A project funded by the United Nations Development Programme/Global Environment Facility (UNDP/GEF) and executed by the United Nations Office for Project Services (UNOPS)

# An Overview of Achievements and Outputs of the Biodiversity Special Study

## BIOSS Final Report

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AUGUST 2000

## Pollution Control and Other Measures to Protect Biodiversity in Lake Tanganyika (RAF/92/G32)

## Lutte contre la pollution et autres mesures visant à protéger la biodiversité du Lac Tanganyika (RAF/92/G32)

| | |
|---|---|
| Le Projet sur la diversité biologique du lac Tanganyika a été formulé pour aider les quatre Etats riverains (Burundi, Congo, Tanzanie et Zambie) à élaborer un système efficace et durable pour gérer et conserver la diversité biologique du lac Tanganyika dans un avenir prévisible. Il est financé par le GEF (Fonds pour l'environnement mondial) par le biais du Programme des Nations Unies pour le développement (PNUD)" | The Lake Tanganyika Biodiversity Project has been formulated to help the four riparian states (Burundi, Congo, Tanzania and Zambia) produce an effective and sustainable system for managing and conserving the biodiversity of Lake Tanganyika into the foreseeable future. It is funded by the Global Environmental Facility through the United Nations Development Programme. |




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# 1. INTRODUCTION TO THIS DOCUMENT

This report provides a brief overview of the achievements of the biodiversity special study (BIOSS). It is designed to complement, rather than repeat, the technical findings of the study, which are reported elsewhere. Having said this, the report should serve as a 'compass' to the whole study, directing readers to appropriate technical outputs as required and placing them in the context of BIOSS as a whole. BIOSS reports can be found on the LTBP website at the following url: http://www.ltbp.org/BIOSS.HTM

This document highlights a range of BIOSS achievements, including the field programmes, biodiversity awareness and the specific skills and experience gained by the field teams through both formal training and their experience of planning and implementing the study. We also aim here to reflect the processes that evolved as the study was carried out, which may be of interest to readers with experience of similar work or those planning field studies of this kind.

# 2. OVERVIEW OF BIOSS TECHNICAL OUTPUTS

## 2.1 BIOSS aims and objectives

The main aim of the BIOSS was to support the development of the strategic action plan to manage Lake Tanganyika. The aim of the strategic action plan was "to provide for the regional management of Lake Tanganyika to enable the sustainable management of biodiversity and the livelihood's of present and future generations of lakeside communities".

The specific objectives of the Strategic Action Programme (SAP) that this study addressed most directly were to 'define and prioritise the management actions required to conserve biodiversity of Lake Tanganyika' and 'enable the Lake Basin Management Committee to provide guidance to the international community on the needs of the Lake Tanganyika region in terms of biodiversity conservation and sustainable use of resources'.

To achieve these aims the BIOSS had four key objectives:

- review current levels of biodiversity in Lake Tanganyika;
- identify the distribution of major habitat types, with particular focus on existing and suggested protected areas;
- suggest priority areas for conservation, based on existing knowledge and recommendations from other SS and supplemented by additional survey work where necessary; and,
- develop a sustainable biodiversity monitoring programme.

The identification and impact of threats fell under the preserve of the three major 'threat' based special studies: pollution, sedimentation, fishing practices, therefore this was not a major objective for BIOSS.

## 2.2 Drawing on existing work – the literature database

Lake Tanganyika has been the focus of intense scientific attention for many years. Indeed, it was researchers with a long history in the region that drew the world's attention to the need to conserve Lake Tanganyika's remarkable biodiversity – an action that resulted in the development of this project.

The first objective of BIOSS was to review the considerable knowledge of the flora and fauna of the lake. To this end a database was developed to draw together information from the published scientific literature, various surveys that remain unpublished and, in fact, any source of data on Lake Tanganyika's aquatic species. The key issue prompting development of the database was the need for species-location data. It is impossible to conserve biodiversity if you don't know where the species are found! It was also of great concern to make these data available to regional scientists and planners; much of the information lies in institutions in developed countries far from the lake, where it is not easily accessible.

The literature database was developed by MRAG and the first entries used to test its design drew from the literature housed in the Natural History Museum in London. Advice was sought from various international researchers with an interest in Lake Tanganyika during development. Once the database design was complete and some quantity of data from London entered, responsibility for building up this resource passed to Burundi. Within the region, Bujumbura's libraries hold a comprehensive set of Lake Tanganyika literature and Dr Gaspard Ntakimazi from the University of Burundi co-ordinated a long programme of data entry. At the conclusion of BIOSS, the database contains data from 144 individual references (including the entire dataset from the BIOSS field survey programme) adding up to 3473 species-location entries.

We anticipate that this resource will continue to develop – its usefulness as a planning and management tool increasing as more data are entered. This database will be one of the key sources of data available to the regional committee charged with responsibility of the strategic action programme. We encourage researchers from around the world to apply to MRAG or

Dr Ntakimazi (Burundi) for a copy of the database and incorporate their data for the greater good of the future management of the lake.

## 2.3 BIOSS field survey programme

The central focus of BIOSS was its field survey programme, which provided the scientific underpinning to the technical and conservation advice submitted to the SAP.

### *2.3.1 Field sites*

BIOSS sampled the shores adjacent to the four existing terrestrial national parks and included additional sights with reputed diversity or threatened status (Figure 2.1 illustrates the areas of coast covered by the survey programme and Table 2.1 names the sites). The security situation presented BIOSS with a severe constraint, leaving DR Congo and some parts of Burundi under-represented in the programme. Logistical constraints meant that the southern section of Tanzania was also under sampled.

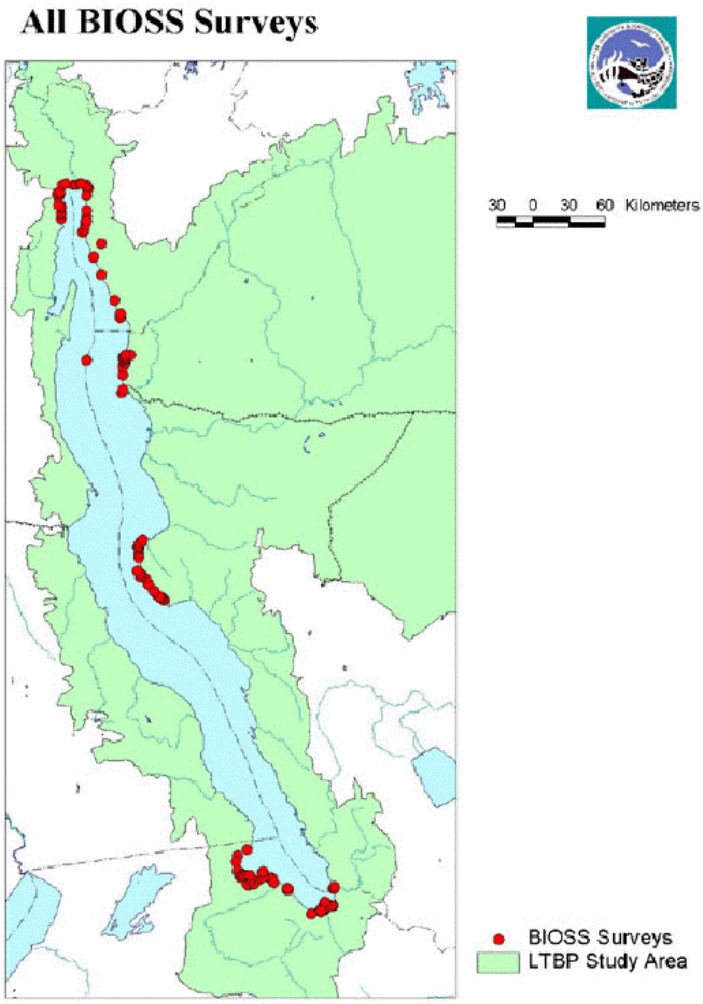



**Figure 2.1 Field locations of the BIOSS survey programme in Lake Tanganyika (source: BIOSS survey database and TANGIS)**

**Table 2.1 Names of BIOSS survey sites with justification for inclusion**

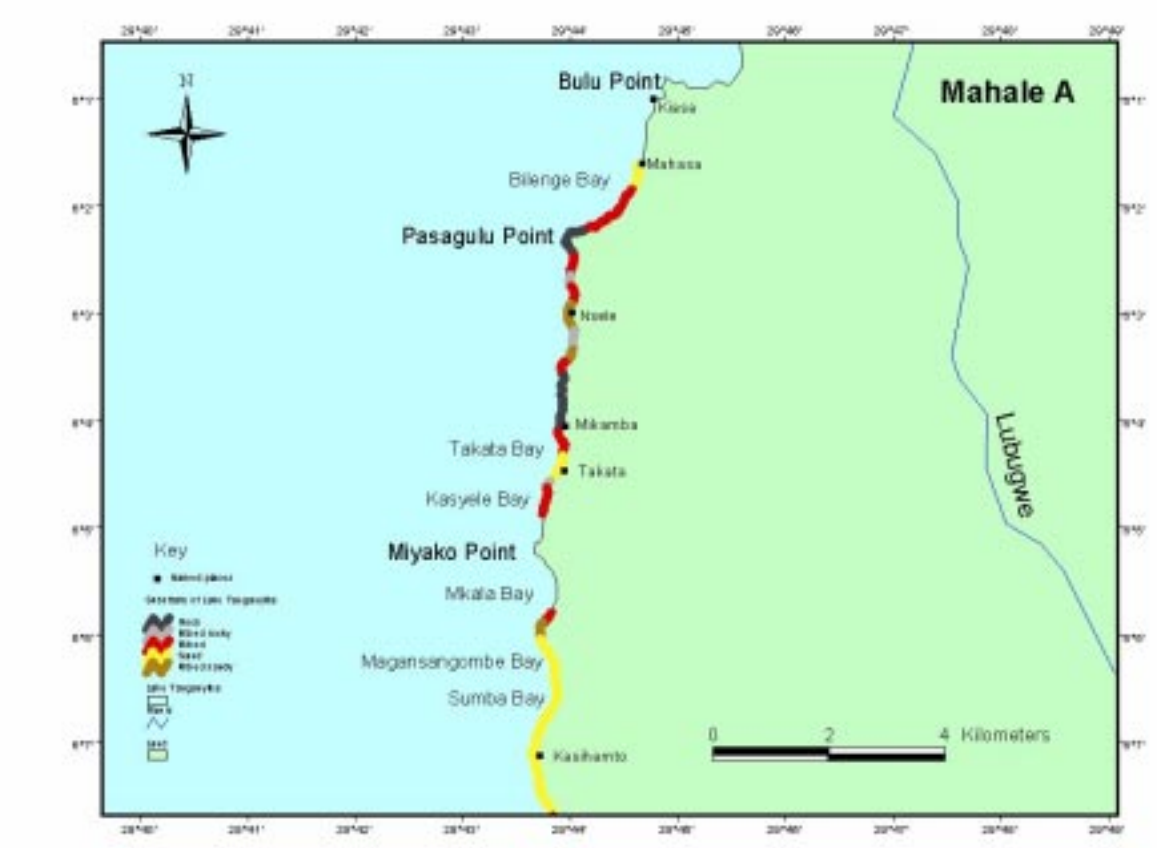
| Nature of BIOSS interest | Site name | Country | Individual BIOSS technical report? |
|---|---|---|---|
| National Park | Rusizi | Burundi | √ |
| National Park - pristine | Gombe Stream National Park | Tanzania | √ |
| National Park - pristine | Mahale Mountain National Park | Tanzania | √ |
| National Park - pristine | Nsumbu National Park | Zambia | √ |
| | | | |
| Impacted | Uvira | DR Congo | |
| Reputed biodiversity, current research interest | Pemba, Luhanga, Bangwe | DR Congo | |
| Rocky & sandy, sites impacted | Gitaza | Burundi | |
| Diverse though impacted | Burundi South | Burundi | |
| Impacted | Bujumbura Bay | Burundi | |
| Impacted | Kigoma | Tanzania | |
| River mouth subject to sedimentation | Kalambo/Lunzua | Zambia | |
| Near Mpulungu, heavily fished | Chikonde | Zambia | |
| Impacted | Mpulungu | Zambia | |
| Same as Kalambo and diverse | Lufubu/Chisala | Zambia | |
| Unprotected, but fairly pristine | Katoto, Kapembwe, Kasakalawe | Zambia | |
| Reported diversity high | Cameron Bay | Zambia | |

Data to prepare habitat maps in conjunction with the GIS have been collected for the entire coastline of both Burundi and Zambia, with stretches of DR Congo and Tanzania being completed within survey expeditions.

In co-operation with NRI[1], the developers of TANGIS (Lake Tanganyika GIS), results of the Mahale manta surveying have been produced for that particular report. An example is presented here as Figure 2.2. In future, it is hoped that the GIS will draw on BIOSS data and produce maps in a format suitable for presentation and planning (1:50,000, laminated).

[1] Particular thanks must go to Ms Anne Jackson, NRI for her help in producing these maps.

**Figure 2.2 Habitat map of selected portion of shoreline within Mahale Mountain National Park**



### *2.3.2 Standardised sampling protocols*

As biodiversity assessment is a new science, the techniques are still developing and no single method is suitable for all situations. BIOSS conducted a review of different approaches, assessing their theoretical and practical suitability to the field situation and BIOSS objectives. Over the course of early consultancies and field work the methods used to survey habitats, fish and molluscs were refined and finalised. This work undertaken by BIOSS represents the first comprehensive attempt to survey components of the lake's biodiversity in a quantitative, replicable and standardised manner.

The survey procedures were recorded in a field "guide", which has evolved over the course of the study as techniques have been refined and finalised in the field. At the close of BIOSS, a key achievement is the production of **"Standard Operating Procedures for BIOSS Field Sampling, Data Handling and Analysis" (Allison, E., R. G. T. Paley, and V. Cowan (eds.), 2000) ("SOP")**. Given the international nature of this project, the importance of standardising survey approaches across countries cannot be overemphasised and this document is one of the key methods by which BIOSS achieved this. The SOP provides field teams in each of the four riparian countries with the regionally agreed set of survey techniques. The rationale behind each technique is outlined with a step-by-step description of how to carry it out and the equipment required. This record is an important resource as field teams recruit new members and provides a framework, within which new taxa can be added to the suite of survey techniques used.

### *2.3.3 Managing data from the field – the survey database*

A bespoke database was designed to support the BIOSS field programme. The evolving nature of the survey protocols in the early days of the programme and technical constraints in country proved a true challenge to both designers and users of the database. But strong commitment from all involved meant that all data was entered in time for the final analysis of the study.

The database provides a system to manage all data collected according to the standard operating procedures. It allows for analysis on either a national or regional basis (a protocol has been established to facilitate data exchange within the region). This is the first comprehensive set of taxonomic data that has been produced for the entire lake according to standardised procedures.

The survey database has its own user-manual and is technically linked to both the literature database (another bespoke BIOSS database, see Section 2.2) and the project GIS system, TANGIS. The teams are all trained in entering data. As the study closes, analysis of the database requires the support of someone with Access database experience. It is hoped that a further project phase would result in the development of a standard set of queries for this database to allow field teams to extract relevant data to spreadsheets for analysis. **A CD-rom of the database and user-manual are available from MRAG Ltd.**

### *2.3.4 Technical reports*

Each of the major surveys (i.e. the national parks) mounted under BIOSS is reported in a separate technical document. These reports were prepared and written by members of the BIOSS field teams, with the regional facilitator (Richard Paley) supporting analysis and editing, where necessary. Table 2.2 lists the technical reports and their authors, all are available from the Lake Tanganyika Biodiversity Project website. These reports have provided new information to national park institutions, which have a strong terrestrial focus. It is hoped that the data provided will enable these parks to develop the aquatic components within (or adjacent to) their boundaries, using the information to promote these remote parks within national programmes for support.

**Table 2.2 List of technical reports on sites surveyed within BIOSS field programme**

| Language | Report reference |
|---|---|
| English | Tierney, P. and W. Darwall. 1998. Gombe Stream National Park survey report. 35p |
| French | Ntakimazi, G., B. Nzigidahera, F. Nicayenzi, et K. West. 2000. L'Etat de la diversité biologique dans les millieux aquatiques et terrestres du delta de la Rusizi. 68p. |
| English | Paley, R. G. T., G. Ntakimazi, N. Muderhwa, R. Kayanda, B. Mnaya, Muzumani Risasi, R. Sinyinza 2000. Mahale Mountains National Park: March/April 1999 Aquatic Survey. 41p |
| English | Paley, R. G. T. and R. Sinyinza. 2000. Nsumbu National Park, Zambia: July/August 1999 Aquatic Survey. 40p. |
| English | Darwall, W. and P. Tierney. 1998. Aquatic habitats and associated biodiversity in Kigoma area of Lake Tanganyika. 25p |

The **Final BIOSS Technical Report (Allison *et al*, 2000)** provides the comprehensive coverage of methods, results and discussion of the survey programme. This report draws from the individual park reports and the analysis completed at the final regional working group meeting convened in Kigoma, March 2000. Subsequent sections of this document refer the reader to the contributions of the Final Technical Report.

## 2.4 Monitoring programme

While the results of the survey programme, as reported in the Final Technical Report, informed the first iteration of the SAP, future developments of the plan should be based on data gathered as part of an appropriate long-term monitoring programme. Therefore BIOSS took the lead role in co-ordinating all special studies to agree on an integrated monitoring programme for the lake. The **Standard Operating Procedures document** provides the finalised details of sites, species and justification for long-term monitoring. The sampling methodology for habitats and species will be as outlined for the survey programme at the appropriate frequency to provide monitoring data, but complemented with environmental and socio-economic data from the other special studies.

## 2.5 Management advice to the Strategic Action Programme

The final analysis of BIOSS survey data provided the scientific basis on which the advice to the SAP was formulated (**Biodiversity Special Study Advice to the Strategic Action Programme, Allison, E., V.J. Cowan and R.G.T. Paley, 2000**). Having surveyed the waters off all existing terrestrial parks using standard procedures, BIOSS was able to provide the **first regionally based scientific assessment of the conservation status of aquatic biodiversity in Lake Tanganyika**. Briefly, by living in the waters adjacent to the existing national parks an impressive degree of protection is afforded the lake's species: some 73% of all the fish species recorded for the Lake were found within the park network.

The management context within which the scientific findings of BIOSS would be discussed was always uppermost in planning the entire special study. When formulating BIOSS management advice to the SAP, all scientific findings were reviewed alongside the social and institutional context of implementing any conservation strategy. Clearly, setting aside great lengths of coast as fully protected areas (i.e. national parks) might achieve the conservation aim of a regional plan but at the unacceptable expense of providing for sustainable use of resources for riparian communities.

Drawing on the scientific findings from BIOSS and our understanding of other special study results, BIOSS recommended that a strategy of coastal zone management would be highly appropriate to the management of Lake Tanganyika. BIOSS concluded that localised threats in the littoral zone presented the greatest challenge to sustainability and that management of lakeshore activities within a regionally integrated coastal zone plan was the way forward. This does not preclude regional managers taking a transboundary approach to some issues, managing the pelagic fisheries provides an excellent example of such a case. BIOSS's

understanding of local, national and regional capacity to monitor and protect the aquatic environment also supports this coastal zone approach.

Within this broad recommendation on strategy, BIOSS promoted the continued protection of waters adjacent to existing national parks. Where the boundaries fall short of the lake (Rusizi and Gombe), appropriate strategies were suggested to take account of the particular constraints facing these two reserves. The advice document provides more background and detail on these matters.

# 3. CAPACITY BUILDING

## 3.1 General principles

This section provides a short discussion of some of the principles that guided the development of the special study.

### *3.1.1 Raising awareness of "Biodiversity" issues*

LTBP was an ambitious project, with many disciplines brought together to develop a management plan for a complex, remote resource of great value to riparian nationals and of global significance for its biodiversity. A key word for BIOSS to take note of here here was 'biodiversity': what does it mean, does it mean the same thing to all stakeholders in the project – from riparian communities, right up through each of the four countries and their insitutions, the project to the donor, the Global Environment Facility.

BIOSS took on responsibility to facilitate some of the debate within the project around the definition of the word and wider policy issues surrounding management of biodiversity. To this end, Dr Allison produced a document that he hoped would inform BIOSS researchers, consultants, members of other special studies and wider project staff. Entitled: **An Aide-Memoire: The Convention on Biological Diversity and the Global Environmental Facility. [Allison, E., 1998]**, it is available from the website.

Within BIOSS, raising awareness of 'biodiversity' issues was more technical. Access to the current debate in the **international literature** is limited in riparian institutions. Dr Allison, as BIOSS co-ordinator, was proactive in bringing papers that discussed issues at the centre of the **current debate on biodiversity conservation** to the working groups and leaving them as a resource in the region. The full range of literature that has informed the BIOSS study is perhaps best represented in the reference list of the final technical report.

In recognition that the participants in the process to develop the SAP were drawn from a wide range of technical backgrounds and institutions, BIOSS provided a briefing on key biodiversity issues. Submitted as the first **section of BIOSS advice to the SAP**, this aimed to inform policy makers of the wider biodiversity conservation context within which the BIOSS objectives and recommendations were formulated.

### *3.1.2 Teamwork between international and lakeside researchers*

In the early stages of the project the special studies did not have full time co-ordinator in the region. This had several drawbacks, not least the means for the international team and regional teams to communicate on developing the study. One method used during this period was to use the work-plan as a working document, i.e. the document evolved as understanding increased and plans were developed. The work plan was the 'place' where ideas and plans to achieve the overall aim for BIOSS were floated for discussion within and beyond the team.

Major revisions usually occurred after lakeside workshops when the entire team (international and national staff) had come together and been able to advance the BIOSS programme. The document was useful for keeping a record of progress within the study and ensuring that all activities were planned to specifically address one or more of the four BIOSS objectives. It was a critical way that BIOSS informed the rest of the project, particularly the other special studies, which were implemented by one of the three consortium organisations (MRAG, NRI or IFE). Once BIOSS had a full time regional facilitator in the field, he took on the roles of consultation and communication more directly, and the work-plan was used more as a guide to maintaining direction and monitoring progress.

### *3.1.3 Building a regional team*

A conscious decision made early in the planning of BIOSS was that the study must provide a regional framework within which, national working plans all addressed common objectives, using standard methods and approaches to achieve the overall aim of providing regional advice. Despite all working on the shores of Lake Tanganyika in various capacities, many of the national researchers, technicians, staff of government departments are not familiar with the work and experiences in other countries. Therefore, the BIOSS team was viewed as a regional body and where project budgets, security in the region and logistics allowed, the team was brought together to conduct field-work and attend training sessions and working groups.

A key motivation for taking this regional approach was to facilitate the development of a network of lakeside researchers with a history of sharing experiences and scientific knowledge. The resource needs to be viewed in its entirety by the community of people who will be charged with providing the scientific basis for future plans. The BIOSS regional team is the beginning of that community.

The capacity within BIOSS to achieve this regional approach was largely due to the support and commitment of the project's Scientific Liaison Officer, Dr Kelly West and by the study having a dedicated regional facilitator (Mr Richard Paley) based on the lake. The teams were enthusiastic participants in these regional activities and much was gained through the sharing of technical skills and experience between counterparts from other countries. Language was of minimal hindrance, with many three-way discussions (French, KiSwahili and English) taking place in the field. In addition, the specific skills of many regional researchers were actively drawn on in formal training sessions.

### *3.1.4 Science to inform management*

At the centre of all thinking and planning of this study was the need to conduct science to inform management. An important question to continually ask was: "what insights into improved management of Lake Tanganyika's biodiversity will this activity provide?". If the answer was "none", or "it really isn't clear" then BIOSS did not persue the activity.

While much of the study was aimed at informing strategic management of the lake, the overall aim of LTBP, BIOSS recognised the need for more immediate, practical advice to resource management. In particular for the national parks, who have a strong terrestrial focus, it was important to provide information to park management on the aquatic resources within or bordering individual parks. The relevant institutions were consulted during field work and results and ideas fed back informally. The reports were tailored to informing the relevant managers by providing inventories of aquatic species sampled by BIOSS and raising the implications of this work.

## 3.2 Training

To achieve a regional approach to biodiversity assessment and develop regional capacity, BIOSS undertook various training activities.

### *3.2.1 Diver qualifications*

During the course of BIOSS, 21 regional members of the study were trained to dive, gaining either BSAC or PADI qualifications. In many instances the training began with participants learning to swim and becoming 'comfortable in the water'. The fact that within months these "trainees" were active members of a scientific team conducting underwater surveys in remote locations around the lake is of great credit to them and their instructors (Dr Paul Tierney, Mr Will Darwall and Mr Christian Furier).

Two rounds of dive training were conducted during the study, the first in July-August 1997 and the second in February-March 1999. Both courses were bilingual and involved participants from each of the four countries. By necessity the trainers for each of these

courses were recruited internationally, however, by the second course two experienced members of the existing dive team (Mr Rueben Shapola, Zambia, and Mr Bernard Sinunguka, Burundi) joined the international consultant and passed on their skills and experience. The first dive consultancy had multiple objectives as the trainers helped develop the survey methodology, while the second consultancy concentrated purely on dive training.

### *3.2.2 Survey skills*

As noted earlier, BIOSS had to develop a set of survey protocols specifically to meet the requirements of the project, and take into account logistic constraints such as remote locations, number of divers, safety etc. The need to have replicable, quantitative data was fundamental to the programme, however the ecological basis to sampling was new to many members of the team. Even those with previous diving experience had often worked on taxonomic, behavioural or evolutionary projects which had focussed more on 'collecting' rather than sampling.

Dr. Allison guided this programme and a series of workshops were held to introduce the concepts and practice of the survey techniques. Every effort was made to move away from formal 'lecture' style training: although this was new to many participants and some teachers!. Participants were encouraged to debate, present work and pass on their skills to counterparts. The first workshop was held in Kigoma, September 1997 as a joint special study workshop that coincided with the first round of dive training. The second was a Francophone workshop, held in Bujumbura in July 1998, and was specifically to develop the workplan and build Francophone capacity to participate in the study. The final training session was held after the second dive course in Kigoma in March 1999. This consisted of experienced members of the team running classroom sessions and then guiding their colleagues in the field during the Mahale survey.

After sessions on the theory, novice divers were paired with experienced buddys to develop their practical survey expertise: both divers recorded data and comparison of the results formed the basis of review at the end of each sampling activity. As much as possible all team members gained experience in all survey techniques, although individuals with great skill in certain techniques did emerge.

### *3.2.3 Taxonomic skills*

An early technical decision taken by BIOSS was to concentrate on two key taxonomic groups – fishes and molluscs. The justification for this decision is outlined in other BIOSS reports, primarily the standard operating procedures and the final technical report. Expertise in these groups was strong within the project: Dr Gaspard Ntakimazi, Mr Felix Nicayenzi and Dr Nshombo Muderhwa led the training on fish identification with Dr Kelly West, the Scientific Liaison Officer leading the mollusc work. BIOSS worked with Roger Bills, (JLB Smith Institute of Ichthyology, RSA) to assist with cichlid identification in the first workshop (Kigoma 1997). The second workshop drew on the skills of Dr Gashagaza for cichlids and Dr. Luc De Vos for non-cichlid fish.

In the early stages of the study it was hoped to increase the number of taxa included in the survey programme: specifically it was hoped that BIOSS would link with the more threat based studies and sample invertebrates to look at the effect of pollution and/or sedimentation on biodiversity. To this end, Dr Koen Martens, (Royal Belgian Institute of Natural Sciences, Belgium) was contracted to provide taxonomic training on ostracods and to produce an identification key for the project. The anticipated overlap did not happen within LTBP: nevertheless, these resources produced under BIOSS provide a valuable start for future work in this field.

## 3.3 Planning and executing expeditions

With some 2000 km of coastline, surveying the littoral zone of Lake Tanganyika requires excellent foresight and planning if expeditions are to be conducted in a safe and efficient manner. This is particularly true of Lake Tanganyika where many sites are far from base

research locations and therefore errors in preparation are not easily rectified once the expedition is launched. Further more, circumstances can be highly unpredictable in such remote locations and therefore planning and preparation should allow for maximum flexibility should problems occur.

The forward planning for surveying Mahale National Park is perhaps a good illustration of the scale and skills needed. The park is remote: the journey trip from Kigoma to the north end of Mahale can take between 8 and 12 hours, depending on the boat. The 18 divers, working in three teams of six conducted a manta survey of the entire 60km of Mahale's coast in three days. 27 sites were chosen for detailed surveying (resources and time constraining the number of sites possible). The detailed surveying took the 18 divers nine days of actual diving, with an additional five days being required for logistics and planning. The preparation for this survey began many months before, with the following list just some of the preliminary planning activities which took place:

- gathering and checking dive equipment and survey kit (some items were available locally while others had to be ordered internationally);
- liaising with appropriate insitutions about staff availability;
- organising the teams arrival in Kigoma from each of the other three riparian countries;
- seeking park permission and clarification of what facilities are available at survey locations;
- logisitical requirements food, fuel, first-aid supplies;
- arranging for medical evacuation if necessary; and,
- checking security situation, etc.

### 3.4 Data management, analysis and reporting skills

The skills within the BIOSS team varied immensely in the areas of data management and analysis – some members had published in the scientific literature while others had no secondary education. At the conclusion of BIOSS, the regional team has remarkable shared experience and qualifications in these areas. Hard lessons in data management were learned, for example, on occasion data had to be re-entered into one of the database due to inadequate backing up procedures etc. It should be acknowledged, that lessons learned from these experiences were subsequently incorporated in the user manuals and the SOP (standard operating procedures).

It was important for the teams to have experience of the entire process of recording BIOSS data: from recording in field notebooks underwater, transfering it to the appropriate data forms in the evenings through to entering data into the database at the conclusion of the expedition. The need to be accurate, legible and comprehensive were all emphasised and skills developed over the course of the study. Many BIOSS researchers also became highly conversant with entering and organising data within the database, which is a considerable step forward in regional capacity given that many in the team had not used computers before participating in BIOSS.

As noted earlier, a background in ecological sampling was not strong in the regional team. Therefore, Dr E. Allison and Mr R Paley led many working group sessions on appropriate analysis techniques. In addition, active discussions on the advantages and disadvantages of various methods (such as species richness, diversity indices etc.) to analyse biodiversity data were carried out in these group sessions. One technique, complementarity analysis actively involved the entire team in determining the best network of sites around the lake to conserve the largest number of species. This led to detailed discussions on the management advice the team should submit to the SAP. The details of the analyses are outlined in the Final Technical Report.

### 3.5 BIOSS team capacity

Table 3.1 lists the names, institutions and skills of the BIOSS dive team. This regional team with their combined experience of planning and executing field work in the lake provides a very valuable resources for the ongoing management of the lake.

**Table 3.1 Skills and experience of the regional team**

| Country | Name | Institution | Dive Qualifications | Key Skills | Particpated in BIOSS surveys |
|---|---|---|---|---|---|
| Burundi | Dr NTAKIMAZI Gaspard | University of Bujumbura | | Senior researcher<br>Taxonomic expert (fish) | Rusizi, Mahale |
| | BIGIRIMANA Celestin | Kamnyosha Secondary School | PADI Advanced open water | Data entry & analysis,<br>Fish taxonomy | Rusizi, Mahale |
| | HAKIZIMANA Terence | Cibitoka Secondary School | PADI Advanced open water | Data entry skills | Rusizi, Mahale |
| | NDAYISENGA Libére | INECN – Bujumbura | BSAC-sport | | Gombe, Rusizi, Mahale |
| | NICAYENZI Félix | LTBP – Bujumbura | BSAC-sport | Fish taxonomy/data entry | Gombe, Rusizi, Mahale |
| | RUGIRABIRORI Albéric | Univ Burundi – Bujumbura | BSAC-sport | | Gombe, Rusizi, Mahale |
| | SINUNGUKA Bernard | DEPP – Bujumbura | BSAC-sport | Fish taxonomy | Gombe, Rusizi, Mahale |
| DR Congo | Dr NSHOMBO Muderhwa | CRH - Uvira | | Senior researcher,<br>Taxonomic expert (fishes) | Mahale |
| | AMUNDALA Shekani | CRH - Uvira | BSAC-sport | | Gombe, Mahale |
| | BAHANE Byeragi | CRH - Uvira | PADI Open water | | |
| | BASHONGA Bishobibiri | CRH - Uvira | BSAC-sport | | Gombe, Mahale |
| | BUDA Kukiye | CRH - Uvira | BSAC-sport | | Gombe, Mahale |
| | MUZUMANI Risasi | CRH - Uvira | BSAC-sport | Fish taxonomy | Mahale |
| | WATUNA Igundji | CRH - Uvira | PADI Advanced open water | Data entry skills & analysis | Mahale |
| Tanzania | KAYANDA Robert | TAFIRI – Kigoma | PADI Advanced open water | Data entry skills | Gombe, Mahale |
| | KIMAMBO Fadhili | TANAPA – Gombe | BSAC-sport | | Gombe, Mahale |
| | MNAYA Bakari | TANAPA – Gombe | PADI Advanced open water | Data entry skills | Gombe, Mahale |
| | WAKAFUMBE Robert | TAFIRI – Kigoma | BSAC-sport | Boatmanship | Gombe, Mahale |
| Zambia | LUKWESA Charles | DoF – Mpulungu | BSAC-sport | Data entry skills | Mahale, Nsumbu |
| | MWENDA Maybin | DoF – Mpulungu | BSAC-sport | | Mahale, Nsumbu |
| | SHAPOLA Reuben | DoF – Mpulungu | BSAC-sport | Boat maintenance skills | Mahale, Nsumbu |
| | SINYINZA Robert | DoF – Mpulungu | PADI Open water | Data entry skills | Mahale, Nsumbu |
| | ZULU Isaac | DoF – Mpulungu | PADI Advanced open water | | Mahale, Nsumbu |

# 4. CONCLUSION

In terms of the objectives set for BIOSS, within LTBP, the study has suceeded. The literature database has established a system that allows researchers and planners to collate and interogate existing datasets to inform future planning. The study has produced underwater habitat maps for the locations it was safe for teams to enter the water. These maps have mostly been produced by hand, but the data were collected in such a way as to allow maps to be produced from TANGIS in the future. BIOSS surveys confirmed that the waters off the existing terrestrial park are priority areas for conservation, providing good coverage of the aquatic species of the lake as well as taking advantage of the protected catchment and the existing institutions[2]. The monitoring programme evolved from the sampling programme developed and implemented by BIOSS and final overlap with other disciplines meant an integrated programme could be proposed.

Taking a wider perspective, BIOSS has suceeded in setting the foundations for a standardised, coordinated regional approach to provide the technical information needed for planning. It is hoped by all involved in the study that future work will build on this base, drawing on the skills and experience in the region and the technical outputs of the study to ensure that Lake Tanganyika remains a resouce of great significance for local people, it's riparian governments and the world at large.

[2] It should be noted that this was wisely predicted by Dr George Coulter in 1995 as we prepared for the study – his guidance greatly helped focus the work.