

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

Special Studies: Pollution of International Waters

Back- to - Office Report: Chris Foxall, University of East Anglia

Visit to Kigoma, Lake Tanganyika and Tropical Pesticides Research Institute (TPRI), Arusha, 28 November to 17 December 1997

1. Introduction

This back- to -office report is a summary of the activities undertaken, meetings attended and tasks accomplished during the visit, together with principal action points.

As detailed in the Terms of Reference, the principal tasks of the visit were as follows :

- to assess the progress of the water sampling and monitoring programme agreed with the TAFIRI laboratory personnel during the previous visit to Kigoma in September/ October 1997.
- to continue and extend the training programme of laboratory staff with particular reference to the chemical analysis of water samples.
- to assist Nikki Wiltshire (NW) to become familiar with the equipment in the TAFIRI laboratory and to run over the extended range of analytical methods with Mr Lyoba (EL) and NW for the various chemical parameters being determined.
- to participate with EL and NW in the analysis of the archived samples resulting from the water sampling monitoring programme that commenced at the end of the recent Sampling and Laboratory Methods Training Workshop held in Kigoma.
- to investigate the nature and extent of the oil pollution resulting from the operation of the TANESCO power station at Kigoma and to suggest practical ways of reducing the flow of oil into the lake.
- to visit TPRI, Arusha, with a view to setting up collaborative monitoring programmes on pesticide, heavy metal, and oil pollution.

2. Summary of Principal Activities

Friday 28 November

Fly to Dar es Salaam

Saturday 29 November

Project planning meetings with Andy Menz (AM), TBW and NW at Kilimanjaro Hotel

Sunday 30 November

Project planning meetings with TBW and NW.

Monday 1 December

Morning flight to Kigoma. Met up with Francis Chale (FC) at Dar airport. Meeting with TAFIRI laboratory staff in the afternoon.

Tuesday 2 December

Morning meeting (TBW, CF, FC and NW) with Mr Lyoba (EL), Mr Muhoza (SL), Edmund Kadula (EK), Ibrahim Katonda (IK) and Mr Kajelelo (MK) to discuss progress with sampling and fieldwork schedules since last visit. Encouraging to find that all water samples had been collected according to plan and that frozen samples safely stored in freezer. Some misunderstandings that had arisen over labelling of samples discussed and resolved. Laboratories found to be clean, well maintained and functioning (electricity supplies permitting). Mr. Lyoba and his staff are to be commended for this encouraging situation.

Afternoon: unpacking and setting up equipment brought out with us. Inspect further improvements (extra shelves on wall and in cupboards, bench in fume cupboard, mosquito netting on door and windows etc), to laboratory that were agreed with Kelly West (KW) at the end of last visit. Improvements successfully carried out and have significantly improved functionality of laboratory.

Wednesday 3 December

a.m.: work with EL, EK, and NW on alkalinity determinations, chlorophyll analyses, operation of spectrophotometer and analytical balances etc.

p.m.: further analytical work and meeting with TBW and KW regarding project progress at Kigoma. Issues discussed included TANESCO situation, staffing (present and future at TAFIRI and role \ responsibilities of NW in Kigoma. FC familiarising himself with nature and objectives of project from project reports.

Thursday 4 December

Most of laboratory staff on scheduled sampling visit to Gombe Stream National Park .
a.m.: EL and CF continue with analysis of samples for soluble reactive phosphorus.

p.m.: Continuation of analysis. Supervision of installation of new 4KV generator, which is now linked to mains circuits in both wet and dry labs.

Friday 5 December

Scheduled sampling and monitoring programme in Kigoma Bay . Discussion (TBW, CF and NC) on sample logging, handling and storage with laboratory staff. EL , CF and NC analyse water samples for chlorophyll a and soluble reactive silica.

Saturday 6 December

CF and EL work on methodology for measurement of total phosphorus in water samples.

Sunday 7 December

Free day.

Monday 8 December

a.m.: Meeting(TBW, CF, FC and NW) with laboratory staff to discuss and agree methods for interpretation and presentation of data. Rained heavily most of previous night and oil slick in bay off TAFIRI very noticeable. On -shore wind smelt very strongly of oil.

p.m.: Further laboratory work with EL, EK and NW on chlorophyll a, phosphorus, alkalinity and silica analysis.

Tuesday 9 December

Public holiday (Uhuru Day). EL and SM agreed to come in. Further analytical work in laboratory. Collection of near-shore water samples for determinations of soil concentrations.

Wednesday 10 December

a.m.: visit to TANESCO power station by KW, CF, FC and IK. We were shown around the plant and the associated interceptor tanks by the Plant Engineer, Mrs Chijendi. The principal sources of the oil leaking from the plant were very frankly pointed out to us by Mrs Chijendi and possible ways of improving the situation were discussed.

p.m.: meeting of KW, CF, and FC with Mr Mshanga the Regional Manager of TANESCO, Kigoma. Mr Mshanga confirmed the major sources of oil leaks from the plant and outlined TANESCO plans to deal with the situation. He pointed out that , at the present time, lack of finance was preventing the implementation of measures to control the oil losses from the plant. A full report on the TANESCO power station in Kigoma including suggested mitigation measures, is being prepared by CF and will be available shortly.

Meeting of KW, TBW and CF to review progress of PSS activities in Kigoma and anticipated work schedules in Mpulungu and Bujumbura. The possible involvement of Dr Chale in the project was discussed and it was agreed that he would be a substantial asset to the PSS programmes.

Thursday 11 December

Further analytical work in the laboratory in conjunction with EL and NW; collation of data; standing instructions for laboratory methods; issue of laboratory books to laboratory staff and discussions as to their use. Meeting (TBW, CF and NW) with laboratory staff to discuss and plan future sampling and analytical programme. Demonstration of Project Web Site by Jerod Clabaugh (JC) to TBW and CF.

Friday 12 December

a.m: travel to Dar es Salaam.

Saturday 13 December

a.m: fly to Arusha.

p.m.: writing reports and preparation for TPRI meeting.

Sunday 14 December

Free day

Monday 15 December

a.m: Meeting with Jonathan Ak'habuhaya (JA), Principal Research Scientist and Head of Pesticide Section at the Tropical Pesticide Research Institute (TPRI), Arusha. JA outlined the research structure of TPRI and indicated that direct government funding of TPRI was declining and that current research programmes are largely dependant upon international projects involving the Institute. Details of these programmes were discussed. JA conducted me on a comprehensive tour of the laboratories and conference facilities and introduced me to the laboratory staff. (Only three in evidence at the time of my visit). The possible involvement of TPRI with certain aspects of the PSS programme (namely pesticides, heavy metals etc) was discussed and on the basis of this discussion a detailed proposal is currently being prepared.

p.m.: Meeting with Dr Moshe, Director, TPRI and JA. Dr Moshe expressed his support for collaboration between the LTBP and TPRI and welcomed the possibility of a joint programme on pesticides, heavy metals etc. He also expressed his concern at the lack of communication between the National Coordinator (Tanzania) of LTBP and his Institute. It was agreed that JA should call into the Project Office next time he was in Dar in order to familiarise himself with project activities.

Overall the two meetings were very productive and it is anticipated that a collaborative programme on pesticides and heavy metals should be agreed in the early part of 1998.

Tuesday 16 December

a.m: return to Dar es Salaam

p.m.: meeting with TBW

Wednesday 17 December

Return to Norwich

Principal Action Points

- The extent and frequency of the oil pollution in Kigoma Bay observed during the present visit emphasised again the urgency of reducing the oil loss from TANESCO. The meetings held with TANESCO personnel were very constructive and it is *recommended that such meetings are planned at regular intervals. A detailed report on the TANESCO situation including suggested mitigation methods will be circulated shortly. (Action CF)*
- Water samples from Kigoma bay were collected by CF during the recent visit and are currently being analysed in the UK by field kit immunoassay techniques. If such relatively inexpensive analytical techniques prove sufficiently sensitive it is possible that such methods could be used to assess oil pollution levels on a wider lakewide basis. Such analyses are relatively simple to perform, do not require investment in expensive equipment and, as they could be carried out in the Lakeside laboratories, offer a potentially sustainable procedure for the long term monitoring technique of oil concentrations in the lake. *A separate report on the outcome of the preliminary immunoassay trials will be circulated as soon as possible. (Action CF)*
- It is of some concern that, despite the proximity of the Kigoma Town water supply intake to visible inflows of sewage and oil into the Lake, no data is, to our knowledge, available on the hydrodynamics of Kigoma Bay. *It is quite possible that, at least at some times of year, the integrity of the water supply may be at risk and it is strongly recommended that detailed measurements are made of the current characteristics in the Bay. In order to provide the spatial and temporal information required the programme would need to run for at least one year and possibly two. (Action : TBW, CF, KW)*
- Although the installation of the portable 4KV generator at TAFIRI in December improved the effectiveness of the laboratories considerably, a permanent and more

powerful electricity supply is needed for the laboratories to operate at their full potential. *It is recommended that the new diesel generator purchased be installed as soon as possible. (Action: KW)*

- As indicated earlier in this report, it is intended that the pesticide analysis programme be set up using TPRI as the lead institution. *A detailed draft proposal is currently being prepared and will be circulated for comment as soon as possible. (Action: CF)*

- Now that the laboratories at Kigoma and Mpulungu are operating well and producing data, the provision of simple science/education *mini-centres* at these locations would provide a key forum for the results of the local staff and other project personnel to be displayed and for links to be made to various sections of the respective local communities. *It is recommended that such mini-centres be set up at these two locations as soon as possible. It is anticipated that similar facilities in the Francophone countries would follow. A number of personnel from various sections of the project have expressed an interest in such centres. A draft proposal for circulation and comment is currently being prepared. (Action: CF)*

- The poor standard of the Project noticeboard outside TAFIRI was mentioned in my previous bto report. *The board continues to present a poor image of the Project and it is again recommended that it be replaced by a more attractive board which incorporates the project logo. (Action: KW)*

- A final, albeit more domestic point, concerns the standard of meals and accommodation experienced during the recent visit. The Kilimanjaro Hotel was shambolic, dirty and smelly. Breakfast could take up to an hour to get even the most rudimentary of meals. The accommodation and the food at the Railway Hotel at Kigoma had deteriorated significantly since our last visit.. Three of us (CF, Sue Daplyn and SBW) ended up with serious stomach complaints. In the case of CF this was identified by the Environmental Health Department in Norwich as being caused by *Campillobacterium sp.*, a virulent organism characteristic of poultry. *As it is difficult for project personnel to perform effectively when the accommodation and food facilities are so poor, it is recommended that the New Africa Hotel in Dar and the Aqua Lodge in Kigoma be used for any future visits. (Action: PCU)*

THE TANESCO POWER STATION

and

OIL POLLUTION IN KIGOMA BAY

Report by:

**Chris Foxall
School of Environmental Sciences
University of East Anglia
Norwich NR4 7TJ**

1. Background

From the earliest days of the LTBP in Kigoma, it has been evident that waste oil from the TANESCO Power station has been flowing into the lake near to TAFIRI. It is not uncommon for a substantial oil slick to form which begins at the shore just to the north of TAFIRI and extends southwards and westwards to include the shoreline below the prison and the headland on which the Hilltop restaurant is situated. The slick frequently extends up to 200 metres offshore.

In several areas immediately to the north of TAFIRI, there are pools of oil on the shore within 2 metres of the lake edge. These appear to be permanent features of the shoreline even during the periods of the year when rainfall is low. An inspection of the beach below these pools suggests that a section of the foreshore of at least 100 metres in length is saturated with oil and that this is acting as a continuous source of oil entering the lake.

During periods of heavy rain, the quantities of oil originating from the plant and its environs increases substantially and the resulting oil slick is particularly noticeable. On one day during the recent visit (Monday 8 December) heavy rain during the previous night resulted in a quantity of oil entering the lake that was sufficient to coat sampling equipment with a film of oil, made diving thoroughly unpleasant and indeed

dangerous (report from Catherine O' Reilly) and resulted in the on-shore wind smelling very strongly of oil throughout the day.

Such levels of pollution are likely to pose health risks to those bathing or swimming in the waters of the bay and may well have detrimental impacts on the organisms living in the affected areas. It is also important to note that the intake for the Kigoma Water supply is only a few hundred metres north of the point where the majority of the oil appears to enter the lake. To my knowledge no study of the direction and strength of the currents in Kigoma Bay has yet been carried out. It is therefore not possible at present to assess the risk of the town water supply being contaminated by oil from the TANESCO plant.

In view of the declared objectives of the LTBP not only to investigate the impact of pollution on the biodiversity of the lake but also to suggest appropriate pollution control strategies, a number of meetings have taken place in the last few months between LTBP personnel and the Regional manager of TANESCO, Mr Mshanga, to discuss potential short-term and long-term strategies to the problem in Kigoma. As part of such initiatives, permission was granted by Mr Mshanga for a fact-finding visit to the TANESCO plant on Wednesday December 10. Present were K. West, I Katonde, F. Chale and C Foxall. The group was shown around by Mrs Rosemary Chijendi, the plant engineer who was very helpful in providing details of the power station, its operation and the sources of the major oil leaks from the plant.

2. Sources of Oil Leaks

The TANESCO power station is nominally comprised of 7 diesel generators all of them manufactured by Stromberg of Finland. At the time of the visit, only 4 were in operation. The remainder were non-operational owing to lack of spare parts. According to Mrs Chijendi this is a fairly typical situation -in fact the last time that all 7 generators were functioning simultaneously was in 1993.

Fuel oil is supplied to the power station from the Kigoma oil depot by a road tanker owned by TANESCO. The oil is stored in 3 underground tanks situated near the main gate. The tanks have a combined capacity of 40 500 litres. Fuel and lubricating oil consumption is, on average, around 10 000 litres/day and 150 litres /day respectively. The fuel oil is pumped from the underground storage tanks near the gate into the header tanks from which the oil is supplied to the diesel generators.

The pump used for this transfer operation, located alongside the main hall of the power station, was identified by Mrs Chijendi as being the principal source of oil leaks from the plant. No spare pump is available and it is in more or less continuous use. Few opportunities therefore arise for the necessary maintenance and repairs. In order to collect the leaking oil, a large collector tray has been placed under the pump.

Judging by the extensive area surrounding the pump which is heavily contaminated by oil, this control measure would appear to be largely ineffective.

After the main oil pump described above, the next largest loss of oil from the plant itself emanates from the fuel pump systems of the generating sets themselves. At present no money is available to purchase the spare parts required.

A further source of oil loss results indirectly from the practice of using untreated lake water for cooling purposes. Lake water has a relatively high pH (9) and dissolved solids content and the use of such water results in the build-up of scale in the cooling water circuits and on the cylinder head gaskets. In the latter case, the build up of such deposits results in oil loss via the gaskets. In order to remove these deposits, the generators affected have to be shut down so that the gaskets can be removed, scraped clean and replaced. Apart from the amount of work and down-time involved, such operations inevitably result in further losses of oil from the plant. It is also worth noting that no water recycling system is in operation at the plant. The volume of cooling water used is thus quite substantial, all of which, contaminated or otherwise, is discharged from the power station. Once again lack of finance has prevented the construction of the planned water recycling facility.

At present at least some of the equipment overhaul and repairs are carried out in an area alongside the entrance driveway to the power station. Such maintenance work involves removing oil from various components using water jets. These operations were in progress during our visit and the resulting waste oil/water mixture was flowing down the driveway into the road.

3. Interceptor Tanks

These are designed to collect waste oil and other fluids from the power station and to enable the oil and water to be separated from each other and subsequently recycled or disposed of as appropriate.

There are two such tanks at TANESCO. The one furthest (approx. 50 metres) from the road is circular, is around 2.5 metres in diameter and is capped with concrete. The date of construction is uncertain, but was certainly installed prior to the arrival of Mrs Chijendi in 1989. The second interceptor tank, which is within 5 metres of the road, was constructed in 1990. This is rectangular in shape, is capped and is fitted with ventilator pipes. Both of these interceptor tanks are apparently full. No estimate of the volume of waste oil/water could be provided as the internal dimensions of the interceptors is not known.

In order to accommodate further quantities of waste oil, two *open* interceptor pits were dug in 1996. These are located near the original circular interceptor tank. Information on the precise depth of these pits was not available but Mrs Chijendi estimated that they were in excess of two metres. It is oil from these pits that is the most obvious source of oil pollution as, especially during the rains, the pits overflow and the resulting oil flows across the road and thence directly into the lake. In addition to the obvious potential for environmental damage, these pits represent a considerable hazard to human life as they are unfenced and are located close to a frequently used footpath.

4. Mitigation Measures

As a result of the various meetings held between TANESCO staff and LTBP personnel a number of measures to control the flow of oil from the plant have been identified. These can be divided into the following categories :

- immediate
- short term
- long term

(a) immediate measures

The most immediate priority is to prevent the open pits overflowing into the lake. Following a meeting between Mr Mshanga, Mr Chitamwebwa and Kelly West, the LTBP agreed to pay casual labour to manually remove some of the oil from the pits and return it to the storage tanks. This operation has already commenced. The earth bank on the downward slope side of the pits has also been raised somewhat but it is quite possible that heavy rain will again demolish the bank.

These measures are clearly unsustainable in the longer term however and , in any case, fail to address the considerable hazard that such open pits represent to the casual labour employed and to the public at large. It is also possible that underground seepage of oil from these pits may continue to contribute to the oil entering the lake.

(b) short term measures

During the discussions held with TANESCO staff , two relatively inexpensive courses of action were suggested that, if implemented, should significantly reduce the off-site migration of oil from the plant.

The first of these involves the purchase of a submersible pump that would be used to pump out the existing interceptor tanks. It was suggested that the contents of the interceptor tanks could be pumped into two presently unused header tanks to enable

the water and oil to separate out. It is quite possible that much of the oil layer might be able to be used in fuel oil in the generating plant. The unusable components would then need to be properly disposed of off-site. In this context, the possibility of using a site some 10 km from Kigoma for disposal of such wastes was discussed during the discussions held with Mr Mshanga. No visit to the site was possible due to lack of time, but Mr Mshanga expressed an interest in LTBP personnel visiting site in order to assess its suitability for such disposal activities.

The second measure would involve fitting the TANESCO road tanker with its own oil pump so that the fuel oil brought to the site could be pumped directly to the elevated fuel feeder tanks rather than be supplied to the underground storage tanks at the front of the power station. As has already been highlighted earlier in this report, one of the major sources of oil loss from the plant is the main fuel pump used to transfer the fuel oil from these underground tanks to the header tanks. Use of the tanker pump would thus obviate the need for using the main pump, at least until such time as it could be repaired.

(c) *Longer term measures*

Taking a somewhat longer term view, it would seem that considerable investment in equipment, maintenance and waste treatment facilities will be required to effect a substantial and permanent reduction in oil losses from the plant. This is likely to involve considerable expenditure and is probably outside the scope of the present project. It is suggested however that the LTBP could usefully alert other organisations and potential donors to the serious situation at the plant and thus catalyse activities to improve the environmental and commercial performance of the power station.

11 February 1998

