



**CENTRE FOR ECOLOGY AND HYDROLOGY - MONKS WOOD
NATURAL ENVIRONMENT RESEARCH COUNCIL**

**DEPARTMENT OF BIOLOGICAL SCIENCES, FOURAH BAY COLLEGE
UNIVERSITY OF SIERRA LEONE**

Habitat Audit and Change Detection in Sierra Leone

Dr. R A Wadsworth (*CEH Monks Wood*)

Professor Hector G. Morgan & Dr. Abdul B. Karim (Fourah Bay College)

June 2004

CEH PROJECT No: C02009

CONTRACT NO: 11-006



Darwin Initiative for the Survival of Species

Final Report

1. Darwin Project Information

Project title	Habitat Audit and Change Detection in Sierra Leone
Country	Sierra Leone
Contractor	Centre for Ecology and Hydrology
Project Reference No.	11-006
Grant Value	£60k
Starting/Finishing dates	April 2002 – April 2004

2. Project Background/Rationale

Background: Ten years of civil war in Sierra Leone caused the displacement of somewhere between one third and half the rural population (there are no reliable statistics). This movement of people and the attendant changes in land use were believed to have had a major impact on land cover and hence on biodiversity. There were no quantitative estimates of what these changes were. Reports on the environment of Sierra Leone endlessly repeat the estimates of land cover published by the FAO in 1970. The BSAP (Biodiversity Strategy Action Plan), NEAP (National Environment Action Plan) and the NSSD (National Strategy on Sustainable Development) all use the FAO estimate of land cover as a base line and none of them contain any maps. Sierra Leone can not meet its obligations under the Convention on Biodiversity unless it knows what it possesses; and land cover must be one of the major determinants of biodiversity.

Staff at the University, (and in other stakeholder organizations), were unable to make quantitative estimates of land cover or land cover change. The lack of quantitative estimates hindered their ability to monitor or assess the threats facing biodiversity, their ability to plan for its protection or sustainable utilization and their credibility when dealing with decision makers in the Government Ministries and with external organisations.

Developments in technology particularly cheap hand-held GPS (global positioning system) devices, more sophisticated image processing software and geographic information systems (GIS) plus relatively cheap satellite remotely sensed data (RS) means that land cover mapping is now technically possible for almost anyone with a reasonably up-to-date computer. Traditionally land cover maps are general purpose objects that result from a multitude of compromises between: the end users, the funding agencies and the technical experts. We believe that general purpose land cover maps are often inappropriate and that a map should be tailored to answer a *specific* environmental question or problems. Maps should be designed by the domain expert so that the “classes” within the map are as close as possible to the semantic and ontological understanding of the relevant discipline and not what a remote

sensing expert thinks is convenient. The classic case of ontological and semantic confusion revolves around the term “forest”, Lund (2002) has catalogued over 550 definitions involving land use, potential land use, land cover, productivity, history, administrative or ownership and miscellaneous characteristics etc. if you are going to map forest you need to be explicit what you mean and realistic in what you can measure (provided of course that your definition requires trees to be present in your “forest”).

The Problem: The “problem” is that no one has a good idea of how much natural resources exist in Sierra Leone, let alone the state of its biodiversity resource. Almost all accessible reports on Sierra Leone are produced by external “experts” these have the tendency to prefer existing “information” from the previous expert’s report to trying to find funds to collect or review that information. A culture of dependency within Sierra Leone, especially within the Government further diminishes the status of the local expert. The University is woefully under resourced, suffers a debilitating “brain drain” and many of the staff are forced to take additional external jobs to remain solvent and therefore have little time for research. The problem may be divided into two components; technical and institutional.

Technical problem is “what sort of habitats and land cover types can be reliably identified from the satellite data?”

Institutional problem is “how to create a group of researchers capable of carrying out land cover / habitat mapping in other parts of the country and in the future?”

It should be noted that in our proposal we underestimated the significance of the Institutional problem but that our stakeholders corrected us in the start up workshop.

Project identification: PI (UK) has had contact with Sierra Leone since 1981 when he went out to an agricultural development project with VSO (voluntary service overseas) and he has maintained contact with the country ever since. Having watched the weight of a GPS decline from over a 100 kg (in 1986) to a few hundred grams (today) and the development in sophistication and ease of use of GIS, he believed that they could be used anywhere. PI’s (SL) were major contributors to the development of the Sierra Leone NSSD (national strategy on sustainable development) and co-authors of the BSAP (Biodiversity Strategy Action Plan) and NEAP (National Environment Action Plan). We made contact through the Sierra Leonian expatriate scientific community in the UK, (which is believed to be of a comparable size to the scientific community within Sierra Leone).

Demand: The University, local Conservation Society of Sierra Leone, local and international NGO’s had all recognised that the major change in the distribution of people in Sierra Leone had had a significant impact on habitats and land cover, but, there were no estimates of its extent, magnitude or significance. Fieldwork is inadvisable in some areas of the country even where it is possible mapping vegetation types in moist tropical forest environments from the ground is very difficult and time consuming. Estimates of habitats and land cover change should have been central to much of the thinking in the NSSD, NEAP and BSAP; each of these documents is in the order of 200 pages but none of them contain a single map. Priority project 3 of the BSAP is “Development and Implementation of a Biodiversity Database System (Bioinformatics)”, this is scheduled to take 5 years and cost \$1.5 million although the implementation plan provides no details of how this is to be achieved except: “Specialist technical resources and expertise will be solicited from sources available to the Biodiversity Coordinating Unit.”

Evidence of demand: for the interest in the project comes from several strands. First the university fulfilled its obligations in supply accommodation, a power supply and identifying trainees. Second the other stakeholders were keen to participate and vocal when given the opportunity to modify the project, to suggest case studies and to increase the amount of training provided. They were also keen to acquire and install the technology (data and software) within their own organisations.

3. Project Summary

The overall purpose of the project was to: Transfer skills and technology necessary to produce reliable maps of habitats and change in habitats from multi-spectral and SAR imagery". The overall objective was to: "create a group of researchers capable of carrying out similar mapping exercises in other parts of the country and in the future as reconstruction commences".

The original logical-framework is supplied as appendix VI.

Modifications to the project: The objectives and activities have not changed, however, their relative importance and time expanded on them has been rebalanced. The change in emphasis occurred at the beginning of the first year as a result of consultations with the stakeholders before and during the start-up workshop. A list of those that spoke at the start-up workshop and the case studies they suggested are provided in Appendix V.

Discussion with the various stakeholders identified four Sierra Leonians who have been trained overseas (in the USA, the Netherlands and Nigeria) in the use of geographic information systems, global positioning systems and remote sensing. Without exception on their return to Freetown they lacked appropriate source data and infra-structure and were forced to operate in isolation, because of this the inevitable organizational, financial and technical problems meant that their skills were rarely exploited for long if at all and quickly decayed. Stakeholders believe that what was needed was to try and develop a self sustaining "critical mass" of researchers using the technology. This group which could be centred on the activities started by our project could then help in sharing the cost of data, providing safe backup facilities, loan of equipment and mutual support activities etc. At the final workshop of our project the new Principal of Fourah Bay College (Prof Dan Fody) took the opportunity to announce that he has allocated funds for the reconstruction of one of the buildings on campus that was destroyed by rebels to become the National Centre for GIS and RS at the University. We received very strong encouragement from the British Council to establish a HEI Link programme, unfortunately this scheme was closed to new applicants more than a year ago and the details of the new scheme (following extensive review by DFID) have still not been announced.

The original proposal contained three study areas; the Western Area, Gola Forests & Tiwai Island and the Outamba-Kilimi National Park. The study of the Gola Forest and Tiwai Island were undertaken in the second year. This had the unexpected benefit of allowing the field work to be done in conjunction with two of the project stakeholders: the Environmental Foundation for Africa (EFA) and the Conservation Society of Sierra Leone (CSSL) together with field workers from the Wildlife Division of the

Forestry Department and a Forester from the Forestry Division and staff from FBC. Data produced as a result of these field trips is being used in the development of two more cooperative bids; one led by BirdLife International/RSPB on conservation concessions in the Gola Forest and the other by EFA on the eco-tourism potential of Tiwai Island. The field work in the Outamba-Kilimi National Park was carried out in the first year with the EFA, Njala UC and staff from the Wildlife Division. Activities in the Park led to its incorporation into a training scheme for Park Rangers led by EFA and Njala College and funded by Conservation International.

Additional unplanned field work was carried out in several areas. In the Kambia District trainees from FBC and RRRI (Rokuprr Rice Research Institute) concentrated on the spread of savannah vegetation and the abandonment of riverine rice growing areas. The representative from RRRI is currently completing his PhD in the Netherlands and is incorporating information from our project in his analysis.

In Kabala FBS trainees concentrated on the spread of savannah which is encouraged by the transhumance of cattle by the Fulas. We also had a brief excursion to the unofficial gold mines in the Lake Sonphon region, but decided to move on after a short visit. Transport problems on that trip prevent an inspection of the Bumuna Hydroelectric site where the impact on the surrounding landscape is clear from the satellite data; however, we have been included in a bid to the World Bank to carry out a (belated) EIA of the project.

Field work to the Kasawe Forest reserve provides a contrast to the Gola Forests especially in terms of plantations versus selective logging, overall objectives and resources available.

At Mokanji FBC staff were able to visit sites for the time in 10 years and the visit provided important information on the fate of abandoned and “restored” areas of Bauxite and Rutile mines. It is also important to note that the mining companies are legally required to restore land after mining but that their pre-war efforts on Rutile spoil were completely ineffective; this needs to be documented before mining restarts.

Two field trips were undertaken to the IVS (inland valley swamps) in central Sierra Leone accompanied by FBC and CSSL staff together with staff from the old Magbosi project.

Field work along the coast revealed that the Department of Lands were right to be concerned with the extraction of beach sand for building as the north end of Lakka has eroded over 40 meters in just under one year; EFA staff volunteered to continue recording erosion rates over this rainy season. Additional field surveys along the coast are contributing to the first ever assessment of the inter-tidal biotopes in Sierra Leone (two theses to be submitted this year).

Numerous field trips were undertaken in the Western Area Forests, these include visiting field plots run by staff from CSSL investigating the intermediate disturbance hypothesis on forest birds that has now been published as an academic thesis, (the remote sensing data being used to quantify disturbance and extrapolate the results). An honours student at FBC is about to submit her thesis on land cover change in the

Western Area (we tried to persuade her to study the far eastern part of Sierra Leone where we lack any field data but were unable to do so). Other field work in the WA was carried out with trainees from the Forest Department to investigate rates of encroachment and the identification of trial plots. Data have been supplied to a student studying the impact of refugee camps in Bo District.

None of the case studies (planned or unplanned) have included the SAR (synthetic aperture radar) data. In the Sierra Leone context we revealed that this data does not add significant additional information over that which can be obtained from good quality Landsat imagery. The “farm bush” is more productive than expected so that the backscatter saturates when it is still very young, this also prevents the creation of a DTM (digital terrain model) from the radar data for almost all the country. The lack of a sufficiently detailed DTM makes it impossible to separate the response from the vegetation from that of the terrain especially in the Western Area. Vegetated swamps in Sierra Leone tend to be so densely vegetated that there is no significant area of open water or open water under emergent trees the radar does not therefore offer any additional information over what is visible (the situation is different for the massive Amazonian and central African flooded forests). The radar is very good at identifying bare and sparsely vegetated areas (hence the use of SAR in studies of the Sahel) but these are also clearly visible on the optical data. If there was a requirement for a relatively crude land cover map in a year when there wasn't any good optical data then radar would produce a product as accurate as the Landsat data but not as precise. Given the amount of information we were already giving the trainees (and the risk of overload) and the lack of any significant benefit to them we (the PI's) decided to omit detailed consideration of SAR from the training.

CBD Activities: A breakdown of the activities of the project under the CBD are given in Appendix I.

CBD articles: The project will have an impact on many of the articles under the CBD, however, the most important articles are: Research and Training (12) and Access to and Transfer of Technology (16), these comprise about 90% of the actual effort of the project. Other articles where the project had a direct input are Identification and Monitoring (7) in particular the identification of a logging road constructed by the Liberians into the Gola North Forest Reserve shows how at least one threat to the forest can be assessed despite the inaccessible location of the site (physically difficult to get there from the Sierra Leone side and security issues if you do get there). Of course whether this monitoring is *useful* depends on whether the Forest Department decides to take action. The project has also had a direct but minor impact on Public Education and Training (13).

It is hoped that some of the project activities will enter the scientific literature through the case studies of how the resource base in Sierra Leone has changed. This will allow the local experts to be seen in a more equal footing to the external experts as well as helping answer specific environmental questions. For example nothing has ever been published on the restoration of Rutile or Bauxite mines in West Africa, the only African references are from South Africa where the climate is very different. Similarly the existing literature on the use of SAR for land cover mapping concerns either central Africa (where they have extensive flooded forest rather similar in some ways to the Amazonian flooded forests) or the Sahel region (where the important distinction

is scrub versus bare). There is virtually nothing published making a direct comparison between the *information content* of optical and SAR land cover maps.

Objectives: The majority of objectives have been achieved and there were a number of additional unplanned outputs (see Appendix II). Objectives which were not achieved were due to deliberate decision not to pursue them rather than actual failures. In particular we underestimated the speed with which the stakeholders would appreciate the benefits of the technology we were trying to introduce, we therefore spent less time on the “publicity” side of the project than we had originally planned.

4. Scientific, Training, and Technical Assessment

Staff: in terms of time much of the research over the two years was carried out with Abu Conteh and Saliue Sankoh both of whom are lecturers in the Department of Biological Science at Fourah Bay College. Abu Conteh is also secretary to the CSSL. A list of the trainees their organisations where they did field work in relation to which question is provided in the table below. The extent to which the field work contributed to the case study varies a great deal. Note that on all field work we were accompanied by at least one person from the local community nominated by the local Chief and in most cases by field workers from one or other of the key Ministries.

Trainee and affiliation	Area	“Question”	Output
Abu Conteh Lecturer FBC (& secretary of CSSL)	Western Area	Impact of land cover change on biodiversity in the FBC Botanic Reserve	Paper submitted
	Kambia	a) Spread of savannah b) Fate of the riverside grasslands?	Proposed case studies
	Kabala	a) Spread of savannah, b) impact of unofficial mining activities, c) impact of hydroelectric scheme	Proposed case studies, included in bid to perform EIA of Bumbuna
	Mile 91, Kasawe, Njala	a) IVS specifically the extent they and the bolis were still in cultivation. b) Comparison between Kasawe Forest reserve and the Golas	Case study, Proposed case study
	Mokanjii	Restored and abandoned rutile and bauxite mines	Case study and proposed paper
Saliue Sankoh Lecturer FBC	As above plus		
	Western Area	Coastal erosion triggered by extracting beach sand	Case study
	Western Area	Biotope mapping (supervising x2 research students)	Thesis to be submitted '04
Kabbie Kanu Herbarium technician FBC	Gola Forest	Occurrence of tree species	Data base and herbarium specimens.

	Mokanjii	Fate of restoration trial plots	Herbarium specimens
Dr. A.B.Karim Head of Dept. FBC	Gola Forest	Forest condition	Report to RSPB, bid for monitoring
Sheku Kamara & Moses Aruna Students FBC	Western Area	Biodiversity of the inter-tidal and near shore zone (north and south sections)	Thesis to be submitted '04
Suna Bundu student FBC	Western Area	Land cover change especially urban expansion	Thesis to be submitted '04
Mohamed Kamara(?) student FBC	Bo	Impact of refugee camp on forests	Thesis to be submitted '04
Sydney Johnson Senior Research Scientist RRRRI	WA	Land cover change, IVS	Proposed case study.
Robert Chakandah, Scientist RRRRI & Wageningen	Kambia	Land cover change; agricultural intensity	PhD thesis on agro-ecology to be submitted '06?
Mohamed Bah, Ministry of Lands	Western Area	Coastal erosion triggered by demand for building sand	Case study
Osman Bah, Ex-Magbosi IADP	Mile 91, Kasawe, Njala	a) IVS specifically the extent they and the bolis were still in cultivation. b) Comparison between Kasawe Forest reserve and the Golas	Case study, Proposed case study
Cecilia Utas , Project manager EFA	O-K NP	Potential for ecotourism	Potential for tourist maps, integration of land cover in GPS training
Tommy Gannet, Director EFA	Tiwai Island	Potential for ecotourism	Draft Business Plan
Gilbert Koker, Senior Conservator Ministry of Forestry	Western Area	Forest condition and demand for fuel wood (especially w.r.t. the fishing industry), forest condition Gola	Proposed case study
Dr. Lebbie Head of Department Njala. Science Director Tiwai	O-K NP	Distribution of large mammals and other "charismatic" species.	Case study, integration of land cover in GPS training
D.D.Safia Director CSSL	Gola Forests	Forest condition, threat of illegal logging and agricultural encroachment	Assessment of report produced by Forestry Dept., inclusion in the conservation concession bid for monitoring.
Arnold O-	Gola Forests	As above	

	Western Area	Intermediate disturbance hypothesis and forest birds	MSc. Thesis passed '03
--	--------------	--	------------------------

Methodology: teaching was orientated towards a “problem solving” paradigm as far as possible, the problems were expressed in a series of case studies. None of the case studies is actually finished, but a range of the more advanced ones are included in the attached “flier”. Case studies cover deforestation, mining, coastal erosion, spread of savannah etc and the topics were proposed or confirmed by the stakeholders at the start-up workshop. When not teaching or on field work more speculative research was carried out on the use of SAR.

Findings: From the case studies where we quantified land cover change (see hand outs).

Forests: In general any forest outside a Reserve that is even reasonably accessible has reduced significantly. Selective logging within the forest is difficult to identify from the satellite data. Clear cutting for timber is rarely practiced in Sierra Leone and enough “weedy” species are left in even the most intensively harvested areas for it to remain spectrally closer to forest than farm bush. There are some strong re-growth or thicket spectral signals within the forest, whether they represent natural or anthropogenic disturbance is currently unknown. Forest and farm-bush are much easier to distinguish using the Landsat data than had been expected; the intense competition and physically uniform canopy that develops after the second year’s harvest makes for a distinct spectral response. Interestingly the regenerating forest (farm bush etc.) has a distinctly greater VI (vegetation index) than more mature forest; this is due to a combination of different species, ages, physical structure and the pattern of above ground competition between individual plants. This is at odds with the general literature (eg Kalacska et al 2004) where the VI increases monotonically with maturity. We proved that threats to the forest from agricultural encroachment were easily identified. We showed that the logging roads built by the Liberians into the Gola North Reserve are large enough to be identified; previously nobody had suspected that they even existed.

Savannah: Drier grassier vegetation and *Lophira* savannah seems to be spreading south, possibly as a result of changing frequency of fires. The extent to which *Lophira* is confined to soils of the Rokel River Series is still in dispute, although undoubtedly the *Lophira* is spreading. Land cover in the north which is seasonally grazed by Fulani cattle herders seems to have under gone a dramatic change from a patch work of farm bush to a few pockets within a “sea” of open dry deciduous woodland; unfortunately we are having difficulty finding any usable information on the general land cover from the 1980’s to confirm these conclusions.

Coastal erosion: Rates of coastal erosion of over 40 meters per year were measured using the GPS at the north end of Lakka beach; the most probable explanation is the extraction of building sand has altered the profile of the beach sufficiently to trigger erosion. There remains the possibility that the erosion has been triggered by other events such as a freak storm (more data is being collected by the EFA this rainy season).

Restoration: The Rutile mine was very destructive to the environment and restoration / rehabilitation was very poor; after more than 10 years cashew trees had only managed

to reach about 2.5 meter tall. Where the spoil had been covered in latterite growth was no better, with less than 50% of the area covered with grass and poor tree growth (remembering the area receives ~3 meters of rain per year the natural vegetation is quite lush). Restoration on the bauxite mines was more successful. Where Acacias were used growth was good but the resulting forest had no biodiversity or economic benefits (the trees are no use for timber, and had been allowed to grow too large to be easily converted to fire wood). Acacia plantations were readily identifiable on the satellite data. Where “wildings” (saplings from the surrounding forest) were used for restoration the result could not be reliably distinguished from the surrounding land using the satellite data. Further data is being collected on the species composition of the restored areas to see how impoverished / biased the species composition is.

SAR: After extensive experimentation in Sierra Leone and the “secondment” of a visiting expert at Monks Wood it was determined that the ERS and JERS radar satellite do not provide significant additional information than that can be obtained from the Landsat data. Papers continue to appear in the Remote Sensing literature that show good results from the ERS and JERS satellites in tropical forests, but we have been unable to replicate their apparent success. Across most of Sierra Leone the farm bush vegetation (and woods and forests) are too thick to allow digital terrain models (DTM) to be constructed from tandem radar images. Without the DTM it is not possible to reliably separate the ground signal from the vegetation signal and hence separate farm-bush from forest. In the rainy season the swamps are heavily vegetated (either natural vegetation palms, swamp forest, dense herbaceous or swamp rice) at the same time the upland soils are saturated so that the radar is not very efficient in separating them out (and again a DTM can not be constructed). Data from longer wavelength radar should be investigated.

Peer review: the paper on the impact of fuel wood harvesting has been submitted to Biological Conservation, papers on restoration of bauxite and rutile mines and on coastal erosion are being prepared. Data from the project formed an important component of Arnold Okoni-Williams thesis on birds and disturbance in the Western Area. Data from the project is central to 4 final year projects being completed in June 2004 (land cover change in the Western Area, land cover change around refugee camps in Bo, biotope mapping of the coastal zone x2).

Selection: trainees within the University sector were selected on the basis of: their interest and enthusiasm in the idea of land cover mapping, their existing knowledge of computers (they had to be computer literate) and their future research needs. Trainees from other stakeholders were selected on similar criteria but with the additional constraint of availability.

Content: the structure of the training followed closely the order given in the training manual, (see attached), although both were subject to revision as experience was gained. For example; the section on geo-correcting data took almost all trainees much longer than was expected (this is indicated in the training material), entering the GPS information was the most variable activity, while unsupervised classification always took much less time than expected. {Although of no immediate relevance to the CBD the speed with which the trainees could allocate meaning to the unsupervised classification could be interpreted as them having a very accurate mental model of the spatial arrangement of the landscape. There were obvious / typical issues with scale but they were very clear on the relative location of different features. If this is a general phenomenon in Sierra Leone then this raises the possibility that

community based GIS around say biodiversity hotspots would be successful}.

Assessment & Accreditation: there was no formal assessment of the success of the training. The success of the project is whether the knowledge is used not whether it could be used. The reviewer of the second annual report suggested that the trainees could have been asked to produce a report of their training; this is probably a good idea that we should have thought of.

5. Project Impacts

Evidence: people trained, outreach, papers in preparation and submitted, new project proposals, in country collaborations, discussions with other external organizations.

Thirteen individuals produced their own maps area relevant to an issue being faced by their organisation or an environmental question they were interested in. A further six were able to observe the process of producing the map before participating in a joint field work activity. Over thirty have participated in workshops where the case studies were proposed or presented. A similar number have been present at less formal presentations in their offices (particularly in the key Ministries). An unknown number saw the half hour television programme or heard the radio broadcast in Sierra Leone. Similarly the outreach of the BBC Network Africa programme, the Nature web site and the Sierra Leone news website is unknown. Planet Earth the NERC magazine has a circulation of several thousand and the article on Sierra Leone initiated several contacts requesting further information. Five case studies were completed to the extent they were adequate for circulation and an equal number are possible given further resources. One paper has been submitted and a further two are in preparation. The “teach yourself” manual has expanded from course notes to a much more detailed “walk through” of the process, this is currently being tested on undergraduates in the Department. Stakeholders are about to submit a proposal for funding on forest restoration. Stakeholders in the University have become more proactive in attracting money and have submitted bids to BES, the Whitley Foundation and the Leverhulme Trust. The University has been included in bids to estimate land cover change around the Bumuna Hydroelectric scheme (the World Bank has a requirement that an EIA be performed on it). The University has also been included in a bid to monitor the threats to the Gola Forest; which could include what is happening with the Liberian logging road into Gola North, agricultural encroachment and illicit mining activity. As well as the discussions that have led to bids we are in discussion with UNDP-WCMC and OneSky for future activities. Land cover information is being included in the GPS training being given to the Wildlife Guides, being run by EFA and Njala.

Contribution to the CBD Articles: Appendix 1 completed. It has helped provide the country with the ability to quantify at a broad scale its habitats and monitor major changes over time. Whether this ability will influence either the Government or the main funding agencies remains to be seen.

Training: all the trainees are still with their host organizations. The trainees have the knowledge, data and technology to look at land cover / habitat change anywhere in Sierra Leone, whether they can find the funds for the transport and field work is another question. As well as the “core” who received the full training there is also a

“periphery” that has, in UN speak, been “sensitized”; this includes the Presidents Scientific Advisor, senior Government Ministers, the Vice Chancellor, Principal and Deans of Faculty at the University and the non-participating staff in the NGO’s.

Collaboration: the project has helped maintain the links between the University and the NGO’s. The University recognizes (and was criticized in a recent report), that it is not very good at getting what it knows out of the academic arena. The case studies shows the way that at least some of the research it does is of practical relevance, it also helps the University see how it can interact with the NGO’s at the “thinking” stage of projects. This sort of collaborative endeavour (outreach?) will be further strengthened if the University is successful in setting up its GIS/RS Centre. The success of the project has led to further ideas of collaboration between the UK partner and the local stakeholders.

The project has also increased the number of linkages between organisations. For example:

- a) The University, CSSL and EFA are preparing a joint bid to look at restoration of mined land.
- b) We’ve had several discussions with RSPB who are closely associated with the Conservation Society they are now including the University in their plans for monitoring threats to the forests.
- c) We’ve swapped data with the GIS Unit of UNAMSIL (United Nations Armed Mission to Sierra Leone), ideas for research collaboration discussed but not implemented.
- d) We were invited to be included in a bid to perform an EIA of the Bumbuna Hydroelectric scheme (led by an international consultant).
- e) We’ve supplied data to “One Sky - the Canadian Institute of Sustainable Living”. Previously they were only collaborating with the Friends of the Earth (SL), but now want to expand their activities outside the capital.
- f) Informal discussions have been undertaken with two representatives of RPCV (returned Peace Corp Volunteers) about collaboration in “less academic” activities.
- g) FBC and CSSL submitted an unsuccessful bid the Whitly Foundation to try and restore the Botanic Reserve.
- h) EFA and Njala are incorporating out land cover information in their training of the Wildlife workers in the O-K National Park.
- i) We’ve discussed with Patrice Ngalla of WCMC a “compare and contrast” between Sierra Leone and Cameroon.
- j) We (FBC & CEH) submitted a proposal to the Leverhulme Trust to investigate the introduction of alien species (specifically weeds of arable crops) that have been introduced through food aid and through the multi-national peace keepers. Unfortunately this was unsuccessful.
- k) Professor Andrew Millington of Leicester University has agreed to sponsor the link between FBC and the UK when the British Council finally sorts out the new rules.

Social Impact: the direct beneficiaries have been the trainees who if nothing else have an increased knowledge base and should be able to perform the jobs more efficiently and effectively because of it. In retrospect it would have been interesting to have requested the resources to take the technology out to some of the communities surrounding major biodiversity resources. A simple question would be to see if there was any consensus on boundaries, resources, attractions and so on. Just something as simple as comparing the official department of Forestry boundaries of the “community”, “salvage” and “reserve” forests with those of the local

communities. More complex questions include; what sorts of forest do the local communities recognize (and how)? There are supposed to be more than a dozen words in Mende for closed canopy forest, but the degree of consensus on where they are, what they are useful for, and can they be detected on the satellite data are all unknown?

6. Project Outputs

Quantifiable outputs: these are listed in Appendix II.

Actual versus Targeted outputs: Extra outputs were achieved in terms of the number of people trained and the number of case studies that reached draft status. Outputs for the public understanding of science were modified due to the television and radio appearances (which reached a much larger audience than our planned output). Outputs regarding interaction with schools were deliberately reduced. We reduced our outputs regarding schools because more experienced communicators considered some of our proposals to be infeasible, instead we agreed to supply material to them (outreach portion of CSSL) to include in their environmental dissemination process. The other hindrance was that the other two PI's were unavoidably unavailable for the critical proportion of the second year.

Publications: publications to date are listed in Appendix III.

Dissemination: the main routes for dissemination are: the case study fliers, personal contacts and "word of mouth". The case studies have been disseminated to all the main Government Departments (Agriculture, Lands etc.) and to organisations like the British Council and British High Commission (although they seem loath to acknowledge our existence). Partners to the stakeholders are also made aware through "word of mouth"; for example RSPB/BirdLife are partners with CSSL and went on field work with us and the Canadian Institute of Sustainable Living who are partners to the SL Friends of the Earth. Unfortunately, the easiest way to access the project outputs is through the UK partner.

8. Project Operation and Partnerships

Local partners: the only official partner was the University of Sierra Leone, however, two of the stakeholders behaved more like partners than clients. The Conservation Society and the Environmental Foundation for Africa were very helpful in providing transport, local guides and encouragement. Individuals within the all Ministries were enthusiastic, but the Ministry of Forestry (which has responsibility for wildlife) is still in many ways dominated by the view that the primary purpose of forests is to produce timber. The stakeholder group changed our plans by requesting that we spent more time training more trainees.

Similar projects: The only other Darwin project in the region was the development of a management plan for the Sapo National Park in Liberia, the situation in Liberia made forming links rather difficult. We have maintained rather sporadic communication with a Fauna & Flora International project using remote sensing to map forests in Liberia (links hampered in part by their staff moving on). We are collaborating in an informal manner by supplying land cover information to a project being run by Dr. Chakanda (currently based in the Netherlands). That project is studying the impact of the war on subsistence agriculture and particularly the loss of genetic material and local cultivars. Collaboration with other organisations has been mainly through discussion of further funding opportunities, most notably the BirdLife/RSPB initiative to purchase a conservation concession in the Gola Forest (we supplied maps and went on a reconnaissance trip with the CSSL).

International Partners: the only international partner was the Centre for Ecology and Hydrology. During the project and since it ended we have been in discussion with the BirdLife/RSPB about future collaboration. We've also discussed possible future projects with the OneSky Canada and with UNEP-WCMC. Mapping staff in UNAMSIL (UN armed mission to Sierra Leone) were interested in applying their skills to environmental rather than military issues but collaboration has been limited to the exchange of data.

Local partners: The University trainees have been busy as far as their resources allow them. It is unclear to what extent the other trainees are active, although as it is approaching the height of the rainy season we would suspect there is little field work going on.

Local and Government strategies: The local PI's were involved (as co-authors) in preparing the NSSD (national strategy on sustainable development), NEAP (national environment action plan) and BSAP (Biodiversity Strategy Action Plan). These have been approved by Government, but it has not yet committed significant funds to implement any of the action points.

Community participation: Elsewhere in the world there are a number of interesting participatory projects using GIS and GPS at the level of the community, especially with regards to the use and demarcation of natural resources. An interesting project could be made using this approach around some of the remaining biodiversity hotspots in the country. Experience with the trainees suggests that they have a clearer and more detailed mental model (conceptual map) of the landscape than might be expected. The closest our project came to participatory GIS was in providing data and advice in the planning stage of a proposed project to train game wardens how to use GPS and how it could be related to land cover.

Private Sector: At the beginning of the project we held discussions with a private company (Life Science and Technology Ltd.) about possible collaboration in terms of training; but discussions stalled on the issue of payments. Historically the only companies with much money in Sierra Leone are the mining companies; they are not generally noted for their interest in the natural environment. Only one small commercial mining company has returned. Existing legislation in Sierra Leone insists that mining companies restore land after mining, although there is some evidence that they have tried in some areas, data from our project shows they were frequently unsuccessful.

9. Monitoring and Evaluation, Lesson learning

Monitoring and Evaluation: Our proposal was that “The trainees will be assessed at the end of each period of training and their destination after the training will be followed by the University. Twelve months after the end of the project a formal review will be made of the take up of the technology and the subsequent activities of the trainees.” At the moment all the trainees are still in place, there has been some (limited) collection of additional data to help “flesh out” two of the case studies (coastal erosion and land restoration). A reviewer of the second annual report suggested the trainees ought to have written an individual report on their training; it is a pity we didn’t think of that earlier. The modified objective of the project was to develop a “critical mass” of workers using the technology to help answer relevant environmental concerns; it is still too early to tell whether this has happened.

External evaluation: there has been no external evaluation of the project apart from the DI. We are still hopeful that we can get some sort of assessment through the Graduate research Centre for the Comparative Study of Culture, Development and the Environment at Sussex University as they have a HEI Link with the Department of Geography at FBC. Getting papers published in the International Journals is the “gold standard” for the quality of the research.

Key lessons:

- a) Even in Sierra Leone (ranked 174 out of 174 on the UNDP Development Index) land cover maps tailored to meet particular objectives (specific questions) can be produced by trainees with only a short period of intensive one-to-one tuition.
- b) Stakeholders were quicker to grasp the potential of the technology (data plus knowledge) than we anticipated but they needed to be supplied with the data and software as well as the training.
- c) Isolated workers are productive for only a short period of time before their skills decline and institutional and technical issues degrade their efficiency. It is essential that a critical mass of trainees be developed and that some sort of cross cutting group be established. They must have access to relevant update data, there is a world of difference between could and will.
- d) Electronic distance learning of this topic is not yet feasible between Sierra Leone and the UK.
- e) There is very little interest in the environment among the larger donor agencies in Sierra Leone (although their head quarters in the UK are interested).
- f) Our exit strategy was hampered by changes in the funding priorities, or

rather a review, of the British Council HEI Link scheme. Fortunately we were successful enough that an alternative exit strategy was offered when the University decided to commit some of its very limited funds to continuing the project ideals.

- g) PI's (SL) are both "high profile" academics and in the second (and final) year were "distracted" by other calls on their skills. The balance is between PI's who have easy access to "key players" or less well known PI's who are less likely to have higher priority issues but who would find it more difficult to get access where it was needed.

10. Darwin Identity:

Publicity: The project has a high profile; we have had meetings with Government officials including two key Ministers (Agriculture, Lands) and the President's Scientific Advisor, and were explicitly described before the President at the University Convocation. We are collaborating with the two largest indigenous environmental NGO's (EFA and CSSL). We have appeared on national television and radio and in the local media. In the second year we switched from discussing with the key stakeholders what case studies might be feasible to presenting the first results. Interest in biodiversity (and environmental problems) was already high within the University, what the project has done is increase their capacity to effectively communicate with decision makers by providing quantitative and visual impressive information on the state of the environment. The University recognizes that it has a poor record in getting its research out of the academic circle and is trying to rectify it (apparently it was the major criticism in a recent review of the Universities activities). Our project therefore helped in both emphasising the need to communicate and the ability to do so. We used the DI logo on everything we produced and acknowledged it in everything we wrote.

Darwin Identity: We have quite a high profile with the British Council, for example we're negotiating to provide an exhibit when their offices are refurbished, but have been much less successful with DFID and the British High Commission. The two largest environmental NGOs are familiar with the DI through this project and through their participation in further bids to the DI. The case study handouts (appendix) also briefly explain what the DI is about.

Context: The DI project was recognized as a distinct project. It must also have been one of the largest environmental projects of any type in Sierra Leone for some years. I suspect that the Global Environment Fund on Bird Hotspots was larger because they bought a land rover in addition to staff time; the RSPB/BirdLife has also probably spent more over the years on various activities. But although these later projects are larger, their profile is limited because of the exclusive focus on one group of organisms in a relatively limited set of sites.

11. Leverage

Additional funds: No additional funds in cash were obtained during the project, however, two of the stakeholders (EFA & CSSL) put in resources in the form of transport, guides and staff time and the University has promised further resources.

Strengthening capacity (funding): No major donor apart from the DI is interested in

the environment in Sierra Leone. Attempts to find other UK partners for “spin out” projects on topics like marine biodiversity assessment have not been successful. The Sierra Leone partners are quite efficient at capturing what limited resources are available for environmental questions; however, these resources are almost always from an external organisation pursuing their own concerns with an explicit or implicit paternalistic attitude. This project has encouraged the stakeholders to be proactive in this regard (bids to the Whitley foundation and BES).

12. Sustainability and Legacy

Legacy: At the very least we have proved to a significant number of people that is perfectly possible to produce usable and useful land cover maps and maps of land cover change in Sierra Leone. We hope that the legacy will be more and that the trainees are already starting to use the quantitative estimates of land cover change to answer interesting environmental problems and influence policy makers. There is one further Institutional barrier that we have not confronted and that may slow down the uptake; the national statistics office in Freetown relies for its estimate of cropped areas on air photography and field surveys. The problem is that these photographs are now more than 25 years old and there is not possibility of a new set being captured, however, the statistics department is jealous of its role and may try and disparage the use of satellite data to protect its own position (personal opinion). All the partners are still in touch and we are exploring several possible ways to collaborate in the future.

Improvement in the Legacy: Our exit strategy has been hampered by the on-going review of the British Council HEI Link program. However, the University authorities have been inspired to find the funds to start reconstructing a building to house a National Centre for GIS and RS. If this had been a 3 year rather than a 2 year project that would have been a near perfect exit strategy as we could have moved our equipment and teaching base from the Herbarium into the Centre and had a significant “founder effect” on the research objectives of the Centre. It would also have gone a long way towards meeting priority project 3 in the BSAP of establishing a Biodiversity Database System.

Further funding: we intend to apply to the British Council for an HEI Link just as soon as they (British Council) can decide what the new rules are. A slightly different mix of partners is applying to the DI for funds on a project on “forest restoration”; so moving from quantifying what is wrong to trying to do something about it.

13. Post-Project Follow up Activities (260 words)

By concentrating on the development of simple case studies the project has demonstrated to a wide range of stakeholders the potential of the technology to help answer *their* environmental questions. The amount of “manoeuvring” that went on to try and obtain the extra licence for the software is indicative of their desire to exploit this technology. The University is committed to trying to establish a National Centre for RS and GIS. So far they have found funds to reconstruct a building. At the moment there are believed to be three Sierra Leonians in Freetown with training in GIS and remote sensing to MSc level, two already work for the University on unrelated areas but whether they can be freed from their current commitments is uncertain. The other issue is whether they and the trainees from our project can cross the knowledge gap from doing to teaching without any extra help.

The one thing Sierra Leone is not short of is environmental problems, but donors are concentrating exclusively on reconstruction, (to the extent that for example DFID will build primary schools, but not fund teacher training). The two key NGO's EFA and CSSL rely on the one hand on the surplus generated from work done for the UNHCR and on the other from very limited funding from RSPB this has been strongly focussed on identifying Important Bird Areas to the exclusion of almost everything else. A follow up activity in connection with the proposed Centre would allow us to influence both the research direction and the teaching that was carried out.

14. Value for money

The project obviously represents the interests of the PI's involved; our opinions are therefore biased. Nor do we intend to try and perform some sort of cost-benefit analysis of funds spent versus conservation benefit achieved. We did not formulate the project after extensive discussions or consultations over what was the most interesting CBD Issue problem facing Sierra Leone. Since its inception the project has identified a whole series of issues that it would be beneficial to work on, whether these would have achieved a better "value for money" criteria is difficult to ascertain. In accessing value for money the issues are whether it could have been better spent elsewhere (different country) or on a different project.

The amount of money spent on this project could have funded two Sierra Leonians to come to Europe to complete a Masters degree in GIS or GIS and Natural Resource Management. Given the current (2004) return rate it is probably that one of them would have returned to Sierra Leone, at least briefly. The training they received overseas would obviously cover many aspects of GIS and remote sensing that were not covered in the training offered under this DI project, however, none of that training would have used information directly relevant to the Sierra Leone conditions and few of the example data sets would have been from tropical countries. It is likely that the returned student would find themselves isolated from anyone else with knowledge of GIS/RS and poorly supported in terms of data and technology available. The handful of Sierra Leonians who have received that kind of training were active for only a brief period before lack of data, or technical or institutional problems intervened.

Sierra Leone still has significant biodiversity resources; however, despite having both strategies (NSSD) and action plans (NEAP & BSAP) the environment is a long way down the agenda of the Government or the external funding agencies. Just by its presence in the country (and appearances on television and the radio) it did briefly raise the profile of the environment outside the stakeholder community.

In our opinion if the University does not falter in its desire to establish a National Focal Centre for GIS and RS then the project will have been very good value for money. If they are diverted then the project has at least been as better than more conventional overseas training.

Author(s) / Date

Dr. Richard Wadsworth, Dr. A.B. Karim, Professor Hector Morgan

June 2004

15. Appendix I: Project Contribution to Articles under the Convention on Biological Diversity (CBD)

Project Contribution to Articles under the Convention on Biological Diversity		
Article No./Title	Project %	Article Description
6. General Measures for Conservation & Sustainable Use	Indirectly	Develop national strategies which integrate conservation and sustainable use.
7. Identification and Monitoring	5	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities which have adverse effects; maintain and organise relevant data.
8. In-situ Conservation		Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
9. Ex-situ Conservation		Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources.
10. Sustainable Use of Components of Biological Diversity	Indirectly	Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector.
11. Incentive Measures		Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training	60	Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).
13. Public Education and Awareness	5	Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.

14. Impact Assessment and Minimizing Adverse Impacts		Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage.
15. Access to Genetic Resources		Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.
16. Access to and Transfer of Technology	30	Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies.
17. Exchange of Information		Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
19. Bio-safety Protocol		Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research.
Total %	% 100	Check % = total 100

16. Appendix II Outputs

Please quantify and briefly describe all project outputs using the coding and format of the Darwin Initiative Standard Output Measures.

Code	Total to date (reduce box)	Detail (←expand box)
Training Outputs		
1a	Number of people to submit PhD thesis	0
1b	Number of PhD qualifications obtained	0
2	Number of Masters qualifications obtained	1 (assisted with)
3	Number of other qualifications obtained	0
4a	Number of undergraduate students receiving training	4 (assisted with)
4b	Number of training weeks provided to undergraduate students	6
4c	Number of postgraduate students receiving training (not 1-3 above)	6
4d	Number of training weeks for postgraduate students	12 (despite failure of computer in second year)
5	Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification(i.e not categories 1-4 above)	0
6a	Number of people receiving other forms of short-term education/training (i.e not categories 1-5 above)	0
6b	Number of training weeks not leading to formal qualification	12
7	Number of types of training materials produced for use by host country(s)	1 (main piece the “teach yourself manual) plus the case studies and posters
Research Outputs		
8	Number of weeks spent by UK project staff on project work in host country(s)	12 weeks (paid) + 10 weeks (unpaid)
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	0
10	Number of formal documents produced to assist work related to species identification, classification and recording.	0
11a	Number of papers published or accepted for publication in peer reviewed journals	0 (1 in review, 2 in prep)
11b	Number of papers published or accepted for publication elsewhere	1
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	0 (Data exists and a copy exists in SL and UK) but is not in a database as there are unresolved technical issues about spectral variations with latitude)
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	0
13a	Number of species reference collections established and handed over to host country(s)	0

Code	Total to date (reduce box)	Detail (←expand box)
13b	Number of species reference collections enhanced and handed over to host country(s)	0

Dissemination Outputs		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	2
14b	Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated.	3 (BES, GISRUK & Cambridge Conservation Forum)
15a	Number of national press releases or publicity articles in host country(s)	1
15b	Number of local press releases or publicity articles in host country(s)	0
15c	Number of national press releases or publicity articles in UK	0
15d	Number of local press releases or publicity articles in UK	0
16a	Number of issues of newsletters produced in the host country(s)	0
16b	Estimated circulation of each newsletter in the host country(s)	0
16c	Estimated circulation of each newsletter in the UK	0
17a	Number of dissemination networks established	0
17b	Number of dissemination networks enhanced or extended	0
18a	Number of national TV programmes/features in host country(s)	1 (plus 1 scheduled for post project)
18b	Number of national TV programme/features in the UK	0
18c	Number of local TV programme/features in host country	0
18d	Number of local TV programme features in the UK	0
19a	Number of national radio interviews/features in host country(s)	1
19b	Number of national radio interviews/features in the UK	1 (Network Africa of the World Service)
19c	Number of local radio interviews/features in host country (s)	0
19d	Number of local radio interviews/features in the UK	0
Physical Outputs		
20	Estimated value (£s) of physical assets handed over to host country(s)	£12,150
21	Number of permanent educational/training/research facilities or organisation established	1
22	Number of permanent field plots established	0
23	Value of additional resources raised for project	0

17. Appendix III: Publications

Provide full details of all publications and material that can be publicly accessed. Details will be recorded on the Darwin Monitoring Website Publications Database.

Mark (*) all publications and other material that you have included with this report

Table 2: Publications

Type *	Detail	Publishers	Available from	Cost £
(e.g. journals, manual, CDs)	(title, author, year)	(name, city)	(e.g. contact address, website)	
Manual	A "Teach Yourself" manual on land cover mapping for the Environmental Sciences. Wadsworth. 2004	-	rawad@ceh.ac.uk or Dr.A.B.Karim, Department of Biological Sciences, Fourah Bay College, USL, Freetown	-
Hand out	Case Studies and Examples. Wadsworth & Karim 2004	-	rawad@ceh.ac.uk or Dr.A.B.Karim, Department of Biological Sciences, Fourah Bay College, USL, Freetown	-
Journal	Effect of Civil Disturbance on Mammalian Biodiversity: a case study from West Africa. Wadsworth & Conteh 2004	Submitted to Biological Conservation	-	-

18. Appendix IV: Darwin Contacts

To assist us with future evaluation work and feedback on your report, please provide contact details below.

Project Title	
Ref. No.	
UK Leader Details	
Name	Dr. Richard Wadsworth
Role within Darwin Project	Joint PI, teaching, field work, research
Address	CEH Monks Wood, Abbots Ripton, Huntingdon, Cambridgeshire, PE28 2LS
Phone	
Fax	
Email	
Other UK Contact (if relevant)	
Name	
Role within Darwin Project	
Address	
Phone	
Fax	
Email	
Partner 1	
Name	Dr. A.B.Karim
Organisation	Fourah Bay College, University of Sierra Leone
Website address	http://fbcusl.8k.com/ (but often unreliable)
Role within Darwin Project	Joint PI, research
Address	Biological Sciences, Fourah Bay College, University of Freetown, Mount Aureol, Freetown, Sierra Leone
Fax	
Email	
Partner 2 (if relevant)	
Name	Professor H.G.Morgan
Organisation	Rice Research Institute (previously University of Sierra Leone)
Role within Darwin Project	Joint PI, organisation and administration
Address	Private Mail Bag 736, Tower Hill, Freetown, Sierra Leone
Fax	
Email	

19. Appendix V. Workshops

Complete reports on the start-up and final workshop exist only on paper in Sierra Leone. The following is a précis of the attendees' issues and conclusions. Note that only the names of those that spoke are given here (problem with UK PI's notes).

Start-up Workshop 19th December 2002

Attending

Dr S.S.Banya – Scientific Officer to His Excellency the President.
Dr. Rajiv Bandre – British Council

University

Prof. V.E.H.Strasser-King – Vice Chancellor of the University of Sierra Leone
Prof. D. Fody – Dean of the Faculty of Science.
Professor H.G.Morgan (PI) – Professor of Zoology
Dr. A.B.Karin (PI) – Head of Department Biological Sciences
Saliue Sankoh – Biological Sciences
Abu Conteh – Biological Sciences
M. Brima – Biological Sciences
Dr. J.Johnson – Geography
Dr. M.Johnson - Geography
Dr. A.Lebbie - Njala UC

Rokuprr Rice Research Institute

Dr. Sydney Johnson – Senior Scientist
Dr. Peter Alpha - Senior Scientist
+2

Conservation Society of Sierra Leone

D.D.Safia – Director
A.O.Williams – Scientist
+1

Environmental Foundation for Africa

Tommy Gannet – Director
Cecilia Utas – Project Manager

Ministry of Agriculture, Department of Forestry

Gilbert Koker – Senior Assistant Conservator of Forests.
Mz. Kit Gannet – Assistant Conservator of Forests
+1

Ministry of Agriculture, Department of Agriculture

Daphne Koker – civil servant
+2

Ministry of Lands, Department of Environment

Mohamed Bah – civil servant

Ministry of Lands, Department of Mines

+1

Department of Statistics

A Mansary – chief statistician to the Government.

+3

Structure of the Meeting

1. Introduction to the purpose of the project
2. introduction to the technology
3. Presentation of unvalidated land cover maps of the Freetown Peninsular
4. Breakout groups to discuss ideas for case studies.

Ideas suggested for case studies

The idea suggested by the stakeholders are given in the table below. In a follow-up meeting between the three PI's each idea was ranked in terms of its desirability and in its assumed technical feasibility. Project that are both desirable and feasible were started first, others were given a lower rank. Note that as the project progressed the range of case studies continued to expand, for example A.O-Williams on forest birds and the intermediate disturbance hypothesis or with EFA and CSSL on potential of ecotourism or RRRI on the impact of the war on the existence of local cultivars and varieties.

Idea	Suggested by	Outcome
Deforestation – especially in the forest reserves	CSSL, Forestry, Biological Sciences	Attempted
Deforestation – mangrove swamps and the demand for wood for smoking fish	Biological Sciences	Failed to get any field data.
Forest condition – especially canopy gaps and thinning	Biological Sciences, Forestry, CSSL	Attempted (poor result)
Development of an agricultural data base	RRRI	Out with the project plan
Extrapolation of agricultural trial sites (climate, soils, topography etc.)	RRRI	Special training given to RRRI staff
Wildfires and spread of grasslands	Forestry, Agriculture	Attempted
Wildfire v. managed fire	Biological Sciences	Not feasible
Length of fallow period	Biological Sciences, Agriculture	Data not very satisfactory
Impact of commercial mines – Rutile & Bauxite	CSSL	Attempted
Impact of indigenous diamond mining	Lands, CSSL	Failed to get any field data

Impact of indigenous gold mining	Lands, CSSL	Failed to get any field data
Use of Inland Valley Swamps	Njala, Agriculture, Geography	Attempted
Extent and state of plantation agriculture	Njala, Agriculture	Attempted (poor result)
Urbanization - extent	all	Attempted
Urbanization – beach sand extraction	Lands, EFA, CSSL, Biological Sciences	Attempted

Final Workshop 15th February 2004

Attending

University

Prof. D. Fody – Acting Vice Chancellor of the University of Sierra Leone

Professor H.G.Morgan (PI) – Professor of Zoology

Dr. A.B.Karin (PI) – Head of Department Biological Sciences

Saliue Sankoh – Biological Sciences

Abu Conteh – Biological Sciences

M. Brima – Biological Sciences

Dr. J.Johnson – Geography

Dr. M.Johnson - Geography

Dr. A.Lebbie - Njala UC

Dr. Jinnah – Biological Sciences

K.Kanu – Herbarium Technician

+4 students

Rokuprr Rice Research Institute / National Institute for Agricultural Research

Dr. Sydney Johnson – Senior Scientist

Dr. Peter Alpha - Senior Scientist

+4

Conservation Society of Sierra Leone

D.D.Safia – Director

A.O.Williams – Scientist

+3

Environmental Foundation for Africa

Tommy Gannet – Director

Cecilia Utas – Project Manager

Rosalind Alp-Hanson – Conservation Officer

Ministry of Agriculture, Department of Forestry

A. Masary – Chief Conservator of Forests

Gilbert Koker – Senior Assistant Conservator of Forests.

Mz. Kit Gannet – Assistant Conservator of Forests

Ministry of Agriculture, Department of Agriculture

Daphne Koker – civil servant
+2

Apologies from Dr. Banyan who was at the climate change meetings and R. Bandre who was in the UK.

Structure of the Meeting

1. A reminder of the purpose of the project
2. Presentation on the case studies.
3. distribution of case study handouts and teaching material (to those who had not received it earlier)
4. The way forward after the project

Discussions and Decisions

- a) Need for the group to continue to meet at least on an informal basis to continue to develop the use of the data to answer specific environmental problems.
- b) Need to attract further funding especially with regards to field work and for keeping data up to date.
- c) Prof. Dan Fody announced that the University had found funds for the rehabilitation of one of the buildings destroyed in the war. The new building is to house the Focal Centre for GIS and RS.

20. Appendix VI - the Original Logical framework.

<i>Project summary</i>	<i>Measurable indicators</i>	<i>Means of verification</i>	<i>Important assumptions</i>
<p>Goal</p> <p><i>To assist countries rich in biodiversity but poor in resources with the conservation of biological diversity and implementation of the Biodiversity Convention</i></p>		<p>Use of better data within the National Environment Action Plan and by Conservation minded organisations within and outside Sierra Leone.</p>	<p>Better information leads to better decisions.</p>
<p>Purpose</p> <p>Transfer skills and technology necessary to produce reliable maps of habitats and change in habitats from multi-spectral and SAR imagery.</p>	<p>Ability of staff in the Department of Biology and Government Departments to generate maps of land cover and quantify change.</p>	<p>Quantitative assessment of products.</p> <p>Qualitative assessment of performance.</p> <p>Take up of product and process by NGOs and Government.</p>	<p>Can find suitable candidates to train</p> <p>Technology and approach will work.</p> <p>Government and NGOs accept new approach</p>
<p>Outputs</p> <p>A group of researchers capable of carrying out similar mapping exercises in other parts of the country and in the future as reconstruction commences.</p>	<p>Example maps of habitats for three selected areas</p> <p>Example maps of changes in habitats in the three areas 1991 to 2001.</p>	<p>Ground truth verification.</p> <p>Uptake of maps and expertise by stakeholder community.</p> <p>Extension of work methods to other areas.</p>	<p>Methodology works and produces an output that is "fit for purpose"..</p>
<p>Activities</p> <p>University identifies suitable trainees</p>	<p>trainees found</p>	<p>trainees turn up.</p>	<p>suitable trainees exist</p>

Stakeholders identify critical habitats	report from first workshop	report circulated to stakeholder community, Cambridge Conservation Forum etc.	agreement can be reached
"hard" and "soft" classification of multi-spectral data.	map	maps validated	suitable imagery exists (Dec-Feb period)
Biomass estimates (SAR)	map	maps validated	Biomass distinguishes "farm bush" before sensor saturates.
Texture analysis (SAR)	map	maps validated	Texture distinguishes primary from secondary forests
Combination of all data	map	maps validated	Combination "adds value"
Verify/ validate.	Report on validation exercise.	validation possible	Maps "fit for purpose"
Dissemination	Response to competitions, number of newspaper reports	Quality of response to competitions, quality of reports in local papers.	Can produce meaningful approach