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Biodiversity Special Study Advice to the Strategic Action Programme

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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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A BACKGROUND

A.1 Purpose and origin of this document

This document provides the 'final' advice from the Biodiversity Special Study (BIOSS) that relates to strategic management of biodiversity and the threats to biodiversity. It updates the preliminary advice submitted to the SAP in January 2000. Under the leadership of Dr Eddie Allison (BIOSS Co-ordinator), a regional working group was convened in Kigoma during February 2000 to complete the final analysis of BIOSS data. Table 1 lists the composition of this group.

Table 1 Composition of team undertaking the regional assessment of BIOSS results

Name	Institution
Dr NTAKIMAZI Gaspard	University of Burundi
M. BIGIRIMANA Celestan	Kamnyosha Secondary School, Burundi
M. NDAMAMA Pierre	University of Bujumbura (Database support)
Dr NSHOMBO Muderhwa	CRH, Uvira
M. MUZUMANI Donatien	CRH, Uvira
Mr Robert SINYINZA	Department of Fisheries, Mpulungu (Zambia)
Mr Charles LUKWESA	Department of Fisheries, Mpulungu (Zambia)
Mr Bakari MNAYA	TANAPA, Tanzania
Mr Richard PALEY	LTBP: Regional Facilitator for BIOSS
Dr Kelly WEST	LTBP: Scientific Liaison Officer
Dr Eddie ALLISON	University of East Anglia. BIOSS Co-ordinator for MRAG Ltd.
Ms Vicki COWAN	MRAG Ltd

As part of the working group's agenda, BIOSS's preliminary advice to the SAP was reviewed and the current document follows guidance provided by this team.

A.2 BIOSS approach to biodiversity

The main aim of the BIOSS is to support the development of the strategic action plan to manage Lake Tanganyika. The aim of the strategic action plan is "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 SAP that this study addresses most directly are 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'.

Objectives
To achieve these aims the BIOSS has 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;
- Develop a sustainable biodiversity monitoring programme.

It should be noted that BIOSS differs from LTBP's other technical special studies in that it is not threat-based, rather it aims to develop the core approach to understanding aquatic biodiversity upon which the other threat-based work can be built. As a result, BIOSS can provide advice to the SAP that may be *proactive*, i.e. recommendations to conserve areas of outstanding biodiversity or *reactive*, i.e. actions needed to mitigate threats. The latter requires that BIOSS work in co-operation with the other threat-based studies, i.e. fishing practices, sedimentation and pollution.

Although much of BIOSS's work was concerned with developing methodology and institutional capacity for biodiversity assessment, this document confines itself to providing advice on the status of biodiversity, how that status has been determined, how change should be monitored in the future, and what strategies should be considered for biodiversity conservation.

Biodiversity assessment is a new science. The techniques for assessing biodiversity are still developing and there is no single method appropriate for all situations. The core principles guiding the BIOSS approach to biodiversity assessment were:

- *Habitats and indicator taxa approach*, The distribution of habitat types is fundamental to the distribution of biodiversity, and modern conservation practice is based on landscape and habitat-based approaches. To assess conservation value of different habitats, certain groups (indicators or total biodiversity surrogates) were chosen for comparative surveys. The rationale behind this approach is that it is not possible or necessary to measure diversity at all scales (habitat, ecosystem, species, genotype), and that protection of the largest scale of diversity is fundamental to protection of the diversity within it.
- *Sound ecological practice*, i.e. replicability, stratified random sampling and standardised protocols, to ensure comparability between surveys;
- *Building capacity of lakeside institutions*, i.e. BIOSS built upon existing capabilities of national institutions, with a deliberate focus on those situated on the shores of the lake, and enhanced their ability to carry out surveys and monitoring activities to assess aquatic biodiversity in Lake Tanganyika; and,
- *Sustainability*, i.e. programmes were designed such that, beyond the current project, lakeside institutions could continue biodiversity assessments with minimal dependency on external support.

It is neither possible or desirable to sample the entire biota, therefore, BIOSS selected fish and molluscs as the taxa that would represent or indicate the total aquatic biodiversity of Lake Tanganyika. As taxonomic and ecological knowledge about particular groups increases and biodiversity assessments in the Lake are asked to respond to specific demands, additional taxa can be included in future survey and monitoring activities within the existing survey framework.

BIOSS addressed its objectives through two field programmes:

- biodiversity and habitat surveys from areas adjacent to existing national parks to allow comparison between areas (the SURVEY programme); and,
- monitoring changes in the biodiversity at one place over time in partnership with impact based studies (the MONITORING programme).

Two databases have been developed to support BIOSS objectives: the literature database collates species location data from published and unpublished sources documenting previous studies of the lake; and, the survey database allows management of data collected in the survey programmes. Both have been developed to complement the GIS system developed under LTBP.

A 23-strong regional team, with members from all four riparian countries has been established during the implementation of BIOSS. With appropriate training and support, the team is capable of conducting standardised underwater surveys, managing the resultant data, analysing results and writing technical reports. Regional scientists provided the majority of the taxonomic training needed for BIOSS and guided the technical aspects of the field programme development. The expertise and experience of this team is an important resource to the future management of Lake Tanganyika's biodiversity.

B RECOMMENDATIONS - FORMULATED FROM KEY BIOSS RESULTS

B.1 Core Biodiversity Issues

This section provides a briefing of the wider biodiversity conservation context within which the BIOSS objectives are formulated. These issues are also relevant to deliberations on the development of Lake Tanganyika's Strategic Action Programme (SAP).

B.1.1 Narrative

Definition of Biodiversity
BIOSS adopted the definition of biodiversity from the CBD:

> "Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

The objectives[1] of the convention have also guided the development of our advice, in that we begin from the premise that conservation must not be carried out at the expense of sustainable development and that great care should be taken to address who bears the cost of any management intervention.

Economic value of biodiversity
The definition of biodiversity as variation (genetic, taxonomic, ecological) implies that the more variation (e.g. species richness) the more valuable a system is in conservation terms. This would be the case only if all species (or other units of biodiversity) had the same value. In practice, this is not the case. Humans place differential values on biodiversity, depending on whether it has 'use values' as well as 'intrinsic value'.

There are three types of economic value that can be associated with biodiversity: **direct use**, **indirect use**, and **non-use** values. These are explained in Annex I (Section C).

The key points to reinforce are:

- Species richness alone is not a reliable guide to biodiversity value. Areas of low richness (e.g. the pelagic zone of Lake Tanganyika) can have very high use values.
- Costs and benefits of biodiversity conservation accrue to different groups of people (local resource users, international scientists). An understanding of the distribution of values will help define and direct conservation action, and identify stakeholders' roles.

Table 1 provides an overview of the economic values of biodiversity, and illustrates these concepts with reference to Lake Tanganyika's biodiversity.

[1] The Convention's objectives are "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources".

Table 1 Biodiversity values and stakeholders: some examples from Lake Tanganyika

Values	Biodiversity Resource	Uses and Users
Direct Use		
Consumptive	Food fish	fishers, processors, market traders, transport companies, rural and urban consumers throughout region.
	Sport fish	Recreational fishers, tourism development
	Ornamental fish	Aquarium fish exporters, local employees, riparian governments (export revenue), aquarium dealers, aquarists in Europe, North America.
	Fish genetic diversity	Aquaculture development – global
Non-consumptive	Eco-tourism: coastal habitats, 'Charismatic species': cichlids, other fish & vertebrates, molluscs, crabs.	Ecotourists, diving tourism and associated development including employment and foreign exchange revenue.
Indirect Uses		
Ecosystem services	All species – particularly phytoplankton, 'keystone' species (e.g. shrimps, clupeids, top predators)	Environmental modulation - role in maintaining lake function, e.g. position of thermocline: trophic cascade effects Ecosystem productivity and stability, to benefit all those dependent on direct uses (above).
Knowledge	All species - especially diverse endemic lineages - cichlids, molluscs, ostracods.	Scientific research on evolutionary processes that ultimately benefits all human society.
Aesthetic	Habitats, charismatic or flagship species	Anyone who derives satisfaction from looking at the lake's biodiversity or habitats
Non Use Values		
Existence	Charismatic species usually	Conservation-minded individuals
Intrinsic	All biodiversity	All humanity, God
Bequest	All biodiversity	Future generations

Consideration of economic values of biodiversity, hypothesised relationships between biodiversity and ecosystem function, and the objectives of the CBD, leads to BIOSS suggesting the following guiding rationale for biodiversity conservation in Lake Tanganyika:

- The purpose of biodiversity conservation in Lake Tanganyika is to maintain the lake's unique, diverse, ecosystems, and their constituent taxonomic and genetic diversity. This will be achieved through efforts to maintain habitat quality and ecosystem integrity, and through regulation of the exploitation of the fish species.
- Biodiversity conservation in Lake Tanganyika should aim to emphasise the conservation of ecosystem function. The most important ecosystem function, regionally, is the production of fish. Internationally, the function of major interest is the set of conditions that have allowed rapid evolutionary radiation in several taxonomic lineages, making the lake an important scientific resource, and of exceptional species richness.
- Biodiversity conservation in Lake Tanganyika should also aim to promote the sustainable use of biodiversity, principally through fisheries management, but also through tourism and other non-consumptive uses.
- Any economic benefits derived from biodiversity conservation in Lake Tanganyika need to be shared equitably within the lake region.

We deliberately avoid the aim of conserving 'each and every species'. This is both very difficult to achieve, and would be almost impossible to monitor or assess. In the long term, it is also a less meaningful goal than conserving the conditions under which the remarkable evolutionary radiations, that make the lake a biodiversity 'hotspot' of international importance, took place.

B.1.2 Recommendations

The TDA should debate and agree wording for an overall objective for biodiversity conservation in Lake Tanganyika, based on the guidelines given in B1.1. The agreed definitions of biodiversity and aims for biodiversity conservation should be communicated to the SAP.

Research into economic valuation of biodiversity is required to improve prioritisation of future actions.

B.1.3 BIOSS outputs

BIOSS has attempted to raise awareness within the LTBP project of the definition of biodiversity and the rationale for its conservation. Much of this awareness-building has been through training workshops and provision of relevant reference and study materials to lakeshore institutions. This has been reinforced by the following documentation:

- An article in LTBP's newsletter "Lakeside"
- An Aide Memoire for LTBP: The Convention on Biological Diversity and the Global Environment Faciliaty (Dr E Allison)
- Relevant chapters in final technical report of BIOSS

B.2 Coastal Zone Management

Insights from BIOSS and other special studies regarding the nature of the threats to biodiversity have lead us to the conclusion that the SAP must have a regionally integrated strategy to deal with localised threats in the littoral zone. Focussing solely on transboundary issues would miss critically important threats, and does not provide guidance for lakeshore development – only for threat mitigation. This section outlines our proposal for adoption of the principles of coastal zone management to achieve threat mitigation within the context of sustainable development.

B.2.1 Narrative

The highest biodiversity, in terms of number of species, is situated in the sub-littoral zone (down to 40 m). We find that a high percentage of this biodiversity is ubiquitous in its distribution, but that there are limited number of taxa with spatially restricted distributions. 73% of described lacustrine fish (90% of species recorded in BIOSS surveys) were found in waters adjacent to existing national parks.

The littoral zone is most threatened by coastal development, particularly loss of terrestrial vegetation leading to increased siltation. At present, over much of the lakeshore, this effect is relatively localised around fishing villages and major towns. It is more widespread around the north basin and along the Tanzanian coast. Only major catchment deforestation in erosion prone catchments could provide a wider threat to diversity. The sediments special study comments on the extent to which catchment-wide deforestation presents an immediate threat to biodiversity.

Increased sedimentation and other human impacts along the coast of the lake may have altered community structure and reduced biodiversity in adjacent sub-littoral areas. It is not known if any species extinctions have taken place as a result of these activities. It is more likely that local variants may have been lost, and that the distribution of some species has been reduced or fragmented. BIOSS divers in Zambia are currently participating in a habitat manipulation experiment, which it hoped will provide more direct evidence on the impacts of sediments on littoral biodiversity.

Fishing activities provide a potential threat to biodiversity conservation. There are questions regarding the sustainability of exploitation of pelagic fish, particularly the larger Centropomids (*Lates* sp.). Sustainable exploitation issues are within the scope of the Lake Tanganyika Research project (LTR) and are presented as a Fisheries Management Plan for Lake Tanganyika. It is unlikely that these species are threatened by extinction, or significant loss of intra-specific genetic diversity. FPSS comments on more detail on the significance of sustaining the pelagic fishery to protect littoral biodiversity.

There is little use of habitat-destructive fishing gear in the lake (e.g. bottom trawls, explosives). Thus, fishing activities only impact directly on fish communities. It is possible, of course, that impacts on fish assemblages have knock-on effects on the rest of the ecosystem, but not enough is known about ecosystem dynamics to assess this at present.

The diverse fish communities of the sub-littoral are exploited by a variety of gears, depending on fish type and habitat. Beach seines have already been banned from Tanzania, due to their perceived negative impacts on biodiversity and sustainability of exploitation. There is little evidence of impact, but such evidence is difficult to obtain, so the ban has been implemented under an environmentalist interpretation of the precautionary principle. It appears that the ban is not enforced completely, reflecting the very real logistic and practical constraints to monitoring and enforcement of such fisheries legislation in Lake Tanganyika. Sandy shore fish communities are also impacted by other gears, such as gillnets, which target the larger

species. There are also a variety of small-scale gears in use on a subsistence basis, whose collective impact on sub-littoral fish community diversity may be significant. The fishing practices special study will comment further on the impact of fishing activities on biodiversity of littoral zone fishes.

Rocky-shore fish species will be relatively unimpacted by fishing activity. Net fishing, except with relatively small gillnets, is not possible where the underwater topography is rocky and complex. Line-fishing and trap fishing are practiced, targeted at a few of the larger species (catfish, mormyrids, *Lates* sp. Boulengerochromis). All these species are widely distributed, and these activities are unlikely to impact significantly on biodiversity (although once again, ecosystem effects of reducing the abundance of larger, predatory fish is not known). Optimal sustainable use issues are another matter, best considered by fishery management agencies, such as those involved in the LTR project.

Organic pollution and other contamination from industrial, mining and domestic sources all have potentially serious consequences for biodiversity, again, particularly in the coastal areas. Sheltered bays with limited circulation are most immediately threatened by eutrophication and even quite small, localised sources of pollution. Kigoma harbour and adjacent Bay provide examples of impacted coastal waters. Of the areas adjacent to terrestrial protected areas, only the waters off Rusizi are potentially threatened by river-borne pollution sources. The waters off Gombe, Mahale and Nsumbu are a long way from current major pollutant sources, and are likely to be fairly pristine. The pollution special study will comment further in this area.

B.2.2 Recommendations

The current threats to diversity in the littoral zone are most immediate from localised environmental degradation (deforestation in small and medium-sized catchments, effluent from coastal towns and villages), situated almost exclusively in the coastal zone.

BIOSS recommends that a strategy of **coastal zone management (CZM)**[2] **be adopted in Lake Tanganyika** where areas are zoned according to their conservation importance, degree of threat, and requirements for human development. This system of zoning would set out the type of coastal development permitted in different areas, thus concentrating effort and resources on ensuring such development does not threaten littoral biodiversity. The planning process would aim to minimise conflicts between identified coastal zone uses, and to locate developments according to an agreed plan, rather than the present unplanned approach to lakeshore development (e.g. construction of roads, harbours, settlements etc.). This would also provide a mechanism to mitigate effects of past unplanned development which have an adverse impact on water quality, biodiversity and fisheries resources.

Note that this BIOSS recommendation does not ignore the existence of transboundary threats - appropriate management of the pelagic fishery, as prioritised by FPSS, is a good example of a threat requiring international cooperation. Nor does it ignore the potential for transboundary threats to develop in the future. Rather, BIOSS sees CZM as **complimentary, not contradictory, to effective management of transboundary issues**.

CZM provides a framework which should achieve a **co-ordinated approach** to addressing threats across the region, ultimately prevent localised threats becoming transboundary in nature, facilitate sharing lessons/experience amongst the four riparian countries and so enhance the **regional cooperation** necessary for transboundary issues. TANGIS will be a critical information management tool to development and implementation of this strategy.

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[2] **Annex II (section D) provides a short briefing on coastal zone management to facilitate discussion.**

The core principle of **sustainable development** requires that the wider strategy of littoral-zone conservation takes into account human-development needs. By adopting a coastal zone management strategy, the regional body set up under the SAP and the Convention, can **target resources** where they are most needed. Thus avoiding the potentially ineffective strategy of spreading resources widely to maintain a whole-basin, whole-lake approach.

A coastal zone management approach will provide appropriate levels of protection to specific habitats. The original project document specified only two options – national parks, or unprotected areas. In practice, a integrated strategy that specified permissible coastal development on a zoned basis could be a more relevant and cost-effective strategy for biodiversity conservation and threat mitigation and prevention in Lake Tanganyika. BIOSS addresses the status and potential of protected areas in the next section.

B.3 Surveys of Protected Areas

BIOSS has focussed most of its field work on surveying waters adjacent to National Parks, with additional sites of special interest being included in the programme as time and resources allowed. Figure 1 shows the site locations of BIOSS's main field activities.

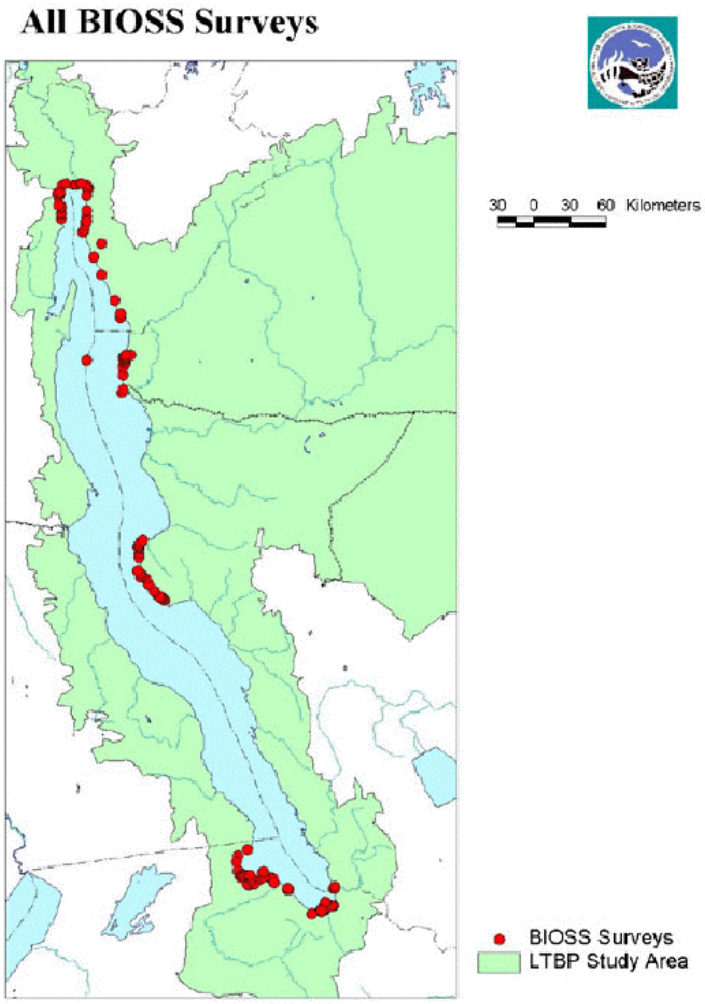

Figure 1 Field location of the biodiversity survey programme in Lake Tanganyika (source: BIOSS survey database and TANGIS)

B.3.1 Narrative

Habitat protection

The waters adjacent to three of the existing terrestrial national parks (Mahale, Gombe, Nsumbu) include relatively unimpacted sandy, rocky and mixed sand/rock/ habitats. The species assemblages associated with these habitats are representative, in terms of overall diversity and ecosystem structure, of communities in similar habitats elsewhere in the lake. The actual species compositions differ, with each area containing some unique species. These unique species make up a very low proportion of total species richness, and it would be impossible to guarantee protection of all species without protecting a very high percentage of the whole coastal zone.

More specialised habitats, such as shell-beds, emergent macrophyte stands and stromatolite reefs are also represented in the areas adjacent to Lake-shore national parks. Shell beds are found in both Mahale (southern part) and Nsumbu (north-western part). Stromatolite reefs are also found in the northern part of Mahale NP. The species associated with these habitats, including unique assemblages of shell-dwelling cichlids therefore benefit from a measure of protection from land-based threats, and in the case of Nsumbu and Mahale, from aquatic protection.

Rusizi National Park provides an area adjacent to a major river delta, that includes emergent macrophyte stands, muddy substrates and the turbid, nutrient-rich waters associated with river-mouths. The major threats to its current diversity originate in the wider Rusizi basin, and are unlikely to be mitigated by protecting a small area of the delta, however the reed-bed areas provide important nursery grounds for fish of commercial importance, as well as trapping some sediment. Extending protection into the lake, to manage fishing and reed-cutting activities is therefore desirable. These are areas of low endemism, but high diversity among non-cichlid fish species, including a number of migrants between the lake and river, and are important for the reasons given above.

Species richness & diversity indices
The immediate objective of the biodiversity survey data analysis is to use estimates, or measures, of biodiversity to compare the diversity of different areas. We use these estimates to compare between areas surveyed for possible inclusion, or retention, in a protected areas network, using a procedure called complementarity analysis, which aims to create a network of protected areas that includes the highest number of taxa in the smallest number of areas. The results of complementarity analysis for fish species richness data are indicated below. Fifteen areas were surveyed using both gillnetting and SCUBA survey techniques, the six areas that between them conserve the highest proportion of recorded fish diversity are indicated in Table 2, in order of most diverse, followed by each successive site that adds the most new species to the total set of areas.

Table 2 Complementarity analysis, fish species richness

Country	**Area**	**Fish species richness (from BIOSS surveys)**	**Cumulative total species**	**Cumulative % of surveyed species represented**	**% of total species recorded from lake**
Tanzania	Mahale NP	137	137	69.9	56.4
Burundi	Ruzizi	73	158	80.6	65.0
Zambia	Nsumbu NP	96	172	87.8	70.8
Tanzania	Gombe	90	178	90.8	73.3
Zambia	Lufubu/Chisala	76	183	93.4	75.3
Congo	Pemba/Luhanga/ Bangwe	73	186	94.9	76.5
ALL	ALL	196	196		243
				Total surveyed/total recorded	80.7

Notes:
Ruzizi, Nsumbu and Lufubu/Chisala were surveyed with gillnets only, so species richnesses are likely to be underestimated
More intensive surveys with gillnets in the Ruzizi area, undertaken in previous years, included a greater number of species
Survey effort was limited in the Congo, due to political problems – this is also likely to be an underestimate

Approximately 243 species of fish are known from the lake (up to 100 additional species are found in the catchment, but not the lake). Of these, 196 (81%) were recorded in the present survey.

The conclusions from this data are:

Mahale has the highest diversity of fish among the areas surveyed. Rusizi, although not the next most rich site, has the largest number of species not found in Mahale (highest complementarity to Mahale).

Waters off the four existing national parks include at least 73% of known fish species from the lake, and over 90% of species recorded by this survey.

The addition of river mouth areas adjacent to Nsumbu, and the rocky areas in northern Congo add a few species to the total, and this trend is likely to be to true of other areas. Each new area added to the protected area network is only likely to uniquely include one or two species not found elsewhere. Adding significantly to the protected area network will therefore only add marginally to the species officially protected. This suggests a lower level of protection, aimed at larger areas of coast, will be most effective for ensuring survival of the small proportion of fish taxa that have spatially limited distributions.

Analysis of the mollusc data yields the following results.

Table 3 Complementarity analysis, mollusc species richness in areas adjacent to national parks

National Park	Number of mollusc species sampled	Cumulative total	(%) of total species recorded in the lake**
Mahale Mountains National Park (Tanzania)	27	27	40.3
Gombe Stream National Park (Tanzania)	17	31	46.3
Nsumbu National Park (Zambia)	16	35	52.2
Rusizi (Burundi)	1	35	52.2
** Currently, 52 species of gastropod and 15 species of bivalve have been described in the lake, although taxonomic work continues.			

The proportion of the total number of species in the lake found in the waters adjacent to the protected areas is clearly much less than for fish. Though it is likely that further sampling of the Rusizi Delta would increase the number of species recorded. A further 8 species were found at sites unconnected with the national parks bringing the proportion of known lake species recorded by BIOSS to 64.1%. The second highest species richness (20 species) and the highest proportion of species not found in any other sampling area were recorded at four sites in the environs of Gitaza (Burundi), which therefore constitute an important centre for mollusc diversity.

B.3.2 Recommendations

These data support our preliminary recommendation to the SAP (December 1999) that a representative sample of the **majority of littoral habitats in the lake can be protected simply by maintaining or extending existing terrestrial parks**. We repeat that associating an aquatic zone with an existing terrestrial park is the most effective strategy as it

minimises resources required for park management, reduces disruption to riparian (human) communities, and serves to ensure that the aquatic habitats are protected from developments in the adjacent coastal zone.

Therefore BIOSS makes the following specific recommendations:-

- **Mahale's** 1.6km offshore zone is maintained as an integral part of this national park;
- **Nsumbu's** 1.6km zone is also maintained. We note that due to the deeply recessed coastline, particularly in the area of Nkamba Bay, administration of the boundary is difficult (it is ambiguous for both fishermen and park staff). We therefore, support suggestions first made by George Coulter that lines drawn between headlands are used to include both Nkamba Bay and potentially Kasaba bay. This use of headlands should improve management of the aquatic zone at this park and hopefully lower areas of conflict with local users. This modification should be implemented in consultation with local communities.
- **Gombe's** boundary falls 100m short of the water line and given our results, we recommend that a buffer zone is extended into the lake to provide some level of protection of the littoral habitat. This boundary need not be as far as 1.6km: the distance should be determined with respect to the depth profile off shore – we estimate no more than 300m is required[3]**. This should provide an easier area for TANAPA at Gombe to administer and limit the costs to neighbouring communities. We suggest a buffer zone**, rather than full protected status as we believe it is possible to balance conservation aims with sustainable development. Within this framework, we note that a beach seining ban is implemented on this shore and suggest the continuation of the TANAPA policy to phase out other intensive fishing practices in the littoral zone, primarily the use of small meshed gill nets. Local communities must be consulted over implementation of this recommendation.
- **Rusizi's** boundary does not extend into the lake and we note that the terrestrial boundary is currently under some pressure, with an area of the park already given over to agriculture. Within this context, extension of the park's boundary is clearly not viable until the security situation improves. When feasible, we would recommend that investigation into the fishing practices in the lake as well as in the swamps of the Rusizi delta is carried out. This should lead to the development of an integrated management plan for Rusizi that will provide some protection for both littoral and riverine species as well as nursery grounds for the commercial pelagic species.

Currently, knowledge and experience of national park's staff is primarily terrestrial: the main exception being the initiative under this special study to include parks staff in biodiversity survey activities. So, in association with the above recommendations to develop a network of protected aquatic areas within existing terrestrial reserves on Lake Tanganyika, **we recommend that the capacity of the relevant institutions is improved to monitor and manage the lacustrine component of their parks.** In particular that:-

- skills relevant to the management of aquatic zones are added to **routine training** of park staff. Topics would include: boat handling and safety; swimming and snorkelling (where safe); gill net sampling techniques; taxonomic skills for monitoring species (currently fish and molluscs); understanding of fishing practices (gears, target species). Guidance can be found in the BIOSS standing operating procedures (SOP).
- opportunities to improve **sustainable use** of the aquatic zone are actively sought by park authorities. Various forms of access to the aquatic resources could prove an effective tool to improve benefit sharing with neighbouring communities and so maintain and improve relationships between these groups and their national parks. For example, access to fishing grounds on a sustainable basis could be agreed.
- the **tourism potential** is explored. The SAP should note that additional tourist revenue from the aquatic zone will not be easily gained in the short term due to a range of constraints. Namely: security in the region (prime concern to many international

[3] Work to determine the depth profile remains outstanding.

travellers); infrastructure (the lake is remote and access to its parks is difficult compared to other tourist options); current tourist patterns (main trail of safari holidays misses out Lake Tanganyika); and, safety (aquatic sports such as snorkelling and diving are not compatible with hippopotami and crocodiles, rigorous protocols would need to be developed where risks are less).

- In the first instance, we see as having greatert tourism development potential, the enhancement of Nsumbu as a sports fishing location, and marketing of snorkelling and swimming as potential alternative, complementary activities to chimpanzee-watching in Gombe and Mahale.

We note with regret, that due to the security situation BIOSS has been unable to adequately sample the extensive coast of DR Congo. Historical surveys indicate that the Congolese territory hosts very high aquatic biodiversity and clearly any subsequent identification of a potential site for a lakeside protected area within Congo should be actively supported by the SAP. Given this situation we note that, from a regional perspective, implementation of the recommendations to secure aquatic zones within existing parks would provide more than adequate protection of the lake's biodiversity. Therefore we consider the establishment of any more sites giving full protection in Tanzania, Burundi or Zambia as a very low priority for the SAP. Rather, the remainder of important sites and recognised threats would best be managed through implementation of the coastal zone management strategy advocated above.

- To address the protection of sites with significant biodiversity and a history of research activity outside the park network, we **recommend that a category of "sites of special scientific interest (SSSI)" is explicitly recognised within the overall CZM strategy**. These sites would receive high priority in terms of the control over activities permitted in the catchment and the lake. The BIOSS survey work successfully carried out in DR Congo has identified three sites, Pemba (3^{o}.611S, 029^{o}.150E), Luhanga (3^{o}.522S, 029^{o}.149 E) and Bangwe (3^{o}.576S, 029^{o}.149E) which we recommend receive SSSI status.
- These locations are all high in species richness and are some of the few largely unimpacted sites within close proximity with Uvira. The provide a valuable research/study area for the Centre Dr Recherché En Hydrobiologie and could attract international scientist who wish to study the fauna of the northern lake basin when the political situation stabilises. Currently, the major threat to their biodiversity is from sedimentation due to deforestation of the slopes above them. Intensive fishing is deterred by the sharp rocky substrate, formal protection is therefore felt to be unnecessary. More effective would be a reforestation programme for the catchment, which could be carried out under the auspices of a local NGO in partnership with nearby communities.
- The Congo coast has been highlighted as a potential location for SSSI's because it currently has no areas which enjoy special protection or status. Nevertheless, BIOSS has identified sites in other riparian countries, which also merit special status owing to the richness or diversity of the aquatic fauna, yet where formal protection may not be the most appropriate or practical option. These include a number of rocky sites in the area of Gitaza in Burundi, the waters next to the Kitwe Wildlife Sanctuary, south of Kigoma and the mouths of the Lufubu and Chisala Rivers bordering Nsumbu National Park, Zambia.

To address the protection of sites important as nursery and spawning grounds for economically important fish species, we recommend designation of **Resource Management Areas**. These may include: the Rusizi, the Malagarasi delta, the Lukuga effluent, or the Lufubu/Chisala river mouths. A possible mechanism for managing these areas for sustainable use is provided by the Ramsar Convention (see below).

BIOSS would like to formally bring the SAP's attention to the fact that the RAMSAR convention on wetlands has recently added a criteria based on fish biodiversity to its schedule for accepting wetlands as Ramsar sites. This is of great potential to Lake Tanganyika which does not currently host a Ramsar site in its catchment. Annex III (Section E) lists information on each country's status with respect to the Ramsar convention and provides a brief summary of the requirements to apply for Ramsar status.

Another recent initiative of potential future interest to Lake Tanganyika's SAP, namely, the establishment of a joint work programme between the Ramsar Convention and the Convention on Biological Biodiversity (CBD).

BIOSS recommends that the SAP actively seeks the establishment of Ramsar site(s) within Lake Tanganyika's catchment and closely monitors the CBD-Ramsar joint work plan initiative. All opportunities to raise Lake Tanganyika's international profile through mechanisms such as these should be pursued.

B.3.3 BIOSS outputs

- Individual reports on each of the survey sites
- Final BIOSS technical report providing regional assessment of biodiversity and conservation strategies based on biological criteria.
- BIOSS standing operating procedures (SOP) for biodiversity field sampling, data handling and analysis
- Survey database collating all BIOSS data on a national basis, with a regional version to be used for analysis
- Literature database collating species data from published and unpublished sources.

(The effectiveness of this database will increase as data from a range of documents continue to be added, this will be one of the key activities to be maintained in order provide appropriate advice to the SAP for the foreseeable future. Advice to the current SAP does not draw heavily from this source).

B.4 Future Work

This final set of recommendations provides guidance for the continuation of fieldwork initiated under BIOSS to support the ongoing development of the SAP and regional capacity to manage the lake.

B.4.1 Narrative

Regional team
The core of BIOSS is the regional team that has supported the field programme and will maintain long term activities, beyond LTBP. All four riparian countries are represented in this **23-strong team**, which is capable of conducting expeditions to survey Lake Tanganyika's aquatic biodiversity following well-established protocols, managing data, analysing and reporting. See Annex IV for a complete list of the BIOSS team members, institutions and skills. Thus, all future requests for biodiversity assessment of an area thought to be of conservation interest, or under particular threat, can call on this lakeside team. These expeditions will generate data and reports comparable to those produced for the areas surveyed within the BIOSS work plan. This is an important resource for the planning and management of the lake's biodiversity.

Survey programme
The BIOSS survey programme has described areas that are not well known and are of conservation interest to the SAP. Priority areas for BIOSS have been the aquatic areas adjacent to existing terrestrial national parks. Specifically, Gombe and Mahale in Tanzania, Rusizi in Burundi and Nsumbu in Zambia with a site in DR Congo, e.g. near Moba which was to be identified as the constraints to working on that coast lessened.

A single BIOSS document, the **standing operating procedures (SOP)**, provides a common manual for field sampling, data handling and analysis. This document lays out the background and justification for the technical approach adopted by BIOSS. It has been a working document, evolving as skills and understanding within BIOSS has developed. The regional teams have played a key role in its development, writing and reviewing sections as field experience modifies practice. The document has been the main mechanism by which regional consistency in national field programmes has been maintained and should serve a similar purpose into the future. It also provides the framework from which the survey programme can expand and develop.

The **BIOSS literature database**, developed as a tool for conservation planning and management, begins to collate the extensive body of work on the flora and fauna of Lake Tanganyika. Much of this original data is not yet published in internationally available literature, and less still is deposited in the riparian countries from which it was collected. This database is linked to LTBP's GIS system and its ongoing maintenance will provide a wealth of data and insight to the SAP. While developed under the auspices of BIOSS, the full potential of the database is yet to be realised and will be a critical activity to continue beyond the lifetime of the current project.

Monitoring
The second strand to the BIOSS field strategy - the monitoring programme - will provide regular data for a series of sites selected for their special characteristics. For example, the sites may be impacted by pollution, sedimentation or fishing practices - alternatively a site may have a unique or exceptional biodiversity.

As with the survey programme, the regional team can work to protocols documented in the BIOSS standard Operating Procedures (SOP).

The monitoring programme requires input from the other impact-based special studies in helping to identify sites, suitable monitoring species, associated environmental data collection etc. The monitoring programme will be the core field activity left in place when the current project ends. The scope of this will be dependent on demand from the developers of the strategic action plan and national resources.

BIOSS is taking a proactive role in the identification of appropriate monitoring sites to address the issues covered by other impact-based studies. A provisional list of sites has already been agreed in consultation with the other special studies and final selection is expected in mid-March.

B.4.2 Recommendations

Institutional support
All future survey work in Lake Tanganyika to support biodiversity conservation should be carried out by the **regional teams** using the **established protocols** as outlined in the BIOSS SOP. This will ensure the continuity necessary to support Lake Tanganyika's strategic action programme.

All future expansion of surveying capacity, such as the addition of new taxa to the field programme, should **follow the ecological principles** that guided the development of BIOSS protocols and be **documented within the SOP** (to be regarded as a working document).

All new members of the field team available to conduct biodiversity assessments should be trained in the principles and techniques as outlined in the SOP. Particular attention should be given to **suitable diver qualifications** and the **safety protocols**.

A system of assigning responsibility **to monitor the integrity of the regional team** that will be called on for biodiversity assessment needs to be agreed amongst the current team. This has technical and safety implications for future expedition work.

Sufficient resources should be made available to the team to enable them to carry out their expeditions safely and efficiently and to report appropriately. Section F (Annex IV) gives the indicative budget lines which need costing to adequately fund such activities.

All surveying and monitoring data should be collected and recorded as is defined in the SOP, with particular care being taken to maintaining the information management rules for location data so that **BIOSS databases and TANGIS will remained linked**.

International researchers and institutions with an interest in Lake Tanganyika's biodiversity should be **approached as potential partners in the continued development** of the literature database. Note that past, present and future data from all sources would ideally reside in this single repository, which can then be made available to managers and researchers alike. A list of institutions has been compiled and is included in the BIOSS final technical report.

To assist the ongoing development of research to address information gaps and inform the SAP we recommend that a **system of incentives is developed to promote international research on Lake Tanganyika** that is complimentary to SAP objectives. For example, research fees could be waived, government institutions could provide institutional support in return for provision of training opportunities, and the lake basin management authority could expedite the preparation of memoranda of understanding for collaborative work with riparian institutions, and for granting research permits.

Research requirements
We recommend the following areas as **high priorities for future research**:

- Developing appropriate biotic indicators for pollution and sedimentation monitoring.
- Research into economic values of biodiversity, and tourism potential of aquatic parks, including market research and development of tourism promotion strategy, if appropriate.
- Developing identification skills and survey techniques for additional taxa that could serve as biodiversity surrogates (BIOSS worked with fish and molluscs).
- Assessing the effectiveness of alternative approaches to biodiversity assessment (for example recognisable taxonomic units, higher-taxon approaches, local knowledge etc, see BIOSS final technical report for discussion on this topic). This could provide more efficient means of surveying and monitoring as these methods take less field time, are less demanding on expert taxonomic knowledge and so ultimately are more cost effective.
- Further biodiversity surveys on the Congolese and Tanzanian Coasts. Apart from the Uvira, Kigoma and Mahale areas, there has been little systematic exploration of these areas.
- An interdisciplinary study on the Malagarasi and other major fringing wetlands in the Lake Tanganyika catchment, aimed at developing sustainable use plans and conservation or enhancement of lake fisheries.

B.4.3 BIOSS outputs

- Qualified regional team
- Standing Operating Procedures for surveying
- Individual technical reports of sites surveyed during BIOSS
- Final technical report providing a regional assessment
- Literature database
- Survey database

C ANNEX I - ECONOMIC VALUE OF BIODIVERSITY

There are three types of economic value that can be associated with biodiversity: **direct use**, **indirect use**, and **non-use** values. Within these categories are several sub-divisions.

Direct use values refer to economic benefits that accrue directly as a result of the continued existence of a genotype, species, community, or ecosystem. Direct uses may be *consumptive* (the organism is harvested or removed from its environment, as in fisheries or the aquarium trade) or *non-consumptive* (economic benefits generated without harvesting, such as revenue from eco-tourism).

Indirect use values are the economic benefits that arise indirectly from the continued existence of biodiversity. In Lake Tanganyika, the diversity of organisms maintain crucial ecosystem functions, such as a relatively stable and productive environment for fisheries production. The interactions between primary production and consumption by higher trophic levels also maintains water quality. An example of indirect use values, and their loss, is the increase in Bilharzia in Lake Malawi following reduction in populations of mollusc-eating fishes that were thought to control the intermediate snail hosts of the disease. This has costs to human health and even to the tourist industry. The indirect value of the snail-eating fish can be estimated through the cost to human communities of poor health, and to the provision of increased health services in the riparian countries.

Biodiversity has value beyond mere utility, and environmental economists have tried to estimate these **non-use** values too. **Existence values** are calculated by economists on the basis of what people are willing to pay to ensure that, for example, a particular cichlid species continues to survive. They do not necessarily want to travel to see it, or to keep it at home, just to know that it still exists. **Intrinsic values** recognise the rights of all living things to share the planet. **Bequest values** recognises that our environment has value to future generations, and that species or ecosystems that are of little or no use to us may find uses to future generations.

Traditionally, resource values have been calculated on the basis of direct use values only. Environmental economists argue that this is why modern societies under-value the environment, and degrade it to convert ‘natural capital’ into ‘financial capital’. They argue that if environmental/biodiversity values can be ‘captured’ or estimated, then the true costs of alternative land, water or resource uses can be calculated. This provides the basis for an analysis of trade-offs between preservation and consumptive use, or to asses the real value of extinctions, in terms of loss, not only of direct use values (the old approach) but also of non-use and indirect use values. With these environmental valuation techniques has come the realisation that when we lose a species, we lose a lot more than we anticipated. Putting a value on bequest, existence and other such concepts is rather difficult in practice, but does serve to bring such values to the attention of policy makers.

This utilitarian approach to environment is becoming much utilised in global environmental management – the use of tradable carbon permits to manage carbon dioxide emissions in combating global warming, and the principle of ‘polluter pays’ are two examples.

In the case of Lake Tanganyika, use values are of most concern regionally, while non-use values are more important internationally. An understanding of the differential values of different biodiversity will help to determine priority approaches. This is already recognised implicitly in the SAP process, but needs to be made explicit to justify decisions. For example, the species flock of endemic leeches of Lake Tanganyika have some intrinsic value, possible bequest value, but little or no use and existence value, while *Lates stappersii* has a high direct use value, but as a single, common species, modest existence and intrinsic value. Recognition of these differences would help to choose between funding a taxonomic and ecological study on the leeches, or a fishery management initiative.

The fact that the values of *Lates* accrue locally, while the value of the leeches accrues internationally, will also provide the SAP with guidance of where funding support can be expected.

D ANNEX II - BRIEF ON COASTAL ZONE MANAGEMENT

What is coastal zone management?

- Coastal Zone Management (CZM) aims to combine the management of near-shore waters with shore-lands. Usually, waters are managed separately from the land, and there is therefore little co-ordinated planning and management that recognises the impact land-based activities have on coastal resources.

- CZM based on sound environmental principles is a powerful mechanism for allocation of natural resources and control of development on the coast (of the lake). It requires networking among all relevant government activities. The key is unitary management of the zone, which treats the shoreland and coastal waters as a single interacting unit and co-ordinates the interests of all stakeholders with a collective agenda.

- A primary strategy of CZM is to regulate construction, land-use conversion and other actions in the coastal zone, often through a project review and permit letting process. CZM attempts to guide future development as a main purpose, while also trying to correct environmental mistakes of the past as a parallel purpose.

- CZM aims to balance multiple uses of the coastal zone, to jointly maximise social and economic benefits, while integrating conservation with development. CZM will allow some activities to co-exist (e.g. conservation, fishing and tourism), while it may restrict incompatible activities (e.g. protection of fish nursery grounds and industrial development). CZM emphasis multiple use and user groups.

- CZM utilises regulatory powers (e.g. such as those developed under the legal convention) to achieve resource conservation by controlling development activities and resolving potentially divisive conflicts among competing users of the coastal zone.

- Fully unified CZM discourages piecemeal approaches to coastal development in favour of a balance between a variety of compatible uses.

- In lakes, the concept of integrated catchments dominates management planning. This concept has been most successful for small and medium-sized lakes, and is appropriate when human activities in the catchment threaten the functional integrity of the whole lake system. The magnitude of the threats from catchment changes in Lake Tanganyika is not that severe yet. A coastal zone management programme will serve to focus intervention where it is most needed, and to resolve conflicts where they most often arise.

- A CZM programme would not have to confine its activities to the designated coastal zone. The zoning strategy that is central to CZM could accommodate both catchment ‘hinterlands’ and offshore areas as ‘zones of influence’ where developments that affected the coastal zone would be monitored, and threats mitigated where necessary.

- A CZM plan is less ambitious than a whole-catchment management plan, and therefore more amenable to immediate implementation. While we support the notion of integrated catchment management planning, and would not suggest the rest of the catchment and the centre of the lake are neglected, we suggest that practical intervention at the whole-catchment scale is less feasible than at the coastal zone scale. It will be easier, more cost effective and more effective in terms of threat-mitigation if an agency has a remit to concentrate its activities in a manageable and meaningful area.

Defining zones

- There is no single definition of the Coastal Zone. Its boundaries are delineated on the basis of the particular problems that the management program is supposed to solve. A CZM programme is issues-based. The main features of the coastal zone are that it should include both the land and the water, and that it is, in planning terms, a 'corridor'.

- It should be noted that the concept of 'corridors' is well known in wildlife conservation, where the importance of linking habitat patches has been recognised, allowing interchange between populations that could otherwise become isolated.

- We suggest the defined coastal zone should extend no more than 1.6 km into the lake (this covers the maximal extent of the current protected areas in Zambia and Tanzania, and in many cases could be usefully defined in terms of a smaller area (e.g. 200 m)

- The areas most seriously impacted by sediment pollution are in the North of the lake, where the distance from the lake shore to the top of the lake-shore hills (the crest of watershed) is usually no more than 2-3 km. This could usefully define the landward area within which efforts to regulate potentially detrimental activities (deforestation, draining of wetlands, blocking river mouths, industrial development, building).

- Conservation of biodiversity and sustainable use of resources should be addressed by a network of designated protected areas, resource conservation areas and sites of special scientific interest. The Great Barrier Reef National Park in Australia is an example of a resource management zone designed under a CZM programme.

- Zonation and implementation strategies will need to be further investigated, and will have a significant mapping and resource survey component. In retrospect, such an approach would have been useful for special study integration within the LTBP project.

- There is a scientific precedent for special focus and consideration of the coastal zone: the UNESCO ECOTONES project on the land-water interface. There is also an operational programme of the GEF entitled 'Land-Water Interface', which is designed to accommodate a CZM approach.

How does the idea of a coastal zone management focus fit with the project/GEF mandate to create a Lake Basin Management Authority?

- The Lake Basin Management Authority would be the institution responsible for overseeing the implementation of the CZM plan. It would ensure that the CZM is formulated with wider catchment management considerations in mind. The CZM focus would serve to concentrate practical implementation of SAP activities in the coastal zone, where they are most needed. The focus will also ensure that decisions are taken with full consultation with lakeshore interests.

Coastal Zone Management	
Advantages	**Disadvantages**
• Concentrates planning, monitoring and mitigation activities around the lakeshore, but does not neglect upstream/inland or offshore impacts. • Focus of power and decision-making remains with people living adjacent to the lake, and lakeshore institutions • Both management measures and outcomes are visible to lake shore people • Provides a zoned development plan, not just a conservation and threat-mitigation strategy • Encourages lakeshore institutions and communities to work together, across sectoral/institutional boundaries • Protecting the coastal 'corridor' is consistent with optimal biodiversity conservation strategies • 'Setbacks' and zoning – the main tools of CZM - are measures readily visualised and understood. • Some elements of CZM 'setback' management are already in place (e.g. no development within 100 m of the lakeshore in Bujumbura; no gravel/sand extraction within 10m of the lake in DR Congo).	• Possible neglect of wider catchment issues • Lakeshore institutions and communities may not have sufficient power to influence central administrations • Catchment is a readily defined functional unit, while the coastal zone is defined relative to the main issues, and is therefore geographically more arbitrary. • The are likely to be administrative costs in redefining interventions in the strategic action programme to emphasise coastal issues • The legal basis for coastal zone management has not been explicitly investigated • Scientific and technical advice in LTBP has not been directed at CZM objectives. • The concept of CZM is not as familiar, and may not be as acceptable, to those more used to working with catchments and basins.
Integrated Catchment Management	
Advantages	**Disadvantages**
• The catchment is a readily defined and acceptable unit of management and planning • The catchment is an ecologically and geographically defined system. Unfavourable changes in the catchment could, if sufficiently large, impact on the lake. • The strategic action programme has accepted and planned its activities on the basis of the entire lake basin • The legal convention has been formulated on a catchment scale • The LTBP project has supported the creation of a Lake Basin Management Authority, with a basin-wide remit • Some of the major threats to biodiversity, such as offshore fishing and deforestation of larger basins, may take place outside the coastal zone	• The catchment is large relative to the capabilities of institutions to manage it, and many of the threats to biodiversity are fairly localised, leading to potentially wasteful dissipation of resources • The catchment management approach highlights conservation, while aiming to ensure conservation does not negatively impact development. It does not plan for or aim to encourage development • ICM, but its nature, requires a high degree of centralised management which may be remote from lakeside concerns • The balance of costs and benefits of basin-scale mitigation measures may be spatially disaggregated, and not readily perceived, and therefore supported, by people living on the lakeshore • The threat of offshore overfishing is already dealt with through joint fishery management agreements. There is limited evidence for the biodiversity impact of basin-wide deforestation. The most immediate threats to biodiversity are in the coastal zone. A basin-wide strategy may fail to deal effectively with the most immediate problems.

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E ANNEX III - BRIEF ON THE CONVENTION FOR PROTECTION OF WETLANDS (RAMSAR 1979)

Source: http://www.ramsar.org/

The Ramsar Convention definition of "wetland" and classification system for wetland type:

Under the Convention on Wetlands (Ramsar, Iran, 1971) "wetlands" are **defined** by Articles 1.1 and 2.1 as shown below:

Article 1.1:
"For the purpose of this Convention wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres."

Article 2.1 provides that wetlands:
"may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands".

DEMOCRATIC REPUBLIC OF CONGO
The Convention on Wetlands came into force for the Democratic Republic of Congo on 18 May 1996. The Democratic Republic of Congo presently has 2 sites designated as Wetlands of International Importance, with a surface area of 866,000 hectares.

Administrative Authority: Secrétariat Général de l'Environnement et Conservation de la Nature, Ministère de l'Environnement, Conservation de la Nature et du Tourisme, Kinshasa/Gombe

Parc national des Mangroves. 18/01/96; Bas-Zaïre; 66,000 ha; 05º45'S 012º45'E. Two plateaus bordered by swamplands along the Zaire River, including coastal and riverine waters, inland ponds, and swamps. Vegetation consists of wet grassland interspersed with forest savanna, grassland savanna, swamp and mangroves. The site supports important fish and crustacean reserves for local fisheries. Nine species of rare or endangered mammals occur, including the manatee; six bird and eight reptile species, including marine turtles, are at risk from habitat destruction. Human activities include fishing, the gathering of medicinal plants, and subsistence cropping.Threats include extensive fuelwood cutting, refinery pollution, and uncontrolled urban development. Ramsar site no. 788.

Parc national des Virunga. 18/01/96; Nord-Kivu; 800,000 ha; 01º15'S 029º30'E. Lying astride the equator and situated in the African Rift Valley, the site contains most tropical biotopes and boasts some of the most substantial concentrations of wild mammals in Africa, or indeed in the world. The Park fringes several biogeographical regions, includes volcanoes recent in origin and still active, and two large lakes. The area is important feeding and wintering ground for migratory birds and is one of the few places where mountain gorilla can be studied in their natural environment. The large mammals include endangered and endemic species.

Archaeologically important, the oldest stone tools in the world have been discovered along the lake shores. Human activities include tourism, conservation education, fishing, hunting, subsistence farming and agroforestry (fuelwood). There is a research center in the park. Ramsar site no. 787.

ZAMBIA
The Convention on Wetlands came into force for Zambia on 28 December 1991. Zambia presently has 2 sites designated as Wetlands of International Importance, with a surface area of 333,000 hectares.

Administrative Authority: Environmental Council of Zambia, Ministry of Environment and Natural Resources, Lusaka

Bangaweulu Swamps: Chikuni. 28/08/91; Northern Province; 250,000 ha; 12º00'S 030º15'E. Special Conservation Area. The site comprises the southern Bangweulu Swamps, which provide water for key waterways in Zambia and Zaire and parts of the Lukulu and Lulimala floodplains. Consisting of woodlands, dambos, swamps, marshes and grasslands, the site supports large numbers of the endemic mammal Kobus leche smithemani and two globally threatened birds and is important for the conservation of indigenous flora and fauna. The basin as a whole is one of Zambia's most important commercial fisheries. Ramsar site no. 531.

Kafue Flats: Lochinvar & Blue Lagoon. 28/08/91; Southern Province; 83,000 ha; 16º00'S 027º15'E. National Parks. Two national parks consisting of marsh and swamp floodplains, termitaria (grassland), woodland zones, and geothermal areas. The site is a conservation area for indigenous and endemic flora and fauna, including globally threatened cranes. The wetlands provide water for hydroelectric power generation, irrigation, fisheries, industrial and urban use. Human benefits include a fishery, wildlife production, and livestock grazing. Ramsar site no. 530.

The Criteria for Identifying Wetlands of International Importance

as adopted by the 4th, 6th, and 7th Meetings of the Conference of the Contracting Parties to the Convention on Wetlands (Ramsar, Iran, 1971) to guide implementation of Article 2.1 on designation of Ramsar sites

[Note: This is just a simple list of the Criteria themselves out of their explanatory settings. They should properly be used as part of the Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance adopted by COP7, 1999.]

Group A of the Criteria. Sites containing representative, rare or unique wetland types

Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

Group B of the Criteria. Sites of international importance for conserving biological diversity

Criteria based on species and ecological communities

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Specific criteria based on waterbirds

Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.

Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Specific criteria based on fish

Criterion 7: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.

Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

F ANNEX IV - BIOSS TEAM – A RESOURCE FOR THE ONGOING DEVELOPMENT OF LAKE TANGANYIKA'S SAP

Table 6 Details of BIOSS team

Country	Name	Institution	Key Skills
Burundi	Dr NTAKIMAZI Gaspard	University of Bujumbura	Senior researcher, taxonomic expert
	BIGIRIMANA Celestin	Kamnyosha Secondary School	PADI Advanced open water, data entry skills
	HAKIZIMANA Terence	Cibitoka Secondary School	PADI Advanced open water
	NDAYISENGA Libére	INECN – Bujumbura	BSAC-sport
	NICAYENZI Félix	LTBP – Bujumbura	BSAC-sport, fish taxonomy
	RUGIRABIRORI Albéric	Univ Burundi – Bujumbura	BSAC-sport
	SINUNGUKA Bernard	DEPP – Bujumbura	BSAC-sport, fish taxonomy
DR Congo	Dr NSHOMBO Muderhwa	CRH - Uvira	Senior researcher, taxonomic expert
	AMUNDALA Shekani	CRH - Uvira	BSAC-sport
	BAHANE Byeragi	CRH - Uvira	PADI Open water
	BASHONGA Bishobibiri	CRH - Uvira	BSAC-sport
	BUDA Kukiye	CRH - Uvira	BSAC-sport
	MUZUMANI Risasi	CRH - Uvira	BSAC-sport, fish taxonomy, data entry skills
	WATUNA Igundji	CRH - Uvira	PADI Advanced open water
Tanzania	KAYANDA Robert	TAFIRI – Kigoma	PADI Advanced open water, data entry skills
	KIMAMBO Fadhili	TANAPA – Gombe	BSAC-sport
	MNAYA Bakari	TANAPA – Gombe	PADI Advanced open water, data entry skills
	WAKAFUMBE Robert	TAFIRI – Kigoma	BSAC-sport
Zambia	LUKWESA Charles	DoF – Mpulungu	BSAC-sport, data entry skills
	MWENDA Maybin	DoF – Mpulungu	BSAC-sport
	SHAPOLA Reuben	DoF – Mpulungu	BSAC-sport, boat maintenance skills
	SINYINZA Robert	DoF – Mpulungu	PADI Open water, data entry skills
	ZULU Isaac	DoF – Mpulungu	PADI Advanced open water

Indicative Budget lines to consider when costing surveying work

Number of Days?
Number of people?
Allowances for divers and supervisors (covers food/subsistence)
Transport
- Boat Rental and Fuel
- Fuel/oils for research vessels
- Travel from home country (if relying on regional team)
- Visa fees (if relying on regional team)

Equipment
- Survey equipment
- Miscellaneous
- Stationary

Miscellaneous Running Costs
- Cooks/camp attendants
- Security/Watchmen/Game ranger