/10/96	400.00	Mkomani Total	Generator Fuel
25	29/10/96	600.00	Links Road BP	Nutrients-Car
25	29/10/96	600.00	New Nyali Shell	Nutrients-Car
25	29/10/96	1,200.00	Gede ESSO	Nutrients-Boat
26	30/10/96	800.00	Mkomani Total # 43814	Macroalgae-Car
26	30/10/96	600.00	Gede ESSO	Macroalgae-Boat
TOTAL		39,578.00		

VOTE C. CHEMICALS AND EQUIPMENTS

FOLIO NO.	PURCHASE DATE	AMOUNT	PLACE OF PURCHASE	RCPT.NO
1	10-Sep-96	10,487.00	Himar Enterprises	
2	10-Sep-96	89,633.00	Himar Enterprises	157
3	10-Sep-96	5,880.00	Himar Enterprises	156

TOTAL 106,000.00

VOTE M: STATIONARY AND MISCELLANEOUS

NO.	DATE	(KSHS)	ITEM	PLACE OF PURCHASE & RECEIPT NO.
1	22/8/96	170.00	Binding Report	Copy Cat Coast # 27148
2	28/8/96	472.00	Various	Shamash Supermarket
2	28/8/96	400.00	Medicine	Makupa Chemist
3	4/9/96	775.00	Lithrum Battery	Photocine Ltd. # 12840
3	4/9/96	300.00	Slide Film	Photocine Ltd # 12839
4	4/9/96	180.00	Plastic	Mercantile Traders
5	16/9/96	357.00	Batteries	Mercantile Traders
6	27/9/96	198.00	Batteries	Moonlit Store # 23269
6	28/9/96	200.00	Medicine	Pearl Chemist # 53590
7	28/9/96	240.00	9v Battery	Moonlit # 97351
8	9/9/96	1,200.00	Boat Hire	Regeneration Project
9	6/10/96	900.00	Boat Hire	Regeneration Project
10	28/8/96	60.00	Ice	Nutrients Project
11	27/8/96	2,000.00	Boat Hire	Regeneration Project
12	20/9/96	1,000.00	Boat Hire	Regeneration Project
13	22/9/96	190.00	Ruled Paper	Regeneration Project
13	22/9/96	229.00	Shoes	Bata Shoe, Digo Road
14	18/10/96	399.00	Paper	Bahari Bookshoop # 18650
15	28/10/96	200.00	Medicine	Makupa Chemist
15	25/10/96	240.00	Batteries	Kenya Njeru Star
16	28/10/96	230.00	Batteries	Shamash Supermarket
17	29/10/96	190.00	Batteries	Bachus
18	Various	180.00	Ice	Nutrients/Plankton
TOTAL		10,310.00		

EXPENDITURE BREAKDOWN

VOTE	TOTAL EXPENDITURE
(A) Allowances	180,400.00
(B) Fuel	39,578.00
(C) Chemicals and Equipments	106,000.00
(M) Stationary and Miscellenous	10,310.00
GRAND TOTAL	336,288.00

SUMMARY REPORT

TOTAL EXPENDITURE	336,288.00
BANK CHARGES	800.00
STATION IMPREST	4,459.00
BANK BALANCE AS PER 31/10/96	500.00
TOTAL BALANCE	4,959.00

**MIDA CREEK BIODIVERSITY PROJECT: 3 rd QUARTER 1996
BUDGET**

MACROALGAE	
<u>Field Allowances</u>	
2 scientists @ 1000 x 6 days x 2	12,000.00
2 technicians @500 x 6 days x 2	6,000.00
Driver @500 x 6 days x 1	3,000.00
SUBTOTAL	<u>21,000.00</u>
 <u>Car Fuel</u>	
50L per trip @33.00Ksh/L x 6 trips	9,900.00
SUB TOTAL	<u>30,900.00</u>
 <u>Geology studies</u>	
1 Scientist @1000 x 6	6,000.00
technician @500 x 6	3,000.00
<u>SUB TOTAL</u>	9,000.00
TOTAL	39,900.00

**MANGROVE REGENERATION AND
PRODUCTIVITY**

Field Allowances

Regeneration and structure:

1 scientist @1000 x 3 days	3,000.00
2 technicians @500 x 3 days x 2	3,000.00
1 driver @ 500 x 3 days x 1	1,500.00

SUBTOTAL	<u>7,500.00</u>
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Litter collection (bi-monthly):

1 scientist @ 1000 x 6 days x 1	6,000.00
2 technicians @ 500 x 6 days x 2	6,000.00
1 driver @ 500 x 6 days x 1	3,000.00

Field assistant.

<u>3 x 9 x 250</u>	6,750.00
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Boat hire

<u>3 x 500</u>	1,500.00
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Car Fuel

50L @33/= per liter x 9 trips	14,850
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Boat Fuel

25L @33/= per liter x 9 trips	7,245.00
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TOTAL	39,525.00
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NUTRIENTS, HYDROLOGY AND PLANKTONField Allowances

5 scientists @2000 x 3 days x 5	30,000.00
4 technicians @1000 X 3 days x 4	12,000.00
driver @1000 x 3 days x 1	3,000.00
coxwains (24hrs sampling)	1,000.00

Borehole survey

2 Scientist@1000 x 3 days x 2	<u>6,000.00</u>
2 technicians x 500 x3	<u>3,500.00</u>

SUBTOTAL 49,500.00

Equipment

Current Meter Batteries (2 pairs)	6,000.00
Ice for samples@150 x 3 trips	300.00
Mosquito repellent@430 x 3 trips	1,290.00
Dry Cells (3 pairs)@150 x 3 trips	450.00
Disposable gloves @100 x 3 trips	300.00
GPS batteries(1 pair)@200 x 3 trips	600.00
Felt pens (2)@100 x 3	300.00
Photocopy papers (3 reams)@400 x 3	1,200.00
Fullscap papers (3 reams)@300 x 3	900.00

SUB TOTAL 11,340.00

Car Fuel

50L @33/= per Litre x 6 trips 9,900.00

Boat Fuel

50L @33/= per Litre x 3 trips 4,950.00

SUB TOTAL 14,850.00

SUB TOTAL 82,190.00

GENERAL CHEMICALS

5 litres Alcohol (AR)	9,600.00
500 Grams Mercuric Chloride	10,000.00
5 Litres Acetone	3,500.00
5 Litres Nitric acid	3,000.00
SUB TOTAL	26,600.00

TOTAL 108,190.00

BIRDS/BENTHOS	
1 scientist @1000 x 6 days x 1	6,000.00
2 scientists @1000 x 3 days x 2	6,000.00
1 technician @500 x 3 days x 1	1,500.00
driver @500 x 6 days x 1	3,000.00
SUBTOTAL	<u>19,500.00</u>
<u>Car Fuel</u>	
50L @33/= per Litre x 6 trips	9,900.00
<u>Boat Fuel</u>	
50L @33/= per litre x 3 trips	4,950.00
SUBTOTAL	<u>14,850.00</u>
TOTAL	<u>34,350.00</u>

FISHERIES	
<u>Field Allowances</u>	
1 scientists @ 1000 x 6 days x 1	6,000.00
2 technicians @500 x 6 days x 2	6,000.00
field Assistants @2,000 x 3 days	6,000.00
6 Fishermen @500 x 3 days x 6	9,000.00
1 driver @500 x 3 days x 1	1,500.00
SUBTOTAL	<u>28,500.00</u>
<u>Equipment</u>	
Weighing Balance	12,000.00
SUBTOTAL	<u>12,000.00</u>
<u>Boat Fuel</u>	
25L per trip @33.00Ksh/L x 6 trips	4,950.00
TOTAL	<u>45,450.00</u>

SUMMARY OF BUDGET

PROJECT	AMOUNT(KSH)
MACROALGAE AND GEOLOGY	39,900.00
FISHERIES	45,450.00
MANGROVE REGEN.	39,525.00
BIRDS/BENTHOS	34,350.00
NUTRIENTS HYDROLOGY PLANKTON	81,190.00
General equipments and Chemicals	59,570.00
General stationary	10,000.00
TOTAL	309,985.00
5 % Contigency	15,499.25
Total	325,484.25
Less funds available	4,959.00
TOTAL BUDGET	320,525.25

**MIDA CREEK BIODIVERSITY PROJECT
3rd QUARTER SAMPLING PROGRAMME
(NOVEMBER - DECEMBER, 1996)**

NOVEMBER

DATE	PROJECT	PERSONNEL	NEEDS	TIDE	TIME OUT
12/11/96 Tue.	Benthos Borehole survey	4 scientists 2 techn.	-	LT-10:48	8:00am
13/11/96 Wed.	Mangrove litter.	1 scientist 2 techn.	One boat	LT-11:24	8:00am
14/11/96 Thur.	Macroalg. Fisheries	3 scientists 4 techn.	One boat	LT-12:02	8:00am
21-22/11/96 Thur - Fri.	Birds	1 scientist 1 techn.	One Rubber Dinghy	*	*
22-24/11/96 Fri-Sat.	Mangrove Regen. + litter.	1 scientist 2 techn.	One boat		8:00am
26-27/11/96 Tue-Wed.	Nutrients Plankton Hydrology	4 scientists 3 techn.	Two boats	LT-10:52 HT-17:03	8:00am
29/11/96 Fri.	Macroalg. Fisheries	3 scientists 4 techn.	One boat	LT-12:30	8:00am

* The research team will be in the field during this period so the Mida Creek survey will be conducted on the return trip to Mombasa.
They do not require transport on 21/11/96.

DECEMBER

DATE	PROJECT	PERSONNEL	NEEDS	TIDE	TIME OUT
6/12/96 Fri.	Mangrove litter.	1 scientist 2 techn.	One boat	LT-7:05	8:00am
10/12/96 Tue.	Benthos Birds Borehole survey	5 scientists 2 techn.	-	LT-9:59	8:00am
11/12/96 Wed.	Macroalg. Fisheries	3 scientists 4 techn.	One boat	LT-10:37	8:00am
13/12/96 Fri.	Macroalg. Fisheries	3 scientist 4 techn.	One boat	LT-11:55	8:00am
17-18/12/96 Tue-Wed.	Nutrients Plankton Hydrology	4 scientists 3 techn.	Two boats	LT-15:03 HT-8:47	8:00am
20-21/12/96 Fri-Sat.	Mangrove Regen. + litter.	1 scientist 2 techn.	One boat		8:00am