

## EARTHWATCH INSTITUTE FIELD REPORT

**Project Title:** Mangroves of Kenya

**Principal Investigators:** Mark Huxham (lead PI), James Kairo, Martin Skov

**Position/Affiliations:** Senior lecturer, School of Life Sciences, Napier University,  
Edinburgh

**Research Site:** Gazi Bay, 60km south of Mombasa, Kenya

**Local Management Status of the Research Site(s) (e.g. National Park, RAMSAR Site, World Heritage Site, IBA etc.):**

No formal designation

**Scientific names of primary species being studied:**

*Sonneratia alba*, *Avicennia marina*, *Rhizophora mucronata*, *Ceriops tagal*, *Bruguiera gymnorrhiza*

**Key Research Objectives:**

- To examine the factors that determine vitality and mortality in mangrove plantations established in degraded environments.
- To explore the effects of species type on the success of mangrove plantations.
- To examine the role of mangrove species richness on the recovery of ecosystem functions, including nutrient retention, crab diversity and productivity, in replanted mangrove stands.
- To test the ability of mangrove plantations to retain sediment and to act as coastal protection.
- To investigate the potential of mangroves as carbon sinks
- To work closely with the local community to establish re-planted mangrove stands for sustainable use in the future.

**Date this report was completed:** 15 December 2005

## Data Collection and Results

- a) Give a concise account of the data you have collected during the past field season.
- Diversity and abundance of crabs living in re-planted and control plots.
  - Sediment characteristics (including salinity, carbon content, redox and granulometry) in re-planted and control plots.
  - Survival data for trees planted in 2003 and 2004.
  - Height and leaf area index data for all plots planted in 2004.
  - Fish abundance in new plantations.
  - Fish abundance in natural forests.
- b) What progress have you made towards achieving your original objectives?

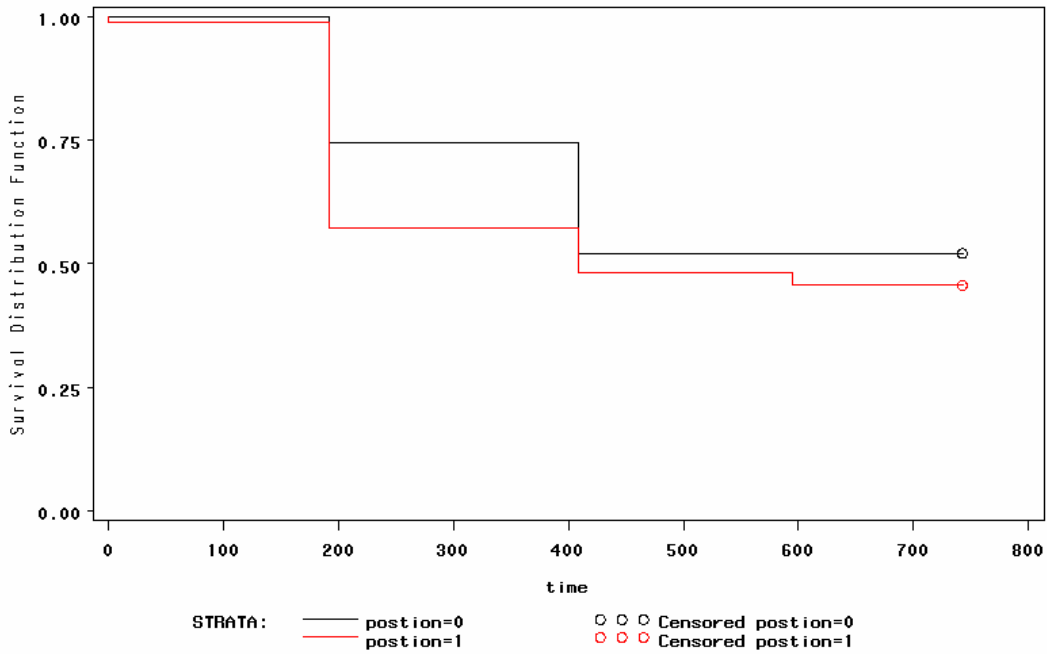
Most of our planting was achieved in 2004; hence this was the first year we could begin to collect results. We faced two major problems with our initial plantations. Our plots at our dry site suffered high initial mortality of one of our species – *Bruguiera gymnorrhiza* – whilst our main beach site plots suffered grazing from goats. Both of these problems are now resolved, we hope (through rapid re-planting and through negotiations with the owners of the goats, respectively). Despite having a slower than expected start, we made good progress in collecting data this year; most of our trees have now established and are growing, and are starting to show evidence of changing the surrounding ecosystem. Hence our first three objectives (studying the dynamics of re-planted forests) are being met; we have preliminary results for these. Because of the goat problem, we are yet to have results for coastal protection, but are confident that we can work on that objective next year. We have begun a major piece of work on carbon sequestration this year, assisted with additional funds from Aviva/Earthwatch, and so intend to report on that objective next year.

- c) Please provide a summary of your results (even if they are preliminary).

All these results are preliminary; our intention is to continue monitoring for at least another three years, since growth can be slow at difficult sites such as the ones we are attempting to restore. However, we have some interesting initial findings:

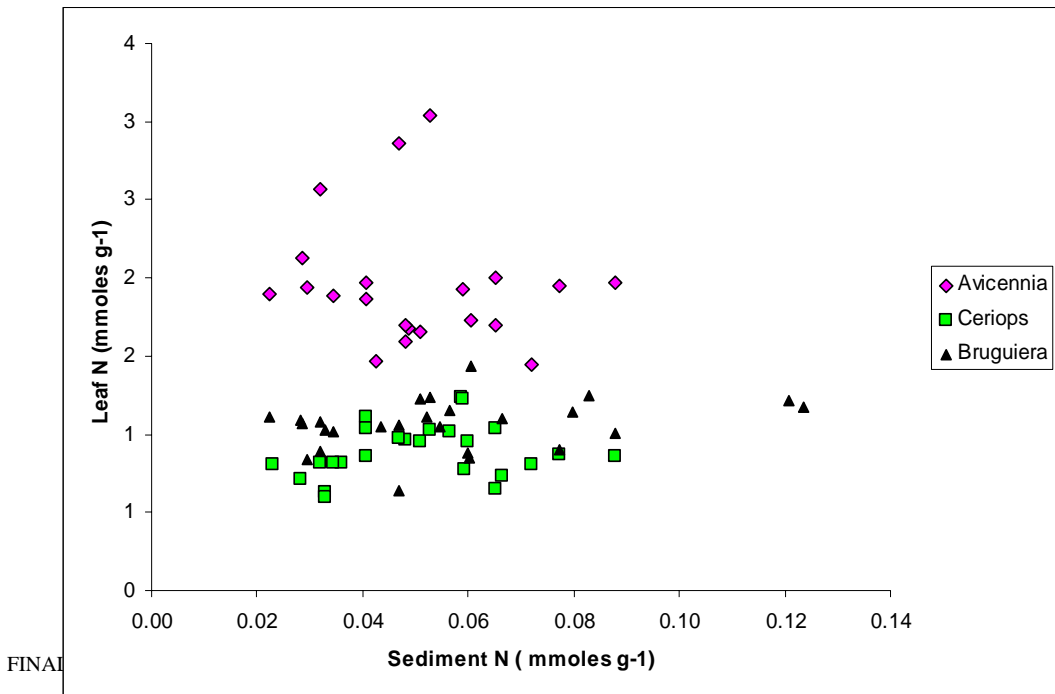
### Mortality

We established a monospecific plot of *Sonneratia alba* at an exposed beach site in 2003. Our objectives included establishing whether the position of a tree in the plot affected its chances of survival (for example, trees at the edge might be more vulnerable to wave damage) and whether the size at planting was important. The survivorship curves for the edge and interior trees are given below:



Statistical analysis of these results shows no difference between edge and interior trees. This implies that re-planted plots do not need to be large in order to survive. However, larger trees had significantly higher survival, implying that where there is a trade-off between larger plots with smaller trees vs smaller plots with larger trees, the latter is a better re-planting strategy.

Formal analysis of survival in our mixed species plots is underway; however it is clear that one species (*Avicennia marina*) is performing better than the others. The reason for this might be to do with this species' ability to sequester nitrogen in competition with other species; results taken this year on nitrogen content of leaves, compared with nitrogen in the soil, show that this species always has higher nitrogen levels:



## **Other sediment characteristics**

There is an emerging trend in our data for higher carbon content in the sediment of our replanted plots – this is not yet significant but we anticipate this trend to continue and to become more pronounced in future years. Other sediment characteristics – such as redox and silt content – are yet to respond to planting.

## **Fauna**

We established a baseline for fish this year – only one species, the mangrove goby, was found in our new plantations. This low diversity was expected given the young age and high position of these plots. No one knows how far fish come into mangrove woods - sampling in future years will help answer this question.

Our crab measurements this year showed increased biomass in planted areas, with a trend in the data towards increased biomass in plots with more species of trees. This is encouraging and intriguing – we will be watching with interest to see if this trend continues.

## **Significance/Benefits of Research**

a) What is/are the significance/benefits of your research at the following levels?

- **Local (in the area of the research site)**  
We support a team of five people (local students and workers) full time at our research site, with at least another five employed part time. Our volunteers and associated scientists currently support nine local school children in their studies (by paying school fees) and have made numerous other contributions. This year we established the Earthwatch Gazi Community Fund to manage donations for local benefit. Hence our presence in the village brings numerous benefits. We intend to make all our plantations available for sustainable use by local people once our scientific work is complete.
- **National**  
We hope our results will contribute towards the production of a mangrove management plan for Kenya, to be written by one of our PIs. We are training two Kenyan postgraduate students, and one undergraduate, contributing to capacity building in Kenyan science.
- **International**  
We anticipate our results will be of international importance (particularly for those involved in mangrove restoration and carbon sequestration policies). However, we will need at least one more year before producing definitive results.

b) How do your findings contribute to issues of sustainability?

Mangroves provide a range of important ecosystem services for local and national communities. They are suffering high rates of degradation around the world. Our work will contribute to knowledge about how best to restore them, and also provide

quantitative data on their contribution to carbon sequestration and coastal protection, hence strengthening the argument for their conservation and sustainable use.

### **Dissemination of Results**

a) Have you provided details of results from your research to or within:

- Scientific papers (indicate status; e.g., peer reviewed or in progress/press)  
First publications anticipated in 2006.
- Management plans and reports (in progress or completed)  
Anticipated 2006
- Presentations (given or planned)  
WIOMSA 2005 international conference. One of our students (Bernard Kirui) presented to an audience of scientists drawn from the West Indian Ocean area. Earthwatch Institute conference, 2005. Keynote presentation by one of our PIs.
- Popular articles or films (in progress or completed)  
Not yet!

Books, chapters, illustrations

Not yet!