RAF/92/G32 - POLLUTION CONTROL AND OTHER MEASURES TO PROTECT BIODIVERSITY IN LAKE TANGANYIKA

Back to Office Report - Tony Bailey-Watts - Visit to Lake Tanganyika Region 14th May to 17th June 1998 - Pollution Special Study activities

Terms of Reference: visit to Bujumbura (Burundi), Uvira (the Democratic Republic of the Congo), Kigoma (Tanzania) and Mpulungu (Zambia) by Dr Tony Bailey-Watts - for approximately 4 weeks from mid-May 1998

1. Purpose and scope of the visit

i) to re-visit Burundian and Congolese institutions and finalise the assignment of personnel to be trained in, and execute, field and laboratory studies for the LTBP Special Study on Pollution and its Effects on Biodiversity - to parallel those in progress in Tanzanian and Zambian waters.

ii) to progress and advance the on-going training of Tanzanian and Zambian nationals appointed to the Special Study in physical, chemical and biological techniques but on this particular occasion the practices required for assessing the effects of eutrophication and other forms of pollution on biodiversity using assemblages of microscopic plankton and epi-benthos ('*Aufwuchs*').

iii) to deliver on a 'long loan' basis a microscope and accessories.

iv) to finalise with Dr Francis Chale in Kigoma, a contract appointing him in the longer term as a national consultant in Tanzania - following a recent successful 6-week trial appointment.

I plan to meet - and indeed rely on the local knowledge of - the following senior national staff during this visit: Shadreck Ngonsela (Environmental Education Co-ordinator) and Christopher Kashinga (Pollution Co-ordinator) in Zambia (both based in Lusaka), Gabriel Hakizimana (INECN) in Burundi, Kalala Tshibangu for the Democratic Republic of the Congo, and Mr Deonatus Chitamwebwe at TAFIRI, Kigoma for Tanzania. The visit to the Francophone countries are scheduled to coincide with, or at least overlap considerably with visits there by Dr Kelly West (SLO), and Dr Bailey-Watts will be accompanied by Miss Nicola Wiltshire (PSS trainer and supervisor of all aspects of the pollution and pollution effects work) for the visits to Kigoma and Mpulungu and environs.

2. Preferred itinerary and schedule

Depart Edinburgh as near to, but preferably no later than, 1 May for Bujumbura *via* London and Nairobi. Return travel Bujumbura-Uvira-Bujumbura will be attempted by road. I need no more than a total of 8 working days for my business in Bujumbura and Uvira - basing myself primarily at the sites of (i) the Documentation Centre of

FAO/FINNIDA Lake Tanganyika Research and (ii) the Belgian Centre Regionale de Recherches en Hydrobiologie Appliquée (CRRHA) and the University in Bujumbura, and the Centre de la Recherche Hydrobiologique (CRH) in Uvira. It is anticipated that a flight from Bujumbura to Kigoma can be arranged through the World Food Programme. I plan to work with the team in Kigoma for approximately 5 days, and use the Lake Tanganyika ferries to travel from there to Mpulungu where I will need 10 or 12 days, before leaving for UK *via* Kasama (road from Mpulungu), Lusaka (light plane) and London; I thus require 'open' ticket/s for the main Lusaka-London-Edinburgh legs, hoping to have at least one day in Lusaka and environs.

These ToR were copied on 10 April 1998 to Dr Menz (Dar es Salaam), and to (i) Mr Mamert (LTBP, Bujumbura) who will contact Mr Hakizamana and Mr Tshibangu if possible), (ii) Miss Wiltshire (LTBP, Kigoma) who will see Mr Chitamwebwe and his staff), and (iii) Martin Pearce (LTBP Support Officer, Mpulungu) who will see Mr Mwape and his staff.

Schedule and main activities and achievements

***Thursday 14th May*:** Travel to Nairobi. NOTE: UK passport holders now require a visa to enter Kenya. This costs 20 US$ (and can be purchased on the way in) although I was let off with 10 US$ on reporting that I was moving on to Burundi the next day.

I was met at the airport (arriving around 2200h) by tax from the 'Fairview Hotel' which I had booked and arranged before leaving UK (Tel: 254 2 723211; Fax: 254 2 721320; Email: Fairview@form-net.com).

***Friday 15th May*:** Visited (a) Professor Frank Muthuri of Nairobi, Kenyatta University (with whom I worked on the Lake Victoria Environment Management Plan in 1995) to express my continuing interest in being involved in that project, and (b) staff at the National Museums of Kenya with whom I also worked in 1995. Flight with Dr Kelly West and Mr Jerod Clabaugh to Bujumbura; registered at 'Novotel'.

***Saturday 16th May*:** Discussions at LTBP Bujumbura HQ with Professor Gaspard Ntakimazi regarding the appointment of graduates of the University of Burundi to the PSS. Scanned cv's and discussed these with Mr Gabriel Hakizimana (INECN) - later appointed as PSS Coordinator in Burundi, and Mr Wilondja Kamalebo (previously with the FAO Lake Tanganyika Research team and known to me since 1995 when we discussed phytoplankton studies). Drafted work plans for PSS activities in Burundi. A first focus will be on Bujumbura Port (impacted zone), mouths of 5 rivers most affected by diffuse runoff (e.g. Rusizi) but also a system receiving effluent from the town's water purification plant and another affected by brewery waste. Sampling stations above point sources of pollution were identified. We discussed and agreed on preliminary sampling frequencies, replication and analytical methods for lake phytoplankton and river epilithic assemblages, as well as chemistry including eutrophication factors and (eventually) heavy metals, pesticides and hydrocarbons.

***Sunday 17th May*:** Further development of work plan and components from 'planning to data interpretation'. Reviewed situation with regard to microscopes in LTBP Bujumbura and Congo and the all-important eyepiece graticules for measuring 'microflora' species and estimating their population densities using a mini-quadrat method.

***Monday 18th May*:** Meeting with the full complement of personnel eventually appointed to the PSS team for Burundi: Gabriel Hakizimana, Aline Irimbere (INECN analytical chemist), Wilondja Kamalebo (previously LTR phytoplankton specialist), Consulata Musanisoni (previously analytical chemist with LTR). Work on phytoplankton species diversity and population density techniques with Kamalebo.

***Tuesday 19th May*:** Further discussions with new PSS team over sampling programme. Assessed equipment available at LTBP HQ (previously occupied by CRRHA); noted a considerable short-fall in mainly consumable items needed for the PSS studies. Met with Denis Barandemaje (Director de Gestion Resource Hydraulique) and discussed PSS plans and how they could relate to his interest. Evening meeting with Joachim Feltes - interested in PSS analytical results in regard to his firm's siting of a water intake for treatment for potable supply. Surveyed (with Kamalebo) room space at LTBP Bujumbura HQ with the view to re-organisation. Basically, there is ample space for custom-arranged offices and room for the SLO and others, for microscopy, 'wet' and 'dry' laboratory activities, aquaria, cold/freezer store and storage of diving gear including boats.

***Wednesday 20th May*:** Attended to PSS personnel budget and visited 'small' and 'large' Rusizi water courses and sampling points (bridges). Further sessions with Kamalebo re- microscopy. Discussion at INECN over PSS Work Plan, with Kelly West and Burundi LTBP National Co-ordinator.

***Thursday 21st May*:** Further refinement of PSS Work Plan for Burundi and drafting ToR's for Hakizimana, Musanisomi, Irimbere and Kamalebo.

***Friday 22nd May*:** Visit to Uvira (Congo) with Kalala Tshibangu (selected for post of PSS Co-ordinator in Congo) and colleagues in CRH Uvira. Discussed work plan and resource needs in the following equipment categories: for getting to the river and lake sampling sites; for recording environmental variables (weather observations, probe readings etc); for collecting samples for chemical and micro-algal analysis; for protecting the samples during transit back to the laboratory; for analysing the samples in the laboratory; and for displaying, analysing, interpreting and reporting on the results. Preliminary debate on the 'when', 'where' and 'what' of sampling programmes resulted in the following: attention to (a) 6 river systems which would be sampled at their mouths (but not in the lake) and above the more or less linear 'populated belt' that runs parallel to the lake shoreline, and (b) initially, 3 open lake sites along a transect approximately 200m offshore and including unimpacted and impacted areas.

***Saturday 23rd May*:** Drafted ToR's for Tshibangu and Mukungilwa Kamalebo (a microscopist) and two analytical chemist positions.

***Sunday 24th May*:** Visit to INECN's Rusizi Reserve.

***Monday 25th May*:** Circulated a document summarising earlier discussions on the PSS work planned for Burundi and Congo, i.e. sampling frequency, sites and determinands. Discussed duties (ToR) and contractual arrangements ('Offers of Engagement') for each of the team members. Completed measuring of the various rooms and laboratories at the LTBP Bujumbura station.

***Tuesday 26th May*:** Finalised ToR's and Offers of Engagement in consultation with the team and Kelly West. More work with Wilondja Kamalebo on phytoplankton assemblage size spectra (P.A.S.S.) and species diversity assessments.
***Wednesday 27th May*:** Planning a very preliminary sampling exercise in order to (a) secure water samples for comparative analysis (i.e. an analytical quality control test) of nutrients and phytoplankton by INECN, IFE and if possible, other LTBP laboratories. In the event, it proved impossible to gain access to open water - having to be satisfied with dip samples (for nutrient and chlorophyll analysis) and 30-m mesh tow net concentrates (for phytoplankton) from a boat moored in a 'marina'. This experience highlighted (as found in Kigoma in the early days) the need for a crafted written agreement allowing LTBP personnel unlimited access to the lake with their craft and equipment. ACTION: Gabriel Hakizimana to arrange this. However, two aliquots of filtered water and two of un-filtered water were collected from bridge sites on the Ntahangwa (below the outfall of effluent from the Brasserie) and Kinyange rivers. Other activities highlighted concerns not over INECN's analytical expertise in areas of river water and effluent analysis, but over the future the need for assessing lake water - which is likely to contain solutes and particulates at levels 2 or 2 orders-of-magnitude less than those characteristic of rivers and effluents.

***Thursday 28th May*:** From earlier discussions between Kelly West and Dr Nshombo (Director, CRH Uvira) it was agreed that Mr Tshibangu (and possibly other PSS staff in Uvira) could travel to Bujumbura to carry out chemical and algal analyses - that is, until the CRH building is refurbished, and the field and laboratory equipment are installed. Thus, before I left for Kigoma, Messrs Hakizimana and Tshibangu had agreed to carry out a joint preliminary sampling of some river waters in Uvira and Bujumbura, and analyse these at the INECN and LTBP Bujumbura laboratories. I fervently hope that by the time I submit my next quarterly progress report (end August) both of these Francophone teams are 'up and running' with regard to field recording and sampling and chemical and biological analyses.

Completed ToR's for all named personnel assigned to the PSS, and the 'templates' for another 2 persons to be recruited (for the Congo). Travel to Kigoma. Discussed PSS work with Eleanor Michelle - a facilitator for the 6-week 'NYANZA' project (including limnology) run by Andy Cohen and colleagues from the University of Arizona - involving 12 US undergraduates and 3 nationals from each of the 4 lake countries.

***Friday 29th May*:** Discussions with Nikki Wiltshire on all PSS activities in Tanzania and Zambia. Significant progress had been made with the following: overall range of field and laboratory work with more sampling stations and analyses. However, some major problems resulting from (a) breakdown of spectrophotometer (it having been out of action for more than two months!), and (b) difficulties over maintaining deliveries of consumables such as glassware cleaning fluid, and chemical reagents. Also, though temporary, there was extra pressure on the use of wet and dry laboratory space due to the NYANZA project. **ACTION: suggest that, even though inflatable craft had to be stored outside the 'wet' laboratory to accommodate the NYANZA group's equipment, a new (permanent) compound should be constructed for these boats much nearer the lake shore. In this connection too, the possibility of appointing an extra security ('night-watchman') for the duration of the NYANZA project's presence and beyond, was raised with Mr Chitawebwe and Kelly West.**

***Saturday 30th May*:** Unpacking equipment (mainly microscope components) brought from UK. Assessed situation regarding microscope- eyepiece-graticule combinations and fitted these accordingly; same done for Mpulungu laboratory later. Dr Chale (now appointed as PSS Co-ordinator in Tanzania) arrived with replacement 'Jenway' spectrophotometer and glassware for nitrate analysis using the Cadmium reduction method. Gave thought to (a) reviewing and stream-lining current sampling schedule, this resulted in operating a fortnightly, rather than the current weekly, routine - at least until the existing backlog of analyses due to spectrophotometer breakdown has been eroded; (b) copying all results to date with the view to examination and interpretation (to be analysed by IFE); (c) take sub-samples of Kigoma and Gombe water of current and stored samples for AQC exercise also involving material brought from Bujumbura.

Packed the following 'B' 30-m mesh tow-net samples collected at the following sites for phytoplankton assemblage size spectra ('PASS') analysis: in Tanzania TG1 26.2.98, TJ 25.2.98, TK1 25.2.98, TK2 25.2.98, TT 25.2.98; in Zambia ZK 11.2.98, ZN1 and ZN2 (both 12.2.98).

New samples collected from sites TJ, TK and TT along with (later) ZK and ZN.

***Sunday 31st May*:** day off - to market.

Monday 1st June: further discussions on AQC exercise with Dr Chale and NJW; Whatman glass fibre-filtered sub-samples of water from the following sites were packed for analysis at IFE, Edinburgh:

from Kigoma: TK1, 6 and 28 April, 12 and 16 May; TK3, 6 April; TK4, 14 and 21 April, 19 and 28 May.

from Gombe: TG2, 30 April, TG3, 28 May.

from Jacobsen's Bay: TJ, 5 May.

from 'TAFIRI' Bay: TT, 22 April and 13 and 27 May.

from near water intake: TW, 7 and 16 April, and 7 and 20 May.

A parallel exercise was initiated for comparing the results of different operators at TAFIRI and Mpulungu involved in the assessment of phytoplankton species and size diversity. Some of the results are to be included in a paper to be presented at the 25th 'Societas Internationalis Limnologiae' (S.I.L.) Congress in Eire, August 1998; the paper will focus primarily on phytoplankton species diversity[1].

Tuesday 2nd June: final testing and distribution of FBA and IFE Zeiss and Vickers microscopes, objectives, occular eyepieces, stage and eyepiece measuring graticules and Miller Squares. The focussing controls on original Zeiss sent to Mpulungu are rather stiff and need attention. The second Zeiss instrument is to be taken by Mukungilwa Kamalebo (with the 'NYANZA' group) to his C.R.H. laboratory in Uvira. primarily for his studies on phytoplankton and micro-phyto benthos.

Photocopied and distributed Lund phytoplankton counting chamber calibration sheets and rankit tables for the LTBP Kigoma laboratory.

Meeting with Kelly West and Dionatus Chitamwebwe to match staff availability and PRA budget for the PSS programme in Tanzania. The following will comprise the PSS staff complement until further notice at TAFIRI: Dr Chale, Messrs Kadula, Longinus, Lyoba, Muhoza and Wakafumbe, and Ms Shalome.

Wednesday 3rd June**:** Discussions with Mr Muhoza on (a) the 'rankit' (normalised scores) method for displaying frequency distribution data where sample sizes are small e.g. <100; (b) a simple, quantitative and repeatable method for generating phytoplankton (and other biota) species and size diversity arrays; (c) the Lund nanoplankton counting chamber, chamber calibration and its use in estimating population densities of microscopic biota (<1 mm); and (d) Catherine O'Reilly's epilithon sampler.

Re-drafted clauses to be added to Dr Chales's and others' ToR.

Packed for departure to Zambia. Boarded ''*Liembe'* at 1500h.

Thursday 4th June (on 'Liemba')**:** Drafted plans on the following issues to be discussed with LTBP Mpulungu staff (primarily those contributing to the PSS, but with other interested personnel as appropriate):

! reviewing sampling schedules in order to take account of main seasonal weather events i.e. heavy rains in February, end of rains in March, dry period in September and end of dry period in November.

! the feasibility of mounting a sampling expedition to Nsumbu during my visit - to include weather recording, probe readings and collection of samples for

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1 PHYTOPLANKTON SIZE AND SPECIES DIVERSITY IN TWO VERY CONTRASTING WATERS: LAKE TANGANYIKA AND LOCH LEVEN. *Bwathondi, G.[1], Kadula, E.[1], Kaweme, K.[2], Lukwesa, C.[2], Makassa, L.[2], Muhoza, S.[1], Wakafumbe, R.[1], Zulu, I.[2], Kirika, A.[3], Wiltshire, N. J.[3] and Bailey-Watts, A. E.*[31] Lake Tanganyika Biodiversity Project, P.O. Box 90, Kigoma, Tanzania, [2] LTBP, P.O. Box 55, Mpulungu, Zambia and [3] Institute of Freshwater Ecology, Edinburgh Laboratory, Penicuik, EH26 0QB, Scotland.

nutrient chemistry and phytoplankton species diversity and population density assessments.

- train 2 or 3 Zambians to calibrate and operate the Lund nanoplankton counting chambers, and estimate phytoplankton population densities and size and species diversity characteristics.
- review PSS data collected by the Mpulungu laboratory to date.
- add two sampling stations to the existing programme, i.e. 1 in more open water than hitherto in each of the Nsumbu and Mpulungu areas.
- assess NJW's progress with her initiation of studies on epilithic algae.
- complete the PSS contribution to the March-May 1998 LTBP Progress Report.
- assess staff's resource requirements.
- draft fuller and more specific than hitherto document on duties to be incorporated in the ToR for Mr Christopher Kashinga (member of the Zambia Pollution Co-ordinator's Unit based at ECZ, Lusaka.

***Friday 5th June*:** arrived Mpulungu 09.30h. Preliminary meeting at LTBP laboratory outlining scope and ToR of my visit; outlined the issues above; these were supplemented by the staff's expressed interests in holding a session on 'data interpretation'.

Some 90 minutes with Monique Trudel and Rachel Roland (LTBP 'Training' consultants); presented the philosophy and approach that I am adopting as regards training, i.e. 'on the job' and continuous monitoring studies as distinct from short-term projects. I suggested that up to 4 nationals be selected from each country to visit and work in IFE and UEA for 2 or 3 month periods; indeed, I stressed that without this - and in spite of the considerable inputs and presence of Miss Wiltshire, Dr Foxall and myself in the region so far - the work would not be sustained after the end of the Project. In common with the teams in Bujumbura and especially Uvira , the staff in Mpulungu and Kigoma identified the absolutely crucial need for books and journals for their laboratories.

***Saturday 6th June*:** Further discussions on phytoplankton species diversity assessment with Chimanga, Kaweme, Makassa, Syapila, Zulu and Mr Mwape himself. Decided for the present to ignore organisms <10m in greatest dimension in these analyses - because experience so far suggests that the small organisms invariably outnumber by far, those that are >10m. Nevertheless, the approximate numerical proportions of organisms less than 10m need to be recorded. Eventually, it is hoped that the investigators will be able to attend to the smaller species - especially when they embark on population density estimation using material concentrated by centrifugation or sedimentation.

***Sunday 7th June*:** Progressed contribution to the LTBP March-May 1998 Quarterly Progress report; paid attention to special requirements due to the fact that this particular report m coincides with the UNOPS 'Mid-term' Review of the Project: thus highlighted leading institutions now assigned to the PSS, the staff appointed (now totalling approximately 20 - though not all full-time), and the main objective of

the next quarter to have Congolese and Burundian teams carrying out routine monitoring of physical, chemical and microscopic biota of the same extent and intensity as the Tanzanian and Zambian groups.

***Monday 8th June*:** Further training and supervision of nationals in the generation of phytoplankton species and size diversity arrays - and the application of the 'rankit' method to assess the size frequency distributions of other measurements, e.g. gastropod snail dimensions. Very comparable results obtained by Isaac Zulu, Miss Wiltshire and myself and on Mpulungu Bay material.

The day was considered by all involved as very special on account of the very striking bloom of what is to all intents and purposes *Anabaena flos-aquae* RALFS *ex* BORN *et* FLAH - common in Europe - but perhaps the tropical form *aptekariana* rather than the European *flos-aquae.* Nikki Wiltshire reported that the same organism was still prevalent in Mpulungu and the Nsumbu area at 29 June 1998.

GENERAL NOTE: Since my last visit to Mpulungu (June 1997) neither of the two banks in the town deal readily with Travellers' cheques; only by almost literally prostrating myself at the feet of the new Manager (Alan) of the Finance Bank, and furnishing evidence that my UK bank had sold me the TC's in my possession, was I able to buy Kwachas - and a considerable number of these in order to pay for my stay at Nkupi Lodge and my light plane flight from Kasama to Lusaka (total approximately 600,000 Zm Kwachas). However, 'Dinish' at Nkupi can sometimes help over this problem. Also to be noted is the newly installed telephone at this lodge.

***Thursday 9th June*:** Because I had to arrange my forthcoming flight back to UK, I was unfortunately unable to join the team on their sampling trip in the Mpulungu area. Nevertheless my enforced confinement to the laboratory enabled me to (a) discuss with Makassa the possibility of producing a map indicating the sampling sites in both the Mpulungu and the Nsumbu areas, (b) complete some P.A.S.S. analyses for material previously taken from sites 'ZM2' and 'ZM3', and (c) discuss with Makassa and Lukwesa re-current problems with the LTBP spectrophotometer; **ACTION: explore possibility of purchasing new spectrophotometers for all 4 LTBP laboratories.**

***Wednesday 10th June*:** Further discussions with Makassa over continuing problems with phosphorus analyses: even duplicate total P analyses give widely divergent results, and the results for the soluble reactive component (SRP) are of limited value since the LTBP 'Jenway' spectrophotometer behaves very erratically: a typical sequence of findings with the SRP analysis is as follows:

i. distilled water 'blank' in cuvette - 'zero' to '0.000' absorbance reading
ii. remove this cuvette
iii. introduce sample - stabilises at 0.044 absorbance
iv. remove this sample and re-introduce original blank (distilled water); new reading - 0.01, but can range up to high + value
v. 'zero' blank again
vi. remove this blank

vii. re-introduce same sample (as iii) above: absorbance reading now 0.049
viii. remove sample and re-insert 'blank': absorbance now +0.008 units
ix. opening lid, and not removing the blank, but closing the lid again: result stable
x. if opening lid, removing sample and replacing it again (even without wiping of cuvette faces): absorbance now 0.072 units, i.e. *cf.* 0.049 in vii above.

Thursday 11th June: reviewed present sampling regime. Few amendments were considered necessary - the current input-output ratio being satisfactory. However, a 6th site was added in order to include an 'open water' station; the existing sites are all situated within 150m from the shore. Whilst environmental recording, probe readings and the sampling and analysis for total and soluble reactive phosphorus, dissolved silica, chlorophyll and alkalinity would continue on a weekly basis, it was agreed that the surface 5-minute, 30-m mesh net tow collections need be done only twice per month. Supervised the inputting and graphing (in Sigma Plot) of rankit and phytoplankton species diversity data from sites ZM2 and ZM3, following a very useful session at the microscope with Isaac Zulu. Collated documentation on Lund nanoplankton counting chamber calibration and population density estimation. Lusaka - London - Edinburgh flights booked.

Friday 12th June: prepared Agenda for forthcoming 'whole station meeting'. This included the following issues:

(a) ToR for the ECZ Pollution Co-ordination unit in Lusaka, Zambia and how these compare with the PSS co-ordination role that falls to Mr Mwape in Zambia as head of the Mpulungu LTBP station.

(b) possible modification of sample sites and sampling frequency. Makassa produced a scale map of the Mpulungu and Nsumbu areas, identifying existing sites and additional sites that might be added later; agreed that Sinyinza and NJW will join the PSS sampling team on their next trip to decide on whether the sampling should be modified and whether the new sites could suit both the SSS and the PSS groups.

(c) no success with mending the fine-focus control on the FBA Zeiss microscope.

(d) the development of phytoplankton studies to include population density estimation(i.e. in addition to the existing rankit - P.A.S.S. studies).

(d) PSS staff complement and the percentages of their time on this study.

(e) highlight the fact that as PSS co-ordinator I am always willing to receive any comments or queries regarding the Project - *via* telephone, facsimile or E-mail.

(f) literature including taxonomic keys.

Progressed the drafting of text on 'standing instructions' for P.A.S.S. studies.

The Mpulungu staff are concerned about the following:

(a) whether people such as myself will continue to visit the region after the official termination of the GEF project?
(b) the lack of literature on all aspects of their work

(c) the likelihood of visits of say three months to UK laboratories.

The latest situation regarding Mpulungu-based staff involvement in the PSS is as follows: Lawrence Mucosa and Isaac Zulu are employed full-time while the following are involved in the PSS for varying percentages of their time: Syapila (computing and data entry); Kaweme (general duties); Chimanga (data entry); Lukwesa (chemical analysis); Chomba (general duties); and Mr Mwape (Station Director) overall involvement.

Saturday 13th June: updated document ('PSS 1.doc) detailing field, laboratory and data handling analysis; presentation and interpretation. Discussions with Nikki Wiltshire on the maintenance of the existing routine activities (at Mpulungu, Nsumbu, Gombe and Kigoma) and new work on epilithic algae.

Sunday 14th June: finalised 'PSS1.doc' incorporating notes on phytoplankton ecology and the role of these organisms as indicators of physical conditions and chemical water quality.

Monday 15th June: 0900h depart from Mpulungu Fisheries station for Kasama for flight to Lusaka. In the event the plane was some three hours late. Arrived Lusaka *ca* 1930h. Booked in at 'Holiday Inn', Lusaka.

Tuesday 16th June: updated Shadreck Ngonsela (LTBP National Co-ordinator and co-ordinator along with Christopher Kashinga) on PSS project developments. Also discussed Christopher's future role in the Project.

Dr Tony Bailey-Watts (Co-ordinator, LTBP Pollution Special Study)
IFE Edinburgh Laboratory
25 September 1998