GCP/RAF/271/FIN-TD/90 (En) February 1999

LAKE TANGANYIKA MONITORING PROGRAMME

by

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FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

Bujumbura, February 1999

PREFACE

The Research for the Management of the Fisheries on Lake Tanganyika project (Lake Tanganyika Research) became fully operational in January 1992. It is executed by the Food and Agriculture Organization of the United Nations (FAO) and funded by the Finnish International Development Agency (FINNIDA) and the Arab Gulf Programme for United Nations Development Organizations (AGFUND).

This project aims at the determination of the biological basis for fish production on Lake Tanganyika, in order to permit the formulation of a coherent lake–wide fisheries management policy for the four riparian States (Burundi, Tanzania, Democratic Republic of Congo and Zambia).

Particular attention will be also given to the reinforcement of the skills and physical facilities of the fisheries research units in all four beneficiary countries as well as to the build-up of effective coordination mechanisms to ensure full collaboration between the Governments concerned.

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For both series, reference is further made to the document number **(01)**, and the language in which the document is issued: English **(En)** and/or French **(Fr)**.

For bibliographic purposes this document should be cited as follows:

Mannini, P., The Lake Tanganyika Monitoring Programme
1999 FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika.
GCP/RAF/271/FIN-TD/90 (En): 65 p.

TABLE OF CONTENTS

The Lake Tanganyika Monitoring Programme

By

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1. Introduction

The initial proposal for a Monitoring Programme for Lake Tanganyika was presented during the 5th Joint Meeting of the Coordination and Scientific Committees of the FAO-FINNIDA Regional Project «Research for the Management of the Fisheries on Lake Tanganyika», henceforth LTR, in 1996[1, 2].. In 1998 at the 6th Meeting of LTR Coordination and Scientific Committees the Monitoring Programme for Lake Tanganyika was finalised based on the formulations of the LTR Working Group on Monitoring[3].. The Monitoring Programme for Lake Tanganyika will be an integral part of the Lake Tanganyika Fisheries Management Plan which is due to be finalised in 1999.

The objective of the Monitoring Programme is the continued study of some of the key parameters of the lake ecosystem which are indicators of the lake productivity. In the present document «Monitoring» is intended as the systematic recording and periodic analysis of information. This is a natural follow-up, although with reduced effort and on a smaller scale, of the work implemented by LTR through the three-year long regular execution of the so-called Scientific Sampling Programme (SSP). The parameters to be monitored originally proposed by the LTR Working Group on Monitoring were the following: wind speed, gust and direction, air temperature, relative humidity, solar radiation, air pressure, rainfall, water level, water temperature, dissolved oxygen, transparency, vertical light penetration, chlorophyll *a*, zooplankton biomass, shrimp abundance, catch per unit of effort (CPUE) and fish catch species composition by fishing gears and areas. Basic socio-economic monitoring of the fishing community is also included.

The Lake Tanganyika Monitoring Programme will be implemented on a regional basis with the employment of the national expertise developed during the SSP execution in each of the four riparian countries (Burundi, Tanzania, Zambia and D.R. Congo ex-Zaïre). The local researchers and laboratory technicians trained by LTR and attached to the appropriate departments or research institutions should run the Monitoring Programme at each station. They will be responsible for the successful implementation of the Monitoring Programme under the supervision of a Regional Coordinator to be appointed on a yearly basis among the most experienced national scientists. While labour costs should be met by the national institutions, the operating, maintenance and supervision costs will be supported by external funding.

The key characteristics for a successful Monitoring Programme are its **feasibility**, **simplicity** and **sustainability**, which depend

on the local field conditions, the availability of human resources and the use of equipment whose maintenance requirements are minimal, inexpensive and simple.

The present document is the result of a field mission carried out around Lake Tanganyika to assess the feasibility of the proposed Monitoring Programme and to formulate guidelines for the standardisation of the work in the riparian countries, so to ensure the homogeneous flow of scientific data from the various areas of the lake.

2. Assessment of available staff, equipment and work capacity at field stations

2.1 Mpulungu

2.1.1. General

The Department of Fisheries (DoF) of Mpulungu (Zambia) is well staffed both in terms of available personnel and general level of expertise. The station premises and laboratory facilities are satisfactorily maintained and in good order. Moreover, the ongoing research work carried out together with the Lake Tanganyika Biodiversity Project (henceforth LTBP) and the research teams from Japanese universities contributes to maintaining a positive working environment.

Most of the scientific equipment required for the study of abiotic and biotic parameters included in the Monitoring Programme is in working condition and mainly in need of being supplied with spare parts and consumable materials.

The R/V Silver Shoal would have needed major servicing and repairs before use in safe conditions for routine sampling. Fortunately, at the time of the mission, the Lake Tanganyika Biodiversity Project had started to rehabilitate the vessel and the work is expected to be completed by the end of 1998. The LTR Zodiac (inflatable boat) is definitely out of working order and unusable for the monitoring programme.

2.1.2 Meteorology and Water Level

The researcher in charge of the meteorological data collection and compilation at Mpulungu DoF is experienced and competent in data handling and basic processing.

Meteo data could be collected at Mpulungu in two ways: through manual data collection and through the automatic meteo station installed near the DoF premises.

Manual data collection is done at fixed times using the available simple devices. These are the anemometer, the wind direction indicator (which needs to be replaced), thermometer, rainfall gauge and water level gauge located in the harbour.

Water level could also be obtained through the automatic water level recorder installed by LTR which is properly located and still functioning, but the laptop computer, necessary to offload the data stored in the memory unit, is not available.

Currently, the automatic meteo station is not recording any data. The problem might rely in the cable connecting the battery unit to the sensors. Sensors were checked in April 1998 and were all working correctly. In December 1998 the cable from the Kigoma meteo station was used to check the meteo station in Mpulungu which again resulted in its correct functioning. It is strongly advisable to replace the damaged cable (a minor repair) because of the importance of the meteo station as a source of data. All meteo parameters included in the Monitoring Programme could be collected with the exception of rainfall, as this meteo station is not equipped with the specific sensor.

Meteo data at Mpulungu would then be obtained from both automatic and manual collection. This would also allow for the checking of the correct functioning of the automatic meteo station sensors.

2.1.3 Limnology

The limnology team of DoF Mpulungu is experienced in basic data collection and analysis. Work on vertical profiles of water temperature and dissolved oxygen can be easily carried out with the existing equipment.

Data collection of chlorophyll *a* concentrations at different depths may be feasible and the available spectrophotometer (Spectronic 301) is still in working condition, so that only the supply of the consumable material is needed.

However, results will have to be critically evaluated because the experience of the laboratory staff on chlorophyll *a* analysis is limited. This parameter was monitored only for a short period during the LTR-SSP execution; consequently the gained on-the-job training experience is scarce. Moreover, chlorophyll *a* analysis, at Mpulungu as well as at all other field stations, was mostly performed by the international LTR staff.

LI-COR sensors to measure the vertical light penetration were due to be re-calibrated by the factory in January 1997. Therefore, and first of all, they should be sent to the factory for the necessary recalibration. Once this is done and new calibration factors are made available, data collection could then be possible. However, it must be pointed out that the handling of this equipment is complex and, in the past, it was done mainly by the FAO-LTR limnologists.

The proper implementation of the work on primary production (at Mpulungu as well as at the other field stations) seems difficult and in conflict with the requirement of sustainability, which must be a requisite of the Monitoring Programme.

2.1.4 Zooplankton and Fish Biology

Regular zooplankton sampling and laboratory data processing has been carried out by the same personnel throughout the execution of the SSP (July 1993 - June 1995) and considerable experience has been achieved. All the necessary equipment is available at the Mpulungu station and is functioning. Only two 100 µm plankton nets must be purchased to replace the old ones which have been intensively used. It is expected that the monitoring of mesozooplankton at the selected sampling station will be implemented without major difficulties.

The fish biology team is also well experienced. The data collection work is similar to that carried out during the SSP execution and the data files to be handled have been only slightly modified. Moreover, some DoF staff attended the two recent sessions of the FAO-DANIDA Training Course on Fish Stock Assessment held in Jinja (Uganda) and Arusha (Tanzania). This should allow for a rather detailed analysis of the collected fish data.

2.2 Kigoma

2.2.1 General

The Tanzania Fishery Research Institute (TAFIRI) centre of Kigoma (Tanzania) used to be one of the most active and efficient LTR stations. Specific scientific activities and a number of international meetings were held at LTR-Kigoma in the period from 1993 to 1998. Unfortunately, the situation at Kigoma has drastically changed and deteriorated in a short time.

The cause of the current disarray affecting this station is due to the unexpected and sudden downsizing of the most qualified and experienced scientific staff. At the time of the mission, of the five graduate researchers assigned to the station during the SSP execution, only one (the current acting director and also LTR Officer-in-Charge) was still on duty. Due to the unfortunate combination of several factors all the others have either been transferred to other posts or have left their job. They were the fully trained and well-experienced biologists responsible for the implementation of the SSP work on hydrodynamics, primary production, zooplankton, fish biology and fishery statistics. Only the limnologist is still at TAFIRI Kigoma, but as he is also the acting centre director, he is now mainly committed to the administrative work.

To partly compensate for the present situation there are two new biologists assigned to this station, who had not been trained by LTR, and both were absent at the time of the mission visit to Kigoma.

Consequently, the available laboratory technicians are without appropriate supervision and, moreover, are committed to the various ongoing LTBP activities.

Currently stored in the premises of TAFIRI Kigoma is a large quantity of scientific equipment, part of which was used during the SSP execution or installed onboard the R/V Tanganyika Explorer. Due to the lack of qualified personnel this valuable equipment is not adequately stored and maintained. Computer facilities are potentially good, but out of the six LTR-desktops available at this station only three are in full working condition with the remaining three in need of repairs. It would be advisable to carry out a thorough storage/inventory exercise of the entire office and all of the scientific equipment, including the expendable material in stock, stationed at the Kigoma centre.

Lastly, the full series of LTR Technical Documents and Field Manuals is no longer available in the library, many of LTR publications are in other offices and most seem to be missing. Only the bound collection of LTR works is available. It is suggested that a list of the available LTR Technical Documents and Field Manuals be made and missing documents be supplied by the LTR Documentation Centre.

The TAFIRI boat R/V Echo is currently maintained by the LTBP and can be used for the needs of the Monitoring Programme sampling work on the lake.

2.2.2 Meteorology and Water Level

The automatic meteo station originally mounted onboard the R/V Tanganyika Explorer has been installed on a cliff near Kigoma, but is not working. As with the Mpulungu automatic meteo station, this meteo station should be repaired. This unit is equipped with sensors which are able to record all the meteo data included in the Monitoring Programme.

Manual data collection should also be carried out for wind speed and direction: the anemometer is available and it should only be mounted. Rainfall can also be recorded daily at a fixed time, since a rain gauge is located in the station yard. Water level recordings from the water level gauge in the harbour are also possible once a day. The automatic water level recorder installed by LTR is out of use due to acid linkage from the battery which damaged some electrical components. Once, and if, the automatic water level recorder will be in working condition again, a laptop computer must be made available to offload the data stored in the memory unit.

The LTR-trained hydrodynamist originally in charge of meteo data collection has resigned from TAFIRI; FAO-LTR staff had been in charge of the data collection but no counterpart was trained again. Consequently, there is no expertise left at this station and a suitable candidate has not yet been identified. A temporary solution is proposed in section 3.1.

2.2.3 Limnology

The Kigoma station limnological team is affected by the absence of the biologist who was in charge of the primary production analysis but who resigned last year.

The YSI temperature and oxygen probe is functioning and currently used also by LTBP. LI-COR sensors for vertical light penetration must be calibrated by the factory; apart from that they are not reported faulty even though the only staff experienced in their use has left the centre and no hand-over and training was done at the moment of his departure. However, the acting director of the centre is an experienced limnologist and could implement the work on primary production if his administrative duties will allow for it. Still, the LTR spectrophotometer (Spectronic 301), necessary for the analysis of chlorophyll *a* concentration, is not working, apparently because of an unrecoverable error, and must be returned to the factory.

2.2.4 Zooplankton and Fish Biology

The biologist who was in charge of the work on zooplankton at the Kigoma station during the SSP is no longer available. However, the experienced laboratory technician is still at the station and can ensure the implementation of the work planned in the Monitoring Programme.

The staff available for the activity related to fish biology and fishery statistics collection is experienced enough to implement the required work, even though the senior biologist responsible for the supervision of this component has left Kigoma. However, the current acting director, a limnologist by training, attended both the recent sessions of the FAO-DANIDA Fish Stock Assessment Training Course and under his supervision the analysis of the collected data should be ensured. Most of the wet laboratory equipment is still available, but the Sartorious weighing scale is broken and should be replaced.

2.3 Bujumbura

2.3.1 General

Most of LTR-trained Burundian staff was assigned to other duties or projects at the end of the SSP. Currently, only three technicians are available at this station. However, they have been participating in the whole three-year long execution of SSP and have gained experience from the on-the-job training routine. Basic data collection in meteorology, limnology, fish biology and fishery statistics can be carried out at this station, but the analysis of the collected data will be inherently limited due to the current unavailability of university-level personnel.

Nobody experienced on zooplankton is available at LTR-Bujumbura, as the local zooplanktologist has been transferred to another project. It is therefore suggested that the LTR-trained zooplanktologist from Uvira (Mr D. Bwebwa) implement the Monitoring Programme work on zooplankton, while in the meantime he trains one of his Burundian colleagues.

The Bujumbura station does not at present have a vessel to be used for the sampling work. However, a boat for the Monitoring Programme sampling work on the lake will be made available through the cooperation of LTBP.

A suitable candidate for the position of Officer-in-Charge (OiC) of this station has not yet been found. It would seem advisable that, at least initially, the experienced scientific director of the Centre de Recherche en Hydrobiologie of Uvira (LTR scientific institution counterpart in the D.R. Congo) also act as OiC of the station in Bujumbura.

2.3.2 Meteorology and Water Level

The LTR automatic meteo station installed in the port of Bujumbura is working and the local staff regularly unloads the data store unit and transfers the data onto the station's desktop computer (whose disk drive needs to be repaired), where they are converted into Excel files.

However, the maintenance of this automatic meteo station, as those in Kigoma and Mpulungu, requires the external assistance of highly qualified personnel. Therefore, it is advisable that the Bujumbura station also be equipped with simple instruments (i.e. anemometer and rain gauge as in Kigoma and Mpulungu) from which data are collected on a daily basis.

The automatic water level recorder is still working, although the station does not have the laptop computer necessary to unload the data. Readings of the water level from the water level gauge at the harbour should also be done during the Monitoring Programme.

2.3.3. Limnology

Basic data collection on limnological parameters such as water temperature, oxygen and transparency can be ensured by the personnel at Bujumbura. The monitoring of parameters related to primary production could be implemented as well. The LTR-spectrophotometer is in working condition (and currently used by LTBP) and LI-COR light sensors are reported to be working, although these too, as those in Kigoma and Mpulungu, must be sent to the factory for re-calibration. It must be noted that the local technicians at LTR-Bujumbura do not have experience in the processing and use of chlorophyll *a* and LI-COR collected data.

2.3.4 Zooplankton and Fish Biology

The technician in charge of zooplankton sampling and data processing is no longer assigned to the station and no experienced staff is currently available at the station. The zooplanktologist from Uvira will ensure the implementation of the work and will also train one of the Burundian technicians.

All the existing staff at LTR Bujumbura is well experienced as a result of the fish biology work carried out during the SSP execution. Field and laboratory work planned for the Monitoring Programme can easily be executed at selected landing sites. Analysis is matter of concern due to the absence of experienced university-level researchers. However, once this work is carried out in cooperation with the colleagues from Uvira, it should be possible to achieve a satisfactory analysis capability.

2.4 Uvira

Most of the scientific and office equipment, and all the vehicles of the Centre de Recherche en Hydrobiologie (CRH) of Uvira have been lost due to the still ongoing civil war in D.R. Congo (ex-Zaïre). Consequently, the majority of the Monitoring Programme's basic activities cannot be implemented at Uvira. However, some of the qualified and LTR-trained staff is still available and can participate in the Monitoring Programme.

Until the political situation returns to normal it is proposed that Congolese team join their Burundian colleagues to execute the Monitoring Programme on meteorology, limnology and zooplanktology. It must be noted that for the latter field of work (zooplankton) the Uvira station has the only available researcher who can currently ensure this work in the northern end of the lake. Also, he will have to carry out the needed on-the-job training of a Burundian colleague to fill the existing gap at the Bujumbura station.

Work in fish biology and fishery statistics can be done in the area of Uvira at selected landing sites with a minimum of equipment. Computer facilities for data storage and analysis will be those available at the Bujumbura station.

3. Proposed Monitoring Programme

There are many physico-chemical and biological parameters that would be, theoretically, advisable to monitor. The choice of the parameters included in the Monitoring Programme is made on the basis of the feasibility and sustainability of their collection and basic analysis in all riparian countries; these can be defined as «**essential**» parameters. This means that they will comprise the core of the basic Monitoring Programme, while other parameters may be defined as «**desirable**», i.e. to be monitored if, and once, the field situations, all factors taken into

account, will allow for proper data collection and processing. In section 3.6 it is proposed how the work on desirable parameters could be put into practice and local expertise built-up.

Monitoring Programme activities are summarised in Table 1 and 2 and material requirements are listed in Table 3. Files to print standard data collection forms and data files to be used at each field stations have been prepared. It is suggested that the hard disk of the computer unit to be used for the Monitoring Programme data storage be organised as illustrated in Annex 1.

3.1 Meteorology and water level

Meteorological parameters support the seasonal variation of the vertical stratification of the water of the lake. Winds, because they cause upwelling, are the driving force of nutrient input into the productive layer regulating the primary production. It is essential to monitor meteorological conditions around the lake.

Meteorological data can be collected through the use of automatic meteo stations and by manual data collection of some parameters. A network of automatic weather stations has been established around the lake (Bujumbura, Kigoma and Mpulungu) by LTR. These meteorological stations are equipped with sensors which allow for the recording of the most important meteorological information: wind speed, direction and gust, air temperature, relative humidity, solar radiation, atmospheric pressure and rainfall (except in Mpulungu where the sensor for rainfall is not available).

However, at present, only one (Bujumbura) out of the three automatic meteo stations is still recording data, while those in Kigoma and Mpulungu are not functioning. The main constraint to the utilisation of the automatic meteo station is that they need highly qualified personnel, which is not available in the field, for their special maintenance (ordinary maintenance can be ensured by local staff) and for the replacement of hardware components which might be necessary. Therefore, the sustainability of the use of this equipment might seem arguable. Nevertheless, this additional cost and effort is balanced by the amount of meteo data which these automatic recording stations are able to provide on a continued basis.

Thus it is proposed that the faulty meteo stations be repaired, and that all of them be checked by an external qualified technician, in order to have this extremely valuable meteorological network located on the lakeshores in full working condition. The amount of information gained through the use of the automatic weather stations makes them fairly cost-effective. In order to extend (i.e. to double) the battery life, it would be advisable to set the recording interval to 20 min. Also, the LTBP could financially cooperate to meet the maintenance costs

of the automatic meteo station upon the agreement of full access and use of the collected data.

The national expertise to handle the data recorded by the automatic meteo station is unevenly available around the lake. The checking of the operational condition of the meteo stations, the replacement of the data storage units (DSUs) and the unloading of data and their conversion into logical files can be implemented at Mpulungu and Bujumbura but not at Kigoma. As a temporary solution to fill this gap, the well-experienced technician in charge of the meteorological data collection in Mpulungu (L. Makasa) will ensure this activity also in Kigoma through periodic visits to this station. Meanwhile he will also train the new personnel who should be assigned to this duty by the OiC of the Monitoring Programme at Kigoma.

Independent of the use of the automatic stations, basic manual data collection of some meteo data (depending on the available instruments) will be regularly carried out at each station. Average wind speed and direction is recorded from the installed anemometers during work days at 8.00 and 14.00 (Burundi time: GMT + 2). It would be desirable to record wind data at 19.00 as well; and when feasible this should be done.

Also daily, at 8.00 and 14.00, air temperature and rainfall data are collected. Lastly, water level is recorded each morning from the water level gauges installed in the harbours of Bujumbura, Kigoma and Mpulungu.

The data collection form is shown in Annex 2. The original blank file for the data collection form is **Meteodat.xls**.. Manually collected data are entered in a single file which has been prepared to hold one year of data (Annex 3). The name of the original blank file is **Meteofil.xls**.. Once the data are entered the filename for the different stations will be:

BJMMET99.XLS; KGMMET99.XLS; MPLMET99.XLS

where the first three letters indicate the field station (Bujumbura = **BJM**, Kigoma = **KGM**, Mpulungu = **MPL**), the remaining three letters mean **Meteo** and the last two numbers are for the year (1999: **99**, 2000:**00**, etc.).

Formulas to compute the average wind speed are in the hidden columns and can be accessed using the Excel «column unhide» command. Average wind speed is calculated from the last two consecutive anemometer readings. Therefore, the average wind speed from the reading done at 08 and 14 hrs is given in column **S**, and the wind speed means from the 14-19 hrs and 19-08 hrs readings, when done, are in column **AC** and **H** respectively. When no reading is taken, the corresponding entry cells must be left blank; in this case, unrealistic, easily detected figures appear together with the default value 0.77 (which is not the actual wind speed), in the wind speed columns (e.g. see Annex 4).

Instructions for the manual data collection are given in LTR Field Manual (FM) **FM/10**[4], and examples of data processing and analysis can be found in LTR Technical Documents (TD) **TD/43**[5, 6], **TD/73**[7], **TD/86**[8] and **TD/87**[9].

3.2 Limnology

The limnological work to be implemented within the Monitoring Programme aims at the collection of continuous information on the water column stratification dynamics which are critically linked to lake productivity. For this purpose the vertical water temperature profile and oxygen concentration should be

monitored. Also, it would be ideal to follow long-term trends in primary productivity through indicators such as water transparency, light penetration and chlorophyll *a* analysis.

On the basis of the assessment of the equipment and expertise available at the field stations, it appears that the work on water temperature and oxygen profiles and on water transparency can be, for the most part, effectively carried out.

The LI-COR instruments placed at each stations to measure vertical light penetration have been due to be re-calibrated by the factory since January 1997. Therefore, it seems logical that this should be done before any further use. Moreover, apart from simple data recording, there is no experience among the national staff around the lake on how to use this information.

The local expertise on chlorophyll *a* analysis appears to be better than in other areas of limnological analysis. However, the Kigoma spectrophotometer (Spectronic 301) is out of use and should be sent to the factory to be repaired and calibrated. Also, it must be stressed that local staff has not been trained to calibrate the spectrophotometer (which normally should be done on regular basis) and, moreover, the last FAO-LTR limnologist on duty (V. Langenberg) recommended that all spectrophotometers be returned to the factory for thorough check-ups and calibrations.

Lastly, it would appear that, at each station, laboratory procedures to analyse chlorophyll *a* concentrations have undergone several uncoordinated changes. It is unclear which one was the final, if any, standard procedure adopted. This is a consequence of the fact that work on primary production could be tentatively implemented only during the last year (1995) of the SSP and sufficient familiarity with the materials and methods involved was not achieved through regular on-the-job training.

Upon consideration of the above, and keeping in mind the feasibility and sustainability of the targets of the Monitoring Programme, it seems advisable to initiate the Monitoring Programme work of ensuring the data collection on water temperature and oxygen profiles and water transparency.

Data collection will be done twice per month during the same weeks when fish catch sampling takes place (see 3.4.1). Sampling work will start from 9.00 hrs (Burundi time) at the same sites where the regular weekly SSP was carried out. These were defined as sampling site A in all countries and their position is reported hereafter:

Country	Sampling site position	
Burundi/Congo	03°28 00′ S	29°17 00′ E
Tanzania	04°51 26′ S	29°35 54′ E
Zambia	08°43 98′ S	31°02 43′ E

Water temperature and dissolved oxygen are measured in the 0-100 m water column at intervals of 10 m using a YSI DO/T probe. A Secchi disk is used for water transparency.

While the above falls into the basic Monitoring Programme, further limnological work on primary production (i.e. vertical light penetration and chlorophyll *a* concentration measurements) could be ideally included once the LI-COR light sensors have been re-calibrated, all spectrophotometers are calibrated and, more importantly, a training session is held in the field on data collection, analysis and equipment handling (e.g. spectrophotometer routine calibration, LI-COR software use). It would make sense that this be carried out by the external specialist in primary production in charge of the technical supervision of the work. This would also allow for the achievement of satisfactory standardisation of methodology, data processing procedures and basic data analysis.

Data collection forms are given in Annex 5 and have been prepared to hold all the information which might be collected (essential: T°, D.O. and transparency; desirable: vertical light penetration and chlorophyll *a*). Space for the inclusion of extra data (pH and conductivity) that individual researchers may wish to collect, independent of the Monitoring Programme, is also provided.

A simple data file is shown in Annex 6. The data collection form to be printed is named **Limnform.xls**. The blank file for data entry is called **Limfile.xls**.. The limnology file produced by each station will be named according to the following system:

LIMNO99A.xls; LIMNO99B.xls; LIMNO99C.xls; LIMNO99D.xls

where **LIMNO** indicates limnology, **99** is the year (e.g. year 1999 = 99, year 2000 = 00) and the last letter is the standard country code used by LTR (Burundi = **A**, Tanzania = **B**, Zambia = **C**, Congo = **D**).

Data collection procedures are detailed in **FM/07**[10, 11], **FM/13**[12] and **FM/18**[13, 14], and examples of data analysis can be found in **TD/46**[15, 16], **TD/54**[17, 18], **TD/56**[19], **TD/72**[20] and **TD/79**[21, 22].

3.3 Zooplankton

Monitoring zooplankton and shrimp abundance patterns is important because of their correlation with local fish abundance. Research carried out by LTR has shown that copepod abundance is related to that of pelagic fish. The occurrence of clupeid *Stolothrissa tanganicae* is linked with that of copepods, with whom there is a direct predator-prey relationship determining the local abundance pattern of the clupeid. Pelagic shrimps are an important prey for adult *Limnothrissa miodon* and mainly for the centropomid *Lates stappersii*, whose occurrence is positively correlated with their abundance.

Basic work on mesozooplankton can be easily implemented within the Monitoring Programme plan. The main constraint could be that only three experienced, LTR-trained technicians are still available around the lake, and two of them are also committed to other duties and projects. Therefore, it is advisable to keep the amount of work minimal to ensure its regular execution, at least until when new staff has been adequately trained. Lastly, the participation and supervision of graduate researchers might be required for the basic data analysis.

Data collection on copepod zooplankton will take place twice per month using the 100 µm plankton net. Three vertical replicate hauls are made from 100 m depth. Sampling will be carried out together with the limnology sampling, as the sites on the lake are the same. Sampling procedures, sample handling and processing are the same as during the SSP and are fully described in **FM/06**[23, 24] and **FM/09**[25].. Data collection forms and data files are the same previously used and they are available at each station. The filename of the blank data file is **Z100FILE.XLS**. As for the SSP, yearly data are entered in one Excel worksheet file to be named:

Z10099A.XLS; Z10099B.XLS; Z10099C.XLS; Z10099D.XLS

where **Z** stands for zooplankton, **100** indicates the 100 µm plankton net mesh size, **99** is for the year, and **A**, **B**, **C**, **D** is the country code (Burundi = **A**, Tanzania = **B**, Zambia = **C**, Congo = **D**).

Examples of basic data analysis can be obtained from **TD/22**[26, 27], **TD/34**[28, 29], **TD/50**[30], **TD/51**[31, 32], and **TD/64**[33].

It has been suggested that zooplankton sampling could be improved using torpedo plankton samplers equipped with both 100 µm and 50 µm nets. This would enhance the accuracy of the sampling work and it would allow for the sampling of copepod nauplii which are not retained in the 100 µm net. However, this is not immediately feasible, first of all because such torpedo nets are not available. They had been locally built in 1994 in Bujumbura where they were tested, but since then they had never been regularly employed. At the moment, out of the three torpedoes built, only one and half, and without nets, could be found in Bujumbura (they were not sent to Kigoma and Mpulungu).

No field work has been carried out in Kigoma and Mpulungu with this kind of plankton samplers. Consequently, local staff has no experience in their use (although it is simple). Zooplankton torpedo samplers might be purchased, but, first, national teams must be provided with clear instructions for their correct use (e.g. sampling operations, calculation of filtration efficiency), then zooplankton sampling can be carried out using the torpedo instead of the current plankton net.

Shrimps have been shown to play an important role within the lake pelagic ecosystem and consequently the LTR Working Group on Monitoring included the work on shrimps in the original Monitoring Programme proposal.

Collection of data on pelagic shrimps would be important. This could not be regularly done during the SSP execution due to the lack of appropriate sampling gear. It was only possible by using a high-speed Gulf-net towed from the R/V Tanganyika Explorer during scientific cruises. Although monitoring work of the pelagic shrimps would be strongly recommended, at the moment suitable quantitative shrimp sampling gear is not available at the field stations. The LTR-scientific coordinator, or the scientific supervisor of this activity, he should therefore indicate the proper sampling devices to be used taking into account the kind of boats from which the sampling is to be carried out.

3.4 Fish and Fishery Statistics

At the highest level of the lake productivity are its fish resources. The pelagic fishery of Lake Tanganyika is, after that of Lake Victoria, the most important freshwater fishery of the African continent. Simply because of that, the status of the lake fisheries and the exploitation level and pattern must be continually monitored. The interactions between the various ecosystem components affecting the fish stocks and the cause-effect dynamics behind it, some of which are highlighted by LTR work, are better understood when long-term time series are available.

The Monitoring Programme work on the commercial pelagic fish stocks (i.e. the three LTR target species: *S. tanganicae*, *L. miodon* and *L. stappersii*) and on fishery statistics will be implemented jointly. Basically, the Monitoring Programme will provide detailed and continuous information on fish catch and fishing effort from selected landing sites. Also, the catch composition by species and size structure of the exploited stocks will be monitored.

3.4.1 Fish Sampling from Commercial Catch

Commercial catches will be sampled mainly in the same way as done during the SSP execution. Fish catch sampling from fishing gear targeting on the pelagic fish stocks (i.e. purse-seine,

lift-net, apollo, kapenta seine, chiromila) will take place once a month at each selected landing site within a two-week period at around the monthly peak of the fishing season: during the week of maximum fishing (which approximately coincides with the moonless phase) and in the week preceding or following it. The sampling calendar will be decided by the Regional Coordinator in agreement with the OiCs of the field stations on a four-month basis. Therefore, in each month both fish sampling and limnology and zooplankton samplings at the lake will be carried out during two consecutive weeks.

The selected landing sites are listed in the following table.

Country	Selected Fish Landing Site
Burundi	Nyamugaru, Rumonge
Congo	Mulongwe, Kivovo, *Kalemie, Moba*
Tanzania	Luanza, Katonga, *Kipili*
Zambia	Mpulungu (industrial), Chipunzi, Sondua

Landing sites have been chosen on the basis of their accessibility from the field stations and because of their size and representativeness (number and types of fishing units reported to land their catches). Landing sites in italics must be sampled once the local circumstances will allow it i.e. civil war in D.R. Congo, no staff at Kipili).

Sampling at all sites will follow a 2-day cycle (referred to as Day-1 and Day-2). On **Day-1**, the sampling is carried out as outlined hereunder and follows the same fish catch sampling routine as during the SSP. The main difference is that the number of Fishing Units (FUs) to be sampled has increased to five. All different types of FUs targeting on the pelagic stocks are sampled if they land at the selected sites.

On **Day-2**, a quick survey of all pelagic FUs at the selected landing site is carried out. This is described in the next section (3.4.2).

Day-1 sampling: each sampling day five, fishing units are sampled (if necessary samples are purchased). Samplings must be from a mixed catch, i.e. unsorted, and according to the following rules of thumb which have proved effective during the SSP:

When clupeids are dominant the weight sample size of the catch of each FU ranges from 0.5 to 1 kg depending on the size of the fish.

When the catch is mainly made of *L. stappersii* then the sample size can range from 1 (catch made of juveniles) to 5 kg (catch made of adult fish).

While the above applies to artisanal commercial fisheries, in the case of the Zambian-based industrial purse-seine fishery no samples are purchased from the FU and the size composition of the catch is obtained by measuring the fish size at the landing

of the fishing companies. Sample size remains approximately the same as indicated above. Fish measurements are done from, at minimum, the landing of two purse-seiners of a fishing company during each of the two sampling weeks (i.e. the fish size composition of the catch of four purse-seiners from two fishing companies is then obtained each month). This will allow the monitoring of the industrial catch in a simple and inexpensive way. More time and, especially, financial resources are then left available to sample the other pelagic fishing gear in Zambia on which the available information is still not satisfactory.

Work routine for sample processing and collection of fish length-frequency (L/F) distributions by species is the same as during the SSP. Procedures are familiar to all the field staff and are detailed in **FM/04**[34, 35] and **FM/08**[36].

Extra work on fish samples (e.g. sexual maturity, stomach content analysis, etc.) might be done depending on each field station's research interest and availability of personnel and time, but for the Monitoring Programme only the catch composition by species and the fish size distribution in the catch must be ensured.

Data collection forms very similar to those used for the SSP are shown in Annexes 7, 8 and 9. The files for the printout of the data collection forms have the following names: **STAFORM.XLS** (for *S. tanganicae*), **LMIFORM.XLS** (for *L. miodon*) and **LSTFORM.XLS** (for *L. stappersii*). Length distributions of target fish species are entered in the length-frequency (L/F) tables (Annexes 10, 11 and 12). The L/F files allow the total catch number of the species from the sampled FU to be calculated on the basis of the size distribution of the sample. The blank data files are called:

for *S. tanganicae*: **STALF.XLS**
for *L. miodon*: **LMILF.XLS**
for *L. stappersii*: **LSTLF.XLS**

Sample numbering and filenaming for the filled monthly files are the same as for the SSP and are detailed in sections 4.3 and 4.4 of **FM/08**[36].

The type of auxiliary information collected on catch and effort is similar to that collected during the fishery statistic work (see section 3.4.2). From each sampled FU the Total Catch (TC) weight, the mesh size of the net, the number of hauls, the number of lamps employed, the sailing time to reach the fishing ground and the hours of actual fishing must be recorded.

The estimate of the species weight composition of the catch is obtained using raising factors (RF) once the weight of each species in the sample has been obtained by weighing them in the laboratory.

Auxiliary information on catch and effort from the sampled FUs is entered in the **FISHSAMP.XLS** file (Annex 13). A hypothetical

example is shown in Annex 14. Data from different fishing gears should be entered in specific files and named accordingly, for example:

LN9901B.XLS where:

the first two letters indicate the type of fishing gear (Liftnet = **LN**, Purse seine = **PS**, Apollo = **AP**, Beach seine = **BS**, Chiromila = **CH**), followed by two numbers to indicate the year: 1999 = **99**, 2000 = **00**, etc., the last two numbers refer to the sampling month (January = **01**, ... December = **12**), and the last letter is the country code (Burundi = **A**, Tanzania = **B**, Zambia = **C**, Congo = **D**).

Examples of data analysis are in **TD/38**[37, 38], **TD/53**[39, 40] and **TD/83**[41]. Further length-based analysis can be carried out as described in Sparre and Venema[42] and some of the staff from Mpulungu and Kigoma has benefited of the recent two-month training sessions (1997-98) of the FAO-DANIDA Training Course on Fish Stock Assessment.

3.4.2 Fishery Statistic Collection

This section is concerned with the collection of catch and fishing effort statistics. It is more detailed than the other sections because a comprehensive LTR Field Manual on fishery statistic collection is not available. Collecting catch and fishing effort data is not easy. Data collection work is important and if data are grossly biased no assessment of the local fisheries is possible.

The first thing to know is the catch weight. How this information is collected will depend upon how the catch is landed. Also, it is essential to know how much fishing effort has been used to catch the quantity of fish landed because it enables an index of abundance (i.e. catch per unit of effort, CPUE) to be calculated. Without knowing the effort it is impossible to understand whether an increase in landings over time resulted from the fish stock being more abundant and the fishing effort remaining constant or viceversa. Fishing effort data are collected at the same time as catch data are collected at the landing site.

It has to be noted that it is difficult to make sure fishing effort data are comparable over long periods. Fishing units tend to become more efficient through the use of, for example, more efficient lamps, different mesh size of the net or, as in the case of purse seiners, fish finder devices (echo-sounder). Therefore, any change of the fishing effort quality should be promptly remarked and reported.

Depending on the local situations the trip to the selected landing site for fishery statistic collection and the carrying out of fish sampling might be combined in the same day. However, often this is not possible and thus two visits to the landing

site must be paid on two consecutive days, Day-1 and Day-2 (unless fishing does not take place due to circumstances such as bad weather, and consequently Day-2 takes place on the next possible day).

There are many ways of collecting information on catch and effort. The data collection programme depends on the budget, the number of staff available to undertake the work, and on the logistic constraints (e.g. transport means). Therefore, the collecting programme must be designed to meet the existing local circumstances. Due to financial, logistics and staff constraints, the basic idea for the Monitoring Programme is to have, as much as possible, reliable and accurate fishery statistics from few selected landing sites (and fishing areas) around the lake to ensure that catch rate trends are closely monitored. Then, this information can be combined with that obtained from the other scientific activities of the Monitoring Programme carried out in the same areas.

Fishery statistic collection is carried out at selected landing sites during two days:

Day-1 when fish samples are taken from the commercial catch at the selected landing site and auxiliary catch and effort data are also recorded. This was described in the previous section (3.4.1).

Day-2 the visit to the selected landing site is paid with the specific aim to record catch and effort data.

Therefore this means that if there are two selected landing sites, the frequency of both Day-1 and Day-2 sampling at each site is once per month within a two-week period as described in section 3.4.1.

Day-2 sampling: in this case the only aim of the visit to the landing site is to record catch and effort data from all, or the majority of, the landing vessels (= active fishing units).

The field team collects the information through direct observation and interviews with the landing vessel skipper or crew.

The catch is generally landed in standard boxes whose weight is known; therefore, the total catch is estimated by simply multiplying the weight of one box per the number of boxes landed by the FU.

Effort data are obtained through quick interviews with the FU skipper or crew. The information to be recorded in the field form (see Annex 15, filename: **Landings.xls**) at the landing sites are:

Landing site/s: name of landing site

Station: research station to which the field team belongs and where the collected data are compiled.

Month/year: sampling month and year

Date: sampling day (in numerals)

Gear type: Liftnet (LN), Purse seine (PS), Beach seine (BS), Apollo (AP), Chiromila (CH).

FU's TC: total catch in kg of the fishing unit.

Hours fished: number of hours of actual fishing, excluding the time spent sailing to and from the fishing ground.

Sailing: time (no. hours) spent to reach the fishing ground.

Hauls: number of hauls or shots.

Lamps: number of lamps used to attract the fish.

Active FUs: number of fishing units at the landing sites that have been fishing at the time of the visit.

No. fishing nights in the month: number of actual fishing nights in the month. This information should be obtained at the end of each month. A record of the number of fishing nights should be kept at each research station and must account for those nights when no fishing takes place because of full moon, adverse meteo conditions, local holidays, etc.

Data collectors: name of the field team members.

Example of basic data analysis can be drawn from **TD/24**[43, 44], **TD/32**[45], **TD/72**[20] and **TD/80**[46].

3.4.2.1 Zambia Industrial Fishery

The commercial pelagic fisheries in Zambia are more complex than in the other countries due to the existence of both the industrial and artisanal pelagic fisheries. Consequently, the work approach to collect data and monitor the commercial fisheries must be adapted to this local situation.

Catch and effort data collection from the industrial purse seine fishery based in Mpulungu is a regular activity of the DoF established since time. This activity is now also included in the Monitoring Programme and new fishing effort measures have been introduced. In agreement with the DoF director and LTR OiC, the data recording form has been updated to include new information on fishing effort. These are the sailing time (i.e. the sailing time spent to reach the fishing ground) and the time (hours) of actual fishing. This is justified by the fact that the sailing time in recent years has much increased due to the overexploitation of the local fishing grounds.

The blank form to be used is named **PSLOG.XLS** (Purse Seine Logbook) and is shown in Annex 16. The file to be filled each month with data from all active purse seiners is called **PSCATCH.XLS.** Once completed it should be saved as in the following example: **PS9901C.XLS,** where: **PS** stands for Purse Seine, **99** is the year (year 2000 = **00**), **01** is the month (January = **01**, ... December = **12**) and **C** is the country code for Zambia. The table can produce monthly statistics such as total catch, catch composition by species group and CPUE indices. An example of the filled form with imaginary data is given in Annex 17.

Further, all the existing artisanal fishing gear targeting on the most important pelagic fish species (*S. tanganicae*, *L. miodon* and *L. stappersii*) will be monitored at the selected landing sites. If successfully implemented, this activity will provide on a regular time scale the much needed information on the Zambian artisanal pelagic fishery which is somehow overshadowed by the presence and economic relevance of the purse-seine fishery.

3.4.3 Catch Assessment Survey and Frame Survey

It is beyond the scope, financial and logistic means of the Monitoring Programme to execute periodic country-wide Catch Assessment Surveys (CAS) and Frame Surveys (FS) on the lake. The riparian countries, possibly with the cooperation of the Monitoring Programme and of any interested projects, should sustain and execute regular CAS and FS.

Catch assessment and frame surveys are and should remain on-going national surveys. Due to national budget constraints, the execution of these surveys may require external financial assistance. Whenever possible the Monitoring Programme should cooperate financially with national CAS and FS execution and, importantly, should assist the riparian countries to achieve the full standardisation of data collection and analysis procedures.

Further, the cooperation of other existing projects such as LTBP lakewide and «Amelioration des techniques de traitement du poisson», funded in Burundi by the African Development Bank, should be actively sought.

3.4.4 Cooperation between the LTR Monitoring Programme and the LTBP Fishing Practices Special Study

The Monitoring Programme work on fish sampling and fishery statistic collection could be carried out and integrated with the LTBP Fishing Practices Special Study (FPSS). This will allow a fully comprehensive knowledge of the whole fishing activity which takes place at the selected landing sites to be obtained.

The Lake Tanganyika Monitoring Programme and FPSS can cooperate on optimising cost and effort through the sharing of available staff and financial resources, thus ensuring that the work is effectively carried out. This cooperative approach is schematised in Appendix A.

3.5 Socio-economy

Monitoring socio-economic variables is essential for the fishery management of the lake. Socio-economic characteristics and the behaviour of resource users are of crucial importance to establish and evaluate fishery management measures and options. Socio-economic realities are variable and dynamic and therefore require continual attention. During the Monitoring Programme implementation this information will be collected at the selected landing sites with the frequency proposed hereunder.

Primary information can be collected by the staff of the field stations that was trained on basic data collection and participated in the execution of the 1997 socio-economic LTR lakewide survey. However, analysis must be done by professional national socio-economists initially coordinated by the scientific supervisor in charge of this component of the Monitoring Programme.

The experience gained during the 1997 survey will be very useful for ensuring the implementation of socio-economic work within the Monitoring Programme framework. For data collection methodology, forms to be used, and procedures, reference should be made to **TD/65**[47] and **TD/66**[48].

Data collection forms are those presented in **TD/66**[48]. **Form 1** is used for the (selected) landing site basic inventory and should be updated at least every year. The information to be collected is on population and settlement, access and transportation, basic facilities at landing sites and on fish processing and trading. The information specified in **Forms 2 and 3** (sections A, B and C) of **TD/66**[48] should be collected every six months. The parameters are those related to the social profile and income status of the resource users (i.e. fishers, fish processors and traders).

Examples of data analysis and discussion are available in **TD/67**[49], **TD/68**[50], **TD/69**[51], **TD/70**[52] and **TD/71**[53].

Higher sampling frequency could be established under the coordination of the socio-economist supervisor should more detailed information be required for specific purposes (e.g. cost-revenue analysis). Also, comprehensive socio-economic surveys could be carried out in conjunction with national fishery frame surveys.

3.6 Monitoring Programme Organization

3.6.1 Structure

While the essential elements of the Monitoring Programme are diagrammed in Annex 18, complementary information concerning the role of each participant is presented below:

Regional (National) Coordinator – The 6th Meeting of LTR Coordination Committee decided that the host country of LTR HQ (i.e. Burundi) be designated to provide the first Regional (National) Coordinator (henceforth Regional Coordinator), with the subsequent coordinators selected from the remaining countries on rotating basis. The Regional Coordinator, to be designated by the concerned authority, will assume the full and direct responsibility for the effective coordination of the field operation in all four lacustrine states. The Terms of Reference for this post are given in Annex 19.

Officers-in-Charge of research stations – The Monitoring Programme's field activities, in each participating research station, will be directed and supervised by an Officer-in-Charge (OiC), to be designated by the concerned authorities, and carried out by 4-5 national colleagues per research station. He/she will be responsible for the execution of the Monitoring Programme's field activities exactly as specified by this Technical Document. The Terms of Reference for this post are given in Annex 20.

Participating research stations – The stations are the following: Department of Fisheries (DoF), Mpulungu (Zambia); Tanzania Fisheries Research Institute (TAFIRI), Kigoma (Tanzania); and the Department of Fisheries (DoF), Bujumbura (Burundi). It should be noted that the designated personnel of the Centre de Recherche en Hydrobiologie, C.R.H./Uvira (D.R. Congo) will carry out the Monitoring Programme in close cooperation with the personnel of the DoF of Burundi. Once the socio-political situation in the D.R. Congo is resolved the Monitoring Programme for this country should ideally be based in Kalemie.

Role of the LTR Coordinator – The LTR Coordinator will continue to coordinate all LTR activities until the end of international field expert presence in the LTR HQ, now scheduled for the end of January 2000. As far as the Monitoring Programme is concerned, he will be specifically responsible for the following: (1) to ensure that this Technical Document is made available, in both official project languages, to all concerned parties without delay; (2) to ensure that the material and/or equipment required for the execution of the Monitoring Programme is procured as soon as possible and made available to all participating research stations; (3) to work closely with the Regional Coordinator, providing assistance, advice and on-the-job training in all aspects; (4) to transfer the day-to-day responsibility for the execution of the Monitoring Programme, including the operation of the Regional Documentation Centre, to

the Regional (National) Coordinator by the end of June 1999; and (5) to evaluate the first year execution of the Monitoring Programme.

Role of the University of Kuopio – As it did during the life of the LTR project, the University of Kuopio (Finland) will assume the overall responsibility for the scientific coordination of the Monitoring Programme. Specifically, this will include the following activities and responsibilities: (1) completion of the required analyses of the pre-analysed field data, forwarded, electronically, by the Regional Coordinator to the University of Kuopio, from all four lacustrine countries; (2) provision of regular and timely supervision missions to the field research station in order to (a) verify the sampling methodology and (b) provide on-the job-training as required; (3) close cooperation with the Regional Coordinator for the completion of annual reports to be sent to the Regional Coordinator, by the end of every January, for official submission to the authorities of all four lacustrine States. Lastly, it was agreed that the data collected during the Monitoring Programme will be stored on CD-ROM and returned to each research station by the Regional Coordinator. These data will also be included in the soon-to-be-restored degree-level fisheries training to be funded again by FINNIDA and implemented by the University of Kuopio.

Role of the Governments of the four lacustrine states – All four participating Governments have already made a firm commitment to provide the field staff required to execute the Monitoring Programme. It is essential that this commitment be 'institutionalised' by all four Governments by eventually including the activities of the Monitoring Programme and their budgetary provisions in the regular programme of the respective lake-based research stations and, in particular, that all lacustrine States make appropriate use of data/information collected during the Monitoring Programme.

Role of the CIFA Sub-Committee for Lake Tanganyika – While the modalities of the eventual management structure of the Lake Tanganyika fisheries are yet to be worked out, it is hoped that the CIFA Sub-Committee for Lake Tanganyika continues to play its role by offering the forum for technical discussions and providing the technical guidance as requested.

Role of the Lake Tanganyika Biodiversity Project (LTBP) and other projects – The LTBP project, through its Fishing Practices Special Study, specifically addresses the impact of fishing on the biodiversity of Lake Tanganyika. Both commercial and artisanal fishing present threats to biodiversity, albeit at varying levels of significance throughout the region. Close cooperation between the Monitoring Programme and the LTBP is essential and should be well-coordinated (sharing/use of the personnel, material, resources and data).

3.6.2 Reporting

Efficient and regular communication among the research stations, the Regional Coordinator and the University of Kuopio will play an important role within the Monitoring Programme framework. The flow of information around the lake must be on a continued, although simple, basis to allow the Regional Coordinator to effectively supervise the execution of the Monitoring Programme and to take the necessary actions when required and without delay. Three levels of reporting, its structure and frequency, are proposed as follows:

Monthly Activity Report by OiCs of each participating research station – Each OiC is responsible for forwarding, electronically, the monthly activity report using the prepared standard reporting forms (Annex 21, filename: **Monthrep.doc**) to the Regional Coordinator. Briefly, this will be a simple document detailing the scientific activities which were carried out and their results, e.g. number of samples collected, processed and compiled as data files.

Six-monthly Scientific Report by OiCs of each participating research station – Every six months from the start of the Monitoring Programme a scientific report must be prepared by each participating research station. These reports will be prepared, using the standard format (Annex 22, filename: **Sixmorep.doc**), under the supervision of the OiC at each research station and forwarded, together with all the basic data collected during the six months, to the Regional Coordinator who, in turn, is to forward all the reports and data, electronically, for further processing, to the Department of Zoology, University of Kuopio.

Annual Scientific Report by OiCs of each participating station – At the completion of a twelve month cycle of Monitoring Programme, each research station will produce a scientific report under the supervision of the respective OiC. These reports will be structured as a Technical Document, i.e. it must include the following sections: Material and Methods, Results, Discussion/Conclusions and Recommendations (wherein suggestions are given to improve future work). Lastly, the full data files from the last six months of the Monitoring Programme must be attached.

Lake Tanganyika Monitoring Programme Annual Scientific Report by the Regional Coordinator – Through close cooperation between the Regional Coordinator and the University of Kuopio, this report will be prepared annually by integrating the annual scientific reports from each country. This report, based on the full data set acquired during the twelve month period (to be stored on CD-ROM format), should detail the significance of the data collected, outlining the trends, and propose the specific management actions to be taken on either regional, sub-regional or state level. The Regional Coordinator will be responsible for (a) ensuring the widest possible diffusion of these reports and

(b) monitoring the action/s of each participating lacustrine State.

3.6.3 Administrative and Financial Procedures

The 6th Meeting of the LTR Coordination Committee decided, and the donor subsequently agreed, that, in order to ensure the effective national responsibility for the implementation of the proposed Monitoring Programme, required budgetary provisions be guaranteed. It was agreed that the initiation of the Monitoring Programme under direct national execution will require an estimated $10,000 per country per calendar year. It was also decided that the Monitoring Programme will be coordinated on a rotating basis by a Regional Coordinator, to whom an annual operational budget, in the region of $10,000 per year, mainly covering travel and communications, will be made available. These funds will be allocated to the FAO Representatives in each participating country and subsequently endorsed as 'Funds at the disposal of either the Regional Coordinator or the OiCs of the research stations concerned' and administered following exactly the "UNDP Procedures for National Execution"[1]. The Regional Coordinator and the OiCs will make local arrangements with the concerned FAO Representatives as to how they will receive these funds and account for them to the FAO Representatives concerned. The LTR Coordinator will ensure that the all concerned are fully briefed on these procedures.

In addition, it was agreed that a required budgetary provision be made in order to cover the equipment/material needs of each participating research station, i.e. replacement of project cars, procurement of one computer per station, spare parts and chemicals.

Categories of Expenditure: the OiCs at each research station and the Regional Coordinator will administer the funds with utmost care. All expenditures must be receipted and certified using the disbursement vouchers shown in Annex 23 (filename: **DV.xls**). Each transaction must be recorded using the spreadsheet file provided (example given in Annex 24, filename: **LTRMP-AC.xls**). There will be four main categories of allowable expenditures as follows:

DOC. LINE	OBJ. EXP.	DESCRIPTION
001	0 15	Duty 4 Travel & other costs
002	0 27	Other 6 operating costs
003	0 29	7 Communications
004	0 81	1 In-service

[1] UNDP Field Programme Circular No. 6/98.

Indicative annual budget and expenditure by the Regional Coordinator:

Annual Budget: $10,000
Tentative Expenditure/Category:

DOC. LINE	OBJ. EXP.	DESCRIPTION	ALLOTMENT (USD)
001	415	Duty Travel	5,000
002	627	Other operation costs	2,000
003	729	Communications	3,500
004	181	In-service training	2,500

Indicative annual budget and expenditure by OiCs:

Annual Budget: $10,000
Tentative Expenditure/Category

DOC. LINE	OBJ. EXP.	DESCRIPTION	ALLOTMENT (USD)
001	415	Duty Travel	5,000
002	627	Other operation costs	2,000
003	729	Communications	500
004	181	In-service training	2,500

3.7 External Supervision and National Expertise Build-up

External supervision and cooperation with the Lake Tanganyika Monitoring Programme, if effectively ensured, may play an important role for the successful implementation of the initial stage (especially in the first year) of the Monitoring Programme.

Plans call for the Monitoring Programme to be supervised by a specialist in each discipline on a regular basis. At least one field visit per year is advisable. It is suggested that the first visits take place at around the sixth month from the start of the Monitoring Programme. Annual field missions of specialists/supervisors must aim at reinforcing the motivation of national researchers and technicians, verifying and maintaining the scientific equipment, and ensuring that the Monitoring Programme work is carried out in the riparian countries as planned.

As stated in other sections of this document, there are few scientific activities which have been judged as currently unfeasible, and these have been defined as desirable activities but are not yet included in the core of the basic Monitoring Programme. Field visits of the supervisor/specialist are essential to put into practice a built-up system through effective training of the national staff in data collection and basic analysis, and in specific scientific equipment handling and maintenance. Only in this way can the Monitoring Programme gradually extend to include the whole set of parameters originally proposed.

4. Conclusions

The LTR Working Group on Monitoring originally proposed a set of abiotic and biotic variables to be included in the working plan. All but three of those parameters are now included in the Monitoring Programme.

The present work has attempted to assess the real possibility of establishing, with limited budget and heterogeneous human resources, the Monitoring Programme on a regional scale to be implemented under national execution by the four riparian countries.

The success of the Monitoring Programme mainly relies not on the degree of sophistication of the methods employed but on its sustainability in spite of the wide range of problems, of different natures, affecting the Lake Tanganyika region. The sustainability of the Monitoring Programme must be based on its feasibility and simplicity. These are the key-words which have been used, as much as possible, in formulating the work proposal.

This document is only a starting point for the implementation of the Monitoring Programme. Because of its investigative nature, the programme is, and must be, open (a kind of work in progress) to all the changes that circumstances will dictate and to the improvements - and there could be many - that those involved in the real work (from field teams to scientific supervisors) will find opportune and necessary.

Acknowledgements

This work is based on the views and comments of a number of persons who are, or have been, involved with the LTR project and are experienced with the reality of Lake Tanganyika. Not all of them will agree with my approach to the Monitoring Programme for Lake Tanganyika. I wish to acknowledge the contributions of: E. Bosma, D. Chitamwebwa, E. Coenen, J. Craig, T. Huttula, J. Kapetsky, P. Kotilainen, H. Kurki, V. Langenberg, L. Makassa, H. Mölsä, S. Muhoza, N. Mulimbwa, L. Mwape, E. Nikomeze, P. Paffen, E. Reynolds, Y. Sarvala, J. Tumba. The structure of the text, the approach and the errors are mine. I wish to thank George Hanek, LTR Coordinator, for his support and effective assistance during the preparation of this document.

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Table 1. Abiotic variables included in the Monitoring Programme. Normal script indicates the parameters included in the basic Monitoring Programme. Italics are used for parameters and sampling methods which may be included in the Monitoring Programme when constraints identified in the Remarks column are resolved (see also the relevant sections of the text). Burundi time is used (GMT +2), which is the same for the Zambian and Congolese sectors of the lake, while it is one hour ahead in Tanzania (GMT +3).

Data	Sampling Frequency & Time	Device used	Remarks
Wind Speed and Direction Air Temperature, Relative Humidity, Solar Radiation, Air Pressure, Rainfall	Automatic at fixed intervals	Automatic Meteo Stations at Mpulungu, Kigoma and Bujumbura	Mpulungu: battery cable to be replaced, no rainfall sensor. Kigoma: to be repaired
Wind speed and direction	daily at 8.00 and 14.00 (19.00 if possible)	Anemometer reading	Available in Mpulungu. Available but to be installed in Kigoma. Not available in Bujumbura.
Air Temperature	daily at 8.00 and 14.00 (19.00 if possible)	Index thermometer	Not available, to be purchased
Rainfall	daily at 8.00 and 14.00	Rain gauge	Available in Mpulungu Available in Kigoma Not available in Bujumbura
Water Level	Daily in the morning Automatic at fixed Intervals	Harbour water level gauge *Automatic water level recorder*	Available in all stations harbours. Available in Mpulungu and Bujumbura. Damaged in Kigoma. All stations require laptop computer to unload the data.
Water Temperature	Twice per month at fixed sampling site starting from 9.00.	YSI D.O/T. probe	Available in Mpulungu. Available in Kigoma. Available in Bujumbura.
Dissolved Oxygen	Twice per month at fixed sampling site starting from 9.00.	YSI D.O/T. probe	Available in Mpulungu. Available in Kigoma. Available in Bujumbura
Water Transparency	Twice per month at fixed sampling site starting from 9.00.	Secchi disk	Available in Mpulungu. Available in Kigoma. Available in Bujumbura
Underwater Light Penetration	Twice per month at fixed sampling site starting from 9.00.	LI-COR	Available in all stations. To be calibrated by the factory. No field experience in the use of collected data.
Chlorophyll á	Twice per month at fixed sampling site starting from 9.00.	Limnos sampler, Spectrophotometer (Spectronic 301)	Available in all stations. Kigoma spectrophotometer is out of order. No experience in regular maintenance/calibration of spectrophotometers. Limited experience in the use of data. Unclear and non-standardised laboratory procedures.

Table 2. Biotic variables included in the Monitoring Programme. Normal script is to indicate the parameters included in the basic Monitoring Programme. Italics are used for variables and sampling methods which may be included in the Monitoring Programme when constraints reported in Remarks column are resolved (see also text). Burundi time is used (GMT +2) which is the same for the Zambian and Congolese sectors of the lake, while it is one hour ahead in Tanzania (GMT +3).

Data	Sampling Frequency & Time	Type of Sampling	Remarks
Zooplankton	Twice per month at fixed sampling station starting from 9.00 combined with limnology sampling	Vertical tows with 100µm plankton net	Sampling could be improved using *zooplankton torpedo samplers* (100 and 50 µm nets), which are currently not available, and after training of field teams.
Pelagic shrimps			No suitable sampling gear available.
Fish catch composition and size distribution of target species	Once per month at each selected landing site	Fish catch sampling	Initially in cooperation with LTBP Fishing Practices Special Study (see Appendix A).
Fish catch and fishing effort	Once per month at each selected landing site	Survey of active Pelagic fishing units	Initially in cooperation with LTBP Fishing Practices Special Study (see Appendix A).

Table 3. Indicative material requirements for the execution of the Monitoring Programme. The list should be made in greater detailed by the Officer-in-Charge at the field stations and the supervisor of each scientific component. Italics indicate the equipment for activities whose immediate implementation does not seem feasible (see text).

Activity	Equipment to be supplied or repaired and basic material requirements	*Station*
Meteorology	Repair automatic meteo station	Mpulungu, Kigoma
	Replacement of automatic meteo station batteries and (within one years) replacement of Data Storage Units (DSU)	Mpulungu, Kigoma, Bujumbura
	Anemometer	Bujumbura
	Thermometer	Kigoma, Bujumbura
	Rainfall gauge	Bujumbura
Water Level	*Repair water level automatic recorder*	Kigoma
	Laptop computers to unload water level recorders	Mpulungu, Kigoma, Bujumbura
Limnology	Membranes, rubber O-rings and electrolyte for YSI Temperature-D.O. probe	Mpulungu, Kigoma, Bujumbura
	LI-COR sensors to be recalibrated by factory	Mpulungu, Kigoma, Bujumbura
	Spectronic 301 to be repaired by factory	Kigoma
	Ten 2 L bottles for sample collection (Chl a), Ethanol (5 L), two vials (50mm Rect. Glass Cell, Milton Roy Co.), 2 boxes of Whatman filters GF/F 47mm (cat. 1825047) and 25mm (cat. 1825025), HCL 2.5 L.	Mpulungu, Bujumbura, Kigoma
Zooplankton	Two 100 µm nets	Mpulungu, Kigoma, Bujumbura
	One multi-channel counter: Interface Systems Model MCC-20A.	Kigoma
	One counting wheel	Kigoma
	One 10 ml counting chamber Hydro-Bios Kiel	Mpulungu, Kigoma, Bujumbura
	One 25 ml counting chamber K.C. Maskiner	Mpulungu, Kigoma, Bujumbura
	One 50 ml counting chamber	Mpulungu, Kigoma, Bujumbura

Table 3 . Continued.

Activity	Equipment to be supplied or repaired and basic material requirements	Station
Fish biology and fishery statistics	One Sartorius weighing scale L2200S	Kigoma
Computer facilities	One Desktop (at least 4 GM HD capacity) with CD-ROM Drive and modem One printer	Mpulungu, Kigoma, Bujumbura Kigoma
Communications and *transport*	Internet Access One small 4x4 vehicle Two bicycles	Mpulungu, Kigoma, Bujumbura Mpulungu, Kigoma, Bujumbura Uvira

APPENDIX A.

Possible Collaboration between the LTR Monitoring Program for Fisheries Statistics and the LTBP (FPSS)

The following points are offered in relation to collaborative studies and joint sampling between LTR and LTBP:

1. A co-operative program of study could be established whereby LTR focused on assessment of artisanal fishing practices that target the three species that comprise the bulk of the pelagic fish landings in Lake Tanganyika, and that the FPSS focus on assessment of other species taken by both the artisanal and traditional fisheries. Tables 1-2 suggest joint responsibilities.

Table 1. Scheme for joint LTR-FPSS CAS and laboratory studies

Day 1 – CAS of 5 artisanal gear/practices		**Day 3** – CAS of beach seines and traditional gear/practices	
Three major target species	Other species	Three major target species	Other species
LTR (field) - catch assessment and sampling LTR (lab) - length measurements by species - back calculation of species and size composition of total catch	FPSS (lab) - species identification - length measurements by species - sex and maturity - back calculation of species and size composition of total catch	FPSS (field) - Catch assessment - and sampling FPSS (lab) - length measurements by species - back calculation of species and size composition of total catch	FPSS (field) - catch assessment and sampling FPSS (lab) - species identification - length measurements by species - sex and maturity - back calculation of species and size composition of total catch

Table 2. Scheme for joint LTR-FPSS FS studies

Day 2 – FS of artisanal gear/practices	**Day 4** – FS of beach seines and traditional gear/practices
LTR (field) - total number of craft per practice - total catch per craft - total number of lifts/hauls - effort (measured as sailing/searching time)	FPSS (field) - total number of craft per practice - total catch per craft - total number of lifts/hauls - effort (measured as sailing/searching time)

1. A 4-day sampling regime would be required to complete all components of the CAS and FS programs. Two sampling sites would therefore require 8 field days.

2. In the field, LTR would perform CAS on the five artisanal gear specified in their program. FPSS would perform CAS on beach seines. Both LTR and FPSS will collect samples for lab analysis of the three target species, and other species.

3. If time and resources permit, the FPSS team could perform boat count and effort survey (FS) of the traditional fisheries on Day 4, but this is the lowest priority of the 4-day schedule.

4. If needed, FPSS can assist LTR with studies on purse seine landings, and the data can be shared by both projects. .

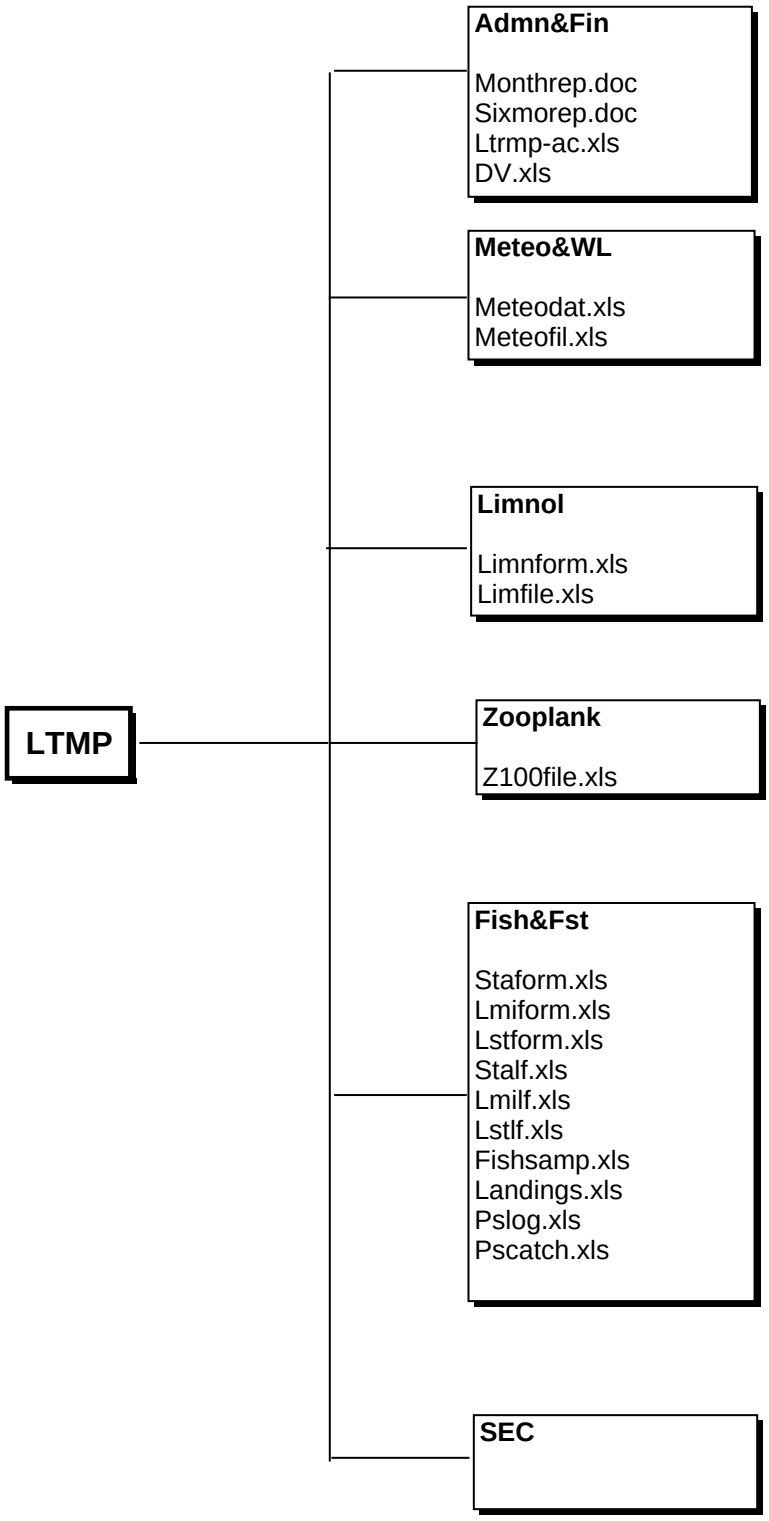
5. Standardization of all field and laboratory sampling and analyses should follow the same protocol and utilize the same or compatible data recording formats whenever possible, for at least two reasons: (a) this will increase the ease and reliability of interactive data use, and (b) the staff have already received training in LTR methods and are competent in their application. Introduction of new or additional methods will place an added burden on the same as well as generate confusion. For example, the CAS the FPSS performs on Day 3 for the traditional fishery should mirror the Day 1 LTR CAS. The same is true for all laboratory analysis and FSs.

6. Often the same individuals will be assigned by their supervisors to perform both the LTR and LTBP work. Additionally, some of these staff will also be involved in other LTBP special studies, and may have other responsibilities not related to these two projects. Hence the requirement to establish field sampling programs that are dependent upon a realistic level of resources, particularly if sustainability is a goal. Therefore, the combined LTR and FPSS CAS and FS programs for the artisanal and traditional fisheries should not exceed 8 field days per month, thereby allowing time for the staff to conduct laboratory analyses, enter data, report results, prepare for upcoming CAS and FS field work.

7. The FPSS could augment the joint LTR-LTBP CAS/FS sampling programs and databases, as well as the BIOS database, by conducting experimental gill netting and laboratory analyses at selected sites that might include the CAS locations or locations monitored by BIOS. This gillnetting would provide additional information of species that are rare or are not a major target of the three fishing sectors.

8. The information on fish species and habitat collected during the BIOS survey and monitoring work (fish censuses and gillnetting) will also augment the collective body of information on all species.

Annex 1



Monitoring Programme field station data archives. Bold font indicate directory and sub-directory names. Files for data collection forms and data entry are shown in the sub-directories. LTMP: Lake Tanganyika Monitoring Programme; Admn&Fin: Administration and Finance; Meteo&WL: Meteo and Water Level data; Limnol: Limnlogy; Zooplank: Zooplankton; Fish&Fst: Fish and Fisheries Statistics; SEC: Socio-economics. See text for details.

Annex 2

Lake Tanganyika Monitoring Programme

Meteo Data & Water Level Form

Station: ______________________ Month/Year: ______________________

Data collected by: ____

Date dd/mm/yy	**Time** hr/min	**Wind speed** anemometer reading	**Wind dir.**	**Air Temp.** (C°)	**Rainfall** ml	**Water level** m

Annex 3

Lake Tanganyika Monitoring Programme

Wind average speed and direction from anemometer daily reading

STATION:

OBSERVER:

DATE/ TIME	ANEMO READING	WIND DIRECTION	AV. WIND SPEED (m/sec.)	AIR TEMP. T (C°)	RAINFALL (ml)	WATER LEVEL (m)	DATE/ TIME	ANEMO READING	WIND DIRECTION	AV. WIND SPEED (m/sec.)	AIR TEMP. T (C°)	RAINFALL (ml)	DATE/ TIME	ANEMO READING	WIND DIRECTION	AV. WIND SPEED (m/sec.)	AIR TEMP. T (C°)	RAINFALL (ml)
01/01/1999 08:00			#VALUE!				01/01/1999 14:00			0.77			01/01/1999 19:00			0.77		
02/01/1999 08:00			0.77				02/01/1999 14:00			0.77			02/01/1999 19:00			0.77		
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05/01/1999 08:00			0.77				05/01/1999 14:00			0.77			05/01/1999 19:00			0.77		
06/01/1999 08:00			0.77				06/01/1999 14:00			0.77			06/01/1999 19:00			0.77		
07/01/1999 08:00			0.77				07/01/1999 14:00			0.77			07/01/1999 19:00			0.77		
08/01/1999 08:00			0.77				08/01/1999 14:00			0.77			08/01/1999 19:00			0.77		
09/01/1999 08:00			0.77				09/01/1999 14:00			0.77			09/01/1999 19:00			0.77		
10/01/1999 08:00			0.77				10/01/1999 14:00			0.77			10/01/1999 19:00			0.77		
11/01/1999 08:00			0.77				11/01/1999 14:00			0.77			11/01/1999 19:00			0.77		
12/01/1999 08:00			0.77				12/01/1999 14:00			0.77			12/01/1999 19:00			0.77		
13/01/1999 08:00			0.77				13/01/1999 14:00			0.77			13/01/1999 19:00			0.77		
14/01/1999 08:00			0.77				14/01/1999 14:00			0.77			14/01/1999 19:00			0.77		
15/01/1999 08:00			0.77				15/01/1999 14:00			0.77			15/01/1999 19:00			0.77		
16/01/1999 08:00			0.77				16/01/1999 14:00			0.77			16/01/1999 19:00			0.77		
17/01/1999 08:00			0.77				17/01/1999 14:00			0.77			17/01/1999 19:00			0.77		
18/01/1999 08:00			0.77				18/01/1999 14:00			0.77			18/01/1999 19:00			0.77		
19/01/1999 08:00			0.77				19/01/1999 14:00			0.77			19/01/1999 19:00			0.77		
20/01/1999 08:00			0.77				20/01/1999 14:00			0.77			20/01/1999 19:00			0.77		
21/01/1999 08:00			0.77				21/01/1999 14:00			0.77			21/01/1999 19:00			0.77		
22/01/1999 08:00			0.77				22/01/1999 14:00			0.77			22/01/1999 19:00			0.77		
23/01/1999 08:00			0.77				23/01/1999 14:00			0.77			23/01/1999 19:00			0.77		
24/01/1999 08:00			0.77				24/01/1999 14:00			0.77			24/01/1999 19:00			0.77		
25/01/1999 08:00			0.77				25/01/1999 14:00			0.77			25/01/1999 19:00			0.77		
26/01/1999 08:00			0.77				26/01/1999 14:00			0.77			26/01/1999 19:00			0.77		
27/01/1999 08:00			0.77				27/01/1999 14:00			0.77			27/01/1999 19:00			0.77		
28/01/1999 08:00			0.77				28/01/1999 14:00			0.77			28/01/1999 19:00			0.77		
29/01/1999 08:00			0.77				29/01/1999 14:00			0.77			29/01/1999 19:00			0.77		
30/01/1999 08:00			0.77				30/01/1999 14:00			0.77			30/01/1999 19:00			0.77		
31/01/1999 08:00			0.77				31/01/1999 14:00			0.77			31/01/1999 19:00			0.77		
01/02/1999 08:00			0.77				01/02/1999 14:00			0.77			01/02/1999 19:00			0.77		
02/02/1999 08:00			0.77				02/02/1999 14:00			0.77			02/02/1999 19:00			0.77		
03/02/1999 08:00			0.77				03/02/1999 14:00			0.77			03/02/1999 19:00			0.77		
04/02/1999 08:00			0.77				04/02/1999 14:00			0.77			04/02/1999 19:00			0.77		
05/02/1999 08:00			0.77				05/02/1999 14:00			0.77			05/02/1999 19:00			0.77		
06/02/1999 08:00			0.77				06/02/1999 14:00			0.77			06/02/1999 19:00			0.77		
07/02/1999 08:00			0.77				07/02/1999 14:00			0.77			07/02/1999 19:00			0.77		
08/02/1999 08:00			0.77				08/02/1999 14:00			0.77			08/02/1999 19:00			0.77		
09/02/1999 08:00			0.77				09/02/1999 14:00			0.77			09/02/1999 19:00			0.77		
10/02/1999 08:00			0.77				10/02/1999 14:00			0.77			10/02/1999 19:00			0.77		

Annex 4

Lake Tanganyika Monitoring Programme

Wind average speed and direction from anemometer daily reading

STATION:

OBSERVER:

DATE/ TIME	ANEMO READING	WIND DIRECTION	AV. WIND SPEED (m/sec.)	AIR TEMP. T (C°)	RAINFALL (ml)	WATER LEVEL (m)	DATE/ TIME	ANEMO READING	WIND DIRECTION	AV. WIND SPEED (m/sec.)	AIR TEMP. T (C°)	RAINFALL (ml)	DATE/ TIME	ANEMO READING	WIND DIRECTION	AV. WIND SPEED (m/sec.)	AIR TEMP. T (C°)	RAINFALL (ml)
01/01/1999 08:00	791994		#VALUE!				01/01/1999 14:00	792673		3.53			01/01/1999 19:00	793093		2.82		
02/01/1999 08:00	793897	NW	2.28				02/01/1999 14:00	794410	NW	2.86			02/01/1999 19:00	794694		2.16		
03/01/1999 08:00	795395		2.09				03/01/1999 14:00	795715		2.07			03/01/1999 19:00	796498		4.59		
04/01/1999 08:00			-1495.28				04/01/1999 14:00			0.77			04/01/1999 19:00			0.77		
05/01/1999 08:00	799072	SE	1501.65				05/01/1999 14:00	799556	NW	2.74			05/01/1999 19:00	799917		2.53		
06/01/1999 08:00	800691	E	2.22				06/01/1999 14:00	801118	SE	2.51			06/01/1999 19:00	801320		1.76		
07/01/1999 08:00			-1504.34				07/01/1999 14:00			0.77			07/01/1999 19:00			0.77		
08/01/1999 08:00			0.77				08/01/1999 14:00			0.77			08/01/1999 19:00			0.77		
09/01/1999 08:00			0.77				09/01/1999 14:00			0.77			09/01/1999 19:00			0.77		
10/01/1999 08:00			0.77				10/01/1999 14:00			0.77			10/01/1999 19:00			0.77		
11/01/1999 08:00			0.77				11/01/1999 14:00			0.77			11/01/1999 19:00			0.77		
12/01/1999 08:00			0.77				12/01/1999 14:00			0.77			12/01/1999 19:00			0.77		
13/01/1999 08:00			0.77				13/01/1999 14:00			0.77			13/01/1999 19:00			0.77		
14/01/1999 08:00			0.77				14/01/1999 14:00			0.77			14/01/1999 19:00			0.77		
15/01/1999 08:00			0.77				15/01/1999 14:00			0.77			15/01/1999 19:00			0.77		
16/01/1999 08:00			0.77				16/01/1999 14:00			0.77			16/01/1999 19:00			0.77		
17/01/1999 08:00			0.77				17/01/1999 14:00			0.77			17/01/1999 19:00			0.77		
18/01/1999 08:00			0.77				18/01/1999 14:00			0.77			18/01/1999 19:00			0.77		
19/01/1999 08:00			0.77				19/01/1999 14:00			0.77			19/01/1999 19:00			0.77		
20/01/1999 08:00			0.77				20/01/1999 14:00			0.77			20/01/1999 19:00			0.77		
21/01/1999 08:00			0.77				21/01/1999 14:00			0.77			21/01/1999 19:00			0.77		
22/01/1999 08:00			0.77				22/01/1999 14:00			0.77			22/01/1999 19:00			0.77		
23/01/1999 08:00			0.77				23/01/1999 14:00			0.77			23/01/1999 19:00			0.77		
24/01/1999 08:00			0.77				24/01/1999 14:00			0.77			24/01/1999 19:00			0.77		
25/01/1999 08:00			0.77				25/01/1999 14:00			0.77			25/01/1999 19:00			0.77		
26/01/1999 08:00			0.77				26/01/1999 14:00			0.77			26/01/1999 19:00			0.77		

Lake Tanganyika Monitoring Programme

Limnological Data Collection Form

Station: _____ Sampling site Lat. _____ Hour start _____
Sampling site Lon. _____ Hour end _____

Date (dd/mm/yy) _____

Depth m	**Water T (°C)**	**D.O. mg/l**	**Secchi Disk m**	pH	Cond. uS/cm	Chl a mg/m3	Water Rad. µm/s-m per µA
0			1st reading				
10			2nd reading				
20			3rd reading				
30			**Avg. =**				
40							
50							
60							
70							
80							
90							
100							

Lake condition: _____ Cloud cover: _____
(from 1 = no clouds to 5 = covered)

Sampling team: _____

Sampling site Lat. _____ Hour start _____
Sampling site Lon. _____ Hour end _____

Date (dd/mm/yy) _____

Depth m	**Water T (°C)**	**D.O. mg/l**	**Secchi Disk m**	pH	Cond. uS/cm	Chl a mg/m3	Water Rad. µm/s-m per µA
0			1st reading				
10			2nd reading				
20			3rd reading				
30			**Avg. =**				
40							
50							
60							
70							
80							
90							
100							

Lake condition: _____ Cloud cover: _____
(from 1 = no clouds to 5 = covered)

Sampling team:

Annex 6

Lake Tanganyika Monitoring Programme																							
Limnology Data File																							
Station:																							
	Secchi Disk	Water T (C°)											D.O. (mg/l)										
Date	(m)	Depth (m)											Depth (m)										
		0	10	20	30	40	50	60	70	80	90	100	0	10	20	30	40	50	60	70	80	90	100

Annex 7

Lake Tanganyika Monitoring Programme

Station: _____ **Sample No:** _____ **Date:** _____

Species: S. tanganicae **FU type:** _____ **Net mesh size (mm):** _____

Total Catch Weight (k): _____ **No. Hauls:** _____ **No. lamps:** _____

Unsorted Sample weight (k): _____ **Sailing Time (hr):** _____ **Fished Hours:** _____

Species sample weight (k): _____

TL (mm)	Measured	Total	TL (mm)	Measured	Total
10			70		
12			72		
14			74		
16			76		
18			78		
20			80		
22			82		
24			84		
26			86		
28			88		
30			90		
32			92		
34			94		
36			96		
38			98		
40			100		
42			102		
44			104		
46			106		
48			108		
50			110		
52			112		
54			114		
56			116		
58			118		
60			120		
62					
64					
66					
68					
Total			Total		

GRAND TOTAL:

Sampling Team: _____

Annex 8

Lake Tanganyika Monitoring Programme

Station: _____ **Sample No:** _____ **Date:** _____

Species: L. miodon **FU type:** _____ **Net mesh size (mm):** _____

Total Catch Weight (k): _____ **No. Hauls:** _____ **No. lamps:** _____

Unsorted Sample weight (k): _____ **Sailing Time (hr):** _____ **Fished Hours:** _____

Species sample weight (k): _____

TL (mm)	Measured	Total	TL (mm)	Measured	Total
10			130		
14			134		
18			138		
22			142		
26			146		
30			150		
34			154		
38			158		
42			162		
46			166		
50			170		
54			174		
58			178		
62			182		
66			186		
70			190		
74					
78					
82					
86					
90					
94					
98					
102					
106					
110					
114					
118					
122					
126					
Total			Total		

GRAND TOTAL:

Sampling Team: _____

Annex 9

Lake Tanganyika Monitoring Programme

Station: _____ **Sample No:** _____ **Date:** _____

Species: **Lates stappersii** **FU type:** _____ **Net mesh size (mm):** _____

Total Catch Weight (k): _____ **No. Hauls:** _____ **No. lamps:** _____

Unsorted Sample weight (k): _____ **Sailing Time (hr):** _____ **Fished Hours:** _____

Species sample weight (k): _____

TL (mm)	Measured	Total	TL (mm)	Measured	Total
10			310		
20			320		
30			330		
40			340		
50			350		
60			360		
70			370		
80			380		
90			390		
100			400		
110			410		
120			420		
130			430		
140			440		
150			450		
160			460		
170			470		
180			480		
190			490		
200			500		
210					
220					
230					
240					
250					
260					
270					
280					
290					
300					
Total			Total		

GRAND TOTAL:

Sampling Team: _____

Annex 10

Lake Tanganyika Monitoring Programme										
Stolothrissa tanganicae										
Month/Year										
Station:										
Landing site:										
Sample number:										
Fishing unit type:										
Fishing Unit Total Catch (kg):										
Unsorted Sample (kg)										
Sampled S. tanganicae										
Raising factor:	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!	
	Numbers	Raised Total	Numbers	Raised Total	Numbers	Raised Total	Numbers	Raised Total	Numbers	Raised Total
Length (mm)										
10		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
12		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
14		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
16		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
18		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
20		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
22		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
24		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
26		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
28		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
30		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
32		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
34		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
36		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
38		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
40		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
42		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
44		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
46		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
48		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
50		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
52		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
54		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
56		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
58		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
60		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
62		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
64		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
66		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
68		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
70		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
72		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
74		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
76		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
78		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
80		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
82		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
84		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
86		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
88		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
90		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
92		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
94		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
96		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
98		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
100		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
102		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
104		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
106		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
108		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
110		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
112		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
114		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
116		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
118		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
120		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
	Total	Grand Total	Total	Grand Total	Total	Grand Total	Total	Grand Total	Total	Grand Total
	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!

Lake Tanganyika Monitoring Programme						
Limnothrissa miodon						
Month/Year						
Station:						
Landing site:						
Sample number:						
Fishing unit type:						
Fishing Unit Total Catch (kg):						
Unsorted Sample (kg)						
Sampled L. miodon						
Raising factor:	**#DIV/0!**		**#DIV/0!**		**#DIV/0!**	
	Numbers	**Raised Total**	**Numbers**	**Raised Total**	**Numbers**	**Raised Total**
Length (mm)						
10		#DIV/0!		#DIV/0!		#DIV/0!
14		#DIV/0!		#DIV/0!		#DIV/0!
18		#DIV/0!		#DIV/0!		#DIV/0!
22		#DIV/0!		#DIV/0!		#DIV/0!
26		#DIV/0!		#DIV/0!		#DIV/0!
30		#DIV/0!		#DIV/0!		#DIV/0!
34		#DIV/0!		#DIV/0!		#DIV/0!
38		#DIV/0!		#DIV/0!		#DIV/0!
42		#DIV/0!		#DIV/0!		#DIV/0!
46		#DIV/0!		#DIV/0!		#DIV/0!
50		#DIV/0!		#DIV/0!		#DIV/0!
54		#DIV/0!		#DIV/0!		#DIV/0!
58		#DIV/0!		#DIV/0!		#DIV/0!
62		#DIV/0!		#DIV/0!		#DIV/0!
66		#DIV/0!		#DIV/0!		#DIV/0!
70		#DIV/0!		#DIV/0!		#DIV/0!
74		#DIV/0!		#DIV/0!		#DIV/0!
78		#DIV/0!		#DIV/0!		#DIV/0!
82		#DIV/0!		#DIV/0!		#DIV/0!
86		#DIV/0!		#DIV/0!		#DIV/0!
90		#DIV/0!		#DIV/0!		#DIV/0!
94		#DIV/0!		#DIV/0!		#DIV/0!
98		#DIV/0!		#DIV/0!		#DIV/0!
102		#DIV/0!		#DIV/0!		#DIV/0!
106		#DIV/0!		#DIV/0!		#DIV/0!
110		#DIV/0!		#DIV/0!		#DIV/0!
114		#DIV/0!		#DIV/0!		#DIV/0!
118		#DIV/0!		#DIV/0!		#DIV/0!
122		#DIV/0!		#DIV/0!		#DIV/0!
126		#DIV/0!		#DIV/0!		#DIV/0!
130		#DIV/0!		#DIV/0!		#DIV/0!
134		#DIV/0!		#DIV/0!		#DIV/0!
138		#DIV/0!		#DIV/0!		#DIV/0!
142		#DIV/0!		#DIV/0!		#DIV/0!
146		#DIV/0!		#DIV/0!		#DIV/0!
150		#DIV/0!		#DIV/0!		#DIV/0!
154		#DIV/0!		#DIV/0!		#DIV/0!
158		#DIV/0!		#DIV/0!		#DIV/0!
162		#DIV/0!		#DIV/0!		#DIV/0!
166		#DIV/0!		#DIV/0!		#DIV/0!
170		#DIV/0!		#DIV/0!		#DIV/0!
174		#DIV/0!		#DIV/0!		#DIV/0!
178		#DIV/0!		#DIV/0!		#DIV/0!
	Total	**Grand Total**	**Total**	**Grand Total**	**Total**	**Grand Total**
	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!

Lake Tanganyika Monitoring Programme						
Lates stappersii						
Month/Year						
Station:						
Landing site:						
Sample number:						
Fishing unit type:						
Fishing Unit Total Catch (kg):						
Unsorted Sample (kg)						
Sampled L. stappersii						
Raising factor:	**#DIV/0!**		**#DIV/0!**		**#DIV/0!**	
	Numbers	**Raised Total**	**Numbers**	**Raised Total**	**Numbers**	**Raised Total**
Length (mm)						
10		#DIV/0!		#DIV/0!		#DIV/0!
20		#DIV/0!		#DIV/0!		#DIV/0!
30		#DIV/0!		#DIV/0!		#DIV/0!
40		#DIV/0!		#DIV/0!		#DIV/0!
50		#DIV/0!		#DIV/0!		#DIV/0!
60		#DIV/0!		#DIV/0!		#DIV/0!
70		#DIV/0!		#DIV/0!		#DIV/0!
80		#DIV/0!		#DIV/0!		#DIV/0!
90		#DIV/0!		#DIV/0!		#DIV/0!
100		#DIV/0!		#DIV/0!		#DIV/0!
110		#DIV/0!		#DIV/0!		#DIV/0!
120		#DIV/0!		#DIV/0!		#DIV/0!
130		#DIV/0!		#DIV/0!		#DIV/0!
140		#DIV/0!		#DIV/0!		#DIV/0!
150		#DIV/0!		#DIV/0!		#DIV/0!
160		#DIV/0!		#DIV/0!		#DIV/0!
170		#DIV/0!		#DIV/0!		#DIV/0!
180		#DIV/0!		#DIV/0!		#DIV/0!
190		#DIV/0!		#DIV/0!		#DIV/0!
200		#DIV/0!		#DIV/0!		#DIV/0!
210		#DIV/0!		#DIV/0!		#DIV/0!
220		#DIV/0!		#DIV/0!		#DIV/0!
230		#DIV/0!		#DIV/0!		#DIV/0!
240		#DIV/0!		#DIV/0!		#DIV/0!
250		#DIV/0!		#DIV/0!		#DIV/0!
260		#DIV/0!		#DIV/0!		#DIV/0!
270		#DIV/0!		#DIV/0!		#DIV/0!
280		#DIV/0!		#DIV/0!		#DIV/0!
290		#DIV/0!		#DIV/0!		#DIV/0!
300		#DIV/0!		#DIV/0!		#DIV/0!
310		#DIV/0!		#DIV/0!		#DIV/0!
320		#DIV/0!		#DIV/0!		#DIV/0!
330		#DIV/0!		#DIV/0!		#DIV/0!
340		#DIV/0!		#DIV/0!		#DIV/0!
350		#DIV/0!		#DIV/0!		#DIV/0!
360		#DIV/0!		#DIV/0!		#DIV/0!
370		#DIV/0!		#DIV/0!		#DIV/0!
380		#DIV/0!		#DIV/0!		#DIV/0!
390		#DIV/0!		#DIV/0!		#DIV/0!
400		#DIV/0!		#DIV/0!		#DIV/0!
410		#DIV/0!		#DIV/0!		#DIV/0!
420		#DIV/0!		#DIV/0!		#DIV/0!
430		#DIV/0!		#DIV/0!		#DIV/0!
440		#DIV/0!		#DIV/0!		#DIV/0!
450		#DIV/0!		#DIV/0!		#DIV/0!
460		#DIV/0!		#DIV/0!		#DIV/0!
470		#DIV/0!		#DIV/0!		#DIV/0!
480		#DIV/0!		#DIV/0!		#DIV/0!
490		#DIV/0!		#DIV/0!		#DIV/0!
500		#DIV/0!		#DIV/0!		#DIV/0!
	Total	**Grand Total**	**Total**	**Grand Total**	**Total**	**Grand Total**
	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!

Annex 13

Lake Tanganyika Research - Commercial Fishery Statistics

Station: ________ **Landing site:** ________ **Month/Year:** ________

	Samp. day (date)	Sample no. (1, 2, 3, 4, 5)	F.U. Type (LN;PS;BS)	TC kg	Sample w kg	RF TC/Sample w	Hours fished No. hours	Sailing No. hours	Hauls No.	Lamps No.	sw. STA kg	sw. LMI kg	sw. LST kg	Tot. STA kg	Tot. LMI kg	Tot. LST kg
D						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
A						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
T						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
A						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
I						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
N						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
P						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
U						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
T						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
						#DIV/0!								#DIV/0!	#DIV/0!	#DIV/0!
Totals:	0		0	0			0	0	0	0				#DIV/0!	#DIV/0!	#DIV/0!

Descriptive statistics

Mean catch:	#DIV/0!	St. Error:	#DIV/0!
St. Dev:	#DIV/0!	CV:	#DIV/0!
95% c.l:	#DIV/0!	Min:	0
Median:	#NUM!	Max:	0

CPUE

kg/FU/night:	#DIV/0!
kg/sailing hr	#DIV/0!
kg/haul	#DIV/0!
kg/lamp	#DIV/0!

Species Composition

	kg/F.U.	%
S. tanganicae	#DIV/0!	#DIV/0!
L. miodon	#DIV/0!	#DIV/0!
L. stappersii	#DIV/0!	#DIV/0!

Annex 14

Lake Tanganyika Research - Commercial Fishery Statistics

Station: | Landing site: | Month/Year:

	Samp. day	Sample no.	F.U. Type	TC	Sample w	RF	Hours fished	Sailing	Hauls	Lamps	sw. STA	sw. LMI	sw. LST	Tot. STA	Tot. LMI	Tot. LST
	(date)	(1, 2, 3, 4, 5)	(LN;PS;BS)	kg	kg	TC/Sample w	No. hours	No. hours	No.	No.	kg	kg	kg	kg	kg	kg
D	10	1	LN	180	1.000	180.0	4.00	1.00	3	5	0.800		0.200	144.0	0.0	36.0
A	10	3	LN	55	0.500	110.0	5.00	1.00	3	6	0.400	0.100		44.0	11.0	0.0
T	10	2	LN	35	0.600	58.3	4.30	1.00	3	4	0.550	0.050		32.1	2.9	0.0
A	10	4	LN	120	0.800	150.0	6.00	1.20	2	5	0.650	0.150		97.5	22.5	0.0
	10	5	LN	140	3.500	40.0	7.00	1.30	3	6	0.150		3.350	6.0	0.0	134.0
I	19	2	LN	75	0.400	187.5	7.50	1.00	2	4	0.050	0.350		9.4	65.6	0.0
N	19	4	LN	100	1.100	90.9	5.00	1.30	2	6	0.700	0.300	0.100	63.6	27.3	9.1
P	19	5	LN	150	0.800	187.5	5.00	2.00	4	7		0.800		0.0	150.0	0.0
U	19	1	LN	60	0.700	85.7	4.00	1.15	3	5	0.500	0.200		42.9	17.1	0.0
T	19	2	LN	80	0.950	84.2	4.00	1.00	2	5	0.750	0.200		63.2	16.8	0.0
						#DIV/0!										
						#DIV/0!										
						#DIV/0!										
						#DIV/0!										
						#DIV/0!										
						#DIV/0!										
						#DIV/0!										
Totals:	10		10	995			51.8	11.95	27	53				502.6	313.3	179.1

Descriptive statistics

Mean catch:	99.5	St. Error:	14.8
St. Dev:	46.9	CV:	47.1
95% c.l:	29.1	Min:	35
Median:	90.0	Max:	180

CPUE

kg/FU/night:	99.5
kg/sailing hr	83.3
kg/haul	36.9
kg/lamp	18.8

Species Composition	kg/F.U.	%
S. tanganicae	50.3	50.5
L. miodon	31.3	31.5
L. stappersii	17.9	18.0

Lake Tanganyika Monitoring Programme - Commercial Fishery Statistics

Landing Site: ______________________________

Station: ____________________________ **Month/Year:** ______________________

Date (day)	Gear Type (LN;PS, etc)	FU's Total Catch (kg, observed)	Hours fished No. hours	Sailing No. hours	Hauls No.	Lamps No.	Remarks

	FU Type		Date	Number
Active		**counted on**		

No. fishing nights in the month: ________

Data collector/s:

Annex 16

Mpulungu Fisheries Department - Lake Tanganyika Monitoring Programme

Industrial Catch Record

Fishing Company: _____
Month/Year: _____
Vessel Type and Name: _____
Gear Type: _____

Date (day)	Locality	Catches (kg)					Draws (No.)	Light Boats	Sailing Time (No. hours)	Hours Fished (No. hours)
		Dagaa (kg)	Mvolo (kg)	Pamba (kg)	Nyuvi (kg)	Others (kg)				
Totals										

Annex 17

Lake Tanganyika Research - Mpulungu Industrial Fishery Statistics

	Month/Year:	Jan-99		Input →			Daily totals from each fishing vessel records →				
	Day	Fishing Vessel Name	TC (kg)	Hours fished No. hours	Sailing No. hours	Hauls No.	Lamps No.	Ndagaa (STA & LMI, kg)	Mvolo (LST, kg)	Pamba (LAN, kg)	Nyuvi LMA & LMC, kg)	Others kg
D	4	adb	222.5	4.0	2.3	2	4	10.0	200.0		10.0	2.5
A	4	abc	168.5	5.0	2.0	3	3	2.5	155.0	5.0	6.0	
T	4	klm	273.0	3.5	3.0	2	4	3.0	270.0			
A	4	bbf	356.0	3.5	3.0	2	4	6.0	325.0	15.0		10.0
	4	thr	407.0	5.0	3.5	3	3	7.0	400.0			
I	4	wkd	299.0	4.0	3.0	3	3	2.0	269.0	25.0		3.0
N	3	tki	368.0	5.0	3.5	2	3	4.0	345.0	7.0	12.0	
P	3	nnn	175.8	5.5	2.0	3	4	5.0	155.0	15.0		0.8
U	3	kkj	211.0	4.5	2.0	2	4	1.0	210.0			
T	5	adb	193.0	4.0	2.5	2	4	5.0	145.0	18.0	25.0	
	5	abc	237.0	3.0	3.0	2	5	2.0	220.0			15.0
	5	klm	188.8	4.5	2.5	2	3	0.8	188.0			
	7	thr	160.0	4.5	2.5	3	3	5.0	155.0			
	7	wkd	111.0	5.0	2.0	2	4	1.0	90.0		20.0	
Totals:	14	14	3370.6	61	36.8	33	51	54.3	3127.0	85.0	73.0	31.3

Descriptive statistics

Mean catch:	240.8	St. Error	23.5
St. Dev:	87.9	CV	36.5
95% c.l:	46.1	Min	111
Median:	216.8	Max	407

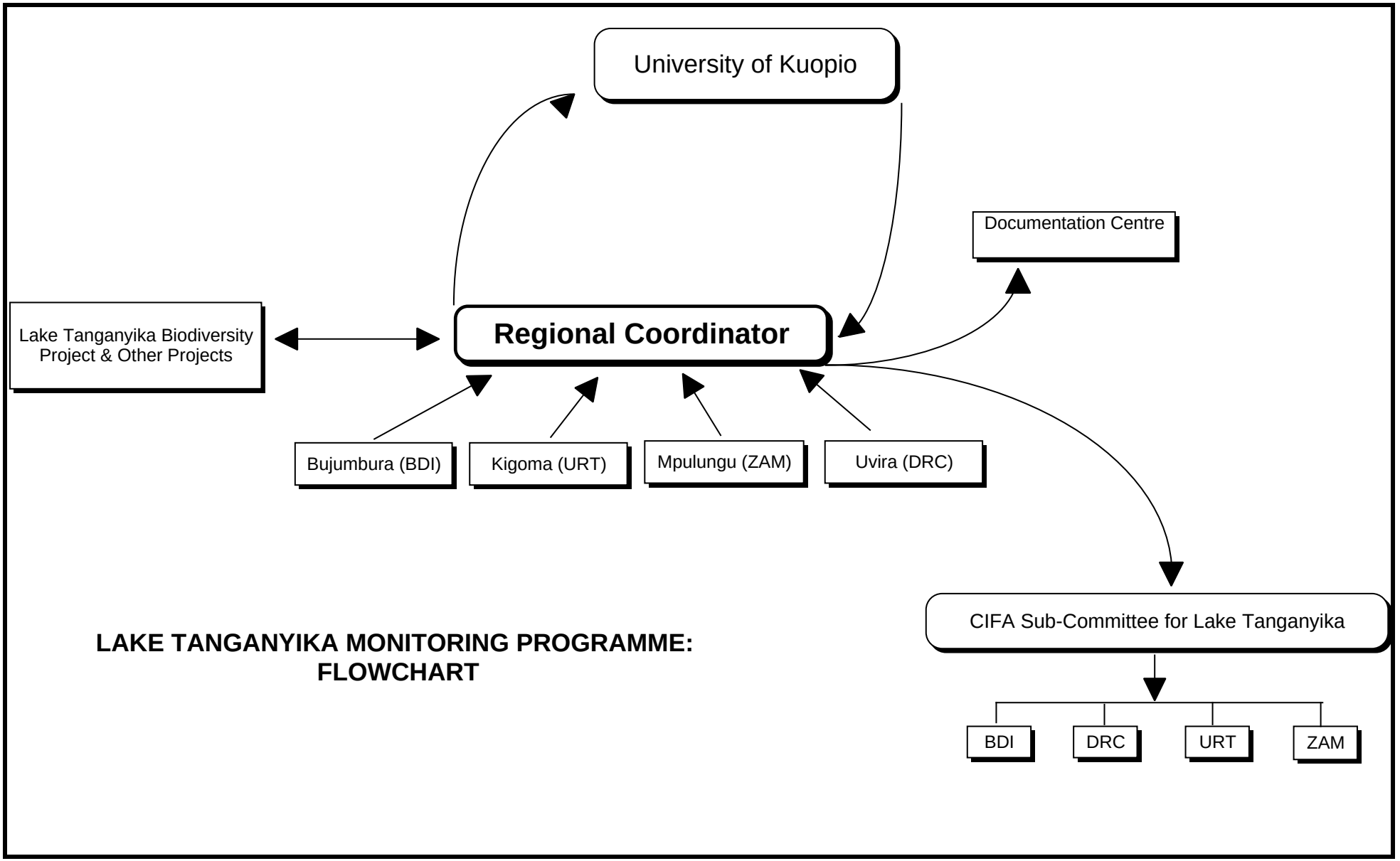
CPUE

kg/hr fished	55.3
kg/sailing hr	91.6
kg/haul	102.1
kg/lamp	66.1

CPUE by species (kg/FU) and catch composition

	kg/F.U.	%
L. stappersii	223.4	92.8
S. tanganicae & L. miodon	3.9	1.6
L. angustifrons	6.1	2.5
L. mariae & L. microlopsis	5.2	2.2
Others	2.2	0.9

Annex 18



LAKE TANGANYIKA MONITORING PROGRAMME: FLOWCHART

Annex 19

GCP/RAF/271/FIN
Research for the Management of the Fisheries of Lake Tanganyika

Terms of Reference

Regional (National) Coordinator

Under the general supervision of the LTR Coordination Committee and in close collaboration with the LTR Coordinator, Project Associates of the University of Kuopio (Finland) and Officers-in-Charge of other research stations, the Regional (National) Coordinator will:

1. assume the responsibility for the technical execution of the Lake Tanganyika Monitoring Programme at the field level, and thus and in close collaboration with the O-i-Cs at each research station, for the overall coordination and supervision of all field teams in all lacustrine countries;
2. assume the responsibility for the proper utilization of all FAO inputs to the LTR including the custody and operation of all project material, supplies and equipment (soon to be officially transferred to the respective Governments), as well as the routine administrative and financial obligations;
3. in close cooperation with the University of Kuopio will establish the reporting deadlines for O-i-Cs for all required reports i.e. Monthly Activity Reports, Six-monthly Scientific Reports and Annual Scientific Reports;
4. specify the sampling dates for all participating research station. These will be specified for each four months period and communicated to each O-i-C during the last weeks of every December, April and August;
5. assume the responsibility for completion and timely transmission of the monthly reports, sixth months reports and annual reports prepared by the O-i-Cs of each station to the University of Kuopio, and their distribution to the authorities of all four lacustrine countries;
6. in close cooperation with the University of Kuopio, assume the responsibility for the completion of the Lake Tanganyika Monitoring Programme Annual Scientific Report and its timely and competent translation to French/English as appropriate and, finally, its production in CD-ROM format and subsequent distribution to all concerned parties;
7. assume other reporting obligations (administrative and financial); and
8. liaise directly with the Directors of Fisheries of the four participating countries.

The Regional (National) Coordinator must be bilingual in French and English, with at least 7 years experience in the administration of field projects, possessing university degree (M.Sc. or equivalent) in fisheries/limnology or related fields. Further, a computer literacy and ability to effectively use PCs, word processing and office technology equipment (Excel, Word) is required.

Duty Station: Bujumbura, Burundi during 1999, with travel within region to supervise the execution of the Monitoring Programme (Kigoma in Tanzania, Mpulungu in Zambia, Uvira and Kalemie in D.R.Congo).

Annex 20

GCP/RAF/271/FIN

Research for the Management of the Fisheries of Lake Tanganyika

Terms of Reference

Officer-in-Charge

Under the general supervision of the LTR Coordination Committee and in close collaboration with the LTR Coordinator, Project Associates of the University of Kuopio (Finland) and, in particularly, the Regional (National) Coordinator, each O-i-C of participating research station will:

1. assume the responsibility for the technical execution of the Lake Tanganyika Monitoring Programme at the field level by effectively coordinating and supervising the field team in his/her in duty station and making sure that the required sampling takes place on days and dates exactly as established by the Regional (National) Coordinator;
2. assume the responsibility for the proper utilization of all FAO inputs to the LTR including the custody and operation of all project material, supplies and equipment (most soon to be officially transferred to the respective Governments), as well as the routine administrative and financial obligations;
3. assume the responsibility for completion and timely transmission of the monthly reports, sixth months reports and annual reports prepared at his/her duty station to the Regional (National) Coordinator respecting the reporting deadlines established by the Regional (National) Coordinator; and
4. assume other reporting obligations (administrative and financial).

Each Officer-in-Charge of participating research station should have at least 5 years experience in the administration and execution of field projects and possessing university degree (M.Sc. or equivalent) in fisheries/limnology or related fields. Further, a computer literacy and ability to effectively use PCs, word processing and office technology equipment (Excel, Word) is required.

Duty Stations: one each in Bujumbura (Burundi), Uvira (D.R. Congo), Kigoma (Tanzania) and Mpulungu (Zambia).

Annex 21

Lake Tanganyika Monitoring Programme

Monthly Activity Report

Station:	Officer in Charge:
Activity Report for the month of:	
Activities carried out:	
Results:	
Remarks:	

Date:	Signature:

Annex 22

Lake Tanganyika Monitoring Programme

Six-month Scientific Report

Station:	Officer in Charge:
Report for the period:	
Activities performed (to be listed for each scientific component of the Monitoring Programme i.e. Meteorology, Limnology, Zooplankton, Fish Biology and Fisheries Statistics):	

Results and Discussion:
Problems met and action required:
Assessment of the station scientific equipment and material (**Note**: material in stock must be sufficient for, at least, the next six months):

Date:	Signature:

Annex 23

LTR - Monitoring Programme

DISBURSEMENT VOUCHER

☐ Bank ☐ Cash
☐ Voucher No.

Paid to

Description	Currency	Amount

Doc. Line No.	Payment received Date: Payee's signature	Total	
		Cheque No.	Date issued

I certify that the above goods and/or services are for official use, that the prices charged are fair and reasonable. I further certify that the goods and/or services have been received.

Date

Disbursing Officer's name, title and signature

LTR - Monitoring Programme

DISBURSEMENT VOUCHER

☐ Bank ☐ Cash
☐ Voucher No.

Paid to

Description	Currency	Amount

Doc. Line No.	Payment received Date: Payee's signature	Total	
		Cheque No.	Date issued

I certify that the above goods and/or services are for official use, that the prices charged are fair and reasonable. I further certify that the goods and/or services have been received.

Date

Disbursing Officer's name, title and signature

Annex 24

		Lake Tanganyika Monitoring Programme							
Station:	Bujumbura	Country:	BDI		Currency:	FBU		Accounts Period:	Jan-99
					Exc. rate:	502			
	Opening Balance	0							
Voucher No.		Bank a/c	Cash a/c	Line 001	Line 002	Line 003	Line 004	Line 005	
	Description								
		0	0						
RV no. 1	Bank replenishment	2000000							
0001/99	CNI- fee for e-mail	-75300					75300		
0002/99	Petty Cash replenishment	-100000	100000						
0003/99	office supplies	-45000						45000	
0004/99	100 l diesel		-37500			37500			
0005/99	PRA for January	-200000		200000					
0006/99	toner for computer	-30000						30000	
	Totals	1549700	62500	200000	0	37500	75300	75000	
	Balance Bank & Cash	1612200							