FIELD REPORT - Mangroves of Kenya

Project scientists
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Country
Kenya

Research site / region
Gazi Bay, Kwale District

Research site latitude / longitude
4° 25´S, 39°50´E

Protected area status
n/a

Report completed
28 November 2010

Period covered
November 2009 to November 2010

Report completed
Mark Huxham

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Dear Volunteers

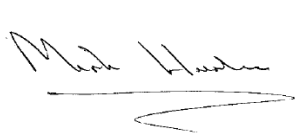
Sitting here in Scotland looking out at the thick blanket of snow that fell last night makes me realize how the months have sped past since we were in Gazi together. I do hope you all had safe returns to your homes and can look back on a successful year; but I also hope that your Earthwatch experience stands out as a highlight of that year.

We started an important new phase in our work this year. We have established a good understanding of the basic ecology of mangrove growth at our restoration sites, and have made important contributions to knowledge of carbon cycling in mangroves. We now want to apply this knowledge by developing the first community mangrove conservation project funded by the voluntary carbon market (we are calling this 'Mikoko Pamoja' or mangroves together). There will be many challenges in doing this. In particular we will need to be very sensitive to the needs of people in Gazi village and around the Bay, and ensure that the project is owned and controlled by them from the start. So team 1 this year focused on the social aspects of our work, and conducted surveys in the village on what people thought about the challenges of climate change and about the opportunity of gaining money to fund conservation. These surveys provided a good foundation for our work; people were enthusiastic about the opportunities and looked forward to working with us. This work would have been quite impossible without the skilled help of our team 1 volunteers, translating climate change terms into Kiswahili and using their tact and social skills to interact so respectfully with local people.

As usual we also made sure we planted more trees, to keep our own carbon balances in the black and to encourage restoration of our degraded sites. Teams 2 and 3 made the biggest contributions here with hundreds of new trees now planted on the beach and at the Kinondo site. Mikoko Pamoja will need careful accounting of the carbon captured by new trees planted and areas of the forest protected. To this end we established new monitoring plots this year where we can measure very accurately the growth of trees under different environmental conditions, and then extrapolate these results to give estimates for the forest as a whole. So your work establishing these plots and taking measurements of growth will be essential in determining this baseline. And of course their role as a carbon sink is only one reason for conserving mangroves, and we are interested in all the other ecological functions that they perform. This is why we asked you to take measurements of the fauna (particularly the crabs) and of the environmental conditions (particularly the grain size and content) so that we can describe how recovering forests help support associated wildlife.

Our project has relied on the enthusiasm, expertise and hard work of so many volunteers. We are extremely grateful to you all, not only for your help with our work but also for the chance to spend such valuable time together and to learn from you about your lives, your jobs and your cultures. Please feel free to get in touch with me, Martin or Kairo whenever you want, and of course you would be very welcome back in Gazi.

Best wishes



Mark Huxham

SECTION ONE

Top highlight from the past field season

We achieved a good level of expressed support from the community for our next step, the implementation of our ground breaking and world first *Mikoko Pamoja* project. With Joseph Langat's work we have established for the first time the nature and extent of greenhouse gas fluxes that occur after cutting mangroves, and we have published important results showing that mangroves can facilitate each other, supporting the recovery of degraded areas.

Non-technical overview of results

- **Community consultation:** We were delighted to receive firm support from the people of Gazi for the first steps in our *Mikoko Pamoja* project, which will aim to conserve an area of mangrove forest and plant trees in the degraded beach areas using funds from the carbon market to support the conservation work and lead to community benefits such as school electrification and better health care. More than 90% of respondents expressed 'strong agreement' or 'agreement' towards the general proposal of conservation using carbon credits. More importantly (because we anticipated it might cause greater disagreement) there was a similar level of support for protecting an area of forest as a no cut zone (See Figure 1). So this is a great start for the next stage of more focused and specific community consultations.

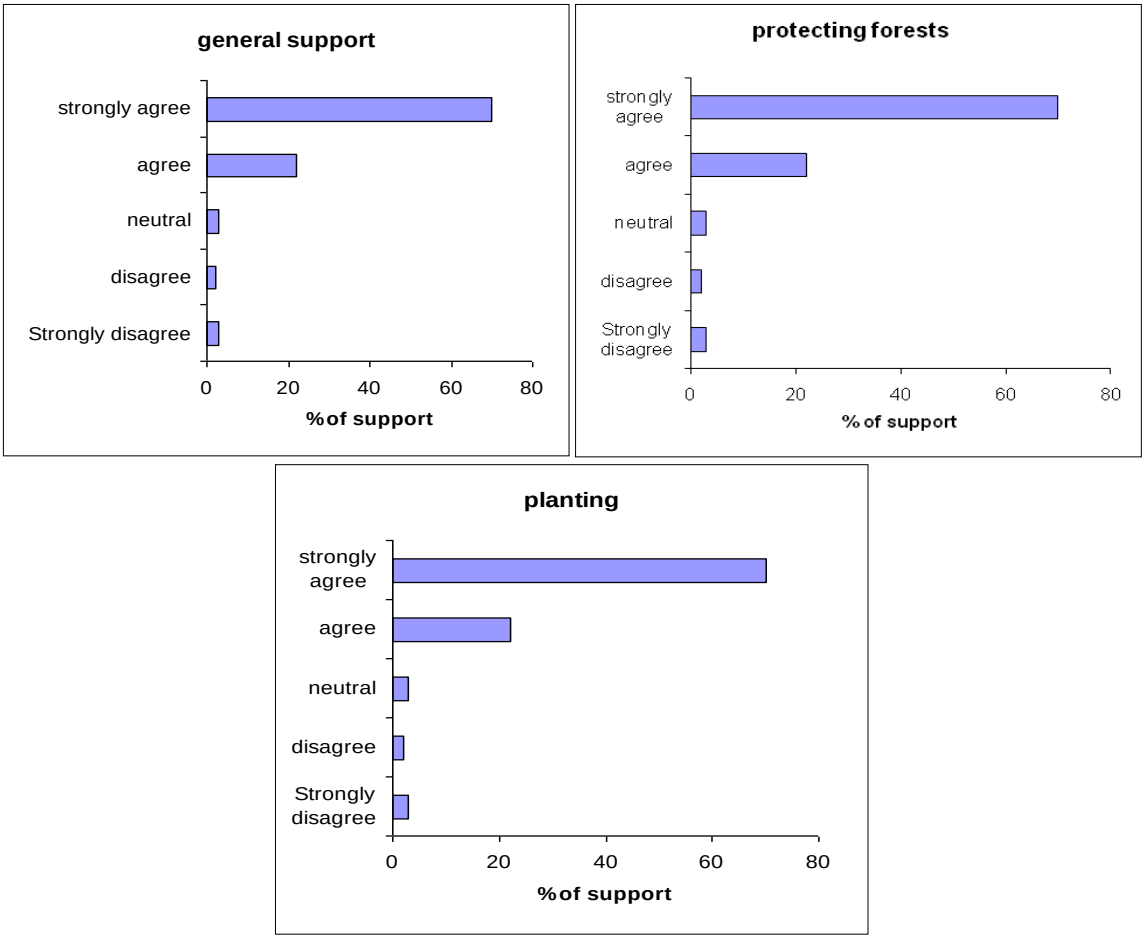


Figure 1: Results from *Rapid Consultation on Mangroves and Carbon Credits Gazi Village 9-10 June 2010* survey. 67 people were consulted, of whom 58% were male. Age groups ranged from 11-20 to 61-70. Respondents were asked to rank their opinions in response to three questions: 1) Do you support efforts to earn carbon credits from mangrove conservation? (General Support) 2) Do you support efforts to protect an area of forest from cutting? (Protecting Forests) 3) Do you support planting more mangrove trees? (Planting).

- **Greenhouse gas fluxes:** Part of our current work involves examining the fluxes of greenhouse gases (particularly carbon dioxide and methane) from intact and cut areas of the forest. This is to help us understand the carbon effects of different types of management and degradation of the forest. For example, if clearcutting (total deforestation) of areas of the forest was permitted, what would the effects be on loss of below-ground carbon? This is important for reasons of understanding the carbon cycle, but also for applied reasons too, in particular to allow us to calculate carbon budgets under different scenarios and to advise on management options. Joseph Lang'at, the PhD student supported by our project, has now recorded significantly enhanced fluxes of methane from cut areas of the forest. This will allow him to calculate the total implied effect of cutting on the carbon balance if this was applied to larger areas.

- **Below ground productivity:** Because much of the carbon in mangrove forests is stored below ground, in the form of roots and peat, we have made concerted efforts to understand what controls root production and decomposition. We published a paper on decomposition this year, showing how species differ, and have now found that mixed species plots show faster rates of root production, probably because of 'niche complementarity' (that is, different species use different parts of 'niche space').

- **Faunal diversity:** We have been monitoring the faunal (particularly crab) diversity in our replanted plots for five years. This year we also recorded other arthropods, particularly insects, and are now ready to publish our results. We have shown that plots with Avicennia support higher numbers and diversity of animals, but again that mixing species can help boost animal diversity.

SECTION TWO: Technical Results

Objective 1: To test how the diversity of mangrove species in replanted stands affects a range of ecosystem functions

Progress towards/against objective 1: This year we finalized analysis of data on below ground productivity that showed enhanced root production in mixed species stands. This is the first time this has been demonstrated in mangroves and one of only a few demonstrations with any species of tree. The paper will be submitted before the end of 2010.

Objective 2: To use controlled experiments to test the effects of replanted mangroves on sediment dynamics (in both low and high energy areas), and to measure how these effects change as the trees mature.

Progress towards/against objective 2:
We published two papers this year based on sediment dynamics, drawing mostly on data from Sri Lanka but including Kenyan data. These showed that enhanced density increased the ability of mangroves to trap sediments and elevate the shore line.

Objective 3: To explore the potential for mangroves to act as carbon sinks and protect against the effects of sea level rise

Progress towards/against objective 3: We have continued with this key objective this year by:

a) Conducting a major new experiment on the effects of controlled cutting of mangroves on greenhouse gas emissions,
b) Recruiting a new masters student to work on productivity of mangroves at different zones in order to allow estimates for total carbon capacity across the forest,
c) Publishing on decomposition processes in roots, as part of our on-going estimates for below ground sink capacity.

Objective 4: To develop a large scale demonstration project of sustainable mangrove utilization, and to use this to influence the management of mangrove habitats in Kenya and beyond

Progress towards/against objective 4: We have made a start on our *Mikoko Pamoja* project, by conducting community consultations, securing significant new funding from the National Environment Research Council to assist with project establishment and meeting with key officials at the Kenya Forest Service.

PARTNERSHIPS
In addition to our on-going and established partnerships (with Kenya Marine and Fisheries Research Institute, Bangor University and Edinburgh University) we have opened a new relationship with the Kenya Forest Service and with Birmingham and Portsmouth Universities.

CONTRIBUTIONS TO CONVENTIONS, AGENDAS, POLICIES, MANAGEMENT PLANS
We presented a keynote talk at the Aquatic Resources of Kenya November 2010 conference and ran a special workshop on mangroves and REDD. This included an explicit commitment to contribute to the REDD preparedness plan for Kenya.

DISSEMINATION

Printed:

- Langat, J., Kirui B., Skov M.W., Kairo, J. and Huxham, M. (2010) Species mixing boosts the below-ground productivity of mangrove roots. *Ecology,* (to be submitted before 31.12.2010)
- Huxham, M., Kumara, M.P., Jayatissa, L.P., Krauss, K.W., Kairo, J., Langat, J., Mencuccini, M., Skov M.W. and Kirui B. (2010) Intra and inter-specific facilitation in mangroves may increase resilience to climate change threats. *Philosophical Transactions of the Royal Society,* 365, 2127-2135.
- M.P. Kumara, L. P. Jayatissa, K. W. Krauss, D. H. Phillips, M. Huxham (2010) High mangrove density enhances surface accretion, surface elevation change, and tree survival in coastal areas susceptible to sea-level rise *Oecologia,* doi: 10.1007/s00442-010-1705-2.
- Huxham, M., Langat, J., Tamooh, F., Kennedy, H., Mencuccini, M., Skov M.W. & Kairo J. (2010) Decomposition of mangrove roots: effects of location, nutrients, species identity and mix in a Kenyan forest. Estuarine, *Coastal and Shelf Science,* 88, 135 – 142

Visual:
We have constructed a new interpretation board for the mangrove walkway women's project, and have a new '*Mikoko Pamoja*' logo

Mass media:
I wrote an article for the BBC greenroom called 'mangroves offer win-win solution':
http://news.bbc.co.uk/1/hi/sci/tech/8893767.stm

Meetings and conferences:
We arranged a local community meeting to discuss our new *Mikoko Pamoja* project.
In addition I gave a keynote presentation at the Aquatic Resources of Kenya II November 2010 conference and we had a dedicated session at that conference on our mangrove carbon project.

Educational resources:
We produced a CD ROM of introductory materials on climate change and forest carbon for use with our *John Ellerman* team

DEVELOPING ENVIRONMENTAL LEADERS

We have recruited two new Kenyan masters students this year, one of whom is being supported directly by the project.

We ran a *John Ellerman* team containing local community participants (3 women from Gazi), 2 Kenyan NGO workers, scientific technicians and Kenyan students. We supported two UK undergraduate and one postgraduate student in their studies, and committed support to a minimum of four more Kenyan school children.

LONG TERM IMPACT OF PROJECT

Taxa of conservation significance enhanced, restored or maintained

Our project is centrally concerned with the restoration and conservation of mangrove forests, and in particular with the species *Rhizophora mucronata*, *Avicennia marina*, *Bruguiera gymnorrhiza*, *Sonneratia alba* and *Ceriops tagal*. None of these species are themselves threatened, but all help to make up mangrove forests that are declining fast across the world.

Habitats enhanced, restored or maintained

We have continued to restore mangrove habitats directly, by planting trees, and indirectly by facilitating habitat change allowing wild trees to establish.
We have also almost completed a complete remote sensing survey of the Kenyan coastline to estimate rates of mangrove loss over the past 30 years.

Ecosystem services enhanced, restored or maintained

Ecosystem services are at the heart of our project; we argue that mangroves are particularly valuable habitats precisely because of the wide range of services that they provide. We are engaged in a world first ‘payments for ecosystem services’ project with our mangrove site, focused particularly on carbon but with the option and intention to include other services too. Mangroves at our site provide provisioning (e.g. timber) regulating (e.g. carbon sequestration) cultural (e.g. ecotourism and spiritual) and supporting (primary productivity and nursery provisioning) services, so by helping to conserve and restore them we are supporting all of these services.

Livelihood assets enhanced, restored or maintained

We opened a new school building last year and this year initiated the *Mikoko Pamoja* project. If successful, this will lead to funds of some 10 -12,000 dollars per year flowing to local community projects. Extensive community consultation has been carried out, and we continue to work closely with local people.

Any other actions or activities that enhance natural and social capital

Our staff and volunteers continue to contribute generously to a range of community benefits. For example have supported more than 15 (and probably more than 20) school children in local schools and are now sponsoring a local student to train for clinical service in the village clinic.

APPENDIX:

Further results from *Rapid Consultation on Mangroves and Carbon Credits Gazi Village 9-10 June 2010.*

Respondents were invited to add qualitative comments on forms giving examples of any perceived opportunities that might arise from the proposed project along with any possible threats. These comments are represented on the next two pages, with font sizes proportional to the number of times each one was raised. Swahili-English translation has been inserted using translation from Google Translate.

msaada kwa vizazi vijavyo

(support for future generations)

kulinda bahari

(protect ocean)

kuimarisha mapato

(strengthening revenue)

hali bora ya anga

(improve the state of the atmosphere)

kutunza ufuo (maintaining the coast)

(building mangroves)

mikoko ya kujenga

kuimarisha mazingira

(strengthening the environment)

Nafasi

(Oppurtunity)

ukosefu wa kuni (lack of fuel)

ukosefu wa mikoko ya kujengea

(lack of mangroves for building)

kuhusika kwa KMFRI kwenye miradi

(Involvement of KMFRI in projects – Kenya Marine Fisheries Research Institute)

(failure of previous projects)

kutofanikiwa kwa miradi iliotangulia

Vitisho

(Threats)