Institution: University of York
Unit of Assessment: 7, Earth Systems and Environmental Science
Title of case study: Measuring and Conserving Biodiversity
1. Summary of the impact

Research by Andy Marshall has led to conservation of biodiversity. The research has spawned a long-term conservation project that is saving a threatened forest from destruction and has led to improved awareness of forest value and sustainable behaviour by local communities. The work has also led to a centre for biodiversity/education research, two educational books, and species revisions on the international Red List. Work on Biodiversity Action Plans (BAPs) led to the development of the world's first BAP by a zoo, followed by workshops and a paper, that are being used for an advice pack to be circulated to over 100 British zoos. Marshall is a regional committee member for monitoring UK BAP targets. Marshall is a senior member of a national committee for encouraging field conservation by zoos, and through this led a report used in a parliamentary debate. Three awards have been received.

2. Underpinning research

Marshall has been conducting forest biodiversity research in Tanzania since 1998. Marshall has been based at the University of York since 2002, starting as a Research Fellow and progressing to Lecturer. Biodiversity conservation is important for ecosystem health and as such is a key target of the UN Millennium Development Goals and the Convention for Biological Diversity.

Marshall's initial work in Tanzania (1998-2006) included field surveys of wildlife for determining the threats of weak protected area designation on forest biodiversity. Marshall used key animal and plant species as indicators of ecosystem health, and emphasised the negative influences of human activities on forest biodiversity. Marshall's early papers emphasised the need for protected area designation to reduce threats to biodiversity. Marshall also made notes and collections on the species composition of these poorly explored areas, resulting in various notes and popular articles.

In 2007-8, Marshall's natural history exploration then turned more towards forest management, through his involvement on the Valuing the Arc project. Under this project Marshall established permanent sample plots for assessing carbon stocks in the Eastern Arc Mountains of Tanzania. This work was the first in the region to employ internationally standardised methods for the measurement of above-ground carbon stocks, and hence provided a baseline estimate for use in carbon creditation schemes. The work showed that previous estimates have seriously over-estimated carbon stocks due to inappropriate methods (Marshall et al., 2012a).

While working on the Valuing the Arc project (2007), Marshall also carried out a consultancy for the WWF-Tanzania programme office with the aim of providing ecological data for supporting improved conservation of a threatened forest named Magombera. The surveys found that the Magombera forest had huge value for biodiversity, especially among the trees, for which >40% were either threatened or restricted in range. These data were used to compile recommendations for future management, including habitat restoration, ecological monitoring, education and sustainable use of natural resources (Marshall, 2008).

More recently, Marshall's biodiversity research in Tanzania led to a formal link with the UK's most visited zoo, Flamingo Land (FL). This spawned a wide-range of practically-orientated research projects investigating biodiversity management, animal exhibit design, measuring the success of environmental education, and the role of zoos. One of the first research outputs from this new partnership was a review of the effectiveness of zoo-led biodiversity conservation projects, culminating in a report on the top ten species dependent on field conservation by zoos for survival (Marshall et al., 2012b) and a proposed method for development of zoo-based biodiversity action plans (Zoo BAPs: Hambly & Marshall, in press).

3. References to the research

Hambly, N., Marshall, A.R. (in press) Zoo BAPs: Biodiversity Action Plans for conserving native wildlife in and around zoological gardens. Journal of Zoo and Aquarium Research. (Peer-reviewed journal article.) *(Available on request)*

Marshall, A.R., Willcock, S., Lovett, J.C., Balmford, A., Burgess, N.D., Latham, J.E., Munishi, P.K.T., Platts, P.J., Salter, R., Shirima, D.D., Lewis, S.L. (2012a) Measuring and modelling above ground carbon and tree allometry along a tropical elevation gradient. Biological Conservation 154 20-33. DOI: 10.1016/j.biocon.2012.03.017. (Peer-reviewed journal article.)

Marshall, A.R., Robinson, J.E., Hindle, B. (2012b) The Top Ten Species Dependent on Zoos. BIAZA Field Programme Committee. (not a peer-reviewed journal article, but required extensive literature review and in-depth correspondence with several experts from across the UK) *(Available on request)*

Marshall, A.R. (2008) Ecological Report on Magombera Forest. Consultant report, Worldwide Fund for Nature, Tanzania Programme Office. (not a peer-reviewed journal article, but quality emphasised by condensed version of this report published subsequently – see "Marshall 2008 Assessing and Restoring Biodiversity" in REF2) *(Available on request)*

4. Details of the impact

Conservation of biodiversity:

- Forest conservation (Marshall, 2008): Marshall assisted the WWF Tanzania Programme Office in securing funds for ecological and socio-economic surveys to support increased protected status of the threatened Magombera forest. Marshall's role in this funding was **ecological consultant,** culminating in an ecological report emphasising the high biodiversity importance of Magombera forest. The report and its recommendations for safeguarding the forest were then presented to Flamingo Land Resort, who subsequently proposed the **establishment of a long-term trust fund** for conservation work in the region. As Executive Trustee of the trust fund, Marshall used this to establish the **Udzungwa Forest Project (UFP)**. The fund now **employs eight staff**, who are monitoring and managing the forest, and working with local villages. The biodiversity result has been an **increase in tree biomass in areas of UFP activity, compared to a decrease outside of this area, and an increase in tree stem regeneration in restoration plots**.
- Awards: UFP was **awarded "Best Field Conservation Project"** by the British and Irish Association of Zoos and Aquaria (BIAZA) and Flamingo Land was awarded the **David Bellamy Conservation Gold Award** for its partnership with the University.

Awareness-raising and training:

- Forest conservation (Marshall, 2008): Ecological surveys of the Magombera forest have directly led to the development of training for local people under UFP. **Approximately 10,000 villagers living adjacent to Magombera forest have been reached** by training in the construction of fuel-efficient stoves, and by educational films powered by an innovative pedal-powered cinema. A **book has been written to inform local villagers on conserving forests**. Thousands of primary school children have also been taught about forest and biodiversity conservation. School fees of around 140 secondary school children have been paid. Experiments are underway to trial the potential for tree-planting and alternative energy sources to reduce forest damage, including establishment of permanent tree nurseries and distribution of over 6,000 trees to date. Four villagers living adjacent to the Magombera forest have been trained in ecological survey methods.
- Forest monitoring (Marshall et al., 2012a): Marshall's work on assessing carbon distribution in Tanzanian forests has led to the development of a **capacity-building course in carbon measurement and statistical modelling methods**, that was attended by representatives from eleven East African institutions in 2013, and will be repeated in 2014.

- Biodiversity conservation (Marshall, 2008; Marshall & Deere, 2011 [section 5]): As a direct result of the establishment of UFP in Tanzania (following Flamingo Land's assessment of the ecological report), Marshall is now Vice Chair of the BIAZA Field Programme Committee (FPC). Since 2011, Marshall's responsibility on the committee has been to assess the financial contribution of the zoos of Britain and Ireland to biodiversity conservation. The results are being used to advise zoos on increasing their contribution to field conservation.
- Public education (Marshall, 2008): The link with Flamingo Land, initially established through Marshall's ecological work (see UFP creation), has led to **creation of a unique research and education centre (CIRCLE)**. CIRCLE's mission is to use scientific evidence to guide biodiversity conservation, animal welfare and public understanding of the natural world. Activities aim to disseminate information to non-academic audiences, through **classes/presentations at Flamingo Land (FL), a weekly newspaper column, monthly bulletin, and information signs**. FL is the UK's most visited zoo, with 1.3 million annual visitors.
- Awards: Marshall's CIRCLE initiative was awarded the **2013 PraxisUnico Collaborative Impact Award**, which recognises "… those teams, and individuals, that have produced outstanding impact through successful knowledge transfer".

Encouraging stakeholder action:

- Stakeholder engagement (Marshall, 2008): Behaviour change through UFP's village education work mentioned above has been seen through a **rise in the proportion of households using fuel-efficient stoves (15% in 2011, to 32% in 2013)**. These activities have led four villages to sign **Memoranda of Understanding in support of forest conservation activities** by UFP, and one village has developed a **bye-law enforcing use of sustainable fuel technology by all households**. **Lobbying letters and meetings** are used each year to raise government and other stakeholder awareness of the plight of Magombera forest, leading to **legal support for conservation of Magombera forest as a Nature Reserve** and part of the forest is now in the process of formal gazettement by the Tanzanian government.
- Biodiversity action (Hambly & Marshall in press): CIRCLE have also now developed the **world's first zoo-based Biodiversity Action Plan (Zoo BAP)** for FL managers to contribute to international biodiversity targets. This Zoo BAP has resulted in biodiversity conservation measures at FL, including the **planting of 6,000 trees** in partnership with the Woodland Trust. The BIAZA Native Species Working Group has agreed to incorporate the Zoo BAP into an information pack to be sent to all 102 BIAZA member zoos.

Public debate (Marshall et al., 2012b): Following Marshall's development of a list of the top ten species most dependent on zoos for survival, **Lord De Mauley used the report to reinforce a parliamentary debate on government funding for zoos**. The report included the ***Polyalthia verdcourtii* tree, whose existence is dependent on the work of UFP**

5. Sources to corroborate the impact

Conservation of biodiversity:

- Scanned letter from Flamingo Land Theme Park and Zoo confirming initiation of long-term trust fund for the Udzungwa Forest Project explicitly stating Marshall's ecological report as the impetus.
- Progress report by UFP dated April 2013 outlines the biodiversity impacts of UFP's work including the increase in biomass along research transects (p9) and in restoration plots (p11).
- Certificate for BIAZA Best Conservation Project for UFP (and photo of Marshall receiving this award from TV celebrity vet Steve Leonard).
- Award notification for the David Bellamy Conservation Award including personal statement from David Bellamy citing partnership with the University of York as the primary reason for granting the award.

Awareness-raising and training:

- Facebook page highlighting UFP awareness-raising activities, including various photographs of project work in action, and references to Marshall as UFP Director: https://www.facebook.com/UdzungwaForestProject.
- Book: Boswell & Marshall, 2011 Saving Our Forests. ISBN 978-0-9569862-0-7 (and Swahili translation ISBN 978-0-9569862-1-4).
- List of course participants that attended the carbon assessment course.
- A report (Marshall & Deere 2011 BIAZA Research Newsletter 12(4) 2-3), and powerpoint presentation (Marshall & Darling 2013) highlight Marshall's role in evaluating annual conservation data for all British zoos.
- PraxisUnico Impact Award press article: http://www.york.ac.uk/news-and-events/news/2013/research/business-collab/ (note: from here there is also a link direct to the PraxisUnico website)

Encouraging stakeholder action:

- Progress report by UFP dated April 2013 contains a summary of the fuel-efficient stove data on p11 and 12 (same report also used above for biodiversity conservation impact).
- Scans of signed village MoUs and letter from village chairman confirming creation of a sustainable fuel bye-law. *(in Swahili)*
- Lawyers' task force report (Aloo et al., Sept 2012) outlining legal support for conservation of Magombera forest, acknowledging "Dr. Andrew Marshall of the Udzungwa Forest Project (University of York/Flamingo Land)... support to Magombera forest conservation which was done through their previous work and/or studies on the need to conserve and protect Magombera Forest which provided the basis of some findings of this assessment report and which actually led to this assessment."
- Signed agreement between the Woodland Trust and Flamingo Land (signed by Marshall) and extracts from the agreement and delivery notes listing 6,000 tree saplings for planting (the first of these mentions Marshall and CIRCLE)
- E-mail communication with BIAZA regarding Zoo BAP info pack.

Transcript from the House of Lords debate where the top ten species report was cited (see p12).