The role of restoration ecology in mitigation of climate change and loss of biodiversity

Thursday 27th November 2008

At the Linnean Society of London

Programme and Abstracts

Many terrestrial and marine ecosystems, which are being eroded by human activities, are central to climate regulation and the damage is exacerbated by positive feedback from the changing climate. Along with the resultant loss of habitat and changing environmental conditions, species extinctions are occurring at alarmingly high rates.

This meeting addresses the extent to which restoration of damaged or lost biologically diverse ecosystems could contribute to mitigation of climate change globally or regionally. It will discuss some current field work that aims to mitigate both climate change and loss of biodiversity, looking at the technical, social and economic aspects of implementation. This will be augmented by a poster session that presents a range of projects and related activities around the world.

Finally, an expert panel will debate priorities for conservation practitioners, for government and institutional support and for private sector action.

THE ROLE OF RESTORATION ECOLOGY IN MITIGATION OF CLIMATE CHANGE AND LOSS OF BIODIVERSITY

27th November 2008

Programme

Chair: Morning session: **Sir Ghillean Prance**

10.00 Chairman's introduction

10.10 The impact of climate change on major habitats and the contribution of major biomes to climate regulation and mitigation of climate change
Chris Jones, *Met Office*

10.45 Hotspots of diversity and extinction: identifying future battlegrounds of mammalian conservation
Andy Purvis, *Imperial College London*

11.20 Coffee

11.50 REDD: the international climate change process
John Lanchbery, *Royal Society for the Protection of Birds*

12.25 Competition for land: food/climate mitigation/conservation
Renton Righelato, *World Land Trust*

13.00 Lunch

Chair afternoon session: **Professor David Cutler**

14.00 Peatlands loss and restoration
Pieter van Eijk, *Wetlands International, Wageningen*

14.35 Forest loss and restoration – a case study of montane tropical forest
Dominick Spracklen, *University of Leeds* and **Roger Wilson**, *World Land Trust*

15.10 Tea

15.40 Mangrove ecosystem restoration and its potential contribution to climate change adaptation and mitigation
Don MacIntosh, *Mangroves for the Future, IUCN, Asia*

16.15 Panel led discussion on (a) prioritising regions and habitats and (b) facilitation: governance, institutional structures, funding mechanisms.

17.00 Reception in the Linnean Society's Library

ABSTRACTS
Invited Papers

Morning Session

The impact of climate change on major habitats and the contribution of major biomes to climate regulation and mitigation of climate change

Chris Jones
Met Office Hadley Centre, UK

Climate change will affect ecosystems, and ecosystem changes will affect climate. The two are tightly coupled within the Earth System. Understanding these interactions and feedbacks is essential to inform successful policies of both mitigating and adapting to climate change.

Here I will discuss research into the impact of climate change on major ecosystems, including how they will continue to respond for long after climate may be stabilised. I will also discuss how both natural and managed ecosystems can contribute to mitigation of climate change, not just in the tropics but around the world.

Hotspots of diversity and extinction: identifying future battlegrounds of mammalian conservation

Andy Purvis
Imperial College London

Global conservation prioritization usually emphasises areas with the highest species-richness or where many species are thought to be in imminent risk of extinction. However, this is a reactive approach to conservation planning, which may not be optimal given the scale of ongoing global changes. In this talk, I outline how we can identify species that are not yet declining rapidly but whose biological attributes make them likely to decline if human impacts increase.

Large-scale comparative analyses of risk patterns and correlates make it possible to see how the levels of extinction risk in a region depend on the intensity of human effects, which varies greatly across the globe. This

spatial variation in levels of damage make it possible in principle to predict how extinction risk patterns will change as impacts increase. Climate change has so far not been a major driver of mammalian decline, making it hard to model in the same way, but can be included by considering it as a driver of habitat loss. The framework could help to highlight the consequences of choosing among different future climatic and socioeconomic scenarios, and could help conservation efforts to get ahead of the curve, rather than reacting to declines that are already underway.

REDD: the international climate change process

John Lanchbery
Principal Climate Change Advisor, Royal Society for the Protection of Birds

Reducing emissions from deforestation and degradation in developing countries (REDD) is now a core part of the so-called Bali Action Plan for an international post-2012 climate change regime. REDD has come a long way since it was first proposed by Papua New Guinea (PNG) and the Coalition for Rainforest Nations (CfRN), as a way of financially compensating developing countries for reducing their emissions from deforestation.

REDD now includes not only the concept of rewarding countries for reducing deforestation but for slowing degradation too. Also, the scope of the regime now includes sustainable forest management and enhancement of carbon stocks.

Although the concept of REDD is supported by all nations, there is considerable disagreement about how governments would be compensated for reducing emissions and enhancing carbon stocks. Some nations, such as PNG, support a market-based approach whereas others, such as Brazil, favour a fund. In between there is a host of proposals for market-linked approaches and different types of fund. A key issue is to develop a mechanism that will deliver the sums of money needed to address the drivers for deforestation, which are conservatively estimated at about $10 billion per year.

Participating in a REDD regime will require a level of domestic capacity that many countries with tropical forests currently lack. All countries thus

agree that, for the next few years, large amounts of capacity-building money will be required.

The final form of a REDD regime is expected to be agreed as part of a post-2012 deal in Copenhagen in December 2009.

Competition for land: food/climate mitigation/conservation

Renton Righelato
World Land Trust

Most of the loss of species rich terrestrial habitat in the last century has been through anthropogenic change in land use - although agricultural land has gone out of production in N America and Eurasia, huge areas of forest and grassland have been converted to pasture and crop production in the tropics. The demand for oil crops, maize and sugar for biofuels competes for land with food production and brings about further land conversion. The avoided emissions from biofuels use are generally less than the carbon that would be sequestered by forest restoration; moreover, the emissions associated with land use change are large compared with the avoided emissions. Hence, maintenance and restoration of forests ranks above biofuels for carbon mitigation. A range of analyses suggest the potential for forest restoration on substantial areas of land at realistic carbon prices.

Afternoon Session

Peatlands loss and restoration

Pieter van Eijk
Wetlands International, Wageningen

Peatlands are increasingly subject to degradation resulting from land conversion, fires, drainage and overexploitation. Each year, this leads to the release of enormous quantities of carbon dioxide, equivalent to 11.5% of global fossil fuel emissions. In Southeast Asia, degraded peat soils emit a staggering 2000 Mton CO_2 annually, largely as a result of oil palm and pulp plantation development.

For over 10 years Wetlands International and partner organizations have been piloting community-based peatland restoration measures, involving construction of dams in drainage canals, fire suppression, land-use planning and re-greening activities. This has led to an estimated avoided emission of 5,000,000 ton of CO_2. Currently efforts are being made to upscale these approaches, by developing formal market mechanisms for trading of peatland carbon and by investigating options for inclusion of peatlands under REDD.

Forest loss and restoration - a case study of montane tropical forest

Dominick Spracklen[1] and Roger Wilson[2]
[1]University of Leeds and [2]World Land Trust

Tropical montane forests are well known reservoirs of biodiversity, supporting a large range of endemic and threatened species, but have largely been overlooked as substantial carbon stores. Here we use case studies of montane forest restoration in Ecuador to demonstrate the potential for carbon sequestration combined with biodiversity protection.

Using permanent one-hectare forest plots we show that mature tropical montane forest in Ecuador stores more than 100 tC/Ha (above-ground) with little reduction in storage over an altitude gradient from 500 m to 2500 m. Over this gradient a reduction in living biomass is largely offset by increased storage in dead wood. Natural regeneration of abandoned pasture sites sequesters 5 tC/Ha/year for the first 15 years.

Use of this carbon stocking potential has been tested as a conservation financing mechanism through voluntary greenhouse gas emissions offsetting in small-scale demonstrations. Land parcels carrying mosaics of forest patches and open pasture are secured and incorporated in reserves. Sequestration comes from a combination of avoided deforestation and reforestation through assisted natural regeneration supplemented by enrichment planting.

The scheme has proved a useful additional tool for forest protection but carries high long-term monitoring costs. At a small scale it is attractive to individuals and enterprises who wish to conserve biodiversity while voluntarily addressing their personal carbon footprint, and are willing to pay accordingly. The techniques are suitable for full independently

verified sequestration projects but these only become viable at larger scale. World Land Trust is now moving in this direction, expanding the original demonstration activities accordingly.

Mangrove ecosystem restoration and its potential contribution to climate change adaptation and mitigation

Donald J. Macintosh
Coordinator, Mangroves for the Future (MFF) initiative

Efforts are being made to restore and protect mangroves in many tropical and sub-tropical countries, particularly as a mitigation response against typhoons (cyclones) and tropical storms, other flood risks and coastal soil erosion. In countries such as Bangladesh, India, Thailand and Vietnam, mangrove "green-belts" or Full Protection Zones have been established through assisted restoration, or rehabilitation. The December 2004 tsunami prompted these and other countries to scale up their mangrove restoration efforts, while even more recent events, such as Typhoon Sidr (Bangladesh, November 2007) and Typhoon Nargis (Myanmar, May 2008) have revealed how effectively mangroves can mitigate against severe climatic events; but conversely, how loss of mangrove forests can contribute to the greater severity of such disasters.

Restoration or rehabilitation usually involves planting one to several species of mangrove propagules or seedlings, either in degraded forest sites devoid of tree cover, or in areas previously converted for agricultural, aquacultural or industrial uses. Species of the dominant mangrove families Rhizophoraceae, Avicenneaceae and Sonneratiaceae have already been used widely for this purpose and effective propagation and planting techniques have been developed to meet various restoration needs and site conditions.

Because different mangrove species are adapted to various intertidal levels (and therefore to different degrees of seawater inundation), it can be assumed that mangrove communities have good potential to adapt to climate change, but sea-level rise is the greatest threat they face. Conversely, temperature rise and increased CO_2 levels are actually likely to increase mangrove productivity and enable mangroves to extend their distribution into higher latitudes. Moreover, within short time scales of a few years, replanted areas usually become colonised by other mangrove plant species. The number of mangrove-associated animal species also

increases rapidly and, as a result, mature mangrove plantations can become almost as diverse floristically and faunistically, and productive, as natural forest habitats.

To date, human impacts on mangroves have been more severe than the threats attributable to climate change, resulting in 35-86% loss of mangrove habitat in specific countries. While healthy mangroves are considered to be quite resilient to climate change, any additional stress from human activities (including other climate change mitigation responses) could act negatively on the adaptive capacity of mangroves. For example, diversion of surface freshwater for irrigation purposes, groundwater extraction, construction of seawalls and other coastal engineering structures, further forest degradation, pollution, or human encroachment into the back-mangroves, could significantly increase the vulnerability of mangroves to climate change events. Thus, to be effective, mangrove restoration efforts should be integrated into an overall coastal planning process that *inter alia* protects the resilience of mangroves to climate change.

ABSTRACTS

Posters

The impact of human activities on mangrove ecology at Ra's al-Hadd, Oman from the Early Bronze Age to the present day

Caroline R. Cartwright
The British Museum

The British Museum has carried out several seasons of archaeological excavations of 3rd millennium BC and later sites at Ra's al-Hadd, Oman. Many different types of site were investigated in order to examine cultural, environmental, subsistence, economic, trade and burial patterns through time. These included settlements, cairn burial tombs and workshop areas. A wide variety of highly diagnostic environmental material was recovered, including charcoal, charred seeds, pollen, fish, marine molluscs, turtle, land and marine mammal bones. Using this evidence, I examine in this poster to what extent the present-day seasonal occupation of Ra's al-Hadd is a result of systematic human over-exploitation of mangrove and lagoon resources over time.

The evidence shows that during the period 3000 - 400 BC the process of mangrove impoverishment had taken hold. Overexploitation of mangrove trees disturbed the fragile balance of this ecosystem, resulting not only in a loss of useful timber and fodder, but in a decline in its resident species of fish, molluscs, birds and crustacea. Less resource diversity was present and there are signs of general increasing aridity. These environmental changes put considerable pressure on the people, their animals and their dependence on the natural resources of the region.

Site-Based Biodiversity Action Plans: Promoting Biodiversity Enhancements and Climate Change Awareness in Quarry Operations and Restoration

Bob Edmonds
SLR Consulting

Minerals operators in the UK, like much of UK industry, are now beginning to tackle climate change and biodiversity issues head-on by looking at ways to sequester carbon and enhance biodiversity in their operational sites and upon restoration. On behalf of Tarmac, SLR Consulting Ltd has developed a series of action plans for quarry sites in Scotland, Northern Ireland and the West Midlands which aim to enhance biodiversity and tackle climate change now and in future restoration. The project has delivered Quarry BAPs for more than 40 sites and over 1500 hectares of land. The poster presents examples of two sites, Cloddach Quarry in Morayshire and Ravelrig Quarry in Lothian where we have chosen restoration options that aim to mitigate climate change through carbon sequestration and maximise biodiversity value of restored sites.

Community-based Mangrove Rehabilitation in the Philippines

LOTTERY FUNDED

Amy Pryor, Jurgenne H.Primavera, Josephine Savaris, Rosalie Joven, Janine Caynap & Alison Debney
Zoological Society of London

Panay Island, in the Western Visayas of the Philippines, used to possess over 12,400 hectares of mangrove forest. Due to extensive clearing to make way for shrimp and fish ponds only 300 hectares remained in 1988, with a resultant loss of biodiversity and ecosystem services.

Zoological Society of London (ZSL) has been working in the Philippines for over ten years delivering sustainable natural resource management. The experience and knowledge gained from working with the Philippines coastal communities and the coastal and marine environment identified the social and environmental need for mangrove rehabilitation: to address coastal erosion, declines in fisheries, water quality issues, coral reef and seagrass health.

In 2008, a new project was established by ZSL, supported by the Big Lottery Fund. The aim of this project is to support the coastal communities of Aklan, Capiz and Iloilo Provinces, Panay Island by reverting abandoned, undeveloped and underutilised fishponds to healthy mangrove forests. This will provide the communities with increased coastal protection, food resources and livelihood income through the sustainable and equitable management of the forest.

Harapan rainforest: restoration of Sumatran lowland forest

Ian Rowland
Royal Society for the Protection of Birds

Harapan Rainforest is a 101,000ha restoration project in central Sumatra, Indonesia. It comprises two former forest concessions, logged to the point at which they held no economic value beyond clearance for plantations. The area had also been subjected to intense pressure from illegal logging and encroachment, and damage from fires.

Despite this damage, Harapan Rainforest represents approximately 20% of the remaining severely threatened Sumatran dry lowland forest, of which there were 16 million hectares at the beginning of the twentieth century, now reduced to below 500,000ha. It is, at the same time, one of the most diverse and one of the most threatened habitats on earth. Harapan Rainforest maintains important populations of the critically-endangered Sumatran tiger, Asian elephant, sun bear, clouded leopard and Malayan tapir. It is also home to 282 bird species.

Deforestation accounts for 18% of the world's greenhouse gas emissions. By preventing natural forest from being razed, Harapan Rainforest is protecting carbon stores vital in the fight against climate change. In addition, by promoting the regeneration of degraded forest, it will lead to

the active uptake of carbon. Initial estimates suggest that the net carbon benefit of Harapan Rainforest will be up to five million tonnes of CO_2 per year.

To preserve these biodiversity and carbon values, the forest is now managed for ecosystem restoration by a consortium of the RSPB, Burung Indonesia and BirdLife International.

This site is representative of nearly 60 million hectares of logged out concessions in Indonesia and, as such, offers a real alternative to clearing logged forest and both protects carbon and biodiversity.

Habitat restoration for the conservation of threatened species

Nigel Simpson and Francisco Sornoza Molina
Fundación Jocotoco - Ecuador

Fundación Jocotoco is a conservation organisation in Ecuador which has formed eight habitat reserves in the Andes and west of the country. These are located to provide protected areas for globally threatened bird species. This region has about 90 such threatened species due to the combination of high level of deforestation and other human impacts, with high species diversity and endemism. Restoration of fragmented natural habitat is a necessary component of its conservation programme.

Whereas some degraded areas regenerate naturally, more often replanting with native species of trees is undertaken. Examples of this work are given in four different habitat types (i) very wet temperate east slope forest at 2500m (ii) seasonally wet tropical west slope cloudforest at 1000m (iii) seasonally dry deciduous forest ('Tumbesian') at ca 800m (iv) cool cloudforest at 3000m in the Central Andes. About 150,000 trees have been planted during the last two years, typically using about 10 native species at each site. Examples of natural regeneration are also illustrated Using the results of Spracklen et al the reforestation plots should sequester ca70,000t of carbon in 20 years, and 100,000t in 40 years.

Posters will be displayed in the Library on the first floor and can be viewed during lunch and tea breaks

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THE LINNEAN SOCIETY OF LONDON

The Linnean Society of London is the world's oldest active biological Society. The Society's Fellowship is international, and its Fellows are drawn from all walks of life, ranging from leading professional scientists to amateur naturalists. The original Royal Charter cites the Society's main aim as *'the cultivation of the Science of Natural History in all its branches*'.

The Society is named after the great Swedish naturalist, Carl Linnaeus (1707-1778) who developed the system of binomial nomenclature. This system today provides the fundamental framework for knowledge of the biota of the Earth, supporting effective conservation measures and the sustainable use of biodiversity.

Since its foundation in 1788, the Society has been an assiduous cultivator of knowledge of the natural sciences, through its meetings, its grants and projects and its journals. It was through the Society that the Linnaean system of binomial nomenclature was chiefly promoted over 200 years ago. It was at a meeting of the Society that Darwin and Wallace's ideas on evolution by natural selection were first presented.

In the early 20th century, the Society was a crucible for the new sciences of evolutionary biology, genetics and ecology, as it was again some fifty years later for the measurement of biodiversity and the practice of conservation. Latterly, the Society has been a midwife to pioneering taxonomic techniques such as cladistics and genomics; it has sparked important developments within medicine and the social sciences through the work of its ethnobotanical Fellows; it has made substantial scientific contributions to the debates around climate change.

In its premises in Burlington House, Piccadilly, the Society maintains the majority of Linnaeus' plant and animal research collections, as well as his library, under optimum conservation conditions. These are of continuing fundamental importance as a primary reference for taxonomy. The collections are enhanced by the Society's unique, rich library, open to Fellows and all interested from the public, which provides key resources for research.

For more information visit:
www.linnean.org

The LINNEAN SOCIETY of London

THE WORLD LAND TRUST

The World Land Trust is an international conservation charity (Reg. No. 1001291), based in Suffolk. It was founded in 1989, initially to raise funds to save 110,000 acres of tropical forest in Belize that was threatened by imminent destruction. Since then WLT has gone on to save almost 400,000 acres of tropical forests and other endangered habitats across the world. WLT aims to preserve the world's most biologically important and threatened lands, together with all their biodiversity, and currently has active land purchase and protection projects in Argentina, Bolivia, Borneo, Brazil, Ecuador, India, Mexico, Paraguay and the Philippines.

An essential part of the World Land Trust's philosophy is always to work through local partner NGOs, believing that too many organisations ignore the opinions, knowledge and sensitivities of the local people. WLT works to empower its local partners by raising funds and providing the finance for land purchase, and then vesting the ultimate ownership of the land with them. Management of the reserves is agreed with the NGO and WLT also assists its partners in sustainable development of these reserves by providing a wide range of assistance, including equipment (computers, GIS), technical advisors on short term contracts and publications and reference books.

The World Land Trust also runs a Carbon Balanced programme: www.carbonbalanced.org, which gives companies and individuals an opportunity to offset their unavoidable carbon emissions. Funds generated for carbon projects are used, not only as a tool to address climate change, but also to assist WLT's biodiversity projects, by replanting and assisting natural regeneration of habitats that have been previously cleared, usually adjacent to protected reserves.

The Trust is supported by many eminent conservationists, and Sir David Attenborough OM CH FRS, and David Gower OBE are its patrons.

WORLD LAND TRUST

For more information visit:
www.worldandtrust.org

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