



BURNSIDE

Appendix C.1
Fisheries Report

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF THE BUJAGALI HYDROPOWER PROJECT (BHPP), UGANDA FISHERIES COMPONENT

The First Quarter Survey of the Aquatic System and
Fisheries of the Upper Victoria Nile, 6th – 13th April 2006

A Report Prepared For R.J. Burnside
International Limited

Prepared by:

National Fisheries Resources Research Institute (NAFIRRI)

P.O. Box 343, Jinja, Uganda

Tel: 256-43-120384

Fax: 256-43-120192

Email: firi@infocom.co.ug, firi@firi.go.ug, director@firi.go.ug

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Executive Summary

In pursuit of developing a 250MW hydropower plant on the Upper Victoria Nile in Uganda, the EIA recommends collection of baseline data prior, during and post plant construction. In 2000, AES Nilepower commissioned an Aquatic and Fisheries Survey of the Upper Victoria Nile to identify potential impacts upstream and downstream of the project site at Dumbbell Island, which was done by NAFIRRI (FIRRI at the time). The present survey assignment was conducted during April corresponding to the Second quarter of AES Nilepower Survey of 2000 and covered similar transects between Kalange (Upstream of the proposed site) and Namasagali (furthest site downstream of the proposed site). The four sampling sites were chosen considering the ease of sampling, transport logistics and ecological diversity. The studies were carried out under standard and acceptable methodologies for the assessment of aquatic system and included socio-economics, bilharzias and other disease vectors and sanitation which were not covered during AESNP Survey of 2000.

The first quarter report on Environmental, Social/Sanitation/Vectors and Impact Assessment (ESIA) undertaken during April 2006 by the National Fisheries Resources Research Institute (NAFIRRI) contracted by Burnside includes introductory chapter, field procedure, sampling protocol and data analysis and eleven chapters on:

- Water quality characteristics
- Algal biomass and species composition
- Aquatic macrophytes
- Micro-invertebrate fauna
- Macro-invertebrate surveys
- Fish species composition and relative abundance
- Biology and ecology of the fishes
- Fishery catch survey
- Bilharzias, other disease vectors and status of sanitation
- Socio-economics
- Discussion and conclusion

The present survey information is compared with the AES Nilepower second quarter survey both having been conducted in the rainy month of April.

Findings were:

Water quality characteristics

Conductivity patterns (2006) reduced progressively downstream while in 2000 it was relatively stable. $\text{NO}_3\text{-N}$ were higher in 2000 compared to 2006 survey while TP was higher in 2006 compared to 2000. Chl-a showed a progressive reduction in 2006 while oil and grease showed an increase at all transects. Less suspended solids were noted in 2006 at all transects compared to 2000. Along all the transects H_2S and C_2H_4 never

changed much at all the transects and these were not analysed in the April 2000 survey.

Algal biomass and species composition

Blue-green algae dominated the algal community in all transects with similar algal distribution and abundance patterns in both surveys.

Aquatic macrophytes

41 macrophyte species (2006) compared to 46 species were encountered. In 2006 however, transect 4 had four times more species in 2006 than in 2000 due to colonization as a result of lower water levels of a wider transect. Water hyacinth (*Eichhornia crasipes*) and Hippo grass (*Vossia cuspidata*) remained the same during the two compared quarters.

Micro-invertebrates

Similar longitudinal patterns, abundance and species richness were observed for the two surveys with more species being upstream and transects 1-3 dominated by copepoda.

Macro-invertebrates

Highest total benthic density dominated by mollusks was transect 1 at Kalange (April 2000) and at transect 3 (Kirindi) in 2006. Ephemeroptera (mayflies) and Tricoptera (Caddis fry) were less abundant (2000), probably due to reduced water levels and sampling in restricted habitats.

Fish species composition and relative abundance

The same keystone species (*Mormyrus kannume*, *Barbus altianalis*, *Lates niloticus*) were encountered both surveys. In April 2000, 21 species compared to 18 in April 2006 were noted; *M. kannume* dominated in 2000 while Haplochromines were more dominant in 2006 both in biomass and number.

Biology and ecology of the fishes

There were no major differences in the diet and ecology of keystone species in April 2006 compared to April 2000. Fecundity in almost all species (in 2000 and 2006) was not easy to determine as specimens with ripe eggs were not easily obtainable.

Fishery survey

No major changes in fishing effort (crafts) were recorded. The types in use (57% increase in Ssesse type, 39% decrease in dugout crafts) and increase in fishers (89 in

April 2000 to 128 in April 2006) this leading to increase in fish traders from 12 in 2000 to 47 in 2006. Target species remained the same and *Rastrineobola argentea* had the highest catch rate (300 kg boat⁻¹). Haplochromines and *R. argentea* were important in April 2006 commercial fishery. The main fishing gears remained the same so were the hook sizes in use. Monthly fish yield from the four transects increased from about 8,000 kg (April 2000) to 17,000 kg (April 2006) with a value of 4m and 12m Ug. Shs respectively.

Bilharzias, other disease vectors and status of sanitation

The baseline information on vector snails (spread of bilharzia) and non-vector snails showed that non-vector snails were more abundant than vector snails except at Namasagali (Transect 4). Of the two-vector snail genera encountered, *Biomphalaria* sp were more abundant at Kalange (Transect 1) and Kirindi (Transect 3) showing a high risk of *Schistosoma monsoni* than *Schistosoma haematobium* at these transects. Samples collected from a range of water users showed that 50% of the population were infested with *Schistosomiasis*. These were mainly the fishers, swimmers/bathing where there was the highest risk.

Feacal coliform contamination due to *Salmonella* and *Shigellosis* contamination was higher at the shallow human and water contact points than in deeper waters. All sites were far above acceptable limit of 5 colonies per 100 mls of water. Crabs collected during the survey did not have Simulim larvae that cause river blindness.

Socio-economic findings

The major economic activity at the four sampled sites is agriculture supplemented by subsistence fishing. The fish species harvested include Nile perch (*Lates niloticus*), Nile tilapia (*oreochromis niloticus*), *Barbus* - Semutundu, *Mormyrus* - Kasulu and *Barbus* sp – Kisinja. Beach Management Units are not fully established.

The fishers on average earns US\$ 5.5-16 per week but only 9.8% of the fishers had the culture of saving.

89% of the fishers own fishing assets while the rest rent these inputs that include multifilament gill nets, hooks, oars and boats.

However, the fishers experience fewer fishing areas leading to reduced fish catch and income from fishing.

1. Background to the Baseline Aquatic Monitoring and Fisheries Survey of the Upper Victoria Nile

1.1. Introduction

Burnside Bujagali Hydropower Project is to develop a 250 MW hydroelectric power plant on the River Nile. The project site is located at Dumbbell Island near the source of the Victoria Nile in Uganda and is about 2.5 km downstream from Bujagali falls (Fig. 2.1a). The ESIA is a follow-up of AESNP EIA conducted in 2000 but has been overtaken by events since then. The ESIA has been conducted in conformity with the methodologies used during AESNP survey.

An Environmental Impact Assessment (EIA) report together with the Environmental Action Plan and Monitoring Plan was submitted by AESNP to Government of Uganda. The EIA recommended collection of baseline water quality and aquatic ecology data, which included the following:

- Hydrology
- Water quality
- Indicators of productivity of lower trophic levels (invertebrates) including critical or keystone species
- Fish and fish population
- Human uses of the aquatic ecosystem particularly as a source of food

The Burnside Bujagali Hydropower Project in addition to the above has included fisheries Socio economics and disease vectors/sanitation. EASNP commissioned FIRRI in 2000 to undertake the required data collection for the pre-construction phase and as a follow up once more, the Burnside Bujagali Hydropower Project has commissioned NAFIRRI.

NAFIRRI is one of the institutes of NARO charged with the responsibility to promote, undertake and coordinate applied research in fisheries, fish production systems and the environment, aquaculture, fisheries, socio-economics while conserving the natural resource base in Uganda. The Institute is also responsible for packaging and transferring research results to users of research information.

The applied research assists among other issues to ensure,

- Increased supply of adequate and balanced food,
- Maintenance and sustainability of fish production, water quality and a healthy aquatic environment,
- Sustained supply of raw material for local industries,
- Stimulation of production for export diversification,
- improvement in rural incomes and quality of life,
- Conservation of the natural resource base for sustainable development,

- The task of NAFIRRI, therefore, is to contribute to modernisation of the fishery sector whilst ensuring sustainable management of natural resources is incorporated into developments.

1.2. Objectives

A major objective of the ESIA study is to carry out surveys at three monthly intervals over one year prior to commencement, during and after construction of the BHPP with emphasis on the following aspects:

- To study an area large enough as to encompass significant impacts anticipated both upstream and downstream of the site at Dumbbell island
- To monitor hydrological water quality determinants
- To carry out algal species composition
- Determine macrophyte composition and distribution
- To carry out invertebrate surveys
- To study the biology of fishes and food webs
- To carry out fish stock and fish catch surveys
- To carry out fisheries socio-economic surveys
- To carry out sanitation/vector studies.

The purpose of this present study therefore is to provide and update the AES Nile Power EIA baseline information on the ecology of the river ecosystem prior to the construction of the dam. The study is intended to provide a basis for evaluating the impact of the project on the river environment, the biological resources associated with it and fisheries socio-economics and the vector/sanitation status.

This report presents the findings of the first sampling regime which was conducted between the dates of 6th – 13th April 2006 and compared with the AESNP Environmental Impact Assessment findings of the second quarter carried out during 5th – 14th April 2000.

CHAPTER 2

2.0. General Methodology and Data Collection

2.1. Materials and Methods

The selected section of the Victoria Nile lies between Kalange/Makwanzi (GPS 36N 0516569, UTM 0054358) to Namasagali/Bunyamira (GPS 36N 049400, UTM 0112000). Kalange/Makwanzi was recognized as the main upstream site and three others downstream of the project site were with increasing distance from Dumbbell Island: Buyala, Kibubamutwe, Kirindi/Namasagali/Bunyamira (Fig.2.1a). The sections of the Victoria Nile in which these sites lie is characterized by rapids, rocky outcrops and river bends. However, such sections merge into slow flowing water zones downstream of numerous islands.

The hinterland along the banks of the study area has been transformed by human activity from the originally wooded savannah landscapes to one dominated by smallholdings of a variety of crops. Perennial crops especially coffee and bananas and annual crops such as maize presently cover the banks and islands. In the more northerly downstream sections, the banks still retain a more natural cover of the original vegetation and a wider flood plain.

For purposes of the survey, four sites were selected. Transects at these sites were recognized according to accessible locations on opposite sides of the river (Table 2.1).

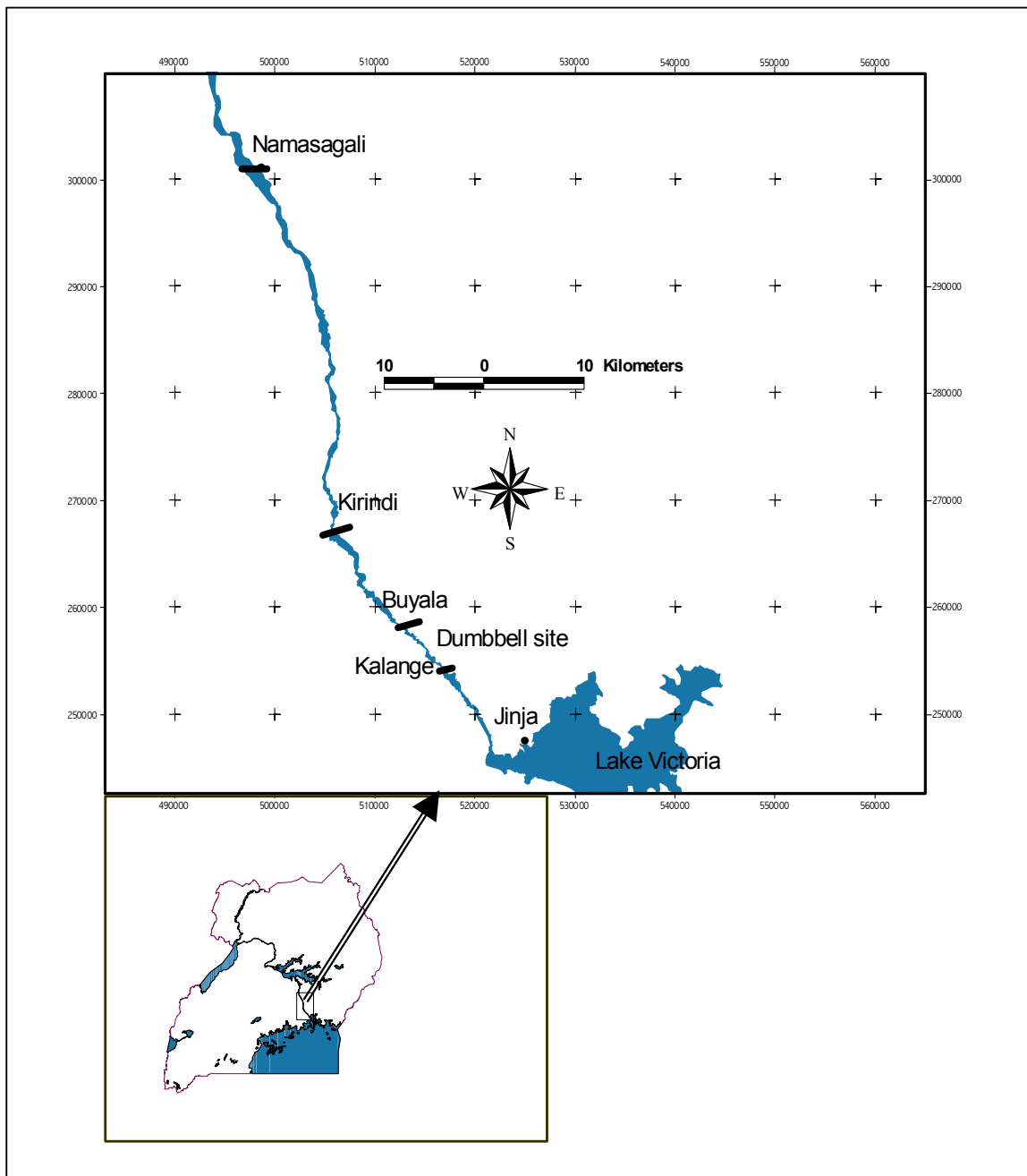


Fig. 2.1a. Location of Project site at Dumbbell Island and the four sampled transects on the Upper Victoria Nile - Uganda

Table 2.1. The distribution of sampled transects and sites along the Victoria Nile

Transect	Location in relation to Dumbbell Island	Sampling base on eastern bank	Sampling base on western bank	Associated villages
1	Upstream GPS 36N 0516569 UTM 0054358	Kalange	Makwanzi	Kikonko Kunjaba Makwanzi Is.
2	Downstream GPS36N 0514575 UTM 0056409	Buyala	Kibubamutwe	Naminy Kisadha Ofwono Zaire Mugalya Kisoga
3	Downstream GPS 36N 0506200 UTM 0075800	Nankandulo	Kirindi	Matumu Kisoga A, B, C Damba
4	Downstream GPS 36N 0494000 UTM 0112000	Karawe Namasagali	- Bunyamira	Kasanga Kibuye Sajjabi

2.2. Identification of Transects along Victoria Nile

The study transects were identified by a team of FIRRI scientists (2000) together with the representatives of AESNP and WS Atkins International Ltd and revisited before the present survey was conducted. The criteria to identify the sampling transects were based on:

- Accessibility on either side of the bank
- Fishing activities in the transect
- Proximity upstream or downstream of the proposed hydro-electric power site at Dumbbell Island
- Transect that covers a wide range of habitats
- Ease to sample aspects of the project objectives
- Transects chosen to be representative of the upper Victoria Nile as a whole

The transects identified (Fig 2.1b) and agreed upon by the two parties were:

Transect 1. Kalange/Makwanzi (36N 0516559, UTM 0054358)

Six km upstream of the proposed hydroelectric power station at Dumbbell. This transect lies downstream of the Bujagali falls. Five islands occur in the transect. The east bank is more gently sloping towards the river and more extensively cultivated than the west bank. Along the river margins *Vossia cuspidata* is the dominant macrophyte occurring in 5 to 15 m wide strips. The tree cover on islands was composed of *Tremor orientalis* and *Ficus* species. The transect was chosen because it had plenty of islands which could shelter more fish and provide more presence of diverse communities.

Transect 2. Buyala/Kibubamutwe (36N 0514575, UTM 0056409)

1km downstream of the proposed hydroelectric power station at Dumbbell Island. This zone is characterized by steep banks on both sides of the river channel. There are rocky reaches and the shoreline for the most part was free of stable vegetation cover. At Buyala/Kibubamutwe, several islands interrupt the flow of the river and create some gentle water flow in restricted zones. The transect was chosen because of its characteristic steep banks on both sides of the river.

Transect 3. Kirindi/Matumu (36N 0506200, UTM 0075800)

24 km downstream of the proposed hydroelectric power station at Dumbbell Island. This site was approached from the more gently sloping west bank at Kirindi. The river channel here is interrupted by a series of islands in an otherwise fast current. At the river margins, the main plant communities were associated with *Vossia cuspidata* and *Phragmites mauritianus*. Beyond the river margins, the land on both sides of the channel was extensively cultivated. The transect sites were selected because they were intensively cultivated near the banks

Transect 4. The furthest downstream transect was located at Namasagali/Bunyamira (36N 0494000, UTM 0112000)

65km downstream of Dumbbell Island. This is the most down-stream site of the survey area and is located at Namasagali/Bunyamira. In comparison to the upstream sites, the river channel here is wider, about 1.5 km and characterized by a more gentle flow. The channel is also associated with a narrow but more defined flood plain at its margins. Both banks are fringed by extensive *Cyperus papyrus* swamp. The river shoreline had frequent patches of *Eichhornia crassipes* and other floating water plants. The transect was chosen because of the gentle wide flowing river.

The detailed locations of the four sampled transects and associated villages are shown in Figure 2.1b.

2.3. Hydrology

Hydrological information is expected to be obtained from DWD and in the form of direct data by Burnside.

2.4. Sampling

Sampling was conducted between the period of 6th – 13th April 2006. The weather for the sampling period was wet.

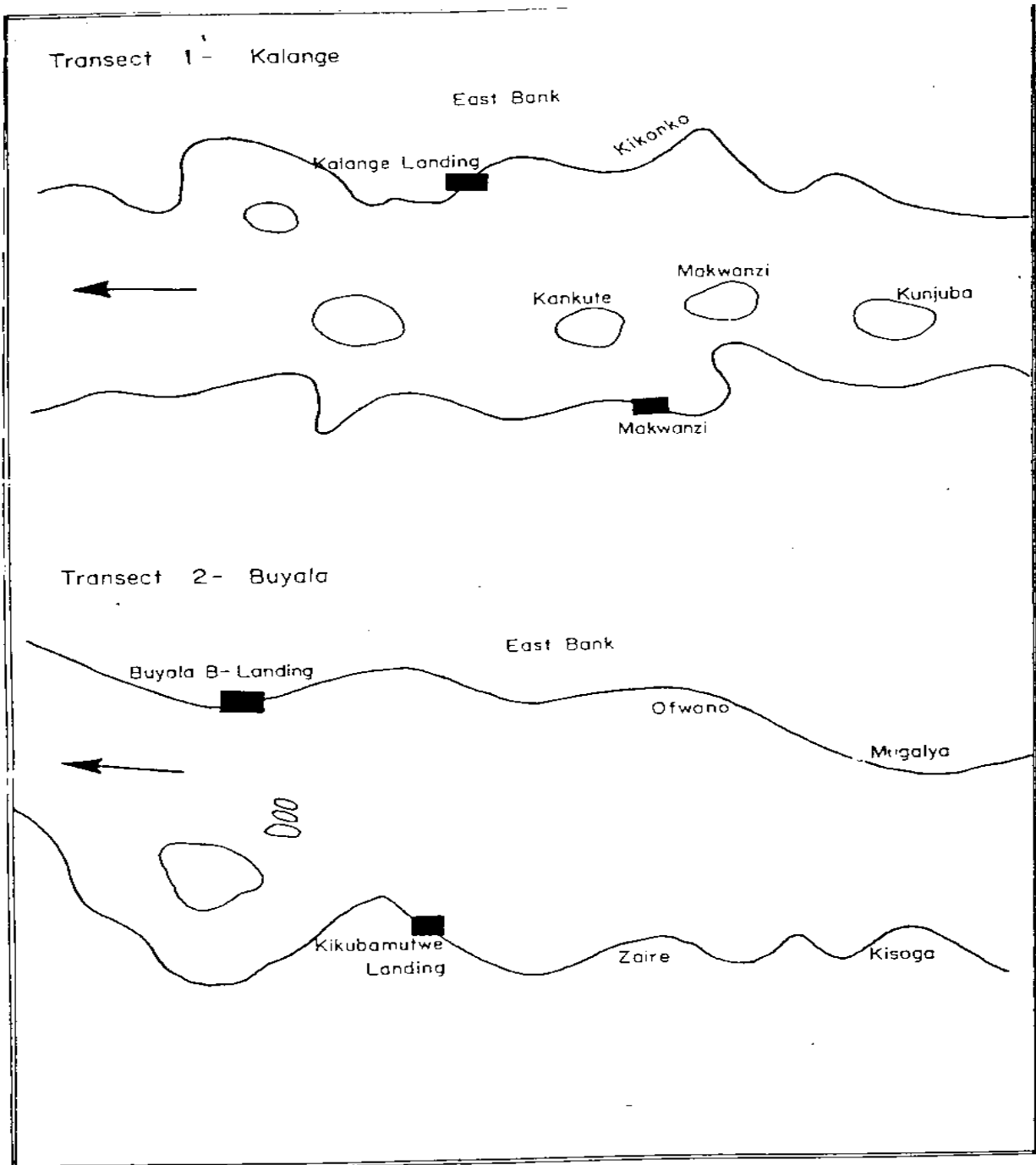
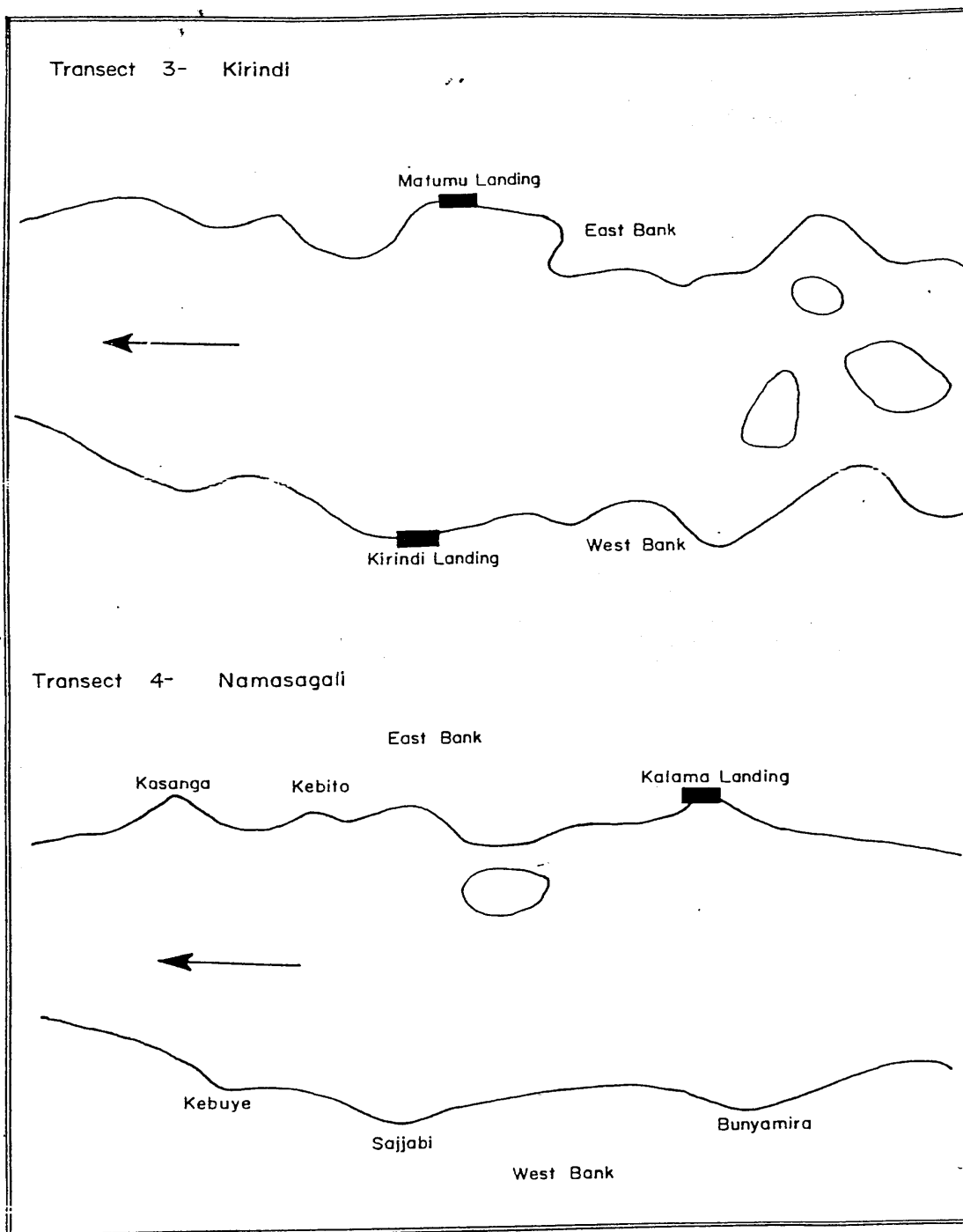


Fig. 2.1b. A description of the sampled transects (Transect 1 = Kalange; Transect 2 = Buyala; Transect 3 = Kirindi; Transect 4 = Namasagali) and associated locations on the Upper Victoria Nile.



CHAPTER 3

3.0. Water Quality Characteristics

3.1. Background

A hydroelectric power dam is to be constructed at the Bujagali waterfalls along the Upper Victoria Nile. As part of an Environment Impact Assessment, a survey was conducted to collect information on the status of water quality. Data was collected on a range of physico-chemical parameters namely total suspended solids (TSS), temperature, dissolved oxygen, conductivity, water transparency, pH, various species of nitrogen and phosphorus, silica, methane, hydrogen sulphide, oil and grease, in addition to chlorophyll-a. This data was then compared with that collected at the same transects during the same period i.e. April 2000. This particular survey of April 2006 was carried out during the onset of the first rains in the year.

3.2. Materials and Methods

Four transects sampled along the upper Victoria Nile were at Kalange, Buyala, Kirindi and Namasagali. Temperature ($^{\circ}\text{C}$), dissolved oxygen (mg L^{-1}), conductivity ($\mu\text{S cm}^{-1}$) and pH were measured in situ using Orion portable meters. Water transparency was measured in meters (m) in the shade of the boat using a 25 cm diameter white disc at all sites during sample collection. A 3 L van dorn water sampler was used to draw water samples for analysis of nutrients, oil and grease. Samples for nutrient analysis were immediately kept in a cool box stocked with ice to reduce deterioration of perishable nutrients. Unless otherwise specified, most of the analyses were done following standard methods for the examination of water (Greenberg *et al*, 1992). Water samples for dissolved nutrients were filtered within four hours of collection and analyzed immediately. Water samples for oil and grease were put in glass bottles and those for methane and hydrogen sulphide in plastic bottles. All samples were kept on ice in a cool box and delivered to the laboratory for analysis the same day. The nutrients (i.e. ammonium nitrogen ($\text{NH}_3\text{-N}$), nitrite-nitrogen ($\text{NO}_2\text{-N}$), nitrate-nitrogen ($\text{NO}_3\text{-N}$), total nitrogen (TN), soluble reactive phosphorus (SRP), total dissolved phosphate (TDP), total phosphate (TP) and silica (SRSi)) were determined as described in Stainton *et al*. (1997).

Analyses of water for suspended solids were determined by weight difference. Here, the initial weight of an oven-dried filter paper (Whatman GFC filters) was obtained before using it to filter a known volume of water. After the filtration, the filter papers were then dried for 1 hour at 105°C before reweighing. Water samples for oil and grease were preserved using hydrochloric acid whereas those for methane and hydrogen sulphide were kept at low temperature under ice. These had to be delivered to the laboratory in Kampala the same day in order to meet the critical holding time of the gaseous state.

Analysis was carried out by the National Water and Sewerage Corporation (NWSC) Laboratory using the partio-gravimetric method as described in Greenberg *et. al.* (1992). Chlorophyll a was determined by the standard spectrophotometric method (Greenberg *et al*, 1992).

3.3 Results

3.3.1. Physical parameters

Physico-chemical and biological parameters are given in Tables 3.1 and 3.2. Electrical conductance of the water in April 2006 ranged between 78.7 and 102.9 μScm^{-1} , with the lowest mean (80 μScm^{-1}) at Buyala and highest (102.5 μScm^{-1}) at Kalange, both of which are upstream transects. Variability in electrical conductivity did not however, differ greatly from previous data of 2000 (Table 3.2). Dissolved oxygen ranged between 4.0 and 7.0 mg L^{-1} , with the lowest mean (4.2 mg L^{-1}) at Kalange and highest mean (6.5 mg L^{-1}) at Kirindi, but with minimal variation. It was noted that dissolved oxygen concentration tended to increase downstream. Comparison of data for April 2006 and that of April 2000 indicated higher mean concentrations of dissolved oxygen during the latter period (Table 3.2). Mean water temperatures varied between 26.4 °C at Buyala and 27.0 °C at Kalange and Kirindi during 2006 survey. A similar trend was noted for the 2000 survey, with temperature ranging between 26.3 °C at Buyala and 26.6 °C at Kirindi. The pH ranged between 6.9 and 7.7 for the 2006 data, with most of the figures centering around circumneutral. The 2000 data however, showed a wider range (5.7 to 8.9). Mean secchi depth during the 2006 survey decreased steadily downstream while the opposite was generally true for the 2000 survey (Table 3.2). During the two surveys, suspended solids were highest at Kirindi and lowest at Namasagali. At Kirindi, mean suspended solids were 2,500 $\mu\text{g L}^{-1}$ in 2006 and 3,250 $\mu\text{g L}^{-1}$ in 2000. At Namasagali, the mean suspended solids were 1,500 $\mu\text{g L}^{-1}$ in 2006 and 818 $\mu\text{g L}^{-1}$ in 2000 (Table 3.2).

Table 3.1. Comparison in the ranges of physico chemical parameters at the four sampling stations of the Upper Victoria Nile

Variables	2006				2001			
	Kalange	Buyala	Kirindi	Namasagali	Kalange	Buyala	Kirindi	Namasagali
Cond. (μScm^{-1})	102.1 - 102.9	78.7 - 98.2	79.8 - 80.2	81.6 - 88.1	96.0 - 101.0	95.0 - 100.0	98.0 - 101.0	96.0 - 102.0
DO (mg/L)	4.0 - 4.4	6.2 - 6.4	6.0 - 7.0	6.0 - 6.2	4.1 - 10.2	6.7 - 8.3	6.1 - 10.7	5.4 - 8.3
Temp. (C)	26.4 - 27.0	26.3 - 26.5	26.7 - 26.8	26.5	25.3 - 26.8	26.0 - 26.7	26.4 - 26.7	25.3 - 26.6
pH	6.9 - 7.1	7.2 - 7.7	6.93 - 7.6	6.86 - 7.29	5.68 - 7.72	6.75 - 8.28	5.64 - 8.86	6.58 - 7.87
SD (m)	1.8 - 2.0	1.6 - 1.9		1.0 - 1.6	0.95 - 2.16	1.52 - 1.97	1.23 - 1.96	1.22 - 2.9
SS ($\mu\text{g L}^{-1}$)	0.0 - 3,000	0.0 - 3,000	0.0 - 4,000	0.0 - 2,000	400 - 1,800	500 - 1,400	900 - 2,200	200 - 1,300
NH ₄ -N ($\mu\text{g/L}$)	3.97 - 96	15.48 - 57.65	2.03 - 20.69	0 - 0.46	0.0 - 16.81	0.0 - 18.79	0.0 - 13.84	0.0 - 26.21
NO ₂ -N ($\mu\text{g/L}$)	8.0 - 9.3	8.0 - 9.3	8.4 - 10.2	8.9 - 10.2	0.2 - 7.07	0.0 - 3.45	0.56 - 2.01	0.0 - 1.64
NO ₃ -N ($\mu\text{g/L}$)	11.6 - 13.7	11.1 - 13.7	11.1 - 14.3	11.6 - 14.8	0.0 - 33.45	52.9 - 83.5	150.62 - 158.5	145.1 - 251.1
Tot-N ($\mu\text{g/L}$)	877.8 - 1655.6	766.7 - 544.4	877.8 - 1322.2	1211.1 - 2100	388.23 - 834.72	596.6 - 864.49	864.9 - 1013.32	N/A
Tot-P ($\mu\text{g/L}$)	78.7 - 145.3	65.3 - 132	105.3 - 125.3	92.0 - 152.0	5.81 - 161.77	63.36 - 83.79	67.08 - 80.08	59.65 - 76.36
SRP ($\mu\text{g/L}$)	13.2 - 23.2	13.2 - 24.8	23.2 - 29.9	14.8 - 24.8	0.0 - 5.81	0.2 - 18.8	7.66 - 37.57	5.81 - 24.37
TDP ($\mu\text{g/L}$)	18.33 - 27.22	25.0 - 33.89	25.0 - 33.89	23.89 - 31.67	0.0 - 3.95	0.0 - 5.81	13.23 - 24.35	16.95 - 31.80
Chl-a ($\mu\text{g/L}$)	0.0 - 7.0	2.1 - 6.3	0.0 - 4.2	2.1 - 2.8	22.9 - 53.5	18.77 - 25.02	8.34 - 24.3	1.39 - 63.94
Oil (mg/L)	0.1 - 3.9	0.1 - 5.3	0.4 - 1.4	11.3 - 12.50	0.13 - 0.29	0.21 - 0.27	0.22 - 0.63	0.23 - 0.66
H ₂ S (mg/L)	0.064 - 0.074	0.053 - 0.064	0.064 - 0.074	0.035 - 0.063	0	0	0	0
C ₂ H ₂ (mg/L)	0.015 - 0.017	0.012 - 0.015	0.015 - 0.017	0.008 - 0.012	0	0	0	0
SRSi ($\mu\text{g/L}$)	237.2 - 372.2	167.2 - 395.5	260.5 - 677.2	222.2 - 421.56	167.1 - 269.5	198.5 - 279.5	216.7 - 224.7	219.97 - 421.56

Table 3.2. Comparison in the mean values of both the nutrients and physico chemical parameters at the four sampling stations of the Upper Victoria Nile

Variables	2006				2001			
	Kalange	Buyala	Kirindi	Namasagali	Kalange	Buyala	Kirindi	Namasagali
Cond. (μScm^{-1})	102.5	88.5	80	84.8	97.8	97.2	99.5	97.2
DO (mg/L)	4.2	6.3	6.5	6.1	7.38	7.47	8.2	7.16
Temp. (C)	26.7	26.4	26.7	26.5	26.39	26.33	26.58	26.11
pH	7	7.4	7.2	7	7.36	7.81	7.1	7.36
SD (m)	1.9	1.7		1.3	1.27	1.76	1.6	2.46
SS ($\mu\text{g L}^{-1}$)	2,000	2,000	2,500	1,500	2,400	1,333.3	3,250	818.28
NH ₄ -N ($\mu\text{g/L}$)	42.26	29.45	8.62	0.46	1.26	6.77	3.76	5.85
NO ₂ -N ($\mu\text{g/L}$)	8.7	8.7	9	9.3	1.83	1.7	1.21	1.02
NO ₃ -N ($\mu\text{g/L}$)	12.5	12.6	12.7	12.9	8.68	66.05	154.14	203.73
Tot-N ($\mu\text{g/L}$)	1174	1192.5	1127.7	1544.4	585.15	699.12	574.27	868.74
Tot-P ($\mu\text{g/L}$)	108.6	100.8	118.6	118.6	64.38	71.35	85.27	74.04
SRP ($\mu\text{g/L}$)	19	19.2	27.1	21.2	0.29	4.23	15.46	15.09
TDP ($\mu\text{g/L}$)	23.1	28.3	30.2	27.4	64.38	71.35	85.27	74.04
Chl-a ($\mu\text{g/L}$)	3.7	4	3.4	2.4	26.86	21.34	8.48	14.73
Oil (mg/L)	6	8.9	4.7	11.7	0.21	0.24	0.35	0.5
H ₂ S (mg/L)	0.07	0.06	0.07	0.043	0	0	0	0
C ₂ H ₂ (mg/L)	0.016	0.014	0.016	0.01	0	0	0	0
SRSi ($\mu\text{g/L}$)	319.9	309.4	443.6	494.3	236.57	219.8	243.43	296.53

3.3.2 Nutrients (NH₄-N, NO₂-N, NO₃-N, TN, Tot P, SRP, and SRSi) and pollutants (Oil, grease, H₂S and C₂H₂)

At the Kalange, Buyala and Kirindi transects, the mean concentration of mean ammonium-nitrogen (NH₄-N) was generally higher in 2006 than in 2000. Additionally, NH₄-N showed a clearly decreasing trend downstream in 2006 while there was no clear pattern during the 2000 survey (Table 3.2). In Namasagali at all sampling points, very low concentrations of NO₄-H were detected. Along all transects, mean nitrite–nitrogen (NO₂-N) concentration was higher during the 2006 compared to that in 2000 (Table 3.2). While the concentration of NO₃-N was lower at all transects during the 2006 than the 2000 surveys, there was a general increasing trend of this nitrogen species along the stream flow (Table 3.2). Also noted was the higher concentration of TN during the 2006 than the 2000 survey. Low algal biomass (Chl-a) was recorded during the 2006 than the 2000 survey, and during both sampling events, there was no clear pattern along the stream flow.

Although the concentration of Total Dissolved Phosphorus (TDP) showed a generally increasing trend in the downstream direction, mean concentrations were lower (range of 23.1 to 30.2 µg L⁻¹) in 2006 than in 2000 (64.3 to 85.2 µg L⁻¹). However, concentrations of Total Phosphorus (TP) and Soluble Reactive Phosphorus (SRP) increased along the stream flow for both sampling events. Additionally, higher concentrations of TP and SRP were recorded during 2006 compared to the 2000 survey. Higher concentrations of silica were recorded during the 2006 than the 2000 survey, with concentrations generally increasing along the stream flow.

Data on grease and oil in addition to H₂S and C₂H₄ are given in Table 3.3. The concentration of oil and grease was higher in the 2006 samples than in those of 2000 by more than five fold. In the 2000 data, oil concentration increased in the downstream trend but no definite trend was noted in the 2006 data although the lower most transect (i.e. Namasagali) had the highest concentration. It was not possible to compare data on H₂S and C₂H₂ since these parameters were not assessed during the 2000 survey.

Table 3.3: Comparison in the mean values of oil and grease, hydrogen sulfide and methane at the four transects of the Upper Victoria Nile. (nd = not done).

	Year	Transects			
		Kalange	Buyala	Kirindi	Namasagali
Oil and grease (mg/l)	2006	6	8.9	4.7	11.7
	2000	0.21	0.24	0.35	0.5
H ₂ S (mg/l)	2006	0.07	0.06	0.07	0.04
	2000	nd	nd	nd	nd
C ₂ H ₄ (mg/l)	2006	0.016	0.014	0.016	0.01
	2000	nd	nd	nd	nd

3.4. Discussion

The decreasing trend in the mean electrical conductance along the river could be attributed to reduction in the amount of rapids thus leading to settling of adsorbed ions on various particles in the water. However the range in conductivity values reflected the normal conductivity ranges of Lake Victoria waters.

The concentration of dissolved oxygen did not vary much among the four transects. However, dissolved oxygen increased in the downstream direction and could have been partly attributed to input from the atmosphere as a result of turbulence. In addition, as the water became calmer (reduced currents) along the stream flow, it was likely that the role of algae through photosynthesis became more important in recharging the system with oxygen. The higher algal biomass in 2000 could easily be related to the higher dissolved oxygen concentration in the water column compared to that determined during the 2006 survey. The low algal biomass (Chl-a) resulting into low primary production and productivity, is thought to have largely accounted for the low oxygen concentrations during April 2006.

Although some slight variations were noted, temperatures were generally higher than normal at all transects. It is likely that with the reduced water volume in the channel, the water column was receiving excess solar energy during the day thus leading to fairly high water temperatures. This could be the case since light penetration through the water column was down to the streambed at most sampling stations.

The wide range in pH in 2000 was probably due to the higher algal biomass at that time compared to that of 2006 bearing in mind the influence of algal photosynthesis on pH. The difference in secchi depth could be attributed in part to differences in the amount of suspended solids flowing downstream from Kalange as a result of landscape erosion by the fast flowing stream waters along the less vegetated river banks. Several stretches of the adjacent banks were devoid of natural vegetation due to clearing to give way to farmlands particularly crops. It was observed in this context that some slopes were so steep ($> 45^\circ$) that they were prone to severe erosion even with minimal rain events. Reduction in suspended solids along the stream flow could be a result of reduced stream currents thus allowing ample time for settling of particles.

The higher concentration of $\text{NH}_4\text{-N}$ in the 2006 compared to that during the 2000 survey was probably an indication of a relatively degraded or deteriorating environment. This could be supported by the high concentrations of $\text{NO}_2\text{-N}$ whose presence could imply the inability of the system to oxidize $\text{NO}_2\text{-N}$ to $\text{NO}_3\text{-N}$. The decreasing trend in the concentration of $\text{NH}_4\text{-N}$ downstream could be attributed to either loss through volatilization into the atmosphere or conversion to $\text{NO}_2\text{-N}$ or uptake by microbes. In addition, the decreasing trend in the concentration of $\text{NO}_3\text{-N}$ could also be attributed to the degrading environment resulting into rapid denitrification, or rapid biological uptake e.g. by algae and other microbes. Input of nutrients into the river through landscape erosion could be one of the major contributing factors to increased concentrations of

nitrogen, phosphorus and silica in the water column compared to what was noted in 2000.

The high levels of oil and grease detected in April 2006 compared to 2000 was probably due to increased activities in the upstream reaches. Some of these activities could be increase use of outboard engines on the lake, tourism activities on the river, car washing or small spillages from the new dam. However, since there is no data on these activities, it is difficult to justify this statement. The higher concentration of oil and grease downstream at Namasagali could be a result of accumulation. Detection of some hydrogen sulphide (H_2S) and methane (C_2H_2) were evidence that the environment was relatively degraded. It is however, not possible to compare with the situation in the 2000 survey since these two parameters (H_2S and C_2H_2) were not determined.

3.5.1 Conclusions

Although some parameters such as electrical conductance and temperature did not show much variance during the two survey periods, a relative shift in most of the water quality parameters was noted. The noted shifts were reduced dissolved oxygen coupled with a reduction in algal biomass. Others included an increase in the amount of suspended solids, increase in nutrients (N, P & Si), and increase in the amount of oil and grease. In addition, detection of hydrogen sulphide, methane, ammonium-nitrogen and nitrite-nitrogen were indications of a deteriorating water environment. The results presented in this report are preliminary hence need more data to enable detailed analysis and interpretation in order to come up with sound scientific recommendations.

CHAPTER 4

4.0. Algal Biomass and Species Composition

4.1. Introduction

Algae are major primary producers in aquatic systems by harnessing solar energy in the presence of chlorophyll and carbondioxide, form carbohydrates that can then be tapped directly by primary consumers or indirectly by secondary consumers. This process, sometimes referred to as photosynthesis, also aerates aquatic systems with oxygen as its by-product, thus making such systems habitable to a range of aquatic organisms including fish. Algae is also an important food in aquatic food webs hence sustainability of this resource is crucial to proper management. Changes in the water environment will alter the composition and abundance of the algal communities and may lead to changes in fish species abundance and species composition. A survey of algal communities of the Upper Victoria Nile was carried out between 6-13th April 2006 in four transects (1- Kalange-Makwanzi, -2 Buyala-Kikubamutwe, 3 -Kirindi-Matumu, and 4- Namasagali-Bunyamira) along the river to determine the species composition, distribution and biomass (Chlorophyll-a).

4.2. Materials and methods

Water samples from the four transects along the Nile were taken using a van dorn sampler. Lugols solution was used as preservative immediately after sampling. Algal biomass as chlorophyll-a was determined by filtering water through a 0.45µm pore size GF/C filter papers and using methanol as an extract (Stainton, 1977); FIRRI lab manual 1996).

In the laboratory 2 mls of the sample was put in Sedgewick counting chamber and allowed to settle for three hours. Algal composition was determined using an inverted microscope at 400X magnification.

4.3. Results

Five major taxonomic groups of algae (Blue-green, Diatoms, Chlorophyta, Cryptophyta and Euglenophyta) constituted the algal community in the four sampled transects along the Upper Victoria Nile (Table 4.1). The blue-green algae were dominant at all transects with Kirindi exhibiting the highest percentage while the green algae and the diatoms were consistently low (Table 4.1). The blue-green algae of the genera *Anabaena*, *Aphanocapsa*, *Merismopedia*, *Planktolyngbya* and the green algae of the genera *Ankistrodesmus*, *Closterium* and *Pediastrum* occurred in all the transects. The species number increased progressively from the previous sampling of 2000 with Namasagali

transect recording the highest number of species (50) compared to the other three transects (Table 4.2).

4.4. Discussion

The algal taxonomic composition was similar to that of lake Victoria and was comparable to the previous AESNP survey of 2000 which was carried out in the same month. Blue green algae dominated in all the transects but there was no significant difference in the species composition with in the transects in this group. The dominance of blue green algae at all sites may be an indication of declining water quality, resulting from nutrient loads that could be coming from the extensive agricultural activities in the sub-catchments along the Nile. The occurrence of nitrogen fixing algae *Anabaena* in all the sites could be an indication of a system that has already started suffering from nitrogen deficiency and this is likely to affect the fishery of the river.

4.5. Conclusion

Five major taxonomic groups of algae (Blue green, Diatoms, Chlorophyta, Cryptophyta and Euglenophyta) constituted the algal community of the Upper Victoria Nile with the blue-green algae of the genera *Anabaena*, *Aphanocapsa*, *Merismopedia*, *Planktolyngbya* dominating in all the transects

The continued influx of nutrients into the river from the catchment may have consequences for algal species composition, which in turn could affect the structure and composition of higher trophic levels

Table 4.1. Numerical abundance (%) of the major algal taxonomic groups in the four transects

Transect	Stations	Blue-Green (%)	Diatoms (%)	Chlorophyta (%)	Cryptophyta (%)	Euglenophyta (%)
Kalange	East	86.36	2.25	11.24	0.15	
	Middle	85.46	3.86	10.39	0.3	
	West	83.73	4.13	11.89	0.13	0.13
Kikubamutwe	East	96.57	1.27	2.03	0.06	0.06
	Middle	85.86	1.63	12.27	0.13	0.13
	West	92.82	2.01	5.09	0.08	
Kirindi	East	97.5	1.25	1.25		
	Middle	97.67	1.85	0.48		
	West	98.56	0.42	1.01		
Namasagali	East	89.85	1.94	8.10		
	Middle	85.74	13.16	0.55		0.55
	West	57.11	2.24	3.47		

Table 4.2. Checklist of the algal species composition from the four sampled transects

Class	Kalenge	Kikubamutwe	Kirindi	Namasagali
Blue-green				
<i>Anabaena circinalis</i>	X	X	X	X
<i>Aphanocapsa decatissima</i>	X		X	X
<i>Aphanocapsa incerta</i>	X			
<i>Aphanocapsa sp</i>	X	X	X	X
<i>Chroococcus dispersus</i>	X	X		
<i>Chroococcus turgidus</i>			X	X
<i>Chroococcus limeticus</i>	X		X	X
<i>Chroococcus sp</i>	X	X		X
<i>Ceolomoron sp</i>			X	X
<i>Gloeococcus sp</i>				X
<i>Ceolosphaerium sp</i>			X	
<i>Cylindrospermopsis africana</i>	X	X		
<i>Cylindrospermopsis cupsis</i>	X			
<i>Cylindrospermopsis sp</i>	X	X		
<i>Cyanodictyon sp</i>			X	X
<i>Merismopedia glauca</i>	X	X		X
<i>Merismopedia tenuissima</i>	X	X	X	X
<i>Merismopedia elagans</i>			X	
<i>Microcystis flos-aquae</i>	X	X	X	
<i>Microcystis sp</i>	X	X		
<i>Planktolyngbya circumcreta</i>	X	X	X	X
<i>Planktolyngbya contorta</i>	X	X		
<i>Planktolyngbya limnetica</i>	X	X		X
<i>Planktolyngbya tallingii</i>	X	X	X	X
<i>Romeria gracile</i>	X	X		
<i>Rhodomonas sp</i>	X	X		
Diatoms				
<i>Cyclotellaphanodiscus sp</i>	X	X	X	
<i>Cyclotella sp</i>	X	X	X	
<i>Navicula gastrum</i>	X			
<i>Navicula sp</i>			X	X
<i>Navicula lacoelata</i>				X
<i>Navicula radiosa</i>	X	X		
<i>Nitzschia acicularis</i>	X	X	X	X
<i>Nitzschia mediocris</i>				X
<i>Nitzschia fonticola</i>	X	X	X	X
<i>Synedra cunningtonii</i>		X		
<i>Cocconeis sp</i>				X
<i>Centric diatoms</i>			X	X
<i>Euglenophyta</i>				
<i>Euglena acus</i>	X			
<i>Trachelomonas sp</i>		X		X

Class	Kalenge	Kikubamutwe	Kirindi	Namasagali
Green Algae				
<i>Ankistrodesmus falcatus</i>	X	X	X	X
<i>Ankistrodesmus fusuformis</i>	X	X		
<i>Ankistrodesmus setigera</i>				X
<i>Chodetella sp</i>		X	X	X
<i>Chodetella subsala</i>			X	
<i>Closterium acicularis</i>	X	X		
<i>Closterium sp</i>	X	X	X	X
<i>Dictyosphaerium sp</i>				X
<i>Kircheriella obesa</i>	X	X	X	X
<i>Botryococcus braunii</i>				X
<i>Monoraphidium contartum</i>	X	X		X
<i>Monoraphidium sp</i>			X	X
<i>Dydmocystis sp</i>			X	
<i>Oosystis sp</i>				X
<i>Oocytistis lucutris</i>	X	X		
<i>Oocytistis solitaria</i>	X			
<i>Oocytistis borgei</i>				X
<i>Pediastrum boryanum</i>				X
<i>Pediastrum duplex</i>	X	X		X
<i>Pediastrum simplex</i>	X	X	X	X
<i>Pediastrum tetras</i>		X		
<i>Selenastrum gracile</i>				X
<i>Scenedesmus acuminatus</i>	X	X		X
<i>Scenedesmus armatus</i>			X	X
<i>Staurastrum curvatum</i>				X
<i>Scenedesmus bijugatus</i>				X
<i>Scenedesmus arcuatus</i>	X	X		X
<i>Scenedesmus apiculatus</i>				X
<i>Scenedesmus quadricuada</i>	X	X		
<i>Scenedesmus perforatus</i>				X
<i>Shroederia setigera</i>				X
<i>Scenedesmus sp</i>	X	X		X
<i>Scenedesmus castato</i>			X	
<i>Staurastrum cuspidatum</i>	X			
<i>Staurastrum gracile</i>	X	X		
<i>Staurastrum sp</i>		X		
<i>Crucigenia fenestrata</i>			X	X
<i>Crucigenia sp</i>				X
<i>Coelastrum sp</i>	X	X		X
<i>Dinoflagelletes</i>				
<i>Glenodinium sp</i>				X
Species	44	41	30	50

CHAPTER 5

5.0. Aquatic Macrophytes

5.1. Introduction

Human activities have transformed the catchment area of the River Nile to the extent that the original landscape is not recognized in most sections of the riverbanks. The original vegetation has mostly been replaced with crop cover, and to a smaller extent grazing of domestic animals. Due to the steep slopes in most sections of the riverbank, conversion of the landscape to agricultural land has left the slopes bare, exposing the soils to various forms of erosion (Plate 5.1).



Plate 5.1: Cultivation at the river bank down to the watermark

Areas most denuded of natural vegetation are those in the upstream reaches of Kalange-Makwanzi, Buyala-Kikubamutwe and Kirindi-Matumu transects. Further downstream, the areas around the Namasagali-Bunyamira transect were relatively better vegetated.

Given the significantly low 2006 water levels in the stream channel that has led to exposure of formerly shallow areas, some aquatic plants had rapidly started colonizing the exposed sections of the river with opportunistic plants. Exposure of shallow areas (Plate 5.2) would imply enhanced biogeochemical cycles that are likely to lead to enhanced availability of nutrients (Barbanti *et al.*, 1992; Bates & Neafus, 1980; Bostrom & Petterson, 1982; James *et al.*, 1996) that foster plant growth. Colonization by plants at exposed sites is also thought to have been favored by the assumed nutrient-rich guano from aquatic birds around shallow rocky areas (Plate 5.3).



Plate 5.2. Exposed shallow zone of the river bank at Kikubamutwe

This study was intended to provide baseline information on the diversity and relative cover abundance of aquatic macrophytes in the four transects of Kalange-Makwanzi, Buyala-Kikubamutwe, Kirindi-Matumu and Namasagali-Bunyamira. This information is to form part of the baseline data upon which future ESAs are to refer to.



Plate 5.3: An exposed rock with guano from aquatic birds

5.2. Study area

This study was undertaken at the same four transects as used in 2000, namely 1- Kalange-Makwanzi, 2- Buyala-Kikubamutwe, 3- Kirindi-Matumu, and 4- Namasagali-Bunyamira between 6th – 13th April 2006.

5.3. Materials and methods

Sampling sites were georeferenced using a GPS hand set (GARMIN 175), with coordinate references recorded in decimal degrees. Water based surveys were conducted on a motorized boat along the shores of the riverbanks and around islands wherever they occurred. Stretches of 300 m were determined and all species of aquatic

macrophytes were recorded; data on macrophyte abundance was determined by three independent observations and the mean evaluation was agreed on. The evaluation of abundance was at five levels i.e. dominant, abundant, frequent, occasional and rare (DAFOR). Those plants that could not be identified on site were pressed and kept for exact identification at some later date, preferably from Makerere University herbarium. A checklist was then prepared to determine the presence or absence of these plants.

5.4. Results

The determination of macrophyte presence based on the DAFOR system is presented in Table 5.1. Though variations occurred among sites, it was found that water hyacinth was ubiquitous despite variations in its occurrence based on the DAFOR system. In an ascending order of species diversity, Kalange-Makwanzi had 6, Kirindi-Matumu had 13, Kikubamutwe-Buyala had 15 and Namasagali-Bunyamira had 37 (Fig. 5.1).

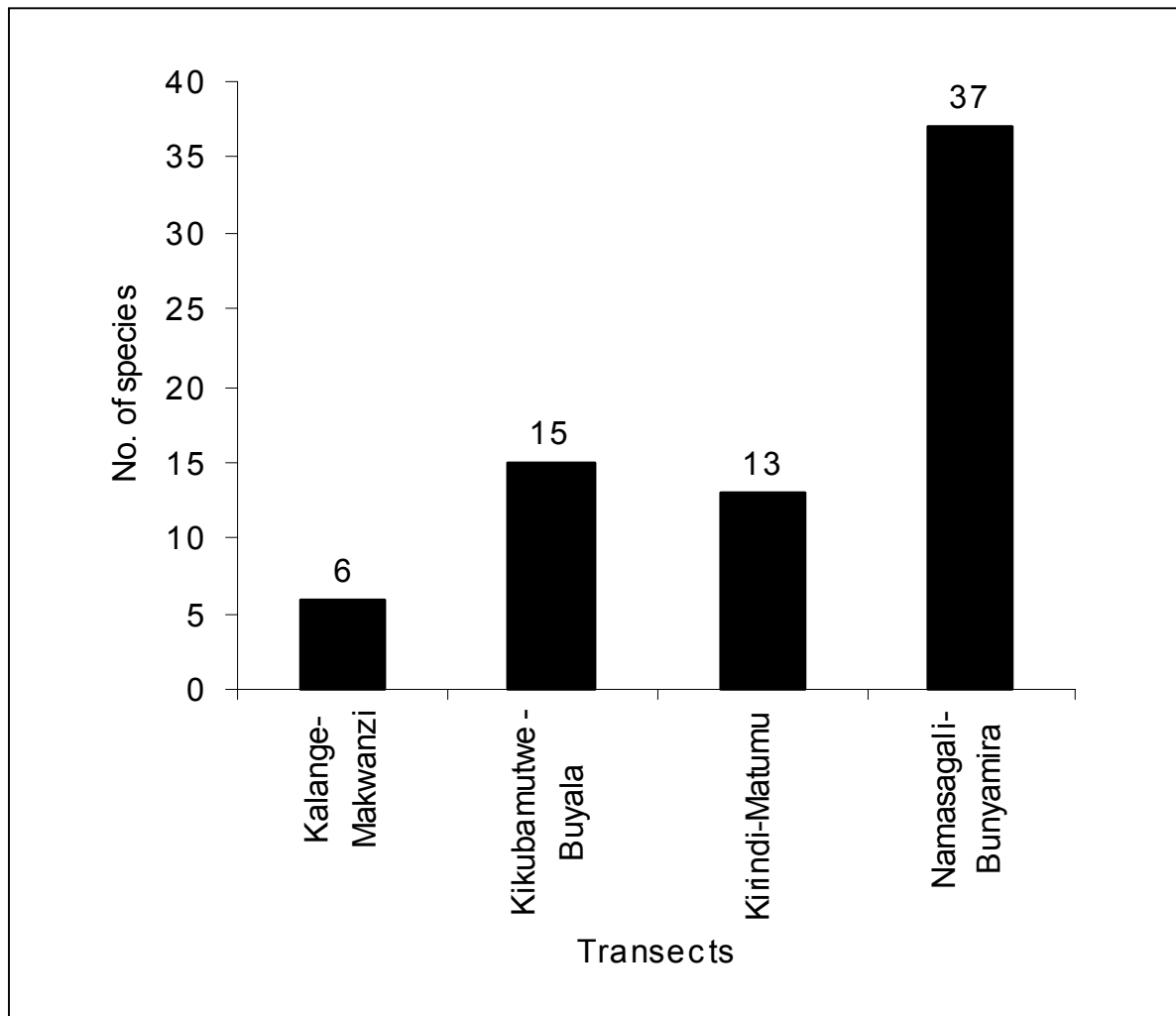


Fig. 5.1: Diversity of aquatic macrophyte species at the four transects

Description of macrophyte occurrence at the transects

5.4.1. Kalange-Makwanzi (Transect 1)

Four sites were sampled at this transect, with replicates of A, B and C i.e. Bubaale, Mukikonko, and Kuntukulu 1 and Kuntukulu 2. This transect was characterized by very steep banks on either side, with the eastern section more cultivated compared to the western part that was mainly a residential area. At Bubaale, the order of occurrence of aquatic macrophytes was such that *Vossia cuspidata* was dominant, *Eichhornia crassipes* was frequent, while *Pistia stratiotes* was rare. At Mukikonko, similar observations as at Bubaale were made; with *V. cuspidata* being the dominant plant, while *Eichhornia crassipes* and *Pistia stratiotes* were frequent and rare, respectively. Other plants that were present were majorly rare and included some climbers locally called libombwe, in addition to *Ipomoea aquatica*. Around the Kuntukulu Island, *V. cuspidata* was frequent, *E. crassipes* was rare, while other were rare and included *Ipomoea aquatica*, *Polygonum* sp., and some unidentified climbers locally called Musasizi. The riverbanks on the western side were denuded of aquatic plants and instead colonized by a weedy tree locally called Nkulaidho. At all these sites, a plant belonging to Asteraceae (Compositae) was present but rare.

5.4.2. Kikubamutwe-Buyala (Transect 2)

This transect was characterized by cultivation down to the watermark, thus exposing the banks to erosion by rain. Sites sampled at this transect were Kikubamutwe A and B on the western side, and Buyala A, B and C on the east. On the western side, *V. cuspidata* was abundant and *E. crassipes* was frequent. Other macrophytes such as *Ipomoea* spp., sedges, *P. stratiotes*, *Lemna* sp., and some genera belonging to the family Asteraceae were occasional. Among the rare plants were *Ficus* sp. and some species belong to Asteraceae.

On the eastern portion of the transect (Buyala), with common plants being *E. crassipes* and *V. cuspidata*. The former ranged from abundant to dominant, while the latter from rare to frequent. Other macrophytes were rare and included some sedges, *Leisia lexadra* and *Lemna* sp.

5.4.3. Kirindi-Matumu (Transect 3)

Like at the Kikubamutwe-Buyala transect, this area was characterized by cultivation down to the watermark, thus making the landscape vulnerable to rain erosion. Sites sampled were Kirindi A and B, Damba on the western part in addition to Nankandulo A and B on the east. On the western part of the transect, *V. cuspidata* ranged from frequent to abundant. Plants that occurred frequently were *Hydrocotyle ranunculoides* and *Cyperus mundtii*, while those that were occasional included *E. crassipes*, *Phragmites mauritianus*, *Lemna* sp. and *Azolla africana*. Others such as *Ludwigia* sp.,

Ipomoea sp., *Sesbania sesban*, some climbers, some species of Asteraceae, sedges, and *P. stratiotes* were rare.

On the east of the transect, *V. cuspidata* and *E. crassipes* were locally abundant, while occasionally occurring plants included *S. sesban*, *P. mauritianus*, and sedges. The rest of the plants were rare and included species of Asteraceae, *Cyperus papyrus* and *I. aquatica*.

5.4.4. Namasagali-Bunyamira

This transect had the highest diversity of aquatic macrophytes probably because of its fairly quiescent waters. The sites sampled were Nsangabiyire and Kasimwe A and B on the east, and Lwabyata A and B and Bunyamira to the west. The landscape on either side of the river was relatively well covered with vegetation compared to the other three transects. There were extensive stretches of swamp with *C. papyrus* as the dominant macrophyte (Plate 5.4). *E. crassipes* on the other hand was the abundant macrophyte (Plate 5.4)



Plate 5.4. An extensive fringe of *E. crassipes* with a papyrus background

Those macrophytes that were frequent included *Ceratophyllum demersum*, *Vallisneria* sp. and *Nymphaea* sp. on the eastern side; on the west were *C. papyrus*, *P. mauritianum*, *Commelina* sp., *Polygonum* sp. Plants that occurred occasionally on the east were *Azolla africana*, *Cayratia ibuensis*, *Polygonum* sp., *Lemna* sp., *Vallisneria* sp., *Cayratia ibuensis* and *C. mundtii*, while on the west were *E. crassipes*, *S. seban*, *Sudia sagitifolia*, *C. demersum*, *Nymphaea* sp., *Najas horrida*, *Lemna* sp., *A. africana*, *Vallisneria* sp., *Cayratia ibuensis*, *C. demersum*, *Nymphaea* sp. and *Polygonum* sp. Several rare plants were identified and on the east were *Lemna* sp., *N. horrida*, *H. verticillata*, *C. bengalensis*, *P. stratiotes*, *V. cuspidata*, *Polygonum* sp., *Virginia* sp. On western side of the river, rare plants included some members of Asteraceae, *C. bengalensis*, *H. verticillata*, *C. mundtii*, *P. stratiotes*, *Sudia* sp., *V. cuspidata*, *Vallisneria* sp., *Lemna* sp. and *A. africana*.

5.5. Discussion

The observed recession in water levels has resulted into expansion of the aquatic macrophyte bed into the river channel, with exposed areas being colonized by opportunistic plants that were characteristic of muddy substrates. Exposure of sediments is known to result into enhanced nutrient release (Barbanti *et al.*, 1992; Bates & Neafus, 1980; Bostrom & Petterson, 1982; James *et al.*, 1996), a process that likely contributed to the expanded vegetated zones. In addition, low water levels led to exposure of rocks that formed ideal perching sites for various water fowl; their guano is assumed to contribute to nutrient enrichment of the system hence favoring rapid colonization of aquatic plants at exposed sites.

A total of 41 species of aquatic macrophytes were encountered (Table 5.1). Despite this diversity, the Kalange-Makwanzi transect had the lowest number of species (maximum of only 6), followed by Kirindi-Matumu transect with 13 species, Buyala-Kikubamutwe with 15 species, while Namasagali-Bunyamira transect registered the highest diversity of 37 macrophyte species. This was likely reflecting the level of human interference on the landscape, with Namasagali-Bunyamira area being the least disturbed hence highest macrophyte species.

5.6. Conclusions

The diversity of aquatic macrophytes was more than twice higher at the Namasagali-Bunyamira transect compared to that at the other three transects. This contrasts sharply from the conclusion made during the former surveys under AES Nile Power (2000). This assumed significant difference could be attributed to the low survey coverage that was done at the Namasagali-Bunyamira transect during 2000. Additionally, the low water levels that have characterized the river led to cultivation along some stretches down to the water mark thus leading to destruction of established macrophyte beds; this was especially so along the Buyala-Kikubamutwe, Kirindi-Matumu and to a lesser extent at the Kalange-Makwanzi transects. It is also possible that the draw down of the river water volume left some sites bare of water hence could have resulted into disappearance of some aquatic macrophytes previously encountered.

Table 5.1a: Check list for aquatic macrophytes at the four transects

SITE	<i>Vossia cuspidata</i>	<i>Eichhonia crassipes</i>	<i>Pistia stratiotes</i>	<i>Lemna trisulca</i>	<i>Polygonum setulosum</i>	<i>Ipomea aquatica</i>	<i>Commelina bengalensis</i>	<i>Ipomea rubens</i>	<i>Enhydra feactuans</i>	<i>Sesbania sesban</i>	<i>Mikania cordata</i>	<i>Amaranthus dubuis</i>
Kalange-Bubale A	A	F	—	—	—	R	—	R	—	—	—	—
Kalange-Bubale B	A	F	R	—	—	R	—	—	—	—	—	—
Kalange-Bubale C	A	F	R	—	—	R	R	—	—	—	—	R
Kalange-mukikonkoA	A	F	R	—	—	R	—	—	—	—	R	—
Kalange-Mukikonko B	A	F	R	—	—	R	—	—	—	—	—	—
Kalange-Mukikonko C	R	A	—	F	—	—	—	—	—	—	—	—
Kalange-Kuntuukulu A	F	O	—	—	A	R	—	—	—	—	R	—
Kikubamutwe Landing A	A	R	R	—	A	R	R	R	R	R	R	R
Kikubamutwe Landing B	A	F	—	—	A	—	—	—	—	—	—	—
Kikubamutwe Landing A	A	A	R	R	—	—	—	—	—	—	R	—
Kikubamutwe-landing B	O	F	—	—	—	—	—	—	—	—	—	—
Kikubamutwe Landing C	F	—	—	R	—	—	—	—	—	—	—	—
Kirindi-Kirindi A	A	R	—	—	—	—	—	—	R	R	—	—
Kirindi-Kirindi B	F	R	—	R	—	—	—	—	R	—	R	—
Kirindi-Damba A	A	F	R	—	—	—	—	—	R	—	—	—
Kirindi-Nankandulo A	F	R	—	—	—	—	—	—	—	—	R	—
Kirindi-Nakandulo B	A	A	—	—	—	—	R	R	—	R	R	—
Namasangali-Nsangabiyire A	R	A	R	R	A	—	R	—	—	—	R	—
Namasangali-Kasimwe A	R	A	R	R	A	—	R	—	—	—	—	—
Namasangali-Kasimwe B	R	A	R	R	R	—	—	—	—	—	—	—
Namasangali-Kaita A	R	R	—	—	—	—	F	—	—	R	R	—
Namasangali-Lwabyanta A	—	A	R	R	F	—	R	—	—	—	—	—
Namasangali-Bunyamira A	R	A	R	10	R	—	—	—	—	—	—	—

Table 5.1b

SITE	<i>Leersea hexadra</i>	<i>Solanum nigrum</i>	<i>Cyperus pectinatus</i>	<i>Ficus amadiensis</i>	<i>Cyperus munditii</i>	<i>Hydrocotyle ranunculoides</i>	<i>Phragmites australis</i>	<i>Azolla pinnata</i>	<i>Punchea diascoridis</i>	<i>Vernonia amygdalina</i>	<i>Sarcocephalus latifolius</i>
Kalange-Bubale A	—	—	—	—	—	—	—	—	—	—	—
Kalange-Bubale B	—	—	—	—	—	—	—	—	—	—	—
Kalange-Bubale C	—	—	—	—	—	—	—	—	—	—	—
Kalange-mukikonkoA	—	—	—	—	—	—	—	—	—	—	—
Kalange-Mukikonko B	—	—	—	—	—	—	—	—	—	—	—
Kalange-Mukikonko C	—	—	—	—	—	—	—	—	—	—	—
Kalange-Kuntuukulu A	—	—	—	—	—	—	—	—	—	—	—
Kikubamutwe Landing A	R	R	R	R	—	—	—	—	—	—	—
Kikubamutwe Landing B	—	—	—	—	—	—	—	—	—	—	—
Kikubamutwe Landing A	—	—	—	—	—	—	—	—	R	—	—
Kikubamutwe-landingB	R	—	O	—	—	—	—	—	—	—	—
Kikubamutwe Landing C	R	—	R	—	—	—	O	—	—	—	—
Kirindi-Kirindi A	—	—	—	—	F	F	R	—	—	R	R
Kirindi-Kirindi B	—	—	—	—	R	F	R	R	—	R	R
Kirindi-Damba A	—	—	R	—	—	—	—	—	—	—	R
Kirindi-Nankandulo A	—	—	O	—	R	—	—	R	F	—	—
Kirindi-Nakandulo B	—	—	R	—	—	—	R	R	—	—	—
Namasangali-Nsangabiyire A	—	—	R	—	R	R	—	R	—	—	—
Namasangali-Kasimwe A	—	—	R	—	R	—	R	R	R	—	—
Namasangali-Kasimwe B	—	—	R	—	R	R	—	R	R	—	—
Namasangali-Kaita A	—	—	R	—	R	—	F	—	—	—	R
Namasangali-Lwabyanta A	—	—	R	—	R	—	—	—	—	R	—
Namasangali-Bunyamira A	R	R	R	R	R	—	—	R	—	—	—

Table 5.1c

SITE	<i>Mondia whytei</i>	<i>Psychatia sesensis</i>	<i>Ludwigia stolonifera</i>	<i>Cyperus papyrus</i>	<i>Phoenix reclinata</i>	<i>Najas horrida</i>	<i>Hydrilla verticillata</i>	<i>Vallisneria americana</i>	<i>Europhia harsfarthii</i>	<i>N. lotus</i>	<i>Cayratia ibuensis</i>	<i>C. demersum</i>	<i>Hibiscus diversifolia</i>
Kalange-Bubale A	—	—	—	—	—	—	—	—	—	—	—	—	—
Kalange-Bubale B	—	—	—	—	—	—	—	—	—	—	—	—	—
Kalange-Bubale C	—	—	—	—	—	—	—	—	—	—	—	—	—
Kalange-mukikonkoA	—	—	—	—	—	—	—	—	—	—	—	—	—
Kalange-Mukikonko B	—	—	—	—	—	—	—	—	—	—	—	—	—
Kalange-Mukikonko C	—	—	—	—	—	—	—	—	—	—	—	—	—
Kalange-Kuntuukulu A	—	—	—	—	—	—	—	—	—	—	—	—	—
Kikubamutwe Landing A	—	—	—	—	—	—	—	—	—	—	—	—	—
Kikubamutwe Landing B	—	—	—	—	—	—	—	—	—	—	—	—	—
Kikubamutwe Landing A	—	—	—	—	—	—	—	—	—	—	—	—	—
Kikubamutwe-landing B	—	—	—	—	—	—	—	—	—	—	—	—	—
Kikubamutwe Landing C	—	—	—	—	—	—	—	—	—	—	—	—	—
Kirindi-Kirindi A	R	R	—	—	—	—	—	—	—	—	—	—	—
Kirindi-Kirindi B	R	R	—	—	—	—	—	—	—	—	—	—	—
Kirindi-Damba A	—	R	—	—	—	—	—	—	—	—	—	—	—
Kirindi-Nankandulo A	—	—	R	—	—	—	—	—	—	—	—	—	—
Kirindi-Nakandulo B	—	—	—	R	—	—	—	—	—	—	—	—	—
Namasangali-Nsangabiyire A	—	—	R	D	—	R	R	F	R	F	R	F	R
Namasangali-Kasimwe A	—	—	R	D	—	R	R	R	R	—	R	—	—
Namasangali-Kasimwe B	—	—	R	D	—	—	—	R	R	—	R	—	—
Namasangali-Kaita A	—	—	R	F	—	—	—	—	R	—	—	—	—
Namasangali-Lwabyanta A	—	—	R	D	—	R	R	R	R	D	R	R	—
Namasangali-Bunyamira A	—	—	R	A	—	—	R	R	R	R	R	R	—

Key to codes:

D: Dominant
A: Abundant
F: Frequent
O: Occasional
R: Rare
-: Absent

CHAPTER 6

6.0. Micro-invertebrates Fauna

6.1. Background

A hydropower plant is planned to be built at Bujagali site located in the upper reaches of the Victoria Nile near Jinja. The status and dynamics of micro-invertebrate (zooplankton) fauna constitutes part of the investigations within a broad study of the fisheries and environment of the river prior to construction of the hydropower station. The study is intended to provide a basis for evaluating the impact of the project on the environment and the biological resources associated with it.

This report presents results on the micro-invertebrate/zooplankton community of the first quarter field sample collections from one site upstream and three sites downstream of Dumbbell Island, the proposed site of the power plant. This study was conducted between 6th – 13th April 2006, and comparison with data from April 2000 are made.

6.2. Materials and methods

Four study/sampling sites are located at Kalange upstream of Dumbbell, Buyala, Kilindi and Namasagali; all lying at increasing distances downstream of the proposed dam site (Fig. 2.1a). The same transects were sampled during April 2000.

Zooplankton were sampled using conical nets of the Nansen type, having a 0.25m mouth diameter and with a 60 µm nitex mesh size net. At each sampling site, one transect was established with five sampling points (except Kirindi and Namasagali which had three) covering as much as possible, the river width. For ease of sampling in running water conditions, sampling points were generally located in areas of low water currents i.e. downstream of islands or rocky outcrops or quiescent bays. At each sampling point, three vertical hauls were taken from about 0.5m above the riverbed and combined to make a composite sample. The samples were preserved in 4% sugar formalin solution (to stop 'ballooning' of Cladocera and consequent loss of contents of the brooding pouch). In the laboratory, each sample was placed in a clean glass beaker and diluted to a suitable volume (depending on the numerical concentration of the organism). Sub-samples of 2 and 5ml were taken from a well-mixed sample using a calibrated bulb pipette, placed on a counting chamber and examined under an inverted microscope (mag. X 20). The organisms were taxonomically identified to species level (adults only) using appropriate identification keys for Copepoda, Cladocera and Rotifera) and count data of the different taxa compiled.

6.3. Results

6.3.1. Faunal composition and frequency of occurrence

The zooplankton community was composed of six species of Cyclopoid copepods, one species of Calanoid copepods, seven species of Cladocera and 12 species of Rotifera (Table 6.1). The most frequent taxa in the samples were *Thermodiaptomus galeboides* (69%), *Thermocyclops neglectus* (62%), *Tropocyclops confinnis* (75%), *Tropocyclops tennelus* (75%), copepodite and naupliar growth stages of copepods (>75%), *Bosmina longirostris* (63%) and *Keratella tropica* (75%). Rare taxa (<10%) included *Ceriodaphnia cornuta*, *Daphnia lumholtzi*, *Macrothrix* sp., and several species of Rotifera.

Table 6.1. Checklist of zooplankton taxa encountered in samples from sites along four transects in Upper Victoria Nile, April 2006.

	Transect 1(Upstream) Kalange to Makwanzi					Transect 2 (Downstream) Buyala to				Transect 3 (Downstream)			Transect 4 (Downstream) Namasagali to				Frequency of occurrence
Sites	Kalange 1	Kalange 2	Kalange 3	Kalange 4	Kalange 5	Mukisoga	Mugalya	Mukisajja	Kazinga	Edge	Mutuma middle	Mutuma edge	Rwabyata inshore	Rwabyata	Nsangabwire egde	Nsangabwire off	
Copepoda																	
<i>Thermiaptomus galeoides</i>	P	P	P	P	P	P	P	A	P	A	P	P	A	A	P	A	68.8
<i>Mesocyclops</i> sp.	P	P	P	A	P	A	A	P	A	A	A	P	A	A	A	P	43.8
<i>Thermocyclops emini</i>	A	P	A	P	P	P	A	P	A	A	A	A	A	A	A	A	31.3
<i>Thermocyclops incisus</i>	A	A	A	A	A	P	A	P	P	A	A	A	A	A	A	A	18.8
<i>Thermocyclops neglectus</i>	P	P	P	P	P	P	P	P	P	A	A	P	A	A	A	A	62.5
<i>Tropocyclops confinnis</i>	P	P	P	P	P	P	A	P	P	P	P	A	P	P	A	A	75.0
<i>Tropocyclops tenellus</i>	P	P	P	P	P	P	A	P	P	A	P	A	P	P	A	P	75.0
Calanoid copepodites	P	P	P	P	P	P	P	P	P	P	P	A	A	P	A	A	75.0
Cyclopoid copepodite	P	P	P	P	P	P	P	P	A	P	P	A	P	P	P	P	87.5
Nauplius larvae	P	P	P	P	P	P	P	P	P	P	P	A	P	A	P	P	87.5
Cladocera																	
<i>Bosmina longirostris</i>	P	P	P	P	P	A	A	A	P	P	A	P	A	P	A	P	62.5
<i>Ceriodaphnia cornuta</i>	A	A	A	P	A	A	A	A	A	A	A	A	A	A	A	A	6.3
<i>Daphnia lumholtzi</i>	A	A	A	A	A	A	A	A	A	A	A	A	A	A	P	A	6.3
<i>Daphnia lumholtzi(helm)</i>	A	A	P	P	A	P	A	P	P	A	A	A	A	A	A	A	31.3
<i>Diaphanosoma excisum</i>	P	A	P	P	P	A	A	A	A	A	A	A	A	A	A	A	25.0
<i>Moina micrura</i>	A	P	A	P	P	A	A	A	A	A	A	A	A	A	A	P	25.0
<i>Macrothrix</i> sp.	A	A	A	A	A	A	A	A	A	A	P	A	A	A	A	A	6.3
<i>Chydorus</i> sp.	A	A	A	P	A	A	A	A	A	P	A	A	A	A	A	A	12.5
Rotifera																	
<i>Brachionus angularis</i>	A	P	P	A	A	P	A	P	A	A	A	A	P	A	A	A	31.3
<i>Brachionus calyciflorus</i>	P	A	P	P	P	A	A	A	P	P	A	A	A	P	A	A	43.8
<i>Brachionus falcatus</i>	A	A	A	A	A	A	A	A	P	A	A	A	A	A	A	A	6.3
<i>Euclanis</i> sp	A	A	P	A	A	A	A	A	A	A	A	A	A	A	A	A	6.3
<i>Filinia longiseta</i>	A	P	A	A	A	A	A	A	A	A	A	A	A	A	A	A	6.3
<i>Filinia opoliensis</i>	A	P	A	A	A	A	A	A	A	A	A	A	A	A	A	A	6.3
<i>Keratella cochlearis</i>	P	A	P	P	P	A	P	P	A	A	A	P	A	A	A	A	43.8
<i>Keratella tropica</i>	P	A	P	P	P	P	P	P	A	P	P	P	A	P	A	P	75.0
<i>Lecane bulla</i>	P	A	P	P	A	A	A	A	P	A	A	P	A	A	A	P	37.5
<i>Polyarthra</i> sp.	A	A	A	P	A	A	A	A	A	A	A	A	A	A	A	A	6.3
<i>Synchaeta</i> sp.	P	P	P	A	P	A	A	A	P	A	A	A	A	A	A	A	31.3
<i>Trichocerca cylindrica</i>	P	P	P	A	A	A	A	P	A	A	A	A	A	A	A	A	25.0

Elements of some macro-invertebrate community such as chaoborid and chironomid larvae, *Caridina nilotica* etc. that were caught along with zooplankton were eliminated from the present analysis.

6.3.2. Species richness

Species richness generally decreased with increasing distance downstream (Fig. 6.2). There was considerable variation in species richness exhibited by the three broad taxonomic groups between and within sampled sites. Upstream sites supported up to 6-8 species of Copepoda, Cladocera and Rotifera while downstream sites had at most 2-3 species.

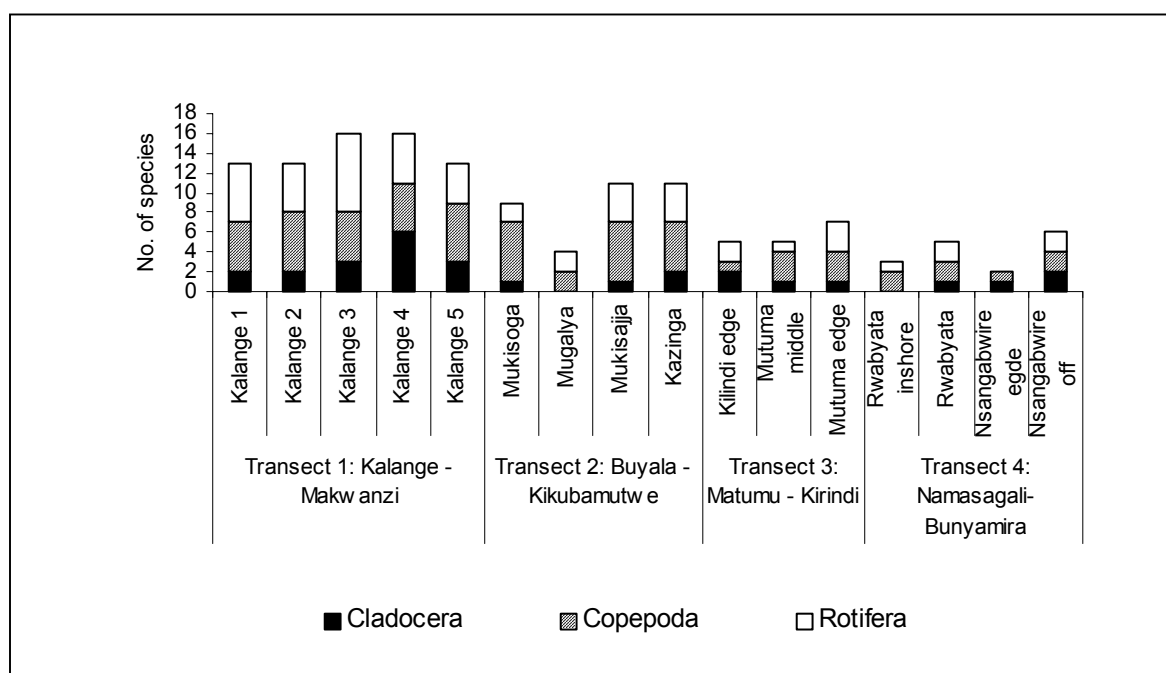


Fig. 6.2. Zooplankton species richness at sampled sites along four transects in Upper Victoria Nile April 2006.

6.3.3. Zooplankton distribution, densities and relative abundance

Most cyclopoid copepod taxa exhibited wide distribution being recovered at most sites especially in the upstream section of the sample area (Table 6.1, Fig. 6.3). Cladoceran and Rotiferan taxa, however, showed discontinuous distribution patterns throughout the sample area. *Keratella tropica*, exhibited the highest frequency of occurrence (75%) among rotiferan species.

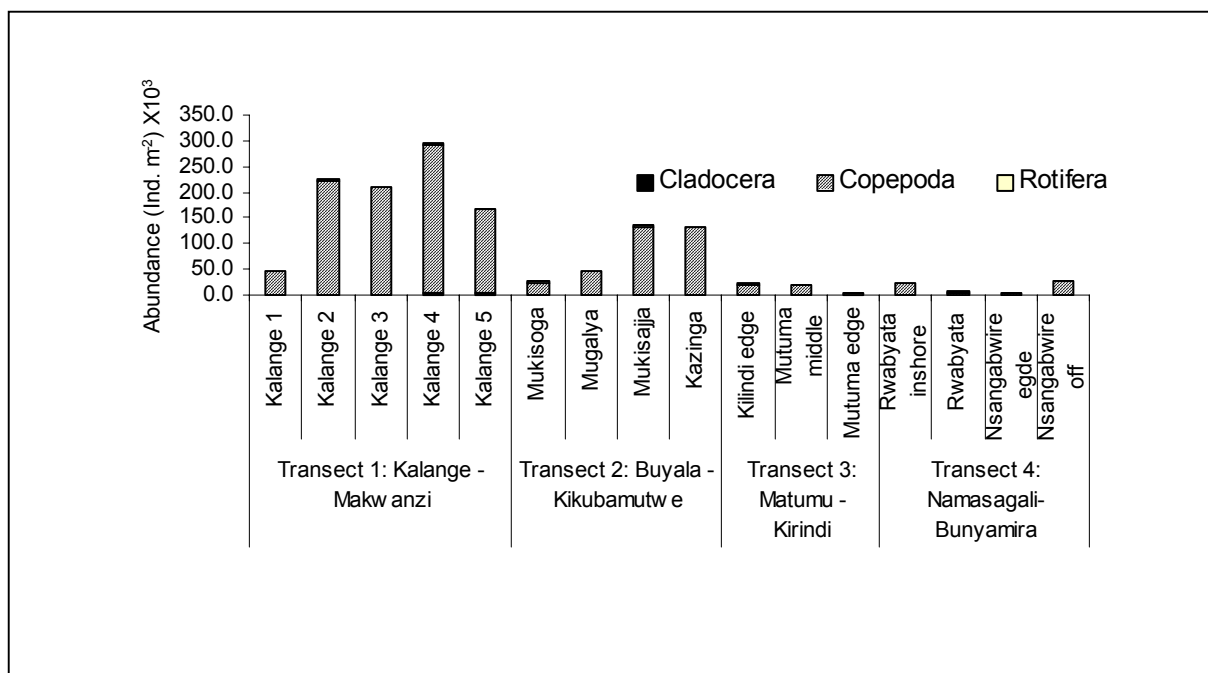


Fig. 6.3. Numerical abundance of zooplankton taxa at selected sampled sites along transects in Upper Victoria Nile, April 2006.

Copepod taxa generally exhibited higher abundance estimates (up to 290,000 indiv. m⁻²) especially in the upstream sites between Kalange-Makwanzi and Buyala-Kikubamutwe (Fig. 6.3, Table 6.2). Other taxa occurred with generally much lower abundance (<5000 indiv m⁻²) at most sites.

Table 6.2. Mean percentage composition of zooplankton taxa at the four sampling stations/transects along Upper Victoria Nile between Kalange and Namasagali, April 2006. Numbers in parentheses refer to Standard Errors (SE).

Parameters	Transect 1 Upstream Kalange to Makwanzi	Transect 2 Downstream Buyala to Kikubamutwe	Transect 3 Downstream Matumu to Kirindi	Transect 4 Downstream Namasagali to Bunyamira
Copepoda	97.3 (0.3)	98.5 (0.2)	73.0 (22.1)	88.1 (7.4)
Cladocera	1.1 (0.2)	0.1 (0.1)	4.3 (3.1)	3.9 (1.8)
Rotifera	1.6 (0.4)	1.4 (0.2)	22.6 (19.0)	7.9 (5.8)

Upstream sites exhibited considerably higher total zooplankton abundance (range 130,000-290,000 indiv. m⁻²) compared to downstream sites (20,000-30,000 indiv. m⁻²).

6.4. Discussion

The taxonomic composition reported here is comparable to that observed in the April 2000 AES report. In the 2000 survey, the second quarter report (Mwebaza-Ndawula *et al.* 2005; NARO AES Report 2000) indicated only a single species of Cladocera, *Diaphanosoma excisum*. This time round, the cladoceran species composition was much more diverse and comprised *Bosmina longirostris*, *Ceriodaphnia cornuta*, *Daphnia lumholtzi*, *D. excisum*, *Moina micrura* and *Macrothrix* sp. Downstream decrease of zooplankton densities was also similar to the pattern observed in April 2000. The magnitude of the total densities observed (<5000 - 290,000 indiv. m⁻²) is within range of those observed in April 2000 surveys (700-130,000 indiv. m⁻²) but is well below density estimates for Lake Victoria which is the ultimate source of the River Nile water. In the 2000 AES report it was suggested that flowing water conditions probably have a major bearing on the biological mechanisms regulating zooplankton abundance as noted by Rzoska (1978). Such and other differences may be expected in comparisons of communities involving standing and running water ecosystems. Species richness decreased from 13-16 upstream to 2-7 in downstream sites. While the trend is similar to that of the 2000 AES data, these ranges appear to be wider than those observed in the 2000 surveys i.e. 2-6 recorded in the April 2000 data. The superabundance of copepods over other taxa is in consonance with observations in the AES data of April 2000.

6.5. Summary

- Species composition was dominated by rotifera while both Cladocera and copepods contributed nearly an equal number of species at most sites.
- Species richness decreased progressively from upstream to downstream sites
- Cyclopoid copepod taxa generally exhibited higher abundance estimates (up to 287,000 indiv. m⁻²) especially in upstream sites at Kalange-Makwanzi and Buyala-Kikubamutwe.
- Upstream sites exhibited higher total zooplankton abundance (range 130,000-290,000 indiv. m⁻²) compared to downstream sites (20,000-30,000 indiv. m⁻²).
- In all cases, Copepoda contributed the greatest percentage of the total zooplankton (> 70%).

6.6. Conclusion and way forward

The survey reveals considerable similarity between the present data and that collected earlier by the AES project in April 2000. Some key aspects of the environment appear to have changed significantly over time. The current low water level is a case in point. This phenomenon was clearly visible during sampling with the watermark having receded as much as 10 metres in some places. Notably however, such changes in water level did not affect the location of sampling sites established during the 2000 AES surveys, which were the same points sampled in the present investigation.

The data generated here will, in due course, be compared to that to be generated in subsequent quarters in order to reveal temporal-spatial patterns of the zooplankton community constituents along the stretch of Upper Victoria Nile under study.

CHAPTER 7

7.0. The Diversity and Relative Abundances of Macro-invertebrates in the Upper Victoria Nile

7.1. Background

Aquatic macro-invertebrates mostly live in/on the bottoms of rivers, streams and lakes but some can live under roots of marginal plants. All macro-invertebrates macro-invertebrates can be seen with naked eyes and have their own adaptations and requirements to life under water. They are good indicators of water quality due to their varying sensitivity to water pollution. Thus, diversity and abundance of macro-invertebrate types and how they frequently occur can be an indication of environmental quality of an aquatic system.

This report provides baseline information on the diversity and relative abundance of macro-invertebrates for the pre-construction period (1st quarter) of the Bujagali Hydropower Project at Dumbbell site on the Upper Victoria Nile. This study was conducted between 6th –13th April 2006. The assessment survey was conducted at three points (east, mid and west) on one upstream transverse transect (Kalange-Naminyia) and three downstream transects (Buyala-Kikubamutwe, Kirindi-Matumu and Sangabwire-Lubwata/Namasagali). Similar data will be collected in the subsequent quarters and during construction and post-construction operation of the project. Results from this survey are compared with those that were obtained in April 2000 under AESNP EIA study of the second quarter.

7.2. Materials and Methods

Samples were collected from among plant roots and from benthic sediments. Sediment samples were collected in triplicate using a ponar grab of surface area 236.45 cm² at three points namely, west, mid and east along the transverse transects, one of which is upstream and three downstream the proposed Hydropower Dam project at Dumbbell site (Fig.2.1a). The macro-invertebrates from plant roots were collected using a 400 µm mesh net of cross-section area 1885 cm². The net, mounted on a long handle, was inserted below the plant roots and moved vertically up and down several times to dislodge and collect the organisms. The samples were sieved through a washing bag of mesh size 500 µm and preserved with 70% alcohol in plastic sample bottles. In the laboratory, the macro-fauna were sorted, identified mostly to genus level (Merritt & Cummins 1997, Pennak 1989, Voshell 2002) and enumerated. Part of each sample was re-preserved in 70 % alcohol and stored in plastic vials for future reference. Results were computed as number of organisms per square meter.

7.3. Results

7.3.1. Comparison of total benthic density: April 2000 and 2006

Total benthic density was highest at Kalange-Naminya (Transect 1) during April 2000 survey whereas in this survey, density was highest at the Matumu-Kirindi (Transect 2) (Fig. 7.2). The overall areal density at the former reached a high of 14,705 ind. m⁻² on the eastern sampling point of the transect and 11128 ind. m⁻² on the western point. At the latter, maximal densities of 2580 and 2453 ind. m⁻² respectively were registered at the eastern and western sampling points of the transects.

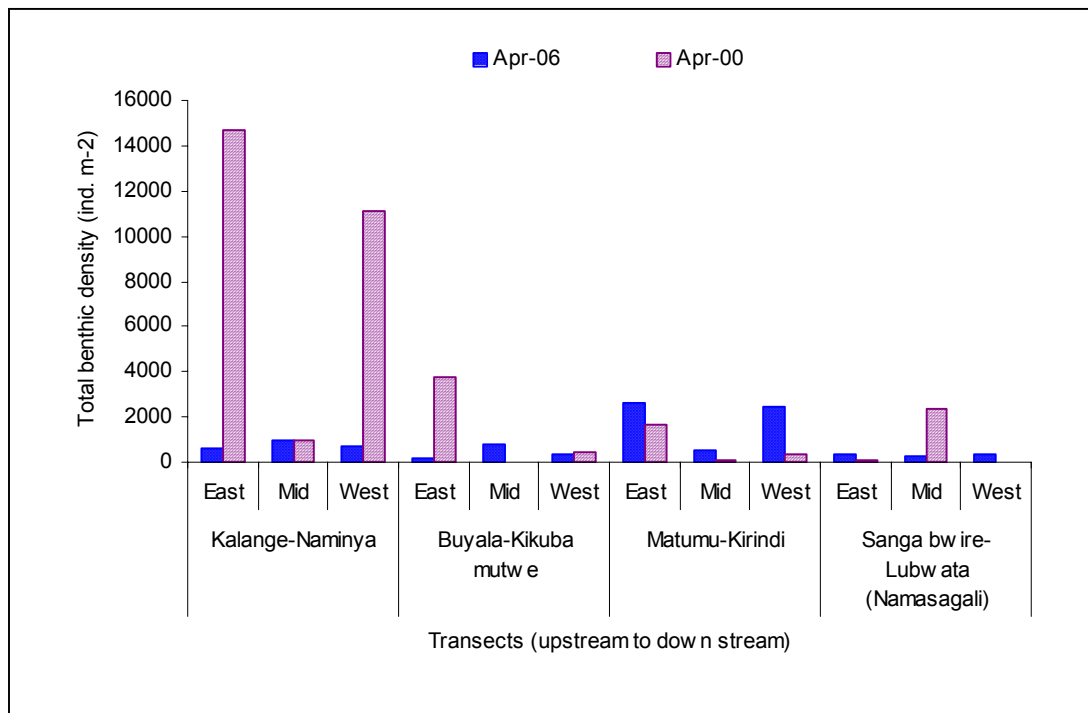


Fig. 7.2. Comparison of overall benthic macro-invertebrates density across four transects on the upper Victoria Nile during April 2000 and 2006.

7.3.2. Comparison of total macro-invertebrate density under plant roots: April 2000 and 2006

The densities of macro-invertebrates under plant roots for this survey were slightly higher than those during April 2000 survey (Fig. 7.3). Density during this survey ranged from 57 ind.m⁻² at the mid point on Kalange-Naminya transect to 354 ind.m⁻² at western edge of Sangabwire-Lubwata (Namasagali) transect. During the April 2000 survey, the density varied from 44 ind.m⁻² at the eastern edge of Sangabwire-Lubwata (Namasagali) transect to 153 ind.m⁻² at the eastern edge of Kalange-Naminya transect.

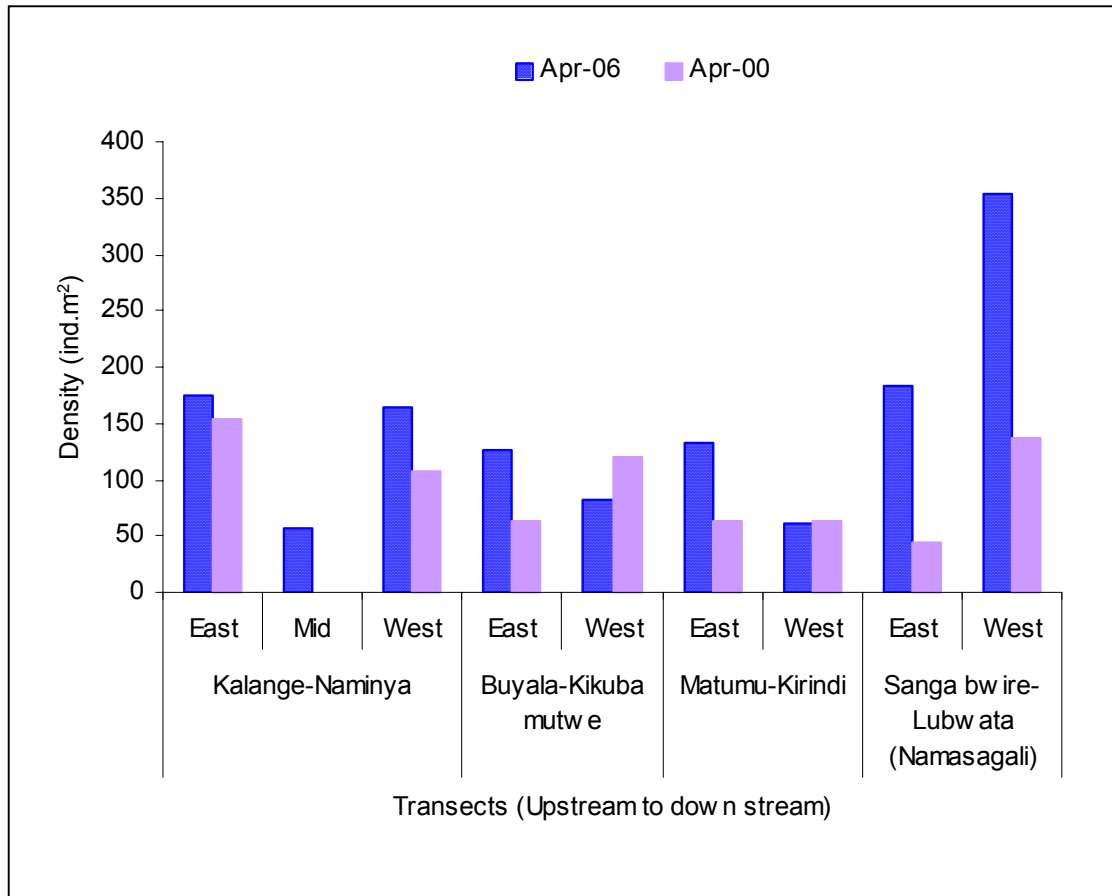


Fig. 3. Comparison of overall macro-invertebrates density under plant roots across four transects on the Upper Victoria Nile during April 2000 and 2006.

7.3.3. Comparison of macro-invertebrate density: benthic and under plant roots

Along all transects benthic macro-invertebrates density was much higher than that under plant roots (Fig. 7.4). The highest benthic density was recorded at the eastern and western sample points of Matumu-Kirindi transect, up to 2580 and 2453 indi. m⁻², respectively. Along the Sangabwire-Lubwata Namasagali transect, density ranged

between 240 at the mid point and 381 indi. m⁻² at the eastern point (Fig. 7.4). For densities under plant roots, there were no samples obtained at mid points except on Kalenge-Naminyia transect, where there was a small island, which had plants.

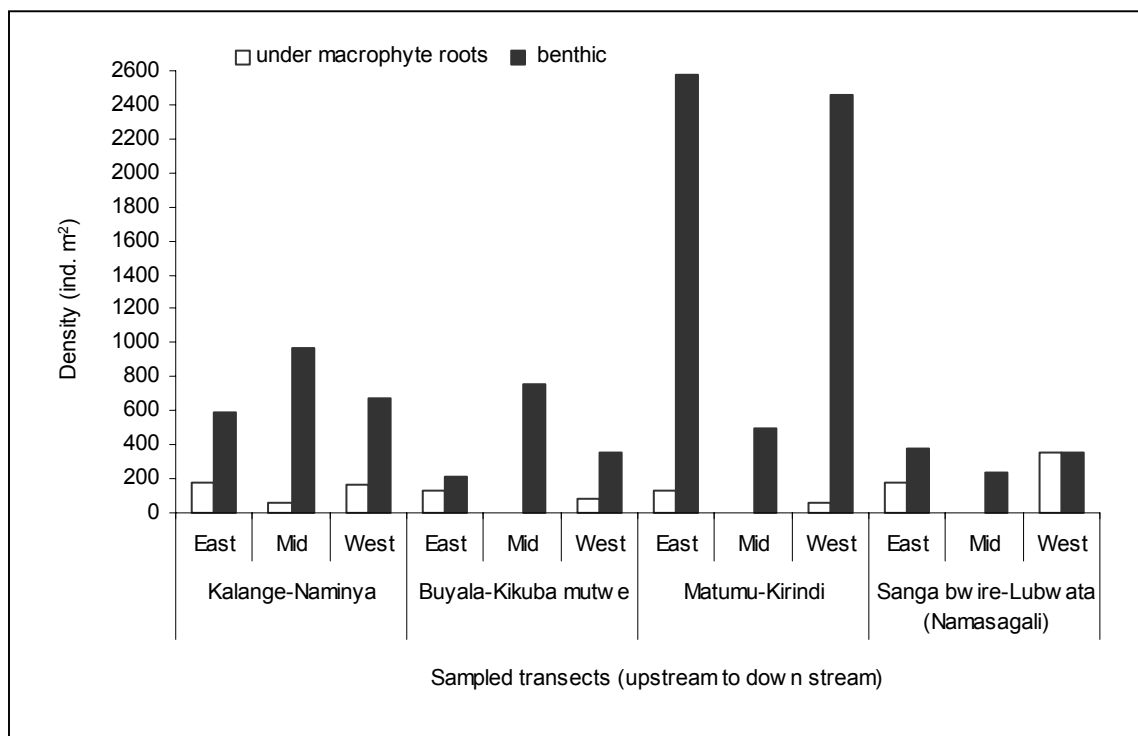


Fig. 7.4. Comparison of benthic macro-invertebrates density and of macro-invertebrates under roots of marginal plants along four transects, April 2006

7.4. Relative taxa densities under plant roots

Along the most downstream transect, Sangabwire-Lubwata/Namasagali, *Caridina nilotica* was the most dominant taxon comprising 69% (244 ind. m⁻²) and 82 % (150 ind. m⁻²) of density at western and eastern points of the transect, respectively (Fig. 5). The other taxa at the western edge of the transect were: Ephemeroptera (9%), Bivalvia (9%), Chironomidae (6%), Gastropoda (3%), Odonata (3%), Coleoptera (2%) and Hydracarina (2%); and at the eastern point, they were: Ephemeroptera (6%), Chironomidae (6%), and Hydracarina (3%). During April 2000 survey, *C. nilotica* was as important as during this survey, contributing 64% (28 ind. m⁻²) and 83% (114 ind. m⁻²) at the eastern and western edges of the transects, respectively (AESNP report, 2nd quarter 2000). Taxa like Ephemeroptera and Chironomidae contributed 17% and 4% respectively at the western edge of the transect during April 2000 survey. Hydracarina was the only other taxon that was recorded at the eastern edge during second quarter April 2000 survey.

At the eastern point on Matumu-Kirindi transect, the bivalves dominated the density by 56% (74 ind. m⁻²), followed by gastropods 36% (48 ind. m⁻²), *Caridina nilotica* 16% (21 ind. m⁻²), ephemeropterans 14% (19 ind. m⁻²), odonates 8% (11 ind. m⁻²) and hemipterans 3% (4 ind. m⁻²) (Fig. 7.3). At the western point on Matumu-Kirindi transect, *C. nilotica* contributed the highest density 45 % (28 ind. m⁻²), then followed by Bivalvia 19% (12 ind. m⁻²), Ephemeroptera 15 % (9 ind. m⁻²) and Odonata 11% (7 ind. m⁻²) and Gastropoda 8% (12 ind. m⁻²). During the April 2000 survey, five taxa were encountered as follows: ephemeropterans 35% (22 ind. m⁻²), Gastropods 10% (6 ind. m⁻²), odonates 18 % (11 ind. m⁻²), tricopterans 10% (6 ind. m⁻²) and Hydracarina 27% (17 ind. m⁻²) at the western edge. On the eastern edge too, 5 taxa were recorded which included ephemeropterans 37% (23 ind. m⁻²), chironomides 37% (23 ind. m⁻²) Gastropods 10% (6 ind. m⁻²), tricopterans 10% (6 ind. m⁻²) and plecopterans 10% (6 ind. m⁻²) at the western edge.

At the Buyala-Kikubamutwe western point, Ephemeroptera contributed 52% (44 ind. m⁻²) the highest density followed by Bilvalvia 13% (11 ind. m⁻²), *C. nilotica* 11 % (9 ind. m⁻²), Gastropoda 11% (9 ind. m⁻²), Odonata 8% (7 ind. m⁻²) and Chironomidae 6% (5 ind. m⁻²) (Fig. 7.4). At the eastern point on Buyala-Kikubamutwe transect, *C. nilotica* 49 % (62 ind. m⁻²) was the most dominant, then followed by Ephemeroptera 29 % (37 ind. m⁻²), Bilvalvia 11% (14 ind. m⁻²), Gastropoda 11% (14 ind. m⁻²) and Hemiptera 9% (11 ind. m⁻²) (Fig 7.5). There were three taxa recorded at the western edge of the transect during April 2000 survey namely: Gastropoda 5 % (6 ind. m⁻²), Bivalvia 90% (108 ind. m⁻²) and chironomidae 5% (6 ind. m⁻²). During the same survey, four taxa were encountered, including Gastropoda 13% (8 ind. m⁻²), Bivalvia 64% (40 ind. m⁻²), Hemiptera 18 % (11 ind. m⁻²) and Chironomidae 3% (2 ind. m⁻²).

At the Kalange-Naminyia western point, Ephemeroptera contributed the most by 34% (55 ind. m⁻²), followed by Chironomidae 13% (21 ind. m⁻²), *C. nilotica* 13% (21 ind. m⁻²), Bilvalvia 13% (21 ind. m⁻²), Simulium sp. 13% (21 ind. m⁻²), Gastropoda 7% (12 ind. m⁻²), Hemiptera 7% (12 ind. m⁻²) and Odonata 4% (7 ind. m⁻²). At the eastern point on the same transect, Ephemeroptera 27% (48 ind. m⁻²) was the most dominant, then followed by Gastropoda 21 % (37 ind. m⁻²), Odonata 16 % (28 ind. m⁻²), Chironomidae 15% (27 ind. m⁻²), *C. nilotica* 7% (12 ind. m⁻²), Hydracarina 8% (14 ind. m⁻²) and Hemipera 2% (4 ind. m⁻²). It was only on this transect that the mid point was sampled for macro invertebrates under plant roots, which consisted of Ephemeroptera 72% (41 ind. m⁻²), Coleoptera 4% (2 ind. m⁻²) and Chironomidae 16% (9 ind. m⁻²) (Fig. 7.5). Unlike in the current survey, during April 2000 survey, Nematodes were recorded at both the eastern and western edges of the transect, contributing 60% (91 ind. m⁻²) and 6% (6 ind. m⁻²) of total density respectively. Apart from Nematodes, three other taxa were recorded at the eastern edge, and these included gastropods 30% (46 ind. m⁻²), ephemeropteran 7% (11 ind. m⁻²) and hemipterans 4% (6 ind. m⁻²). Then on the western edge, six other taxa were encountered and these were: gastropods 21% (23 ind. m⁻²), ephemeropterans 21% (23 ind. m⁻²) and hemipterans 16% (17 ind. m⁻²), chironomids 10% (11 ind. m⁻²), odonates 16% (17 ind. m⁻²) and Hydracarina 10 % (11 ind. m⁻²).

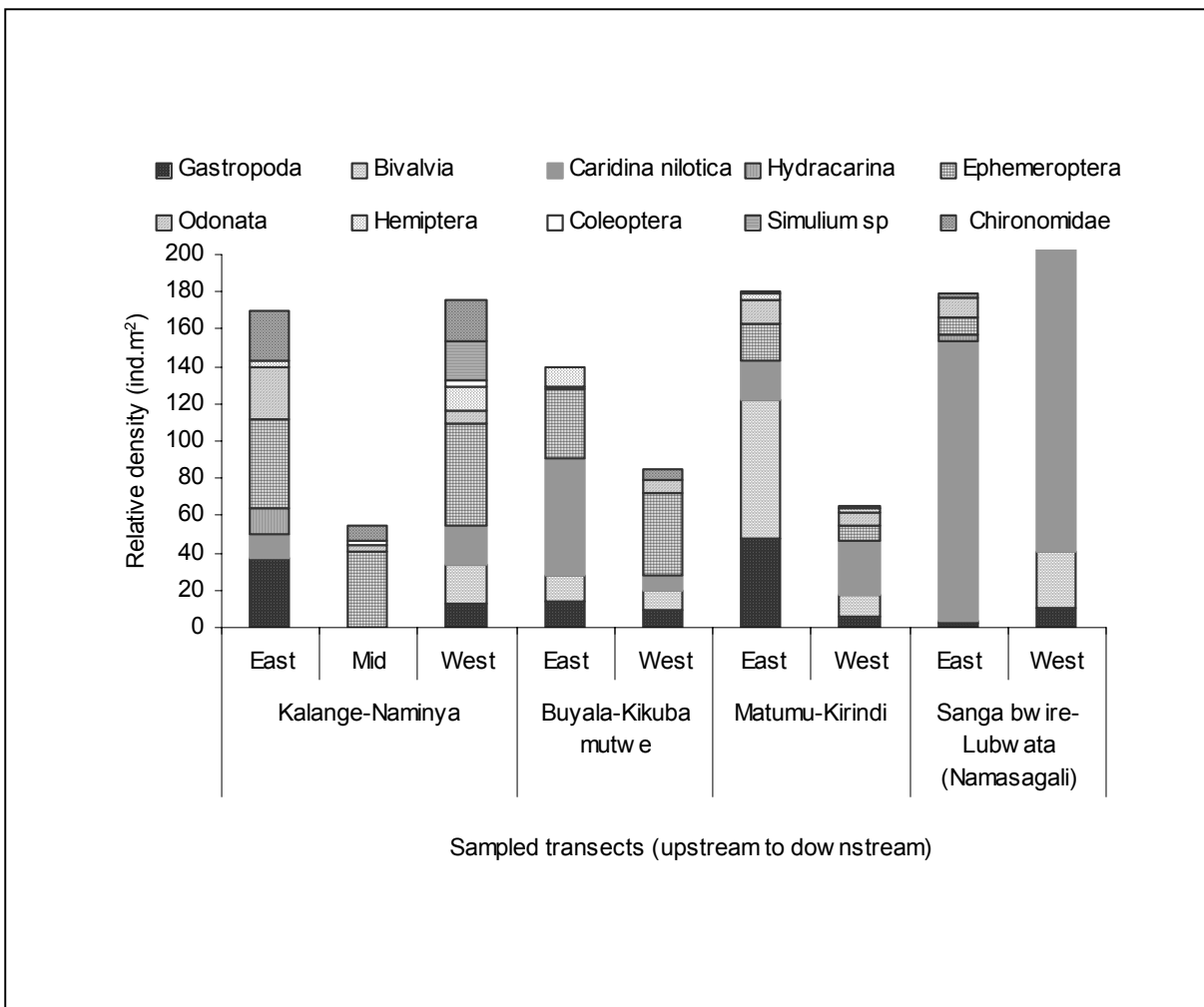


Fig. 7.5. Relative density of major taxa of macro-invertebrate under roots of plants along four sampling transects on Upper Victoria Nile, April 2006.

7.5. Relative taxa densities of benthic macro-invertebrates

Along Sangabwire-Lubwata Namasagali transect, at western and eastern points respectively, only one taxon, Chironomidae at densities of 310 and 296 ind. m⁻² was encountered (Fig. 7.6). However, at the mid of the transect, three taxa were found namely Chironomidae 47% (113 ind. m⁻²), Bivalvia 18% (42 ind. m⁻²) and Ephemeroptera 6% (14 ind. m⁻²). During the April 2000 survey, two taxa, Nematoda 63% (68 ind. m⁻²) and Chironomidae 37% (41 ind. m⁻²) were recorded at the eastern edge. At the western edge too in this survey, two taxa, Bivalvia 67 % (27ind. m⁻²) and Chironomidae 33% (14 ind. m⁻²) were encountered, and at the mid point, six taxa groups were encountered dominated by Bivalves 82% (1972 ind. m⁻²). The other taxa included Ephemeroptera, Trichoptera, Odonata, Nematoda and Chironomidea.

At the eastern point on Matumu-Kirindi transect, Chironomidae dominated the density by 61% (1579 ind. m⁻²) followed by Bivalvia 16% (409 ind. m⁻²), Gastropoda 10% (268 ind. m⁻²), Ostracoda 7% (169 ind. m⁻²) and Ceratopogonidea 3% (70 ind. m⁻²). At the western point on this transect, Chironomidae still contributed *the* most by 61% (1508 ind. m⁻²) followed by Bivalvia 28% (677 ind. m⁻²), Gastropoda 7% (169 ind. m⁻²) and Ceratopogonidea 2% (42 ind. m⁻²). The mid point on the transect registered very low benthic density that comprised of three taxa: Chironomidae 31% (155 ind. m⁻²), Ephemeroptera 26% (127 ind. m⁻²) and Bivalvia 17% (85 ind. m⁻²). During the April 2000 survey, 5 taxa group were recorded at both the western and eastern edge of the transect. At the eastern edge, these were Chironomidae 74% (1197 ind. m⁻²), Ephemeroptera 24% (380 ind. m⁻²), Tricoptera 1% (14 ind. m⁻²), Bivalvia 1% (14 ind. m⁻²) and Gastropoda 1% (14 ind. m⁻²). At the western edge, Chironomidae 52% (190 ind. m⁻²), Bivalvia 30% (108 ind. m⁻²) Odonata 11% (41 ind. m⁻²), Tricoptera 4% (14 ind. m⁻²), and Nematoda 4% (14 ind. m⁻²) were recovered. At the mid, two taxa, Chironomidae 57% (54 ind. m⁻²) and Tricoptera 43% (41 ind. m⁻²) were recorded.

At the Buyala-Kikubamutwe western point, three taxa were encountered namely: Ephemeroptera 56% (197 ind. m⁻²), Gastropoda 16% (56 ind. m⁻²) and Chironomidae 16% (56 ind. m⁻²) Fig. 6. At the mid point of the transect, three taxa too were encountered as follows: Bivalvia 35% (268 ind. m⁻²), Gastropoda 37% (282 ind. m⁻²) and Chironomidae 26 % (197 ind. m⁻²). At the eastern point on the transect, Bilvalvia was 20% (42 ind. m⁻²). The other two taxa were Chironomidae and Gastropoda each contributing 33 % (70 ind. m⁻²). During April 2000 survey, Bivalvia was the most dominant taxon at both eastern and western edges of the transect by 70% (2643 ind. m⁻²), and 58% (258 ind. m⁻²), respectively. At the eastern edge during the same survey, five other taxa were recorded as follows: Gastropoda 21% (784 ind. m⁻²), Ephemeroptera 2% (81 ind. m⁻²), Tricoptera 1 % (45 ind. m⁻²), Odonata <1% (14 ind. m⁻²), Chironomidae 5% (204 ind. m⁻²) and Nematoda <1% (23 ind. m⁻²). The mid point registered no benthos during this survey.

At the Kalange-Naminyia eastern point, three taxa were encountered, namely Chironomidae 62% (367 ind. m⁻²), Bivalvia 29% (169 ind. m⁻²) and Ceratopogonidea 2% (14 ind. m⁻²). At the mid point, three taxa were encountered as follows: Chironomidae 52% (508 ind. m⁻²), Bivalvia 25% (240 ind. m⁻²) and Ephemeroptera 10% (99 ind. m⁻²). At the western point, only two taxa were encountered, Gastropoda 27% (183 ind. m⁻²) and Bivalvia 62 % (423 ind. m⁻²). During April 2000 survey, Gastropoda was the most dominant taxon at both eastern and western edges of the transect by 53 % (7768 ind. m⁻²), and 89% (9862 ind. m⁻²), respectively. At the eastern edge during the same survey, six other taxa were recorded as follows: Ephemeroptera 23% (3414 ind. m⁻²), Tricoptera 1% (45 ind. m⁻²), Bivalvia 3% (462 ind. m⁻²), Odonata <1 % (14 ind. m⁻²), Chironomidae 5% (204 ind. m⁻²) and Nematoda <1% (23 ind. m⁻²). Apart from gastropods, five other taxa were encountered namely: Ephemeroptera 2% (299 ind. m⁻²), Tricoptera <1% (14 ind. m⁻²), Bivalvia <1% (54 ind. m⁻²), Chironomidae 4% (490 ind. m⁻²) and Nematoda 3 % (408 ind. m⁻²).

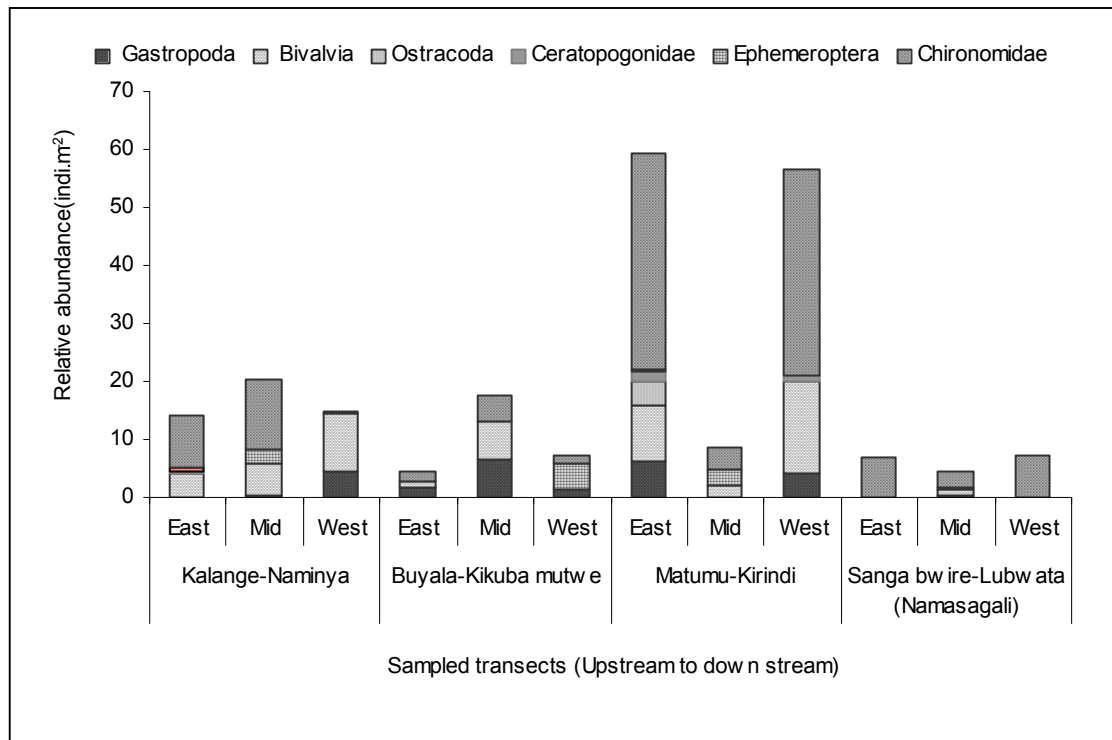


Fig. 7.6. Relative taxa composition and abundance of benthic macro-invertebrates at the eastern, mid and western sampling points on four transects across the upper River Victoria Nile, April 2006

7.6. Discussion

One group of organisms especially sensitive to water pollution are the combined insect Orders of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), abbreviated EPT. High numbers (at least 100 indi. m⁻²) of these organisms in a river represent good water quality. Their absence or just occasional occurrence may indicate a pollution problem. A macro-invertebrate community dominated by organisms more tolerant of pollution, such as aquatic worms and midges, usually indicates a problem.

CHAPTER 8

8.0. Fish species Composition and Relative Abundance

8.1. Background

Construction of the proposed Bujagali Hydroelectric dam at Dumbbell Island on the River Nile is likely to cause changes in the river water regimes both upstream and downstream. This may affect fish habitats and thus composition and abundance of fish populations above and below the dam. Many fish species presently occurring in this river are suited to particular types of habitats that may be altered by the presence of the dam. Water quality characteristics during construction are likely to be altered and could also affect fish distribution along the river. Considering that fish provide the cheapest source of animal protein and income to the riparian human populations along this river any change in the fish populations could affect the livelihood of these people. It is therefore necessary to monitor changes in fish composition and abundance to mitigate dam construction effects. The objectives of this study therefore were to:

- a) Determine fish species composition at selected transects upstream and downstream of the proposed dam site.
- b) Determine changes in their size distribution over time at those sites.
- c) Assess the relative abundance of the species.
- d) Monitor the above parameters during and after dam construction.

This part of the report gives the present fish species composition, distribution and their relative abundance along transects upstream and downstream of Dumbbell Island and compares the results with the April 2000 study. Monitoring the above parameters is expected to be done prior to, during and after construction in order to determine changes in fish population as influenced by both the construction and the presence of the dam.

8.2. Materials and Methods

Three fleets of gill-nets comprising pieces of mesh sizes 1" to 5.5" in 0.5" increments, and 6 to 8 in 1" increments were set overnight twice at each of the four transect stations between 6th – 13th April 2006. A similar procedure was used during the April 2000 survey. At each station, fleets were set so as to cover a broad range of habitat conditions i.e. of different bank features such as vegetation or rock, adjoining bays, mid-channel, and off islands. Locality names were noted.

The nets were set between 1800hr to 1900hr, and removed between 06.00h and 07.00h the following day. Each block of nets was separated and handled according to fishing grounds.

Experimental catch and biometric data on large sized fish species were taken on spot while the smaller sized ones were preserved for laboratory examination. Fish were sorted according to mesh size, identified and separated into species

Measurements (weight in grams, length as total length in centimetres) and other biometric indices (sex, gonad condition, degree of stomach fullness and fat content) were recorded. Gonad maturity state was based on I to VII - scale according to the method of (Bagenal and Braum, 1978). Stomach fullness and fat content were assessed by eye as empty, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and full.

Stomach contents of small fishes and the tilapiines and ripe ovaries - states V and VI were preserved respectively in a mixture of 5-10% formalin and 50% ethanol for laboratory analyses. Due to their growth form, the length (in centimeters) of fish was measured either as Total Length (TL), Forkal Length (FL), or Standard Length (SL).

8.3. Results

8.3.1. Catch composition

A total of 18 fish species were recorded at all stations along the river (Table 8.1). 11 species were recorded at Buyala, 10 at Kalange, seven at Namasagali, and six at Kirindi. *L. niloticus* and the Haplochromines were caught at all stations sampled. Although experimental nets missed *Rastrineobola argentea*, the species was observed at Buyala from the local fisher's catches.

In terms of numbers, catches were dominated by the haplochromines. *M. kannume* and *L. niloticus* were second and third respectively in importance (Fig. 8.1). By weight, *M. kannume* became the dominant fish species followed by *L. niloticus* and then the haplochromines (Fig. 8.2).

8.3.2. Catch rates / biomass estimates

As a measure of standing biomass, catch rates (i.e. catch per net per night) was used as indicator of relative abundance of fish species from the stations under survey. To analyze for catch per net, gillnets were grouped into three size categories, small (1 to 2½ inches stretched mesh), medium (3 to 4½) and large (5 to 8 inches). There was no order of biomass with distance from either lake. Highest biomass was recorded at Buyala and lowest at Kirindi. The overall catch per net both by numbers and weight decreased with the size category of net (Fig. 8.3). Total catch rates of different fish species from the four stations during the current and a similar quarter in 2000 are given in Table 8.2. Highest biomass in the river comprised of the haplochromines with a catch rate of 188.7g per net. *M. kannume* with a mean catch rate of 165.7.2g per net was second. Other fish species showing high rates in order of importance were *L. niloticus* (70.4g), *Tilapai zillii* (30.4g) and *Barbus altianalis* (29.3g). All these are species that grow to large adult sizes (keystone species) and therefore form the basis of the artisanal fishery along this river. With the exception of the haplochromines which

dominated the catch, catches of all species from the April 2006 survey were lower compared to a similar period in 2000.

8.3.3. Length frequency Distribution

Size distribution of *Lates niloticus* caught during the survey (Fig. 8.4) ranged from 8 to 37cm TL. All the *Lates* specimens caught were immature with mean length ranging from 18.3 cm in Buyala to 21.6cm TL in Kirindi. *M. kannume* ranged in size from 14 to 64cm FL. Fishes of the size range 21 to 25 cm FL dominated the population of this species in the river (Fig. 8.5). The overall mean length was calculated at 19 cm TL. The largest *Mormyrus* was at 64 cm FL and was recorded at Buyala. All *R. argentea* caught in the artisanal fishery at Buyala were immature with an average length of 19 mm SL.

8.4. Discussion

Fish species caught in the Upper Victoria Nile are typical Victorian (inshore) and Kyoga fauna. At Kirindi, the middle station yielded *Xystichromis bayoni*, a typical Upper Victorian haplochromine. Using catch rates (catch per net), one can arrive at an indication of the biomass of different fish species found in the river. These rates will over time be the basis of comparative assessment of stocks at different times and from different transects. Gillnetting revealed low catch rates compared to a similar period in 2000. The order of importance of fish species also shifted in favour of the haplochromines in the April 2006 survey. This is in agreement with the current trends in the two lakes terminal to the upper Victoria Nile. In these lakes a recovery of haplochromines has been observed (IFMP reports 2005, NAFIRRI Report 2006). There was also a noticeable increase in the biomass of *Oreochromis variabilis* a species native to the two lakes, (Lake Victoria and Lake Kyoga) whose numbers had been greatly reduced in these waters. *O. niloticus* performed poorly compared to the previous April 2000 survey. Even among the artisanal catches this species was prominent in Kalange the nearest station to Lake Victoria and at Namasagali, nearest to L. Kyoga. Low catches of *O. niloticus* are common during breeding periods of the species as mobility and thus access to gillnets is reduced due to breeding activities.

8.5. Summary

- 18 fish species were recorded from experimental nets along the river, between Kalange and Namasagali.
- Highest species diversity was observed from Namasagali consisting mainly of anadromous fish species from Lake Kyoga.
- All keystone species identified during the previous survey were present. Commercially important fish species in the river *M. kannume*, *B. altianalis*, and *L. niloticus* were encountered at all stations along the river.
- Gillnets set in shallow waters very close to the shores recovered fish species that grow to a small adult size and juveniles of the large species while the large adults tended to be found in the deeper waters in the middle of the river.

- Small sized fishes dominated catches with the highest rates registered by the haplochromines.

8.6. Conclusion

All keystone fish species expected in the river were recorded. Poorer fish catches were realized compared to a similar season in 2000. This could have probably been due to less amount of movement due to breeding activities. This time round, the perennial problem of net loss in the river was minimal. It occurred only at Namasagali where on the first day of setting, a whole fleet was washed away by the strong current.

Table 8.1. Fish species recorded at the four sampling stations on the Upper Victoria Nile April 2006

Family	Species	Transect 1 Upstream Kalange to Makwanzi	Transect 2 Downstream Buyala to Kikubamutwe	Transect 3 Downstream Kirindi to Matumu	Transect 4 Downstream Namasagali to Bunyamira	All Transects April 2000
Bagridae	<i>Bagrus docmak</i>			p		p
Centropomidae	<i>Lates niloticus</i>	p	p	p	p	p
Characidae	<i>Brycinus jacksonii</i>		p			p
	<i>B. sadleri</i>	p				p
Cichlidae	<i>Oreochromis niloticus</i>	p	p			p
	<i>O. leucostictus</i>	p	p			p
	<i>O. variabilis</i>	p	p			p
	<i>Tilapia zillii</i>	p	p		p	p
	<i>Haplochromines</i>	p	p	p	p	p
Cyprinidae	<i>Barbus altianalis</i>	p	p	p		p
	<i>B. paludinosus</i>		p			p
	<i>Labeo victorianus</i>			p		p
	<i>Rastrineobola argentea</i>					p
Mochokidae	<i>Synodontis afrofisheri</i>	p				p
	<i>S. victoriae</i>				p	p
Mormyridae	<i>Marcusenius grahami</i>					p
	<i>Mormyrus kannume</i>	p	p	p		p
	<i>M. macrocephalus</i>					p
	<i>Gnathonemus victoriae</i>				p	p
	<i>G. longibarbis</i>				p	p
Schilbeidae	<i>Shilbe intermedius</i>					p

(p = present)

Table 8.2. Catch per net per night (g) of fish species from experimental gillnets during the 1st quarter (April 2006) at the four transects along River Nile.

Species	Transect 1 Upstream Kalange to Makwanzi		Transect 2 Downstream Buyala to Kikubamutwe		Transect 3 Downstream Kirindi to Matumu		Transect 4 Downstream Namasagali to Bunyamira		All Transects April	
	2000	2006	2000	2006	2000	2006	2000	2006	2000	2006
<i>Bagrus docmak</i>	0	0	19.1	0	131.0	11.2	0	0	37.5	3.5
<i>Lates niloticus</i>	39.9	20.6	48.7	141.5	184.2	12.4	86.6	180.3	89.9	70.4
<i>Brycinus jacksonii</i>	1.6	0	0	3.3	0	0	0	0	0.4	1.0
<i>B. sadleri</i>	0	0.6	0	Nil	0	0	14.3	0	3.6	0.2
<i>Oreochromis niloticus</i>	0	2.4	75.7	5.9	0	0	47.8	0	30.9	2.5
<i>O. leucostictus</i>	29.4	3.7	0	7.6	0	0	1.1	0	7.6	2.8
<i>O. variabilis</i>	33.8	33.5	0	11.6	0	0	0	0	8.5	13.5
<i>Tilapia zillii</i>	0	6.9	0	81.9	0	0	40.5	38.1	10.1	30.4
<i>Haplochromines</i>	7.3	303.9	17.1	284.9	7.7	7.7	33.9	98.0	16.5	188.7
<i>Clarias gariepinus</i>	0	0	0	12.0	0	0	0	0	0	3.6
<i>Barbus altianalis</i>	0	25.2	213.9	63.9	297.1	8.5	7.7	0	129.7	29.3
<i>B. paludinosus</i>	0	0	0	0.5	0	0	0	0	0	0.2
<i>Labeo victorinus</i>	0	0	0	0	13.6	19.3	4.2	0	4.5	5.8
<i>Protopterus aethiopicus</i>	27.9	0	0	0	0	0	0	0	7.0	0
<i>Synodontis afroischeri</i>	0	0	0	0	0	0	135.9	153.5	34.0	18.6
<i>S. victoriae</i>	7.1	0	0	0	0	0	31.1	20.5	9.6	2.1
<i>Marcusenius grahami</i>	0	0	0	0	4.8	0	9.2	0	3.5	0
<i>Mormyrus kannume</i>	239.4	144.1	205.7	284.3	4.9.5	124.1	46.2	0	225.2	165.7
<i>M. macrocephalus</i>	0	0	0	0	0	0	20.5	0	5.1	0
<i>Gnathonemus victoriae</i>	0	0	0	0	0	0	1.6	151.3	0.4	15.1
<i>G. longibarbis</i>	0	0	0	0	0	0	2.8	18.5	0.7	1.9
<i>Shilbe intermedius</i>	0	0	0	0	0	0	23.5	0	5.9	0

NB: Localities associated with Transect 1 upstream include: Kikonko, Kunjaba, Makwanzi Is, Transect 2 downstream include: Naminya, Kisadha, Ofwono, Zaire, Mugalya, Kisoga, Transect 3 downstream include: Matumu, Kisoga A,B,C, Damba, Transect 4 downstream include: Kasanga, Kibuye, Sajjabi

Table 8.3. List of fish and their common names (English and Local) found during the surveys of the River Nile.

Scientific Name	Common English name	Local name
<i>Bagrus docmac</i>	Cat fish	Semutundu
<i>Barbus altianalis</i>	Barbel	Kisinja
<i>Labeo victorianus</i>		Ningu
<i>Brycinus sadleri</i>		Nsoga
<i>Gnathonemus longibarbis</i>		Kisoma
<i>Gnathonemus victoriae</i>		Kisoma / Bobo
Haplochromines		Nkejje
<i>Labeo victorianus</i>		Ningu
<i>Lates niloticus</i>	Nile perch	Mputa
<i>Mormyrus kannume</i>	Elephant snout fish	Kasulubana
<i>Oreochromis leucostictus</i>	Tilapia	Ngege
<i>Oreochromis niloticus</i>	Tilapia	Ngege
<i>Oreochromis variabilis</i>	Tilapia	Mbiru.
<i>Synodontis afrofisheri</i>	Catfish	Nkolongo
<i>Synodontis victoriae</i>	Catfish	Nkolongo
<i>Tilapia zillii</i>		Ngege

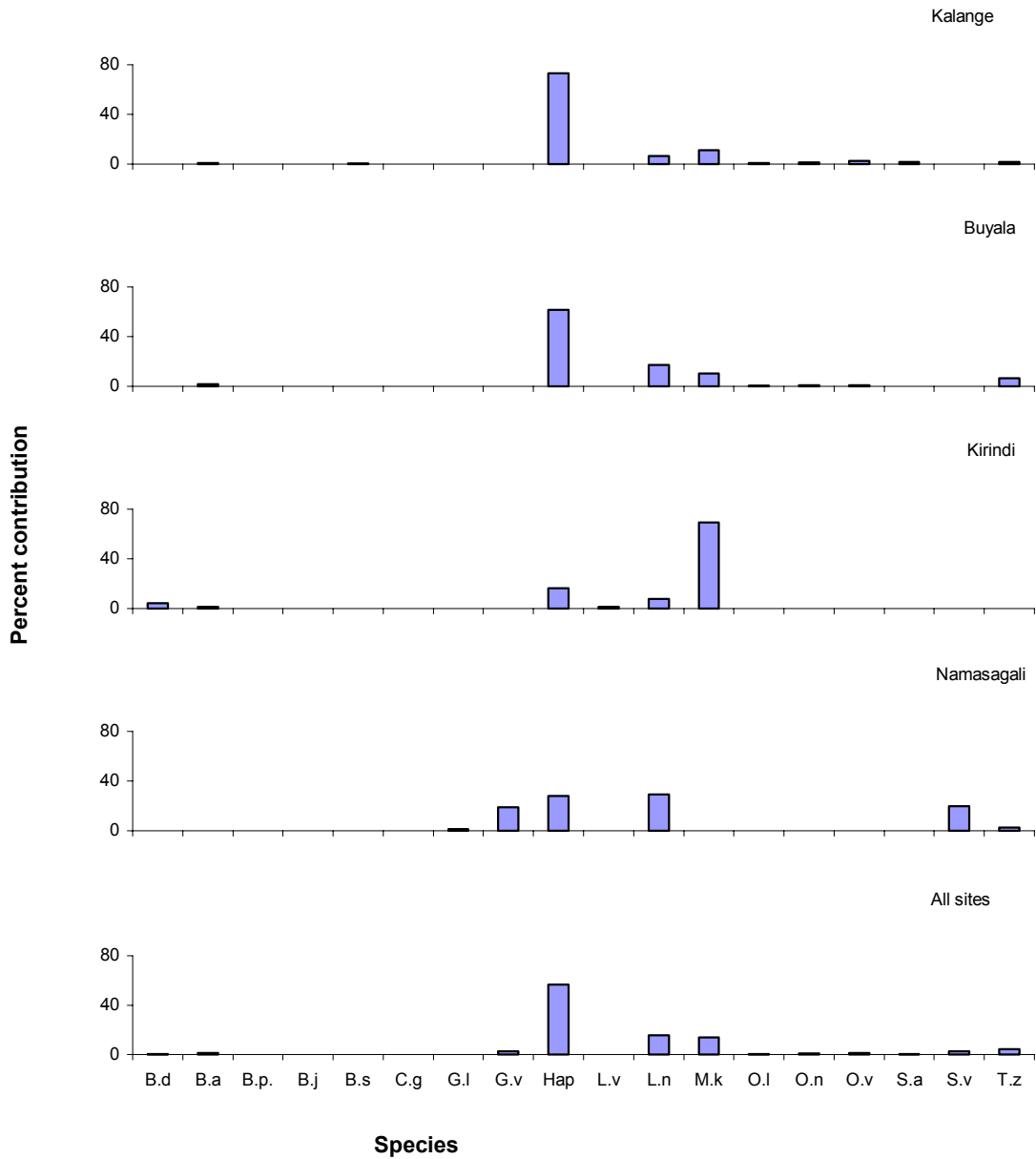


Figure 8.1 Relative abundance (numbers) of fish species caught in gill nets in April 06 along the Nile

B.j	<i>Brycinus jacksonii</i>	G.l	<i>Gnathonemus longiba</i>	O.n	<i>Oreochromis niloticus</i>
B.s	<i>Brycinus sadleri</i>	G.v	<i>Gnathonemus victoria</i>	O.l	<i>Oreochromis leucostictus</i>
B.a	<i>Barbus altianalis</i>	Haps	<i>Haplochromines</i>	O.v	<i>Oreochromis variabilis</i>
B.p	<i>Barbus palludinosus</i>	L.v	<i>Labeo victorianus</i>	S.a	<i>Synodontis afrofisheri</i>
B.d	<i>Bargrus docmac</i>	L.n	<i>Lates niloticus</i>	S.v	<i>Synodontis victoriae</i>
C.g	<i>Clarias gariepinus</i>	M.k	<i>Mormyrus kannume</i>	T.z	<i>Tilapia zillii</i>

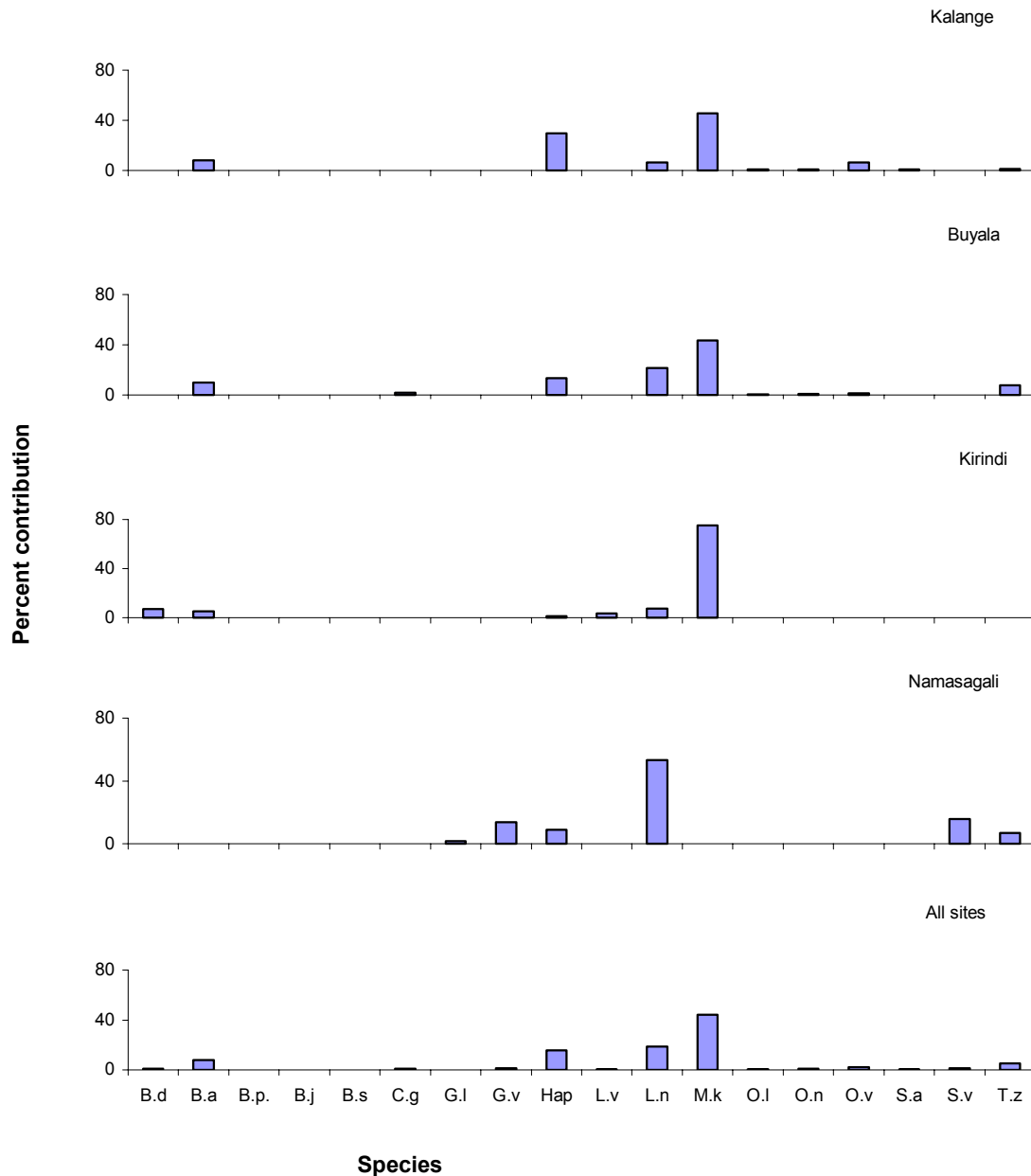


Figure 8.2 Relative abundance (weight) of fish species caught in gill nets in April 06 along the Nile

B.j	<i>Brycinus jacksonii</i>	G.l	<i>Gnathonemus longiba</i>	O.n	<i>Oreochromis niloticus</i>
B.s	<i>Brycinus sadleri</i>	G.v	<i>Gnathonemus victoriae</i>	O.l	<i>Oreochromis leucostictus</i>
B.a	<i>Barbus altianalis</i>	Haps	<i>Haplochromines</i>	O.v	<i>Oreochromis variabilis</i>
B.p	<i>Barbus palludinosus</i>	L.v	<i>Labeo victorianus</i>	S.a	<i>Synodontis afrofisheri</i>
B.d	<i>Bagrus docmac</i>	L.n	<i>Lates niloticus</i>	S.v	<i>Synodontis victoriae</i>
C.g	<i>Clarias gariepinus</i>	M.k	<i>Mormyrus kannume</i>	T.z	<i>Tilapia zillii</i>

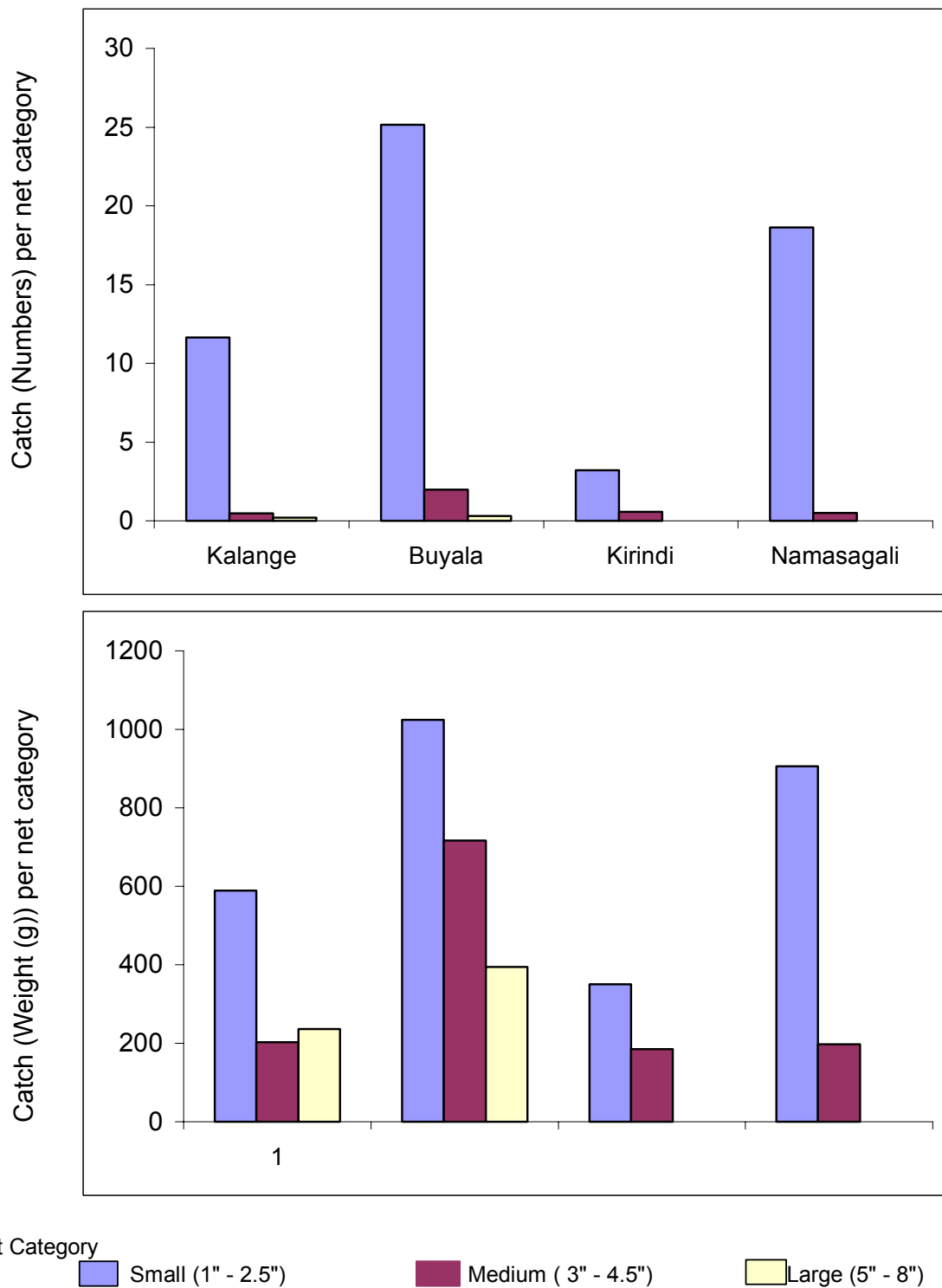


Figure 8.3 Mean catch per net category from sampled stations along River Nile - April 2006

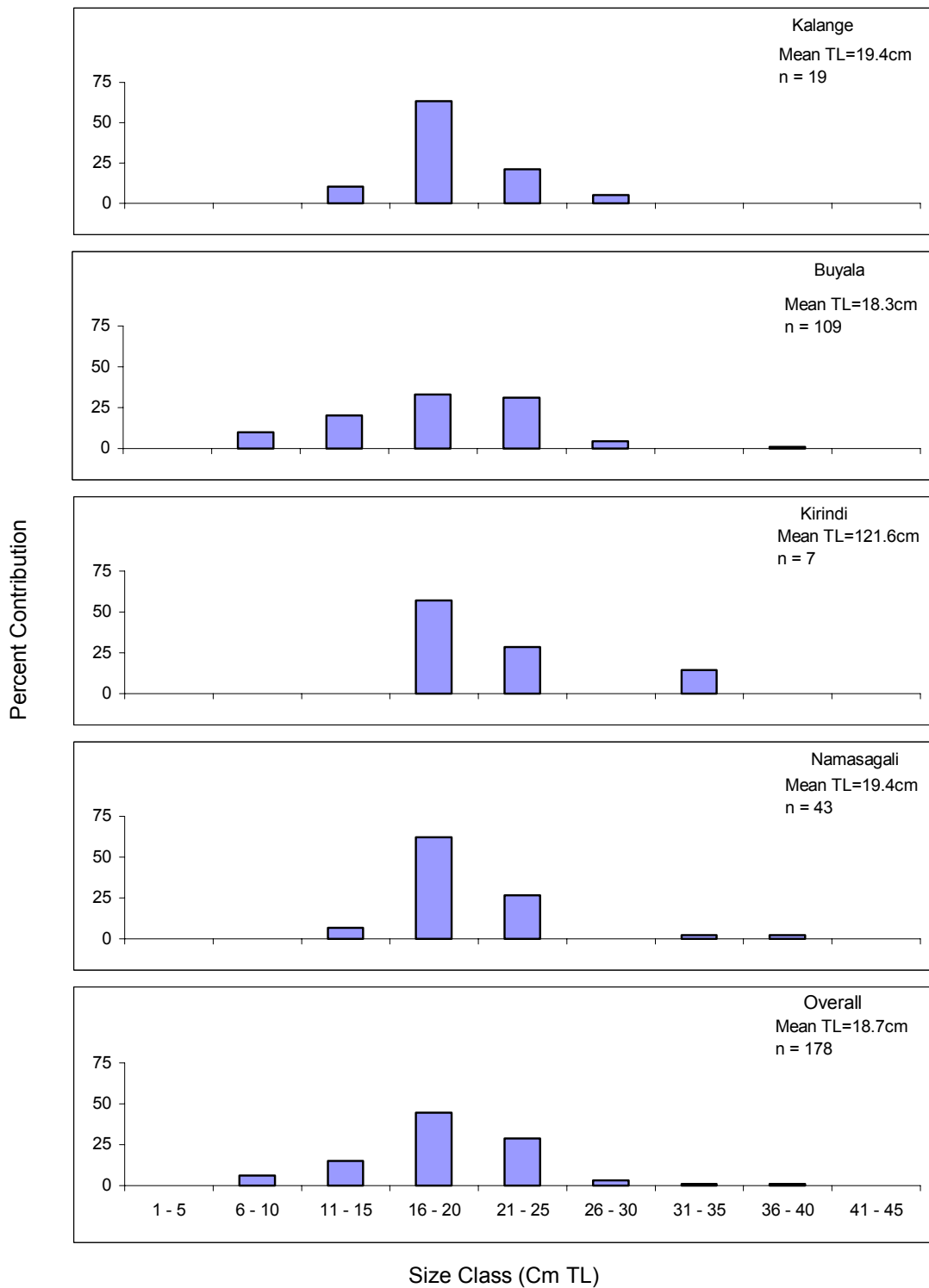


Figure 8.4 Size distribution of *Lates niloticus* caught in experimental gillnets at sampled stations along the Upper Victoria Nile April 2006

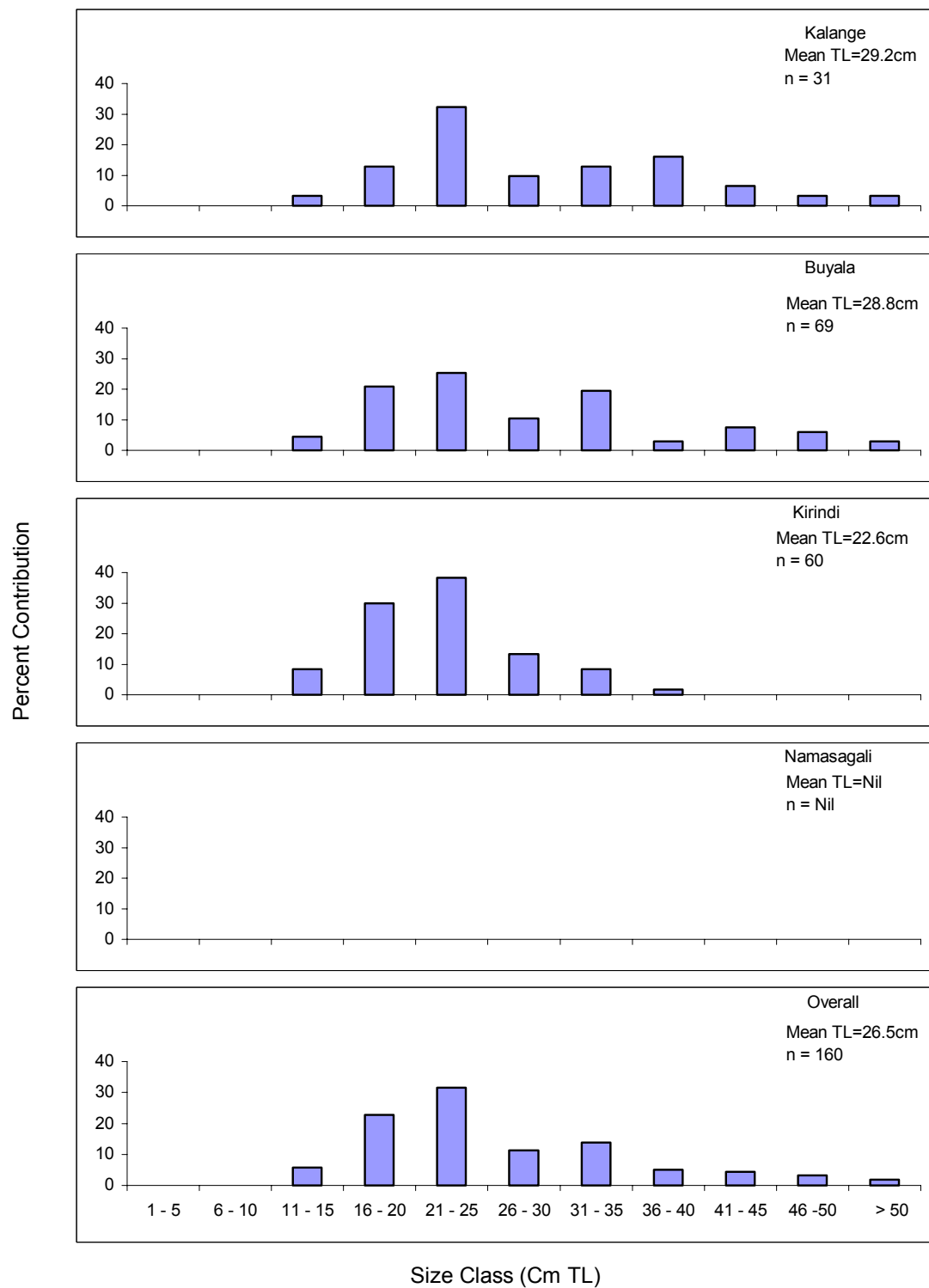


Figure 8.5 Size distribution of *Mormyrus kannume* caught in experimental gillnets at sampled stations along the Upper Victoria Nile April 2006

CHAPTER 9

9.0. Biology and Ecology of Fishes

9.1. Introduction

Fish are among the major components of aquatic ecosystems that may be adversely impacted by hydropower projects along rivers. Some of the ecological aspects of development that may affect fish are changes in water flow, characteristics of new water regimes and interruption in breeding for those fishes which are migratory. Changes in composition of food organisms may also affect the ecology of fishes. As riverine fishes are important in the socio-economic livelihood especially of the riparian communities, baseline information on the ecology of fish populations prior to development is very important. In this report, the biology and ecology of the fishes occurring between an upstream of the proposed project transect and 3 downstream transects was studied and compared with similar studies conducted in April 2000 in the same transects. Two main aspects have been evaluated – the feeding ecology and breeding (egg production).

9.2. Materials and methods

Stomach content analysis and fecundity were conducted as detailed in the report of the previous AESNP Survey of April 2000.

9.3. Results

9.3.1. The food and trophic ecology of the fishes

Six fish species were used as indicators of trophic ecology. They included *Mormyrus kannume* and *Lates niloticus* in most sites, *Synodontis afrofisheri* and *Gnathonemus victoriae* from Kalange and Namasagali transects; *Oreochromis variabilis* from Kalange and *T. zillii* from Kalange, Buyala and Namasagali

9.3.1a. *Mormyrus kannume*

In all the sites where it occurred most abundantly, Transect 1 to 3 (corresponding to Kalange, Buyala and Kirindi) respectively, *Mormyrus kannume* fed mostly on insects which included chironomids, Ephemeroptera, Trichoptera, and unidentified insect remains. Other prey items included *Rastrineobola argentea*, unidentified fish remains, molluscs and crabs. The relative importance of food items in the diet of *M. kannume* is shown in Fig. 9.1.

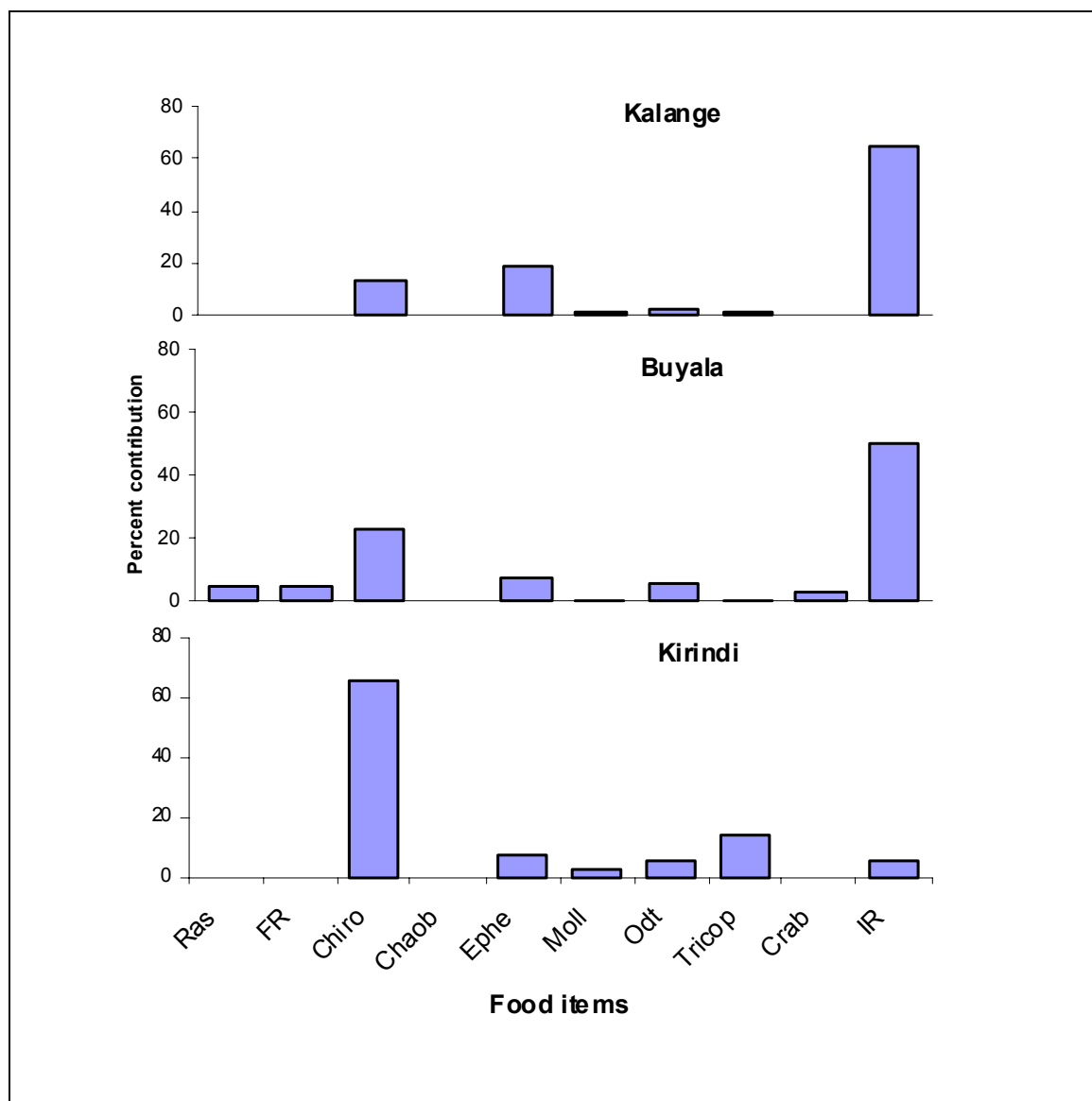


Fig. 9.1. The relative importance of food items in the diet of *Mormyrus kannume* caught at the 3 transects along the Victoria Nile

Ras = *Rastrineobola argentea*; FR = Fish remains; Chiro = chironomid; Chaob. = Chaoborid; Ephe. = Ephemeroptera; Moll. = Mollusc; Odt. = Odonata; Tricop. = Trichoptera; IR = Unidentifiable insect remains

9.3.1b. *Lates niloticus*

As in previous surveys, *Lates niloticus* had ingested mostly fish prey which was dominated by haplochromines, *Clarias* sp. and unidentified fish remains (Fig. 9.2). Other prey items included *Caridina nilotica*.

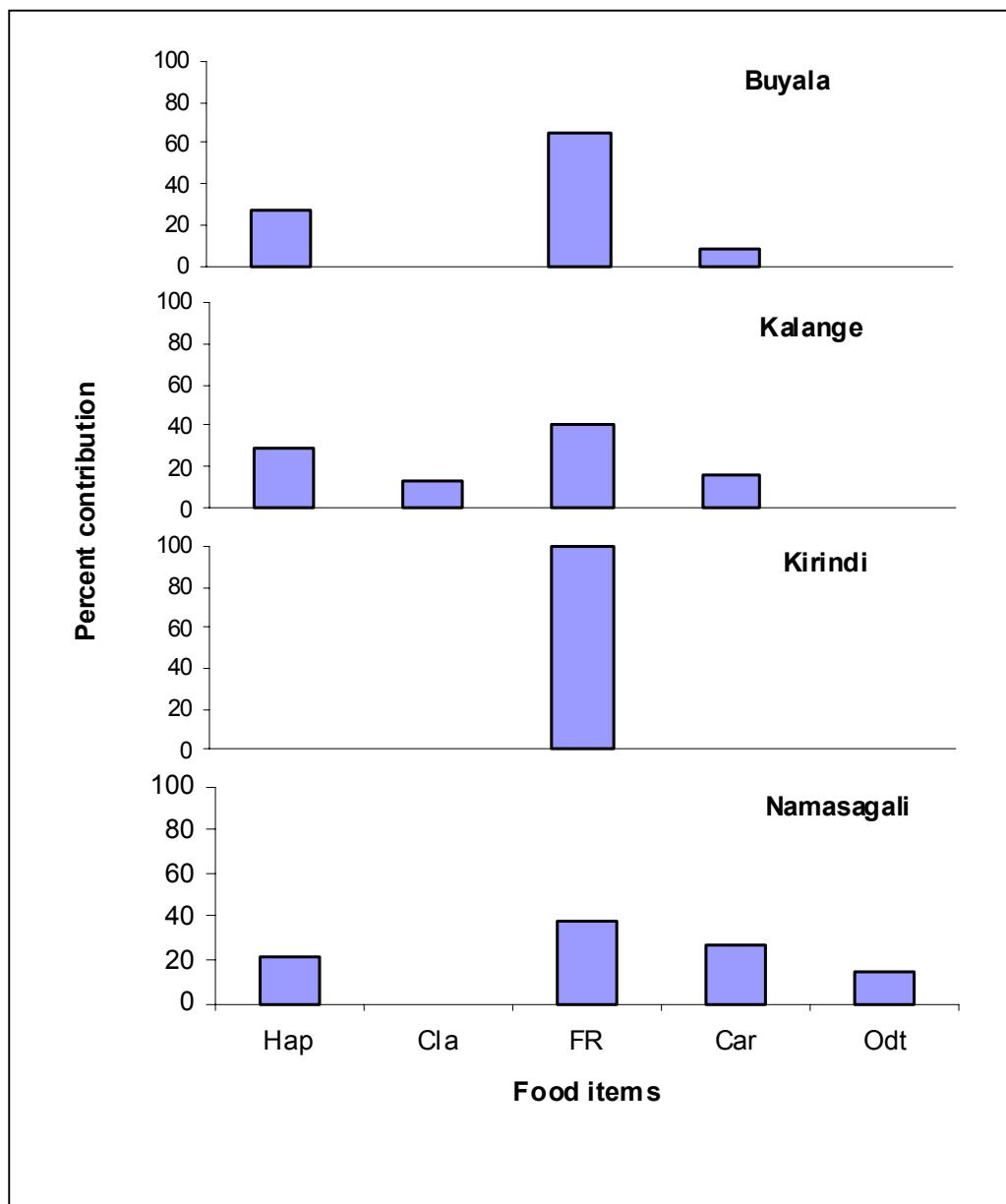


Fig. 9.2. The relative importance of food items in the diet of *Lates niloticus* caught at the four transects along the Victoria Nile

Hap. = haplochromines; Cla. = *Clarias* sp.; FR. = Unidentifiable fish remains; Car. = *Caridina nilotica*; Odt. = Odonata

9.3.2c. *Synodontis afrofisheri*

The main food of *Synodontis afrofisheri* during this survey was chironomids (35.7%), Odonata (32.1%), chaoborids (14.3%), unidentified insect remains, (14.0%), Ephemeroptera (3.6%) and molluscs (0.3%). This contrasted with results obtained in the April 2000 survey results in which the dominant food items were Isoptera.

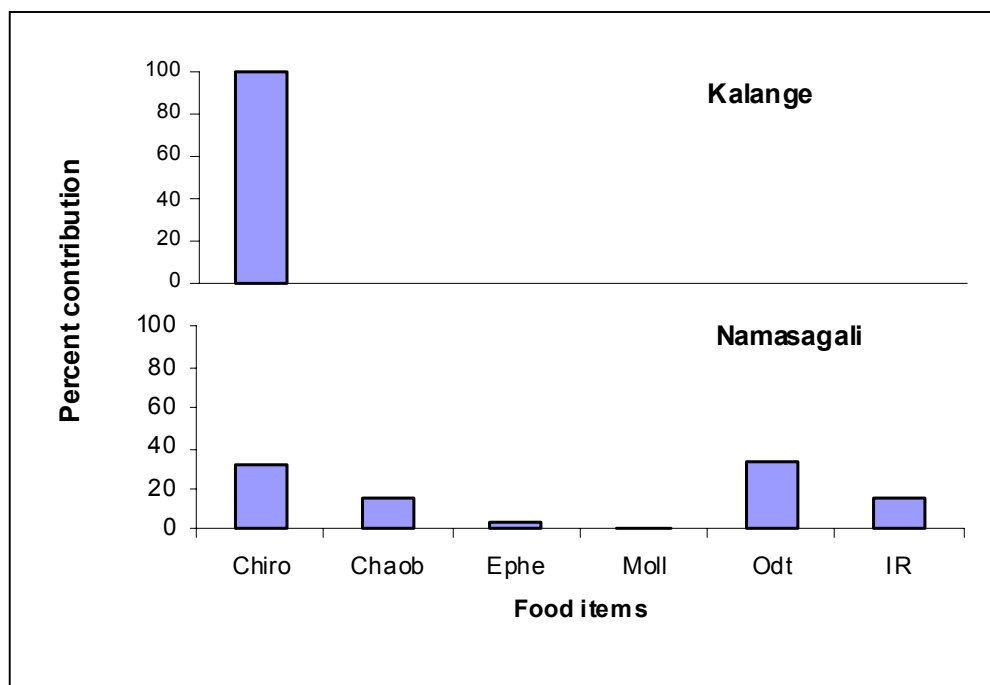


Fig. 9.3. The relative importance of food items in the diet of *Synodontis afrofischeri* caught at the two transects along the Victoria Nile.

9.3.2d. Food of other fish species

Among the tilapiines, only *Oreochromis variabilis* and *Tilapia zillii* had stomachs with food contents. In *O. variabilis*, the food items included algae (63.9%), detritus (32.4%) and high plant material (3.6%), while in *Tilapia zillii*, the dominant food item was algae (94.1) followed by high plant material (4.6%) and detritus (4.6%). There were no *O. niloticus* specimens with stomach contents.

Bagrus docmack fed predominantly on fish prey (60%) and Ephemeroptera (40%) while *Gnathonemus victoriae* fed exclusively on chironomids.

9.3.3. Fecundity (egg production)

Fecundity was only assessed in *Oreochromis niloticus* where only one ripe female was recorded with a fecundity of 4414 eggs. This was higher than in the survey of April 2000 where the only female specimen recorded had a fecundity of 1922 eggs. The mormyrids were not considered for fecundity studies because most of the ripe female had partially shed the eggs while in *Lates niloticus* there were no ripe female specimens recovered in the catches.

9.4. Discussion

Results of the food analysis indicate that *L. niloticus* and *B. docmack* were the main predatory fishes in the sites surveyed although in Buyala *M. kannume* was found to have included *R. argentea* and unidentifiable fish remains in its diet. However, insects especially chironomids were the main food items ingested by all the fish species recorded in the catches. Other food items included molluscs, *Caridina* and crabs. High plant material was an important food item for *T. zillii* and *O. variabilis*. Thus vegetation dominated habitats are important in the food web of the Upper Victoria Nile probably because, in addition to being a food item for the tilapiines, they are also an important habitat for other organisms especially insects, which are an important food item for most of the fish species recorded in the catch.

Higher densities of breeding adults of mormyrids were encountered as in the previous sampling of April 2000. This seems to be correlated with the onset of breeding triggered by the onset of the rain season. Despite the large number of *Lates niloticus* recorded from the experimental gillnets and *O. niloticus* purchased from the commercial fishers, only 1 specimen of *O. niloticus* had ripe gonads and no breeding specimen was recorded for *L. niloticus*. For *L. niloticus* this observed trend may be due to absence of adult specimens (>50 cm TL) which usually have ripe gonads while for *O. niloticus* it was not yet peak breeding.

CHAPTER 10

10.0. The Fishery Catch Survey

10.1. Background

Fish and fish products in Uganda are very important as a source of food, income, export earnings and employment. The higher diversity of fish species also attracts global attention in evolutionary studies. The fishery sector is directly employs more than 350,000 people and indirectly over 1.2 million people. Fish is the cheapest source of animal protein in Uganda. In 2005, it is estimated that fish exports earned Uganda US \$ 142 million up from US \$ 103 million in 2004, making it almost the first most important non-traditional export commodity. Despite the importance of the fishery industry to the people that live along the Victoria Nile, the amount of fish caught from the river is not known. The existing fishery is basically subsistence and the fishing is mainly done using cast nets, hooks (long line and angling) and to a lesser extent gill nets.

Tapping the hydropower potential of Victoria Nile like any other developmental project on a natural resource has to comply with legal provisions governing projects of this nature in Uganda (NEMA, 1996). Environmental Impact Assessment (EIA) for the proposed development has to be undertaken to evaluate among other issues, fishery related aspects relevant to the development. Their report is therefore an update of EIA findings based on a field commercial fish catches study of the same project area and/or period covered during the 2000 surveys as a first study during the pre-construction phase.

10.2. Materials and Methods

A fish catch survey of the first quarter (corresponding to AESNP second quarter period 2000) of the study was conducted during March 2006 at four transects (one upstream and three downstream of the proposed hydro electric power site at Dumbbell island. Within each transect the names of major fish landing sites which were accessible were sampled along with the records of the number of active boats at each landing site. The types of full time jobs supported by the fishery were recorded by gender at the time of sampling.

For each sampled boat the following information/records were made:

Date of sampling, boat type, season, number of days the fisher goes out fishing per week, whether day or night catch, type of propulsion, number of crew per boat, gear type, size and number per boat, types of species caught per gear, gear size and fishing method, total weight of individual fish species per gear, gear size fishing method and the total length of each species were measured (the form used is attached). The fishers

provided information on the price (Shs/kg) of different fish species at the sampled landing sites.

The procedure used for estimation of fish catch was outlined in the first quarter report 2000 (AESNP, 2000) and was again followed during April 2006.

10.3 Results

10.3.1 Fishing effort at landing sites sampled

The active boats operating in the transects and those sampled in the April 2000 and April 2006 are shown in Table 10.1. Out of the 51 active boats at the landing sites in the 4 transects, 37 (73%) were sampled compared to (46) 92% of the 50 active canoes sampled during the second quarter of 2000 surveys. The active canoes comprised, 57% Ssese compared to 12%, 39% compared to 50% dug out canoes and 4% compared to 38% parachute in a second quarter of 2000 surveys. It is important to note that Ssese and parachute are all planked canoes but parachutes have flat bottom while Ssese canoes, have the bottom plunks that meet at an angle. In the present sampling, these different types have been distinguished. For the sampled canoes, 67% compared to 13% were Ssese, 30% compared to 54% were dug out and 3% compared to 33% were parachute.

10.3.2 Fulltime jobs supported by the fishery

Boat builders increased from 6 men to 12 men (Table 10.1). Namasagali (transect four) and Buyala (transect two) recorded 5 men each compared to 2 men and 3 men in the similar quarter of 2000 survey. Kalange (transect one) recorded 2 men compared to 1 man and Kirindi 1 man compared to none in the similar quarter of 2000 survey. Though not directly investigated in this survey the possibility of migration of these boat builders within the four transects should be considered.

There was a noted decrease of (33%) of food vendors from 9 in April 2000 to 6 in April 2006. The men and women were one and 8 respectively (April 2000) compared to one man and 5 women in April 2006, a reduction of 37.5% in female vendors. There were no net repairers in April 2006 while one man was operating at Namasagali in April 2000. Men cleaning the fish landing sites were at Namasagali (one in April 2000 and two in April 2006).

89 fishers operated at the sampled fish landing sites in April 2000 compared to 128 in April 2006, an increase of 43.8%. Fish traders were 22 in April 2000 compared to 47 in April 2006, an increase of 114%. Men fish traders were 7 in April 2000 and 25 in April 2006 while females were 15 (April 2000) and 22 (April 2006).

Chairpersons of fish landing sites increased from one (April 2000) to three in April 2006. in April 2000, the only one Chairperson was at Namasagali while in April 2006 two were recorded at each at Kalange and Kirindi unlike in April 2000, where four fisheries staff

were recorded. In April 2006, only one at Kalange was in place. Only Namasagali had two Askalis at the fish landing site (April 2000) compared to one in April 2006.

10.3.3 Importance of commercial and local food fish species being caught in transect 1- 4

Based on percentage composition by weight of different fish species caught by different gears (Tables 10.2-10.4) *Oreochromis niloticus* remained the most dominant 75.8% compared to 81%, in transect 1, *Mormyrus kannume* (32.6%) also remained dominant compared to (29.8%), in transect two, *Rastrineobola argentea* (91.9%) was dominant compared to *Lates niloticus* (63%) and transect three *Barbus altianalis* (38.5%) compared to *Bagrus docmak* (100%) in the second quarter of 2000 survey. Over all the four transects (Table 10.5) *R. argentea* (62%) contributed highest percentage by weight compared to *O. niloticus* (53.2%) in the similar quarter of 2000 survey. Unlike in the second quarter of 2000, where *O. niloticus* was the most dominant in all transects except transect 3, in this quarter it was only dominant in only transect four Namasagali. Higher catches of *O. niloticus* were from hook operations unlike in the second quarter of 2000 where Cast nets higher. *O. variabilis* like in the second quarter of 2000 remained restricted to transect one Kalange. Like in the second quarter of 2000 *C. gariepinus* was only recorded in transect four Namasagali. *Protopterus aethiopicus* which had been encountered in the second quarter of 2000 was missing in the catches during this quarter. Haplochromine fish species also appeared in the catches but had not been recorded in the second quarter of 2000.

A total of 12 different fish taxa were recorded along the Victoria Nile compared to 10 fish taxa during second quarter of 2000. Noted absent in the second quarter was *P. aethiopicus* while haplochromines and *R. argentea* were recorded in this quarter but were absent in the second quarter of 2000. Most importantly *R. argentea* contributed the highest percentage by weight in this quarter.

10.3.4 Size structure of major commercial fish species

The size structure of various major fish species encountered are shown in Figs 10.1 – 10.3. The major fish species were encountered in transects one and four where there were reasonable numbers (≥ 30 specimens) for frequency analysis. The size range of *T. zillii* from castnet catches (transect 1 at Kalange) was 12 - 31 cm TL (mode 20–21 cm TL) compared to 18 - 31 cm TL (mode 24-27 cm TL) at the same transect for the second quarter of 2000 (Fig.10.1)

A Kalange transect one, there were few specimen of *O. niloticus* (19) for frequency analysis from Cast nets compared to (14) in the second quarter of 2000. However, these had a size range of 15 -33 cm TL compared to 16 – 49 cm TL in the second quarter of 2000. This slight shift in the range could be explained by the shift in mesh size from 4" and 5" in the second quarter of 2000 to 3" in this quarter.

There were very few (25) *L. niloticus* specimen from cast net catches at Kalange. However, these had a size range of 21-35 cm TL compared to a size range of 22-37 cm in second quarter of 2000. Like in the second quarter of 2000 they were all immature.

At Namasagali (transect four) the *O. niloticus* commercial catches from gill nets. The size frequency distribution is shown in Fig. 10.2. The mode was at 29-30 cm TL compared to 33-36 cm TL and range was 25-36 cm TL compared to 27-48 cm TL in second quarter of 2000. All fish were mature.

M. kannume commercial gillnets catches in transect one – (Kalange) for the this quarter had a bimodal of 40-41 and 44-45 compared to 38-39 cm TL in the second quarter of 2000 and size range was 28-67 cm TL in this quarter compared to size range of 34-57cm TL in the second quarter of 2000 (Fig. 10.3) The mesh size of nets varied slightly (4" – 5") in second quarter of 2000 compared to 3.5" – 5") in this quarter (Table 10.6)

Rastrineobola argentea was, like in the AESNP fourth quarter report of 2000, recorded at transect two and was harvested by the 2mm mesh size mosquito net applying one lamp compared with a 3 mm mesh size scoop net of fourth quarter 2000. The mesh size harvested mainly juvenile fish of size range 14 mm – 32 mm SL with a mode at 22 mm SL (Fig. 10.4)

There was no length frequency analysis in this quarter for catches from Angling and Longline in transect four at Namasagali because the specimens were too few for such analysis compared to second quarter of 2000 where *O. niloticus* from longline and angling in transect four at Namasagali both had similar mode (25-26 cm TL). However size of Angling hooks and long line hooks changed from 6-14 to 10-12 and 7-12 to only 7 in second quarters of 2000.

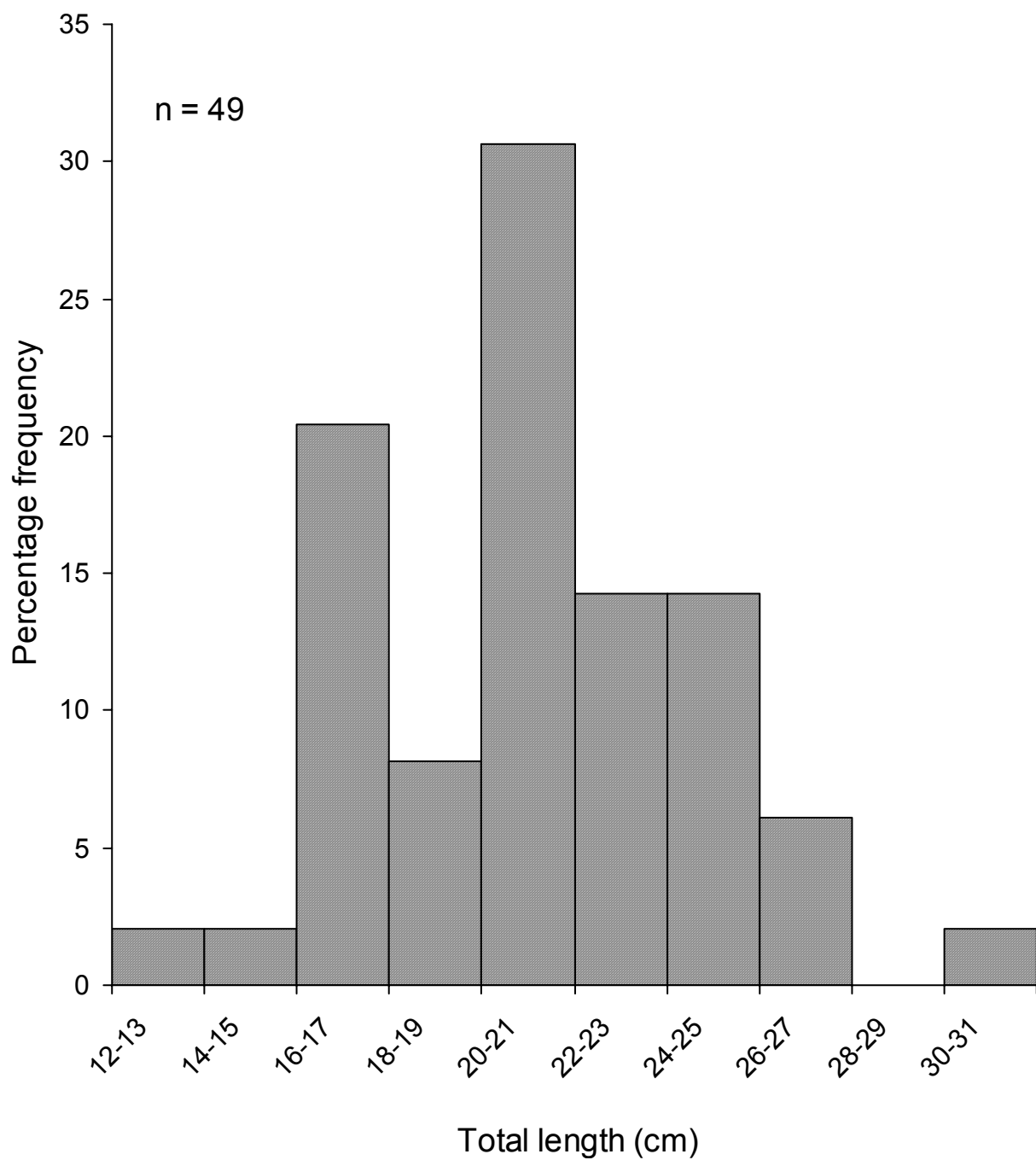


Fig. 10.1. Length frequency distribution of *Tilapia zillii* from commercial catches of cast nets transect one (Kalange-Makwanzi-upstream of Dumbbell Island) -2 cm intervals

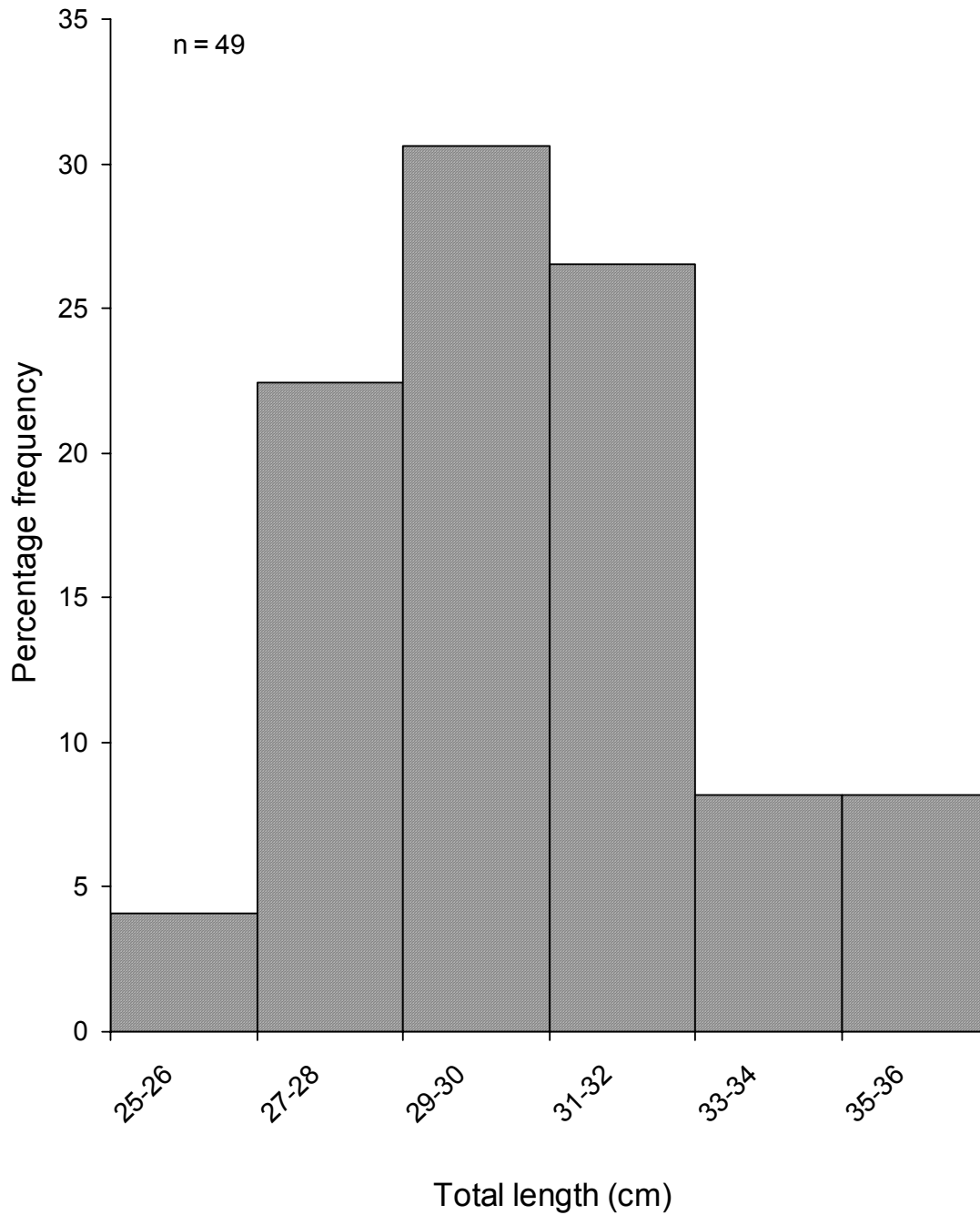


Fig. 10.2. Length frequency distribution of *Oreochromis niloticus* from commercial catches of gill nets transect four (Namasagali -downstream of Dumbbell Island) 2 cm intervals

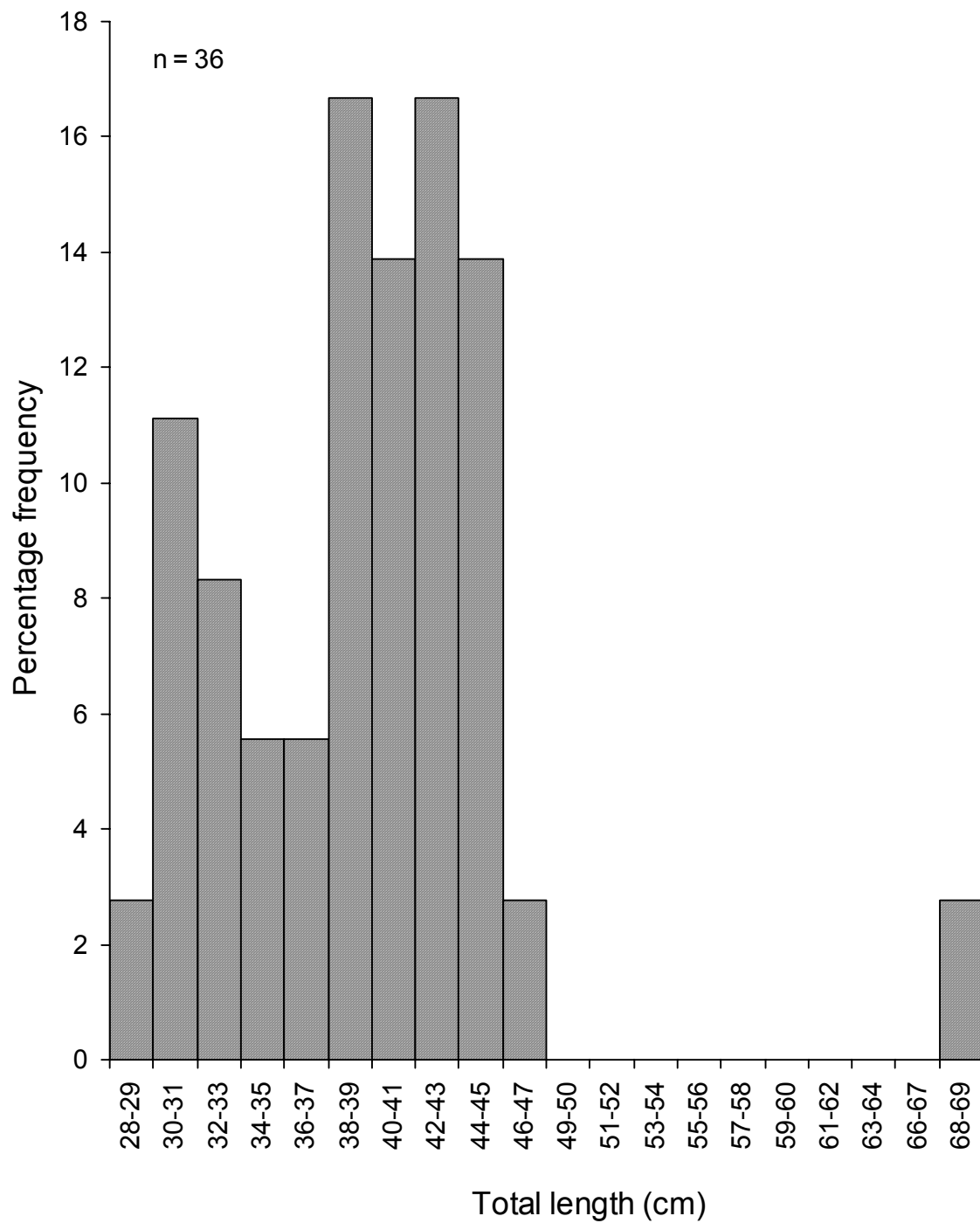


Fig. 10.3. Length frequency distribution of *Mormyrus kannume* from commercial catches of gill nets transect four (Namasagali – downstream of Dumbbell Island) 2 cm interval.

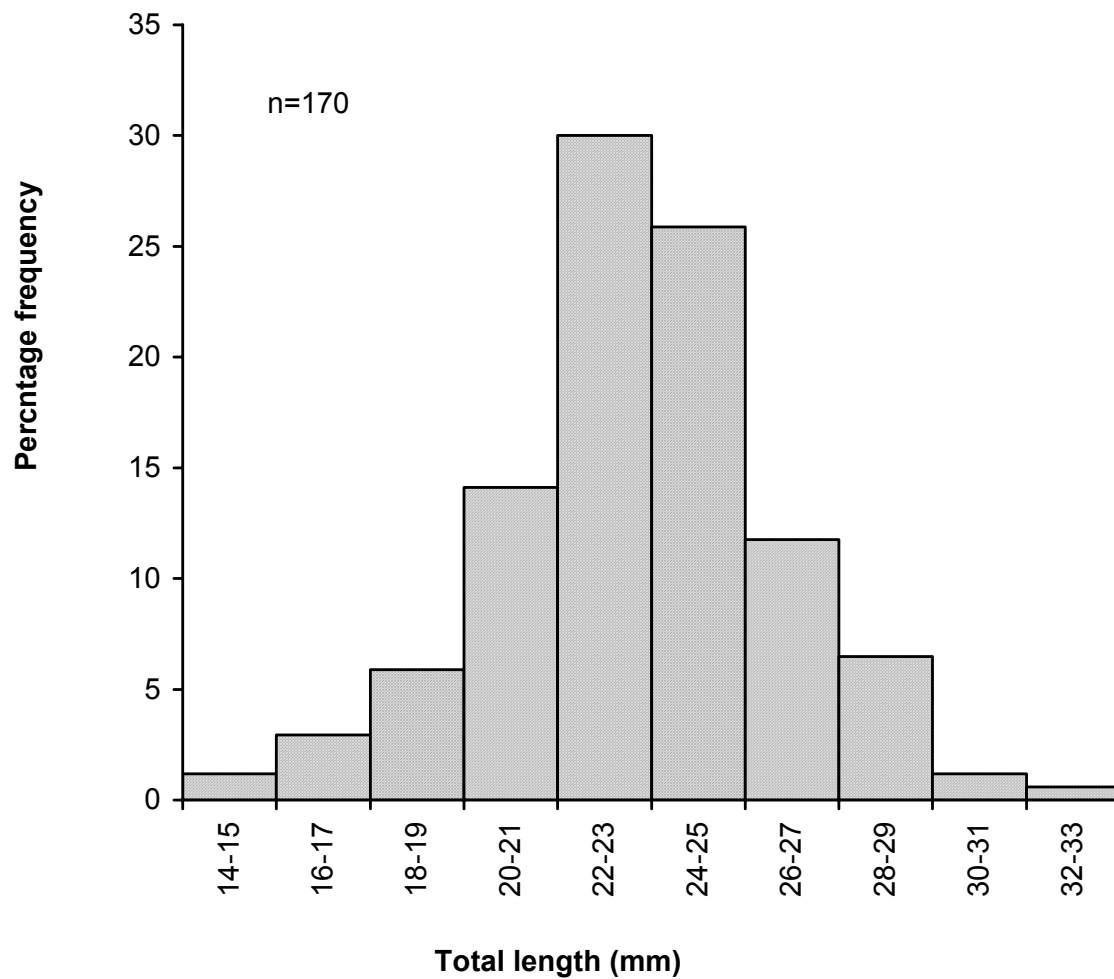


Fig. 10.4. Mukene length frequency distribution in (mm).

10.3.5. Estimates of total yield

10.3.6. Fish catch estimates

The composition of fish catch, average fishing days per week, average gear per canoe and fishing methods and gear sizes are shown in Table 10.6. Like in the second quarter of 2000, there was variation in the average number of gear per canoe but the size of gears did not change significantly. In this quarter a new gear the seine net (mosquito net) of mesh size 1 mm targeting *R. argentea* was recorded in transect two Buyala.

10.3.7. Catch per unit of effort (CPUE)

The highest catch (kg) per canoe along transect 1-4 was from mosquito net catches 300 kg per canoe Buyala-Kikubamutwe (Transect 1), followed by gill nets at 15.6 kg/canoe and 14.3kg/canoe at Namasagali-Bunyamira (Transect 4) and Kalange-Makwanzi respectively. The least catches (0.4 kg/canoe) were recorded from longline at transect two Buyala-Kikubamutwe. Noted absent were catches from longline at transect one Kalange –Makwanzi which had contributed the highest catch per canoe during the second quarter of 2000 followed by gillnet catches at (14.7kg/boat) and 13.5 kg/canoe in castnet catches at Kalange – Makwanzi in transect one (Table 10.7).

The total estimated monthly fish yield was 16816 kg compared to 7,966.4kg in the second quarter of 2000 (Table 10.10). The increase by 66% is explained by the high catch rates of *R. argentea* recorded in transect two Buyala-Kibubamutwe, even though the catchability of the different fishing methods are not comparable.

10.3.8. Estimates for total commercial value of catch

The average cost prices of individual fish species obtained from fishers are shown in Table 10.11 for each transect. There was a general increase in prices of fish across the four transects but notable was for *L. niloticus*, *O. niloticus* and *B. docmak* that doubled in price wherever they were encountered and *M. kannume* that increased more than three times in price at transect one Kalange Makwanzi of the second quarter of 2000.

The estimated monthly fish value obtained was 12.1 million Ugandan shillings compared to 4.02 million Uganda shillings obtained in second quarter of 2000.

10.3.9. Non-commercial uses of fish.

As reported in the second quarter of 2000, there was no change of non-commercial uses of fish during April 2006.

10.3.10. Sport fishing

No sport fishing was observed in both this quarter and similar quarter of 2000.

10.4. Discussion

The overall number of active canoes at the landings in the four transects did not change significantly (51 active canoes and 50 active canoes in this survey and that of 2000 respectively compared to 90 in the first quarter of 2000) (Table 10.1). However there was an increase in transect 3 downstream (Matumu-Kirindi) where the number doubled from four to nine. This like in the second quarter 2000 makes fishers switch from fishing to land tillage in preparation for crop planting. The increase in the number of active canoes at Kirindi could be explained by migration of fishers within transects manifested by a reduction in active canoes in Namasagali – Bunyamira (25-20), Buyala-Kikubamutwe (13-9) and Kalange-Makwanzi (9-6).

There was an overall reduction in food vending activities across the four transects as shown in the reduction in the number of food vendors from 8 (all women) to 6 (5 women and 1 man) and complete absence of food vendors in transect 2 (Buyala) and transect 3 (Kirindi). Food vending was dominated by women while fishing, boat building/repairing, fisheries staff, and chairpersons were dominated by men (Table 10.1). Absence of food vendors relates to the fishers not being permanently in the transects and thus participating in other activities like crop cultivation. No net repair was recorded at Namasagali compared to the second quarter of 2000 due to the continued reduction from 25 and 20 active boats in the second quarter 2006 and second quarter 2000 respectively. Despite the a slight increase in the number of active canoes across the four transects, the number of fishers and fish traders increased mainly due to the observed general increase in fish prices per Kg (Table 10.11).

The number of species caught by fishers along the Upper Victoria Nile increased slightly from 10 in second quarter 2000 to 12 fish taxa in second quarter 2006 respectively because haplochromines and *R. argentea* not previously recorded were encountered in this quarter. The percentage contribution of the haplochromines to the overall catches was negligible (>0.1%) compared to that of *R. argentea* which contributed (62%) overall and 91.9% in transect 2 Buyala-Kikubamutwe. It should be noted that *R. argentea* was only being fished in transect 2 (Buyala-Kikubamutwe) and information was recorded from one canoe out of the total two that fish for it in transect two. *P. aethiopicus* which had been recorded in the second quarter of 2000 did not appear in the catches during second quarter 2006.

At Kalange (Transect one), cast net fishers during first quarter 2006 were using mesh size 3" compared to mixed mesh sizes 4" – 5" in the second quarter of 2000. However, the size range of *O. niloticus* caught was 15-35 cm TL compared to 16-49 cm TL in the second quarter of 2000. This is explained by the corresponding shift above in mesh sizes used.

The size of *M. kannume* in commercial catches at Kalange (Transect one) varied with a bimodal 40-41 cm TL and 44-45 cm TL compared to mode 38-39 cm TL in, range 28-67 cm TL compared to 34-57 in second quarter of 2000. This was mainly attributed to the

changes in the minimum mesh size 3" in this quarter from 4" in the second quarter of 2000 (Table 10.6.).

Changes in the average number of fishing gears was due to some fishers buying additional gear while others may have discarded old ones but the gear sizes did not substantially change as they are the sizes normally used to target particular fish species using a specific fishing method. The parameters used in fish catch estimates are shown in Tables 10.8 – 10.9

The total monthly catch estimates in this quarter was double (16815.9 kg) that of the second quarter of 2000 where as the value was three times (12.1m shillings) that recorded in the second quarter despite an almost no increase in the number of canoes (51) in this quarter and (50) in the second quarter of 2000. Correspondingly the number of fishers and fish traders also increased and were 128 and 47 respectively in this quarter compared to 89 and 27 respectively in the second quarter of 2000. The increase in monthly catches is mainly attributed to the introduction of *R. argentea* fishery in transect two Buyala to Kikubamutwe which recorded the highest catch rate (300Kg/day/canoe). The number of fishers and fish traders increased probably due to both the increase in catches and especially in price per kg of fish caught at almost all the transects. The increase in the observed monthly catches and prices explains the three-fold increase in value.

10.5. Summary

- A total of 37 canoes out of 51 active canoes were sampled in the four transects compared to 46 sampled canoes out of 50 active ones in the second quarter of 2000.
- The active canoes comprised the Ssesse type (57%), dugout (39%) and parachutes (4%) where the sampled canoes comprised Ssesse (67%), dugout (30%) and parachutes (3%) compared to active canoes, Ssesse (12%), dugout (50%) and parachutes (38%) and sampled canoes; Ssesse (13%), Dugout (54%) and parachutes (33%) in the second quarter of 2000.
- Full time jobs supported by the fishery included food vending and boat building.
- Food vendors were 6 people compared to 12 in the second quarter of 2000. Women made up 83% of the labour force compared to 77% in the second quarter of 2000. At Namasagali two men cleaned the landing compared to one in second quarter of 2000.
- Boat builders in all the four transects were 12 compared to 6 builders in the second quarter of 2000, chairmen of fishing landings remained three like in the second quarter of 2000 and the number of fisheries staff reduced from two in second quarter 2000 compared to one in first quarter of 2006.
- Fishers in this quarter were 128 compared to 89 in the second quarter of 2000 and fish traders were 47 (47% women compared to 60% in the second quarter of 2000) compared to 25 observed in the second quarter of 2000.
- The major fishing gears/methods were angling (40.5%), Gill nets (31.0%), long line (16.7%), Cast nets (9.5%) and Mosquito net (2.4%) of the sampled canoes.

In the second quarter of 2000, of the sampled canoes, Angling and long line contributed 34.8% each of the sampled canoes, gill nets (21.7%) and cast nets (8.7%).

- The major commercial fishery along the Victoria Nile transects in order of importance were *R. argentea* (62%), *O. niloticus* (11.5%) *M. kannume* (6.1%), *L. niloticus* (5.8%), *B. docmak* (5.4) and *B. altianalis* (4.9%) in the first of 2006. In the second quarter of 2000 *O. niloticus* contribution was (53.0%), *M. kannume* (13.6%) *L. niloticus* (13.5%) and *B. altianalis* (5.7%).
- The importance of fish species in commercial catches along the Victoria Nile changed slightly to include *R. argentea* as the most important fishery and *B. docmak* which became less important in the fishery was 5.4% compared to 2.4% in the second quarter of 2000.
- The highest CPUE was in transect two (300 kg per canoe) compared to transect one (15.3 Kg/canoe) in second quarter of 2000.
- The total monthly yield estimates from the 4 transects was 16816 kg compared to 7969.4kg in second quarter of 2000 and the estimated monthly fish value was 12.09 million Uganda shillings compared to 4.02 million in the second quarter of 2000.
- As was the case in the second quarter of 2000, there was no sport fishing.

10.6. Conclusion

The estimated monthly catches doubled and the value increased by three times those of the second quarter of 2000, mainly due to the increase in fish prices and capture of *R. argentea* that recorded the highest catch rate per canoe per day (300 kg). Correspondingly the same two factors led to an increase in the number of fishers (89 to 128) and fish traders (27 to 47). The highest monthly yield estimates were got in transect two (16815.9 kg valued at 9.8M) and transect four (2042kg valued at 1.74M) and the least was transect three 669 Kg valued at 0.43 compared to 3637.7 kg valued at 1.81M, in transect four and 3421.7kg valued at 1.72M in transect one and the least was in transect three 308.0 Kg valued at 0.09M of the four transects along Victoria Nile in the second quarter of 2000. Transect four (Namasagali) had the highest fishing effort (20 canoes) as was the case in the second quarter of 2000 but the number had reduced by five canoes (20%).

However the highest CPUE (catch kg per canoe) was in transect two at 300 kg per canoe compared to transect one at 16.7 kg per canoe in the second quarter of 2000. The gears and fishing methods in order of importance were angling (40.5%), followed by gill nets (31.0%), and long line 16.7% for the fishing canoes sampled. The *R. argentea* was the overall most dominant species (62.0%) compared to *O. niloticus* (53.2%) in the second quarter of 2000. A total of 12 fish species were recorded compared to 10 in the second quarter of 2000. However, *P. aethiopicus* was not encountered. The highest number of fish species (8) were in transect one followed by transect 2 and 4 each with 6 species.

Table 10.1 The composition of fish catch survey information of April 2006 compared with second quarter April 2000 survey (in brackets) at the four sampling transects of the upper Victoria Nile. D= Dugout: S=Ssese: Pa=Parachute

Parameters	Transect 1 Upstream Kalange to Makwanzi		Transect 2 Downstream Buyala to Kikubamutwe		Transect 3 Downstream Matumu to Kirindi		Transect 4 Downstream Namasagali to Bunyamira	
Major landing sites								
Active canoes	9S(6 Pa, 6S)		13S (8Pa, 1D)		7S, 1Pa, 1D (2Pa, 2D)		19D, 1Pa (22D, 3Pa)	
Sampled canoes	9S (6 Pa, 6S)		9S (6Pa, 1D)		7S, 1Pa, 1D (2Pa)		10D (24D, 1Pa)	
Jobs supported by the fishery	Men	Women	Men	Women	Men	Women	Men	Women
Boat builders/repair	2 (1)		5 (3)		1 (-)		5 (2)	
Food vendor		4 (4)	- (1)	- (4)			1	1
Net Repairer							- (1)	
Cleaner fish landing							2 (1)	
Fishers	57 (22)		26 (9)		5 (12)		40 (46)	
Fish traders	11 (3)	12 (7)	5 (3)	8 (7)	1 (1)	2 (1)	8	
Chairperson	1				1		1 (1)	
Fisheries staff	1 (1)		- (1)				- (2)	
Askali landing site (securicor)							1 (2)	

NB: Localities associated with all the transects in all the Tables are: Transect 1 upstream include: Kikonko, Kunjaba, Makwanzi Is, Transect 2 downstream include: Naminya, Kisadha, Ofwono, Zaire, Mugalya, Kisoga, Transect 3 downstream include: Matumu, Kisoga A,B,C, Damba, Transect 4 downstream include: Kasanga, Kibuye, Sajjabi

Table 10.2. Records of the commercial and local fish species caught and their percentage composition by weigh (kg) in individual gears compared with second quarter 2000 (in brackets) at the four sampling stations of the upper Victoria Nile

Parameters	Transect 1 Upstream Kalange to Makwanzi	Transect 2 Downstream Buyala to Kikubamutwe	Transect 3 Downstream Matumu to Kirindi	Transect 4 Downstream Namasagali to Bunyamira
Composition in gillnets				
<i>O. niloticus</i>	3.2 (18.0)			78.2 (69.8)
<i>O. leucostictus</i>	- (0.6)			- (1.8)
<i>O. variabilis</i>	3.0 (4.4)			
<i>L. niloticus</i>	7.5 (8.2)	15.6 (39.0)	31.6	
<i>M. kannume</i>	69.5 (64.6)	33.6 (61.0)	68.4	- (2.0)
<i>B. altianalis</i>	15.3 (4.0)			15.4 (26.3)
<i>B. docmak</i>	- (0.3)	- (49.8)		
<i>T. zillii</i>	- (1.5)			2.7
<i>C. gariepinus</i>				3.7

Table 10.3. Records of the commercial and local fish species caught and their percentage composition by weight (kg) in cast nets and hooks compared with second quarter 2000 (in brackets) at the four sampling stations of the upper Victoria Nile

Parameters	Transect 1 Upstream Kalange to Makwanzi	Transect 2 Downstream Buyala to Kikubamutwe	Transect 3 Downstream Matumu to Kirindi	Transect 4 Downstream Namasagali to Bunyamira
Castnets:				
<i>O. niloticus</i>	16.5 (27.1)			50.9
<i>O. leucostictus</i>	2.0 (0.5)			44.8
<i>O. variabilis</i>	8.5 (26.6)			
<i>T. zillii</i>	42.3 (31.0)			
<i>L. niloticus</i>	24.6 (8.9)			4.2
<i>B. altianalis</i>	15.3 (2.0)			
Haplochromines	0.3			
<i>M. kannume</i>	5.8			
Longline				
<i>O. niloticus</i>	(3.9)			
<i>L. niloticus</i>	(45.1)	(30.7)	15.2	100 (98.1)
<i>M. kannume</i>	(5.7)			
<i>B. altianalis</i>	(19.3)		43.1	
<i>B. docmak</i>		100 (69.3)	41.7	
<i>P. aethiopicus</i>	(6.0)			
<i>C. gariepinus</i>	5.3			1.9

Table 10.4 Records of the commercial and local fish species caught and their percentage composition by weight (kg) in angling catches compared with second quarter 2000 (in brackets) at the four sampling stations of the upper Victoria Nile

Parameters	Transect 1 Upstream Kalange to Makwanzi	Transect 2 Downstream Buyala to Kikubamutwe	Transect 3 Downstream Matumu to Kirindi	Transect 4 Downstream Namasagali to Bunyamira
Angling				
<i>O. niloticus</i>	75.6 (76.6)	2.8		84.9 (77.2)
<i>O. variabilis</i>	- (9.7)			
<i>T. zillii</i>	2.8 (7.7)	0.8		
<i>L. niloticus</i>	13.2 (13.9)	19.5 (88.0)	69.2	15.1 (22.5)
<i>M. kannume</i>	8.4	7.2		
<i>B. altianalis</i>		5.0	30.8	- (0.3)
<i>B. docmak</i>		64.1 (12.0)	- (100.0)	

Table 10.5. Overall percentage composition by weight (kg) compared with second quarter 2000 (in brackets) at the four sampling stations of the upper Victoria Nile

Parameters	Transect 1 Upstream Kalange to Makwanzi	Transect 2 Downstream Buyala to Kikubamutwe	Transect 3 Downstream Matumu to Kirindi	Transect 4 Downstream Namasagali to Bunyamira	
<i>O. niloticus</i>	22.4 (26.8)	0.2		75.8 (81.0)	11.5 (53.2)
<i>O. leucostictus</i>	0.8 (0.4)			2.3	0.1 (1.4)
<i>O. variabilis</i>	4.6 (10.0)				0.7 (4.3)
<i>T. zillii</i>	17.8 (7.7)			2.0	3.0 (3.3)
<i>L. niloticus</i>	15.3 (14.7)	1.5 (63.0)	25.0	8.1 (8.8)	5.8 (13.5)
<i>M. kannume</i>	32.6 (29.8)	1.2 (15.1)	4.1	(0.5)	6.1 (13.6)
<i>B. altianalis</i>	6.3 (5.1)	0.3	38.8	11.4 (6.7)	4.9 (5.7)
<i>B. docmak</i>	- (0.1)	4.9 (22.0)	32.4 (100.0)		5.4 (2.4)
<i>P. aethiopicus</i>	- (3.7)			(6.7)	(1.9)
<i>C. gariepinus</i>	- (1.8)			2.7	0.3 (0.8)
<i>R. argentea</i>		91.9			62.0
Haplochromines	0.1				

Table 10.6. The composition of fish catch survey fishing gears, fishing methods and size of gear compared with second quarter 2000 (in brackets)at the four sampling stations of the Upper Victoria Nile

Parameters	Transect 1 Upstream Kalange to Makwanzi	Transect 2 Downstream Buyala to Kikubamutwe	Transect 3 Downstream Matumu to Kirindi	Transect 4 Downstream Namasagali to Bunyamira
Av. gear per boat				
Gillnets	5.2 (6.6)	3.5 (2)	2 (-)	6.2 (4.3)
Castnets	1 (1)			- (1)
Angling (Hooks)	2 (2.3)	4.8 (2.8)	5.8 (-)	4.3 (5.1)
Longline (Hooks)	- (210)	40 (38.5)	68.5 (15)	29 (18.4)
Mosquito net		1 (-)		
Size of gear				
Gillnets	3.5"-5 (4"-5")	- (3")		5", 6" (4.5", 6")
Castnets	3" (4/5'-4.5" - 4.5/5")		3" (-)	- (4")
Angling (Hooks)	10-15 (10-14)	7,8 (12,8)	7,8 (7)	10-12 (6,11,12,14)
Longline (Hooks)	- (8)	- (8)		7 (7,9,10,11,12)
Mosquito net		1mm (-)		

Table 10.7. The catch per unit of effort (kg) per boat, gear or fishing method compared with second quarter 2000 (in brackets) at the four sampling stations of the Upper Victoria Nile

Parameters	Transect 1 Upstream Kalange to Makwanzi	Transect 2 Downstream Buyala to Kikubamutwe	Transect 3 Downstream Matumu to Kirindi	Transect 4 Downstream Namasagali to Bunyamira
Catch per unit of effort per boat				
Gillnets	14.3 (14.7)	6.7 (4.1)	1.9 (-)	15.6 (12.4)
Castnets	8.6 (13.5)			- (8.3)
Longline	- (24.4)	0.4 (1.9)	10.0 (2.7)	2.5 (5.8)
Angling	7.1 (8.6)	12.2 (2.2)	3.4 (-)	5.5 (9.4)
Mosquito net		300 (-)		
Per gear				
Gillnets	1.2 (2.5)	1.1 (2.1)	1.0 (-)	1.2 (2.9)
Castnets	7.3 (13.5)			- (8.3)
Longline	- (0.12)	0.01 (0.05)	0.1 (0.23)	0.04 (0.3)
Angling	1.4 (3.7)	0.7 (0.2)	0.2	0.8 (1.8)
Mosquito net		300 (-)		

Table 10.8. Estimates of the total yield (kg) per day compared with second quarter 2000 (in brackets) for sampled boats at the four sampling stations of the Upper Victoria Nile

Parameters	Transect 1 Upstream Kalange to Makwanzi	Transect 2 Downstream Buyala to Kikubamutwe	Transect 3 Downstream Matumu to Kirindi	Transect 4 Downstream Namasagali to Bunyamira
Total number of active boats at landing	9 (12.0)	13 (9.0)	9.0 (4.0)	20.0 (25.0)
Boats sampled	12 (9.0)	9 (7.0)	9.0 (9.0)	10.0 (25.0)
Average days fished/week	5.2 (6.1)	7.0 (7.0)	5.2 (7.0)	5.0 (4.6)
Yield estimates of species per day (kg)				
<i>O. niloticus</i>	8.3 (44.0)	0.5		38.7 (160.2)
<i>O. leucostictus</i>	0.3 (0.7)			
<i>O. variabilis</i>	1.7 (16.5)			(4.6)
<i>T. zillii</i>	6.6 (12.6)			1.0
<i>L. niloticus</i>	5.7 (24.2)	4.8 (10.5)	8.0	4.2
<i>M. kannume</i>	12.2 (48.9)	4.0 (2.5)	1.3	(17.4)
<i>B. altianalis</i>	2.4 (8.5)		12.4	5.8 (1.0)
<i>B. docmak</i>	(0.2)	15.9 (3.7)	10.4 (5.5)	(13.3)
<i>P. aethiopicus</i>	(6.0)			(1.2)
<i>C. gariepinus</i>	(2.9)			1.4
<i>R. argentea</i>		300		
Haplochromines	0.1			
Total weight (kg) landed per day	37.2 (164.5)	326.4 (16.7)	32.1 (5.5)	51.1 (197.7)

Table 10.9. Estimates of total yield kg/month compared second quarter 2000 (in brackets) at the four sampling stations of the upper Victoria Nile

Parameters	Transect 1 Upstream Kalange to Makwanzi	Transect 2 Downstream Buyala to Kikubamutwe	Transect 3 Downstream Matumu to Kirindi	Transect 4 Downstream Namasagali to Bunyamira
Total yield (kg/week), kg/month				
<i>O. niloticus</i>	202.5 (915.2)	20.2 (-)		15448 (2947.7)
<i>O. leucostictus</i>	7.2 (14.6)			- (84.6)
<i>O. variabilis</i>	41.7 (343.2)			
<i>T. zillii</i>	160.9 (262.1)	6.1 (-)		40 (-)
<i>L. niloticus</i>	138.4 (503.4)	192.1 (378.0)	167.1 (-)	166 (320.2)
<i>M. kannume</i>	295.1 (1017.1)	161.8 (89.6)	27.2 (-)	- (18.4)
<i>B. altianalis</i>	57.1 (176.8)	40.4 (-)	258 (-)	232 (244.7)
<i>B. docmak</i>	- (4.2)	643.1 (134.4)	217.2 (308.0)	
<i>P. aethiopicus</i>	- (124.8)			- (22.1)
<i>C. gariepinus</i>	- (60.3)			56 (-)
<i>R. argentea</i>		12133.3 (-)		
Haplochromines	1.2 (-)			
Total	904 (3421.7)	13200.4 (602.0)	669.5 (308.0)	2042 (3637.7)

Table 10.10. Estimates of total cost per fish species per month and estimates of total value in millions of Uganda shillings at the four sampling stations of the Upper Victoria Nile

Parameters	Transect 1 Upstream Kalange to Makwanzi		Transect 2 Downstream Buyala to Kikubamutwe		Transect 3 Downstream Matumu to Kirindi		Transect 4 Downstream Namasagali to Bunyamira	
	Sh/kg	Millions	Sh/kg	Millions	Sh/kg	Millions	Sh/kg	Millions
<i>O. niloticus</i>	750 (743)	0.15 (0.68)	500 (-)	0.01 (-)			100 (500)	1.55 (1.47)
<i>O. leucostictus</i>	500 (750)	0.004 (0.01)			1000 (-)	0.22 (-)	- (300)	- (0.03)
<i>O. variabilis</i>	550 (660)	0.02 (0.23)						
<i>T. zillii</i>	550 (600)	0.09 (0.16)					500 (-)	0.02 (-)
<i>L. niloticus</i>	900 (500)	0.12 (0.25)	2250 (700)	0.43 (0.27)	1250 (-)	0.21 (-)	1000 (350)	0.17 (0.11)
<i>M. kannume</i>	786 (220)	0.23 (0.22)	667 (600)	0.11 (0.05)			- (225)	- (0.004)
<i>B. altianalis</i>	800 (500)	0.05 (0.09)	1500 (-)	0.06 (-)			- (500)	- (0.12)
<i>B. docmak</i>	- (767)	- (0.003)	2000 (1100)	1.29 (0.15)	1000 (700)	0.22 (0.09)		
<i>P. aethiopicus</i>	- (220)	- (0.03)					- (200)	- (0.004)
<i>C. gariepinus</i>	- (875)	- (0.05)					1400 (-)	0.08 (-)
<i>R. argentea</i>			600 (-)	7.3 (-)				
Haplochromines	0.05 (-)							
Total		0.67 (1.72)		9.2 (0.47)		0.43 (0.09)		1.74 (1.81)

CHAPTER 11

11.0. Bilharzia, other Disease vectors and Status of Sanitation

11.1. Introduction

The study of bilharzia and snail vectors as well as other disease vectors such as *Simulium sp* and the effect of the extent of water quality to humans who use it for bathing, drinking and cooking, fishing, swimming is essential in baseline information and changes that may occur during and after dam construction. Bilharziasis (Schistosomiasis) is spread by two major snail vectors, *Biomphalaria spp* and *Bulinus sp*. The former is a vector of *Schistosoma mansoni* while the latter is a vector of *Schistosoma hematobium*. River blindness, one of the very dangerous disease for riparian communities along polluted rivers is spread by *Simulium* larvae. This report provides preliminary information on the prevalence and intensity of waterborne diseases mainly schistosomiasis and river blindness, and the sanitation status among the riparian communities along the Upper Victoria Nile.

11.2. Materials and Methods

11.2.1. Sampling for Bilharzia (schistosomiasis) snails

The snails were sampled by making 3 transects on both banks of the river at selected sites. Each transect measured one square metre. The snails were collected by hand picking from rocks and by use of a grab for the river bottom. These were the only viable methods due to the presence of rocks at the site, which made the conventional scooping method unsuitable. The vector snail samples were then placed in test tubes and water was added before they were exposed to sunlight for 2-4 hours to shed them for cercaria.

11.2.2. Sampling stool for parasitological analysis of Bilharzia in humans

Stool samples were obtained from the residents both male and females present at the landing sites, were involved. Consent was obtained from the residents and the local leaders were informed. High-risk water-human contact activities were determined as Fishing, Bathing/swimming, washing clothes, fetching water and playing.

The Kato-Katz stool analysis technique was used, whereby 41.7 mg of human faecal material was collected from each of the 15 people per selected site, giving a total of 60 samples from the people. Intensity of infection from these samples was determined by placing the faecal material on a slide with the aid of a template and a cellophane cover

slip dipped in malachite green. Samples were examined under a compound microscope for purposes of estimating the eggs per gram load (EPG).

11.2.3. Prevalence of schistosomiasis by different water users

Prevalence of schistosomiasis was evaluated for the following water contact activities: fishing, fetching water, bathing and swimming, playing and washing by taking sample populations of 14, 11, 10, 10, and 15 people, respectively covering the four transects.

11.2.4. Sampling for faecal coliforms

Samples were taken from one site from each of the 4 transects along the river for the purpose of testing for faecal coliforms. The sites were Kalange (Transect 1), Kikubamutwe (Transect 2), Kirindi (Transect 3) and Namasagali (Transect 4) at shallow fast moving waters and deep water points. Equipment was sterilised using methylated spirit. The water was filtered, a pad prepared and culture media (Mackonky's broth solution) was applied to the pad and incubated for 20-22 hours in line with the testing method using DelAgua Testing kit.

11.2.5. Sampling for *Simulium* (Blackfly) larvae

Samples of crabs and vegetation in fast moving waters of the river were collected and checked for *Simulium* larvae at the four transects.

11.3. Results

11.3.1. Bilharzia snails abundance and distribution

The non-vector snails were more abundant than the vector snails at three sites except Namasagali (Fig. 11.1). Of the vector snails, only two were infectious i.e. shed cercaria. One, a *Biomphalaria* was from Kalange and the other was *Bulinus* from Kikubamutwe (Transect 2). Though the number of infected vector snails were few, they may be quite significant in the spread of disease. Of the two vector snail species, *Biomphalaria sp.* was more abundant at Kalenge and Kirindi sites (Fig.11.1). The prevalence land is indicative of a higher risk of *Schistosoma mansoni* than *Schistosoma haematobium*. Kalange had the highest number of vector snails while Namasagali had the lowest. At all sites, the vector snails were encountered and thus their number, distribution and abundance could be a source of transmission. Shedding of cercaria by the *Bulinus sp* is indicative of transmission of *S. haematobium* that has not yet been clinically detected in Uganda and therefore merits further follow up.

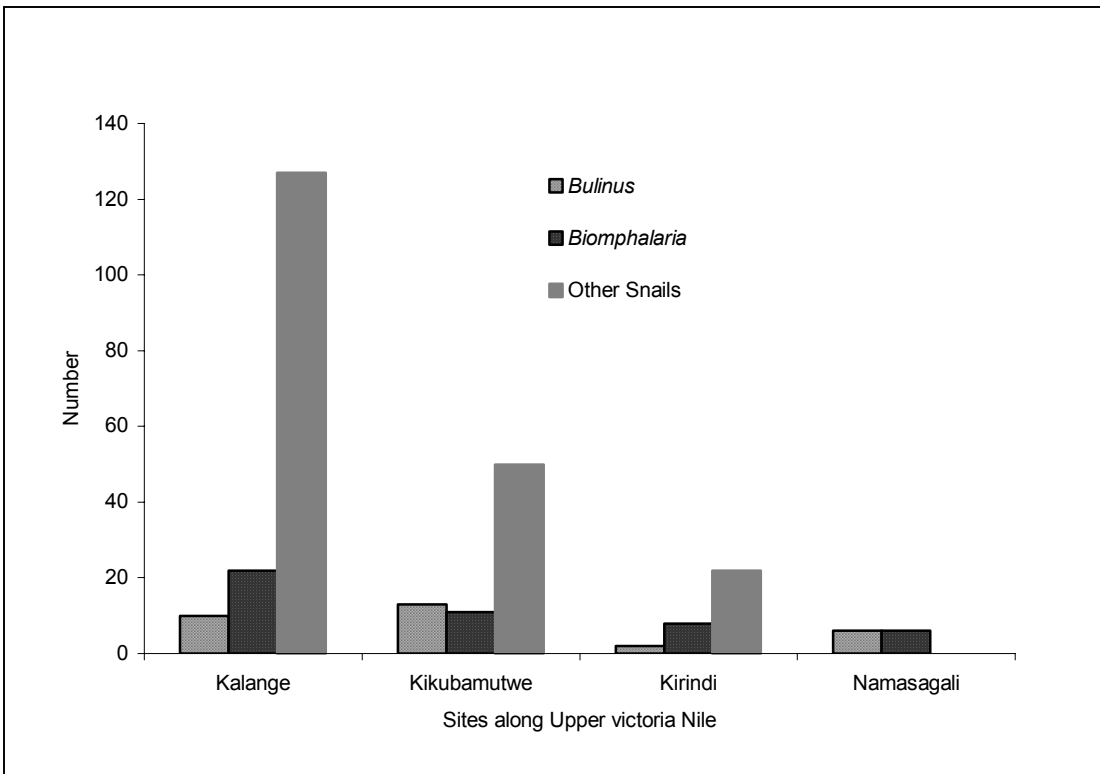


Fig. 11.1. Abundance and distribution of bilharzias vector (*Bulinus* and *Biomphalaria*) snails and non-vector (*Bellamya*, *Melanoides*, *Lymnaea* and bivalves) molluscs along the Upper Victoria Nile

11.3.2. Parasitological analysis of bilharzias in humans

Of the 60 samples collected from a population of 265 people, 50 % of the sampled population were infected with Schistosomiasis (Table 11.1).

Table 11.1 Sample population and samples collected at the sites along Upper Victoria Nile for prevalence of Schistosomiasis

Village	Site	Popn. at site	Samples collected	Positive s
Buwenda	Kalange	65	15 (23%)	8
Kikubamutwe	Nankwanga	60	15 (25%)	7
Kirindi	Bukwaya	70	15 (21%)	7
Namasagali	Kabanga	70	15(21%)	8
Total		265	60 (22.6%)	30

Infection with schistosomiasis was highest (53%) in both Kalange and Namasagali (Fig. 11.2). It is especially significant in Kalange area when you find that there is presently an active deworming programme using mass chemotherapy with paraziquantal. This is indicative of a high rate of re-infection.

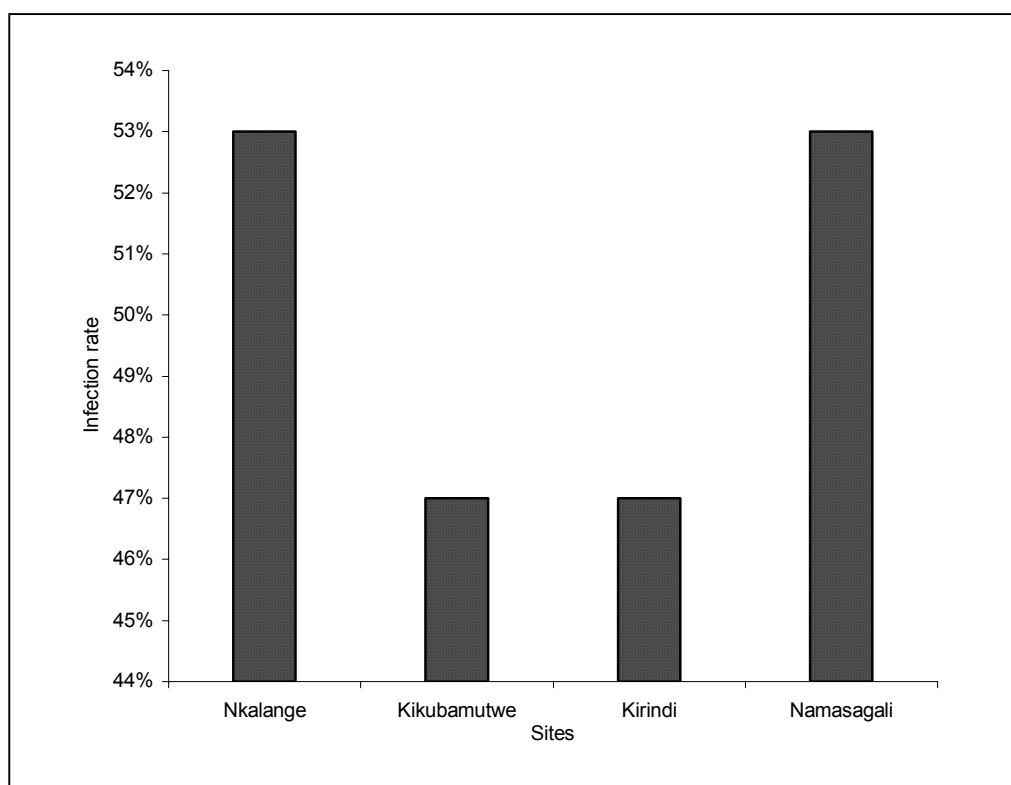


Fig. 11.2. The infection rate of schistosomiasis at four sites along the Upper Victoria Nile

11.3.3. Intensity of infection by schistosomiasis

Kalange and Namasagali have moderate to heavy intensity while Kirindi and Kikubamutwe have light to moderate intensity (Table 11.2). Thus, a concerted effort is needed to promote chemotherapy and environmental sanitation measures to reduce parasite loads and transmission in the riparian villages on Upper Victoria Nile

Table 11.2. Intensity of schistosomiasis infection

Site	Samples	Positive No.	Light intensity	Moderate intensity	Heavy intensity
Kalange	15	8 (53%)	1 (6.7%)	5 (33.3%)	2 (13.3%)
Kikubamutwe	15	7 (47%)	2 (13.3%)	4 (26.7%)	1 (6.7%)
Kirindi	15	7 (47%)	4 (26.7%)	2 (13.3%)	1 (6.7%)
Namasagali	15	8 (53%)	2 (13.3%)	4 (26.7%)	2 (13.3%)
Total	60	30 (50%)	9 (15%)	15 (25%)	6 (10%)

11.3.4. Prevalence of schistosomiasis by different water users

The major predisposing activities for Schistosomiasis infection were fishing and swimming/ bathing (Fig. 11.3). These activities therefore will form the focus of subsequent the health interventions.

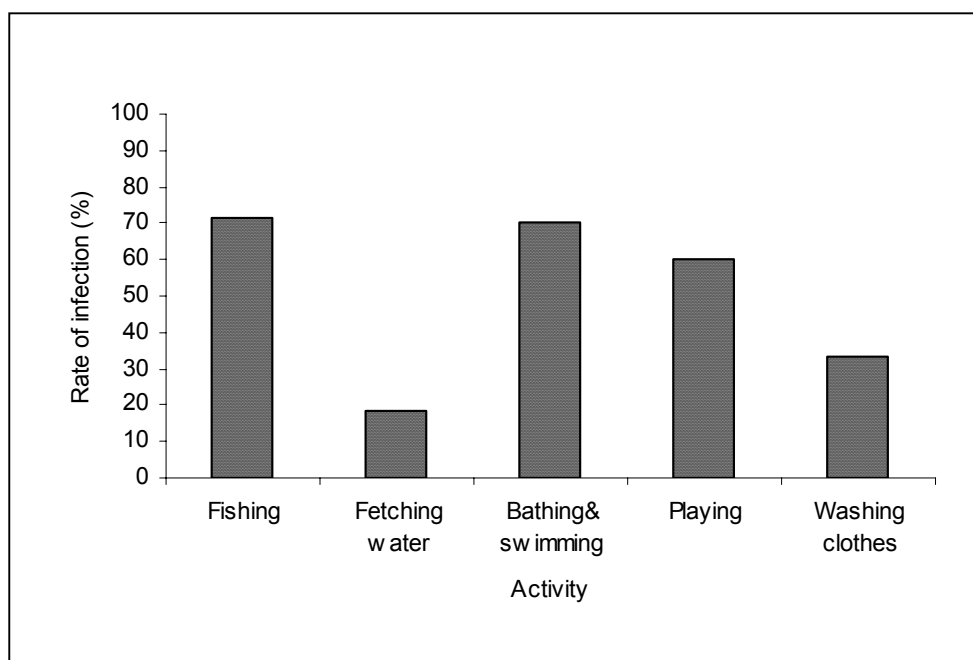


Fig. 11.3. Prevalence of schistosomiasis by water contact activities

11.3.4. Faecal coliforms contamination

The micro-organisms of medical importance were predominantly *Salmonella* and *Shigello*sis. Contamination was higher at the shallow human and water contact points than in the deeper water (Table 11.3). All sites were far above the acceptable limit of 5 colonies per 100 mls of water. Ten colonies and above are indicative of urgent need for health interventions to reduce the threat of disease. Contamination at Kalange was exceptionally high, although that recorded at Namasagali was also of high risk of contamination. Mass health education, home improvement campaigns and mass chemotherapy should be undertaken at the sites to mitigate the effects of disease transmission.

Table 11.3. Faecal coliforms colonies at the inshore and deep points of the transects on Upper Victoria Nile

Transect	Kalange		Kibubamutwe		Kirindi		Namasagali	
Station	Inshore	Deep	Inshore	Deep	Inshore	Deep	Inshore	Deep
No of colonies/100 ml of water	200	40	50	10	60	20	80	20

11.3.5. *Simulium* (Blackfly) larvae survey

Medically important species of *Simulium* flies mostly live in sheltered areas of the river/stream in fast moving waters. Vegetation collected showed no signs of medically important *Simulium* larvae. A total of 55 crabs which were collected did not have any *Simulium* larvae. However, invertebrate survey carried out during this study found some *Simulium* larvae (21 ind. m⁻²) under plant roots at the eastern and western banks of the Kalenge-Naminyia transect.

11.4. Discussion

Results from this survey, the first one of its kind show that the sanitation environment of the riparian communities along the Upper Victoria Nile is poor as indicated by faecal coliform load of over ten colonies per 100 ml of water at all sites. The acceptable limit of coliform load for good sanitation is 5 colonies per 100 mls of water (Barrel *et al.*, 2000). Ten colonies and above are indicative of urgent need for health interventions to reduce the threat of disease. Risk and prevalence of schistosomiasis were noted especially for people predisposed to water by fishing and bathing/swimming activities. River blindness seemed not to be a threat at present along the Upper Victoria Nile.

Therefore, there is a need to sensitize the communities about health hazards through mass health education, home improvement campaigns and mass chemotherapy at the sites to mitigate the effects of disease transmission. The origin of high levels of faecal coliforms (*Salmonella*) contamination should be further monitored.

CHAPTER 12

12.0. Fisheries Socio-economics Findings

12.1. Objectives of the survey

The main objective of the survey was to provide baseline fisheries socio-economic information on activities in the project site.

12.2. Survey sites and tools

The survey was focused on the areas previously sampled during AESNP EIA 2000. Participatory Rural Appraisal tools including transect walks, focus group discussions and key informant interviews were used. Additional socio-economics information captured in meeting notes is not included in this report.

12.3. Populations and activities at sampled sites

The major economic activity prevailing in the sampled sites is predominantly agriculture with some smallholder fishing activity. Although fishing is largely carried out on a subsistence level, the activity essentially supports many livelihoods as far as basic needs such as food, health income are concerned. Some of the species harvested are Nile perch (*Lates Niloticus*), Tilapia (*Oreochromis niloticus*), *Bagrus* (Semutundu), *Mormyrus* (Kasulu), and *Barbus* (Kisinja). Other economic activities include; charcoal burning, poultry farming, bars/restaurants and grocery shops. Livestock farming (cows, goats and sheep) is also practiced.

Beach Management Units (BMUs) around landing sites are not yet fully established. On average the fishers' earn of between Ush 10,000-30,000, an equivalent of US \$ 5.5-16.2 per week per fisher. However, majorities of them do not save. Only 9.5% had bank accounts in various locations, which indicates that they attach little value to their future income sources.

12.4 Fishing assets owned

Most of the fishers (89%) owned fishing assets while a few rented. Amongst the assets owned include; boats, oars, hook and gillnets.

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ANNEX A



A scoop-net on River Nile. This gear is used for fishing the small pelagic cyprinid Mukene (*Rastrineobola argentea*).



Washing in the Nile River. One of the ways communities along the river get infected by water-borne diseases especially bilharzias a common disease on the Nile.



Sun-drying the catch. Mukene caught from Kibubamutwe were very small immature fishes. The BIC pen lid shown is 57 mm long.



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Appendix C.2

Climatic Data

(Source: Appendix C.2 - AESNP Hydropower Facility

EIA, March 2001)

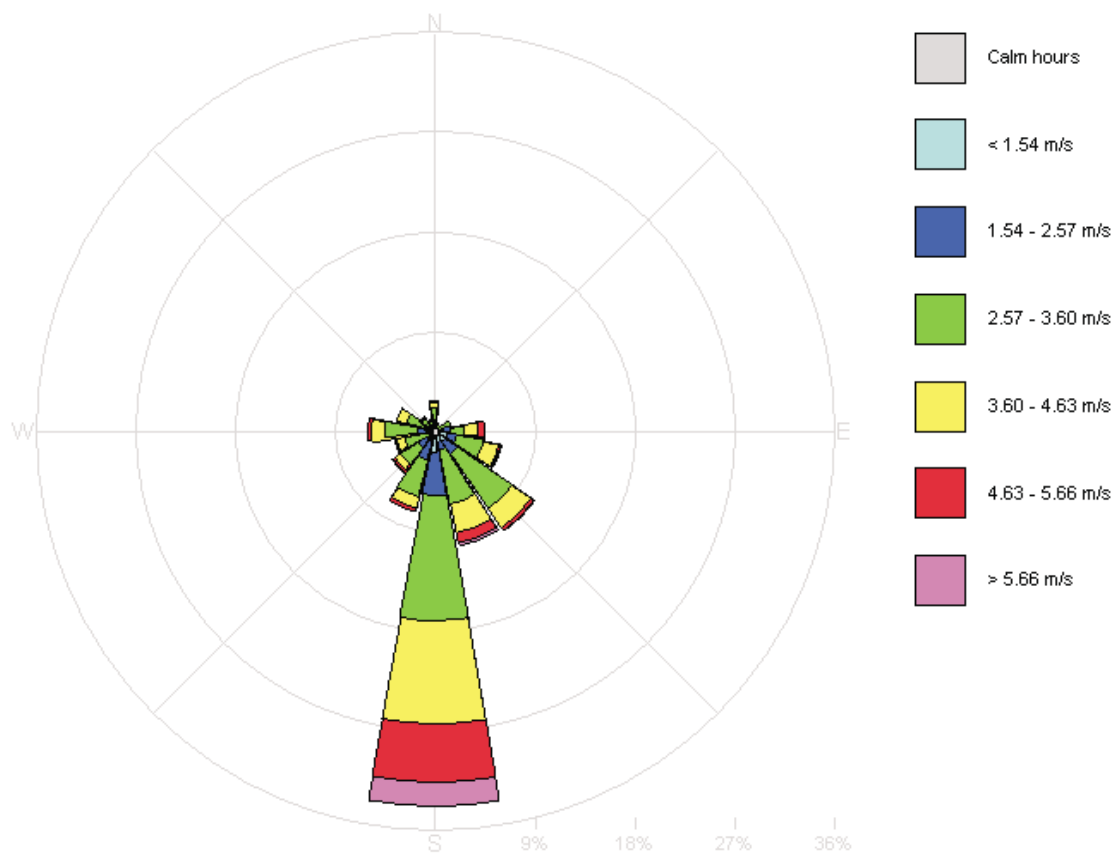
APPENDIX C.2

WIND DATA

Table C.1 Relative Frequency Distribution of Wind Speed and Direction at Jinja Kimaka Meteorological Station for Period January 1999 to June 2000

Speed m/s Direction	≤1.54	1.54 to 2.75	2.75 to 3.60	3.60 to 4.63	4.63 to 5.66	>5.66	Total %
0	0.137	0.685	0.959	0.479	0.068	0.068	2.397
22.5	0.000	0.000	0.274	0.137	0.000	0.068	0.479
45	0.000	0.000	0.274	0.000	0.000	0.000	0.274
67.5	0.137	0.000	1.027	0.000	0.000	0.000	1.164
90	0.342	0.685	1.164	1.301	0.616	0.068	4.178
112.5	0.685	0.959	2.466	1.370	0.205	0.137	5.822
135	0.753	1.370	5.959	2.123	0.274	0.137	10.616
157.5	0.685	0.685	4.932	2.740	0.890	0.274	10.205
180	1.644	3.836	11.301	9.178	5.342	2.123	33.425
202.5	0.685	1.644	3.425	1.027	0.411	0.000	7.192
225	0.685	0.822	1.918	0.685	0.205	0.068	4.384
247.5	0.205	0.205	2.192	0.753	0.137	0.068	3.562
270	0.616	0.753	2.877	1.301	0.274	0.000	5.822
292.5	0.548	0.342	1.507	0.959	0.000	0.000	3.356
315	0.068	0.411	0.616	0.274	0.068	0.000	1.438
337.5	0.274	0.068	0.548	0.000	0.000	0.000	0.890
Total %	7.466	12.466	41.438	22.329	8.493	3.014	95.205
Calms							4.795
Missing							0.000
Total %							100.000

Source: Department of Meteorology, Uganda



Source: Jinja Meteorological Station

Project Name: BUJAGALI HYDROPOWER FACILITY EIA	Date: MARCH, 2001	G0503_H_31	Figure C.1
Prepared for: AES NILE POWER	WIND ROSE DIAGRAM FOR JINJA JULY 1999 TO JUNE 2000		



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Appendix C.3

**Terrestrial Ecological Assessment
Report**

Bujagali Hydropower Project: Terrestrial Ecological Assessment (Plants, Birds and Mammals)

May 2006

Client: RJ Burnside International Ltd

Prepared by: Makerere University Institute of Environment and Natural Resources

Prof. Derek Pomeroy, Robert Kityo, Paul Ssegawa

FAUNA & FLORA – REPORT

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Executive Summary

As the previously extensive forest has been cleared over the past few decades, all but a few forest trees remaining, the predominant land use is now subsistence farming. Such agro ecosystems can support quite a high diversity of native flora and fauna, especially where, as in these areas at present, agricultural practices are largely small-scale and relatively traditional. Thus we did not expect many rare or threatened species, and this was confirmed by our findings.

The only major change between 1998 and 2006 has been the fencing of part of the west bank, and the subsequent rapid growth of thickets. Both here, and at other sites (including the Forest Reserve) a number of young trees are growing, so that the potential for natural forest regeneration seems quite good. Once the dam is closed, it would be possible to imagine the lake surrounded by forest, and with several forest island, supporting some tourist activities and breeding sites for water birds, as well as a sanctuary for native mammals. With good management, the degraded Forest reserves could likewise regenerate into an attractive feature on either bank, with forested islands between. As elsewhere, some sustainable uses of these forests could occur, once regeneration is well underway.

Overall more species of plants have been recorded in all sites compared to the results in 1998.

Some of the islands in the project area (e.g. Dumbbell, Namizi and Bujagali), will probably be completely submerged following the dam construction. Although largely cultivated these islands still supported a lot of species characteristic of forests, especially in the uncultivated areas and particularly the peripheries.

The invasive exotics, *Broussonetia papyrifera* and *Lantana camara* are quite abundant in most of the areas visited these could be controlled through a sustained regime of clearing to encourage native species to regenerate.

Exclusion of human activities, particularly farming on river banks, and enrichment planting with *Albizia grandebracteata*, *Albizia coriria*, *Milicia excelsa* and *Ficus* spp. will protect the river banks from erosion. Encouragement of natural regeneration of indigenous mid and late successional species such as *Ficus ovata*, *Warburgia ugandensis*, *Albizia grandebracteata*, *Celtis africana* especially in the Kalagala forest reserve will enhance the aesthetic value of these forests and contribute to tourism.

Numbers of species of birds were generally higher in 2006, partly because of the presence of Palearctic migrants, but probably also because the wet season increases the food supply for many species.

Of the various sites surveyed in 2006, the Forest Reserves had the most species. Of sites in the dam area, east and west banks had similar total numbers of species, as well as species of various specialities. No *globally-threatened* species were recorded, but several

species of regional interest were present. However, their populations within the Bujagali are a negligible proportion of the population of the species as a whole, so that construction of the dam will not affect them significantly.

The surviving mammalian diversity is largely comprised of small sized mammals including Rodents, Bats and Monkeys since all larger species are long gone from the area.

We have not recorded many species of conservation concern in the area however a few merit mention: -

- i. *Milicia excelsa* (Mvule) is categorized as Low Risk/ Near threatened by the IUCN (2000).
- ii. Other restricted range species include *Ficus cordata* and *Ficus ottonifolia*, which have been recorded in only one floral region out of the four that occur in Uganda.
- iii. Of the species of mammals recorded to still occur in the area only the African Spot Necked Otter *Lutra maculicollis* is listed by IUCN as vulnerable. Although the species is faced with a diversity of threats, it however remains widespread in many of Uganda's large fresh water bodies of which the Victoria Nile is only a small part.

The major conclusions from these surveys are that: -

- Regeneration in the fenced areas on the west bank has been remarkable, and shows interesting potential for natural reforestation.
- The islands, and to some extent the two reserves of the 'Kalagala offset' retain significant numbers of native trees, which, with appropriate management, could also lead to natural reforestation. In both cases, this would have considerable visual appeal (important to ecotourists) and have conservation benefits too.
- The east bank areas between Bujagali and Namizi remain essentially the same as in 1998.

BUJAGALI ESIA – FLORA and FAUNA

1 INTRODUCTION

1.1 Site description

Fieldwork at the sites concerned in the Bujagali ESIA took place between 15 and 26th March 2006. In this section, we have three parts – site descriptions, the vegetation structure and human use. These are followed by detailed accounts of the plants, birds and mammals of these areas and, finally a brief overview. Here we consider the main features of the six surveyed areas, as a background to their flora and fauna. The area as a whole has a high human population, especially on the east bank, so that the landscapes are predominantly determined by human activity, past and present. Less than 40 years ago, however, the banks of the Nile river were extensively forested, then the source of the disease known as river blindness, transmitted by *Simulium* flies, was eradicated, and people progressively cut down almost all of the forest, although a few forest trees remain within the farmland, and many more on some of the islands.

1.1.1 THE EAST BANK OF THE HYDRO AREA contains two of the sites that were surveyed in 1998, and which have been revisited in 2006. One is adjacent to Bujagali Falls (but mainly in the farmland outside the developed tourist area) and the other opposite Dumbbell Island. This area was not fenced in March 2006.

Namizi – this area, which is quite intensively used for smallholder/subsistence farming is relatively flat but slopes gently towards the river. A few houses have recently been built by richer members of the community; some are not lived in permanently. Native trees are preserved and common with the farmlands.

Bujagali village – the tourist area. We mainly surveyed the area outside the various camps, which however are still considerably affected by tourists, such as the riders of ‘all-terrain vehicles’, which are noisy and probably damage the tracts. Trees are again common. Between the occasional new houses, many people in these areas remain very poor.

1.1.2 THE FENCED AREA OF THE WEST BANK also contains two sites (the more northerly one embracing both Kikubamutwe and Malindi). These were surveyed for birds, mammals and plants in 2006, but only the northerly one was a bird site in 1998.

Kikubamutwe – the area just inside the fence, marking the main entrance to the fenced area – slopes gently down to the river, where the bank is relatively low. Since the people left the area in 2002, few signs of their presence remain, but there are a few banana plants and some mango and jackfruit trees. Most trees, however, seem to have been cut before the area was evacuated. Of those that remain, there are a few large ones which are certainly important for birds. The most striking feature is extensive, dense bush, composed largely of *Lantana camara* but with a high abundance of Paper mulberry, as described in Section 2. Scattered through the area are some open places, apparently derived from murram pits, and the roads are also wide, providing a contrasting habitat to the bush.

North of Naminya. This area, within the fence, is similar in many respects to the dam site, but there are more open areas, and as the track follows the perimeter fence, it was easy to observe the adjacent mixed farmland too. *Imperata* grass is now flourishing in an area of more than a hectare that had been recently burnt.

1.1.3 THE FOREST RESERVES or Kalagala-Itanda offset. These may well have been intact forests at the time of gazettment, but are degraded now. There is some dispute as to whether the islands belong to one or other of these reserves, or neither, it is reputed that one of the rafting companies has acquired the largest island.

Nile Bank Forest Reserve, on the east bank, some 15 km north of Dumbbell Island, is marked by an NFA signpost but consists to a very large extent of maize. It is alleged that the NFA authorities allowed the local communities to plant annual crops for one more growing season and thereafter will be planted with *Pinus*. However, no houses have been built in the area, suggesting that people accept that it is a reserve. The area is predominantly flat, sloping gently towards the river until within some 30-40 metres of the river bank, when it falls steeply, these slopes are partly cultivated too.

The few remaining trees form a clump of perhaps a hectare at the picnic site (used by rafters at the downstream end of their journey) and under the care of a very helpful lady, Ms Sarah. Elsewhere in the area we surveyed, which is within a few hundred metres of the picnic site, there are also some scattered trees.

Although within the surveyed crop area, maize is dominant, other crops included beans and tomatoes, and there were a few pawpaw trees.

Kalagala Forest Reserve, opposite Itanda on the west bank, retains a small clump of large trees, and a number of smaller trees are scattered along the area between the road and the river. The area is quite attractive and is well-used by local people for washing clothes – and by small boys for swimming. This reserve extends inland for approximately 300 m, where the absence of houses suggests that people are aware of its existence; if it were to be allowed to regenerate, they would lose their fields but not their homes.

1.2 Vegetation Structure

The number of trees, thickets, amount of ground cover and such-like features are a simple way of describing the landscape. This vegetation structure is also important to birds and mammals, many of which use trees, for example.

Information on vegetation structure was obtained as follows. Ten points were selected at random within the overall area; usually these were along paths, but offset to one side to exclude the path and its edges. Vegetation was recorded as the estimated percentage cover (i.e. the amount of ground covered, as seen from above) in four height zones – 0-1, 1-3, 3-8 and more than 8 metres in height. Vegetation was classified as native or non-native (crops and other introduced plants), and woody (trees and shrubs) or non-woody, (such as beans or grasses). The estimates were made by looking at the area within ten metres of the point where the observer stood, and dividing it into four nominal quadrants; the maximum cover in any one layer is

therefore 25%, in any one quadrant. This method is of course approximate, but as seen in Figure B1 there are obvious differences between the six sites.

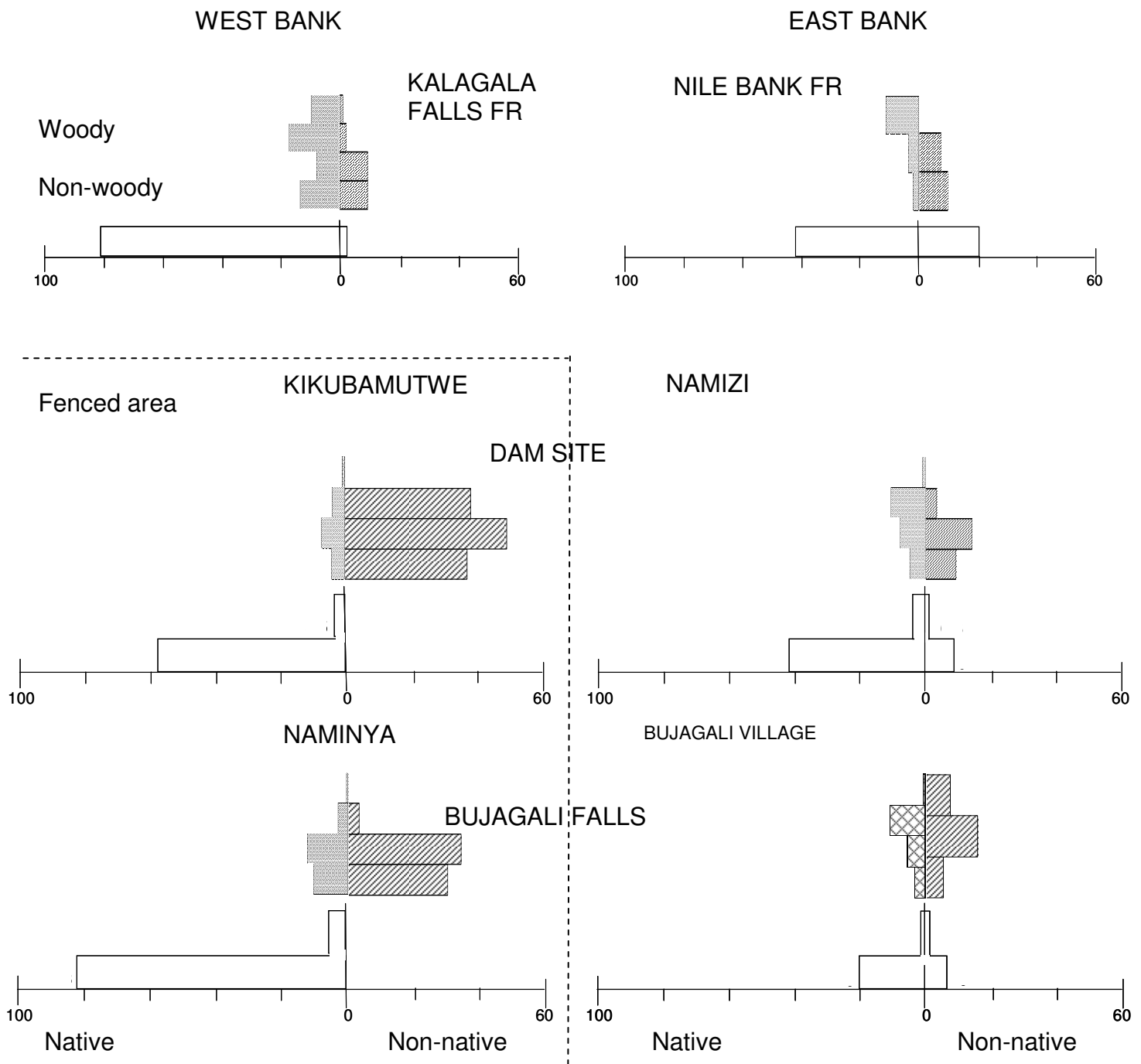


Figure B1. Estimated % vegetation cover, by vegetation type, at six survey sites. For each site, native vegetation is shown on the left, and woody vegetation above. See text for details.

The most widespread land use in the area as a whole is *smallholder farming* (Bolwig *et al* 2004), and the east bank sites at Namizi and Bujagali Village are fairly typical of this type. There are mature trees, some in clumps but mostly scattered, with an average canopy cover above 3 metres of about 15%, of which more than half is formed by native species. Trees are important as feeding, nesting and roosting sites for birds, and are also important for some bats and other mammals.

Planting of crops was actively going on – even on a Sunday! – So there were considerable areas of bare ground, which would become covered as the crops grow. A third of the ground was covered by native species – mostly ‘weeds’ in the fallow areas and grass elsewhere. These are important areas for smaller mammals, and a variety of birds.

On the west bank, two sites within the *fenced area* show extensive and often dense growths of *Lantana* and Paper Mulberry (see Figure A1 and plant section). Native trees and shrubs in these areas were less than half those on the east bank; it seems likely that, before they left, people cut down most of the useful trees for timber and other purposes. Outside the thickets, the cover of native grasses and other plants was generally dense.

In the two *Forest Reserves*, we surveyed those areas where native trees remain, and the nearby areas with crops. Kalagala Falls FR retains more trees than Nile Bank FR, most of which has been converted to maize. The tree cover at Kalagala was the highest of any site, and included a clump of mature pines which, however, are having their bark removed, perhaps for tinder.

1.3 Human Activities

Birds and other fauna are affected by human activity, usually negatively. We observed the extent of cultivation, the amount of fallow land, whether there were signs of recent-cutting or fire, and whether livestock were grazing in the area; finally we noted how many people were moving in the area, each of these being scored from zero to five. The results are summarised in Table A1.

Table A1. Human activities and disturbances at the six sites

	Fenced area		Smallholder farms		Forest Reserve	
	Kikubamutwe	Naminyia	Namizi	Bujagali	Kalagala	Nile Bank
Cultivation	0	0	4	4	3	4
Fallow	5	5	2	1	1	1
Tree-cutting ^a	1	0	0	0	2	1
Fire	0	2 ^b	0	0	0	0
Grazing ^c	0	0	2	1	2	1
People ^d	1 ^e	0 ^e	5	4	5	3

Notes: a Whole trees, branches and charcoal-making

b several hectares had been burnt recently

c mainly by cattle and goats

d an indication of the numbers of people moving through the area, actively cultivating etc.

e inside fenced area

2 FLORA COMPOSITION AND DESCRIPTION OF VEGETATION TYPES

2.1 Introduction

According to Langdale-Brown *et al.* (1964), the project area was originally characterized by species in the genera *Celtis* and *Chrysophyllum* as the climax (primary forest) tree species. The early successional stages are usually dominated by *Albizia* spp with *Teclea nobilis*, *Celtis africana* and *Antiaris toxicaria* while the mid-successional stage is predominantly *Bosqueia*, *Funtumia*, *Celtis*, with *Teclea nobilis* as the dominant understorey species.

The WS Atkins International 2001 report indicated that most of the project area including the Islands contained little native vegetation due to intensive agricultural activities. The Kalagala offset is still relatively intact because it is mainly a forest reserve with a few islands with limited human activities that can impact greatly on the vegetation. However, the Nile Bank Forest Reserve is largely planted with maize and there are some scattered tree species mainly *Maesopsis eminii* and *Antiaris toxicaria* but the river banks are still relatively intact with *Celtis* and *Holoptelea grandis* dominating.

This report presents a floristic assessment of the various sites within the project area including the Kalagala offset. It also gives a comparative overview with the previous vegetation survey as reported in the WS Atkins report 2001.

2.2 Methods

The field surveys were conducted between 15th and 26th of March 2006. Randomly located quadrats of 10 X 10 m were placed in representative habitat types at ten study sites (the six 'riverbank' sites discussed in Section 1.1, plus four 'island' sites: Itanda/Kalagala island, Namizi Island, Bujagali Islands and Dumbbell Island). The habitat types included gardens for the sites with intense agricultural activities, bushes, fallow land and forested areas especially along the riverbanks and islands. These were used to record trees over 10 cm diameter at breast height (dbh). Nested plots of 2 X 2 m were also used to assess the herbaceous vegetation (i.e. forbs and grasses). This was expected to give a good measure of the relative abundance of each species in a given study site. Inventory sampling was also done so as to produce a near complete species list for every site. Voucher specimens were collected for those species that could not be identified in the field and were brought to Makerere University Herbarium (MHU) for identification. Botanical nomenclature follows Polhill *et al.* (1954).

2.21 Data analysis

A compilation of the species at site level was done indicating the individual abundances at different sites using the semi-quantitative DAFOR scale (Dominant, Abundant, Frequent, Occasional, Rare). The number of times a species appeared in the quadrats gave a good indication of its abundance in a particular study area. A total of 137 quadrats of 10 X 10 m were used in the entire assessment.

Cluster analysis was used to group sites according to their respective species assemblage compositions to determine the degree of similarity among them. This was based on the presence/absence data. Cluster analysis is a technique that sorts objects (such as samplings units) into groups or clusters based upon their overall resemblance to one another (Ludwig & Reynolds, 1988). There are several cluster analysis algorithms, including single-linkage, average linkage and complete linkage, all having different ways in which clusters are formed (Johnson & Wichern, 1992); and although most cluster analyses give similar results, several algorithms should be explored and the results compared. Clusters can then be determined from one of the cluster analysis methods based on the underlying 'ecological knowledge of the data' (Ludwig & Reynolds, 1988).

Overall, 298 species were recorded in binary (presence or absence) format for the 10 sites investigated. To determine similarity of sites, the 298 X 10 array was used to calculate Sorensen's coefficient (S) (Ludwig & Reynolds, 1988) for each pair (A and B), where $S = a/(a+b+c)$, and a is the number of species sites A and B have in common, b is the number of species present in site A but absent in site B, and c as the number of species present in site B but absent from site A. The S values range from near 0 (for a site pair dissimilarity) to near 1 (site pair similarity).

To place sites into meaningful groups, the S values for all combinations of site pairs were summarized into a 10 x 10 array or similarity matrix. An agglomerative clustering technique (weighted centroid) provided in the Multivariate Statistical Package (MVSP) of Kovach (1999) was used to produce a dendrogram containing all 10 sites. A minimum S of 0.1 was used for defining clusters. Other measures of similarity and also measures of distance between sites were attempted along with several different methods of clustering (single-linkage and complete-linkage techniques). All techniques yielded similar results, with the S and weighted centroid clustering being most meaningful ecologically.

2.3 Results and Discussion

2.3.1 Floristics

There were 298 species, belonging to 215 genera and 75 plant families. The most dominant plant family was Fabaceae with 40 species followed by Euphorbiaceae, Poaceae, Moraceae and Asteraceae with 27, 24, 21 and 15 species respectively (see Appendix P1). The most abundant genus was *Ficus* with 16 species followed by *Phyllanthus* with five species only. The trees species constituted 30.5% (91 species) of the total, followed by forbs with 30.2% (90 species) and shrubs, 18.5% (55 species.). The commonest tree species recorded included *Markhamia lutea*, *Albizia grandibracteata*, *Broussonetia papyrifera*, *Maesopsis eminii* and *Milicia excelsa*. These occurred in at least 8 of the sites surveyed (Appendix P1). There were 20 exotic (non-native) species recorded of which *Broussonetia papyrifera* (Paper mulberry) and *Lantana camara* were the commonest.

The presence of *Maesopsis eminii* and *Albizia grandibracteata* was alluded to by Langdale-Brown *et al.* (1964) as being characteristic of the project area. However, the presence of the invasive Paper mulberry and *Lantana camara* in high abundances

reflects the absence of tree cover, because these species are light demanders and can only proliferate under conditions of canopy openness especially in abandoned fields or farmland and in this case the fenced off areas at Kikubamutwe and Naminya sites. However, it was also observed, especially at Kikubamutwe and Namizi, that seedlings and saplings of *Albizia* were growing. This regeneration was even more pronounced at Kikubamutwe where saplings of *Albizia* were struggling through the rather dense Paper mulberry and *Lantana camara*. Langdale-Brown *et al.* (1964) argued that *Albizia* species represent early successional stages, which are eventually followed by *Celtis* and *Chrysophyllum* as the late successional species. Therefore, if succession is allowed to occur, *Lantana camara* and Paper mulberry could eventually be eliminated as the indigenous tree species grow and provide tree cover particularly in the fenced areas.

2.32 Species richness at the various sites

The Kalagala area registered the highest observed species richness of 104 species followed by Kikubamutwe and the Itanda/Kalagala Island with 101 and 91 species respectively (Figure P1). The species richness at Kalagala area, which is the most species-rich, is about a third of the total plant species recorded. This further shows the differences in floristic compositions at different sites and varying habitat type conditions caused mainly by human activities.

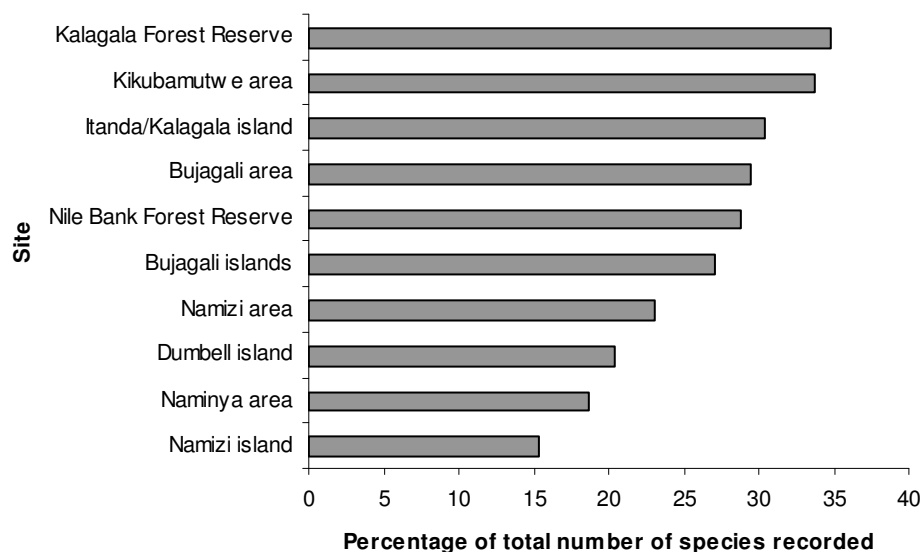


Figure P1: Observed species richness at various sites

The Naminya area and Namizi Island registered the least numbers of species with 56 and 46 respectively. This is due to the intense agricultural activities. Most of the natural vegetation has been cleared for agriculture and only a few scattered trees remain standing. The main crops grown include *Ipomoea batatas* (sweet potato), *Manihot esculentus* (cassava), *Musa sapientum* (banana), maize and beans. Weeds of agriculture such as *Bidens pilosa*, *Euphorbia heterophylla*, and *Commelina benghalensis* dominate the herbaceous vegetation

The richness registered at the Kalagala site can be attributed to the fact that the area is a forest reserve with a certain level of protection from encroachment. The riverbanks also represent a rich flora characteristic of typical semi deciduous forest dominated by *Celtis*, *Ficus* and *Holoptelea* trees with typical shrubs and herbaceous vegetation.

2.33 Site vegetation descriptions

- *Bujagali area*

This is a predominantly agricultural area with *Coffea robusta* (coffee), *Musa sapientum* (banana) and *Zea mays* (maize) as the main crops. There are scattered trees of mainly *Artocarpus heterophyllus* (Jack fruit tree), *Broussonetia papyrifera* (Paper mulberry), *Lantana camara*, *Markhamia lutea* and occasionally *Milicia excelsa*. The riverbanks are dominated by *Lantana camara* and *Broussonetia papyrifera*. The herbaceous vegetation is predominantly *Commelina africana*, *Bidens pilosa*, and *Ageratum conyzoides*.

- *Kalagala Forest Reserve*

The Kalagala site is a forest reserve with some large, tall trees and thick natural vegetation along the riverbank. The dominant trees and shrubs include *Albizia coriaria*, *Ficus ovata*, *Maesopsis eminii*, *Antiaris toxicaria*, *Vernonia amygdalina*, *Ficus vallis-chaudae*, *Holoptelea grandis*, and lianas such as *Urera trinervis* and *Loeseneriella africana*. The herbaceous vegetation is typical of forest species including *Desmodium velutinum*, *Hibiscus* sp. and *Pycneus polystachyos*.

- *Nile Bank Forest Reserve*

Most of the Nile Bank Forest reserve is planted with maize but the local people have been asked to harvest their crops and leave at the end of the next growing season to pave way for replanting with *Pinus*. However, there are scattered trees of mainly *Milicia excelsa*, *Maesopsis eminii*, *Antiaris toxicaria* and *Ficus ovata*. The river banks are dominated by *Celtis wightii*, *Ficus ovata*, *Holoptelea grandis* and the exotic Paper mulberry and *Lantana camara*.

- *Namizi area*

This is an area that is largely farmland. It is characterized by gardens of Coffee, Banana, maize and sweet potato with scattered homesteads. There are scattered trees of *Markhamia lutea*, *Ficus exasperata*, and *Ficus mucoso*. The dominant shrubs include *Vernonia amygdalina* and *Flueggea virosa*. There are weeds of agriculture dominating in farmland and these include *Digitaria abyssinica*, *Achyranthes aspera*, *Bidens pilosa*, *Sorghum arundinaceum* and *Sida rhombifolia*. The riverbanks are dominated by *Broussonetia papyrufera* and *Lantana camara*. Some *Albizia* spp and *Milicia excelsa* were regenerating. However, it was observed during the survey that some riverine vegetation had been cleared away for farming.

- *Naminya site*

A large section of this site was fenced off and has come to be largely dominated by the invasive exotics, *Broussonetia papyrifera* and *Lantana camara*. Other trees recorded in this area included *Markhamia lutea*, *Spathodea campanulata*, *Albizia grandibracteata*, *Albizia coriaria* and *Artocarpus heterophyllus*. The dominant shrubs included *Flueggea virosa* and *Vernonia amygdalina*. The herbaceous vegetation was dominated by *Bidens pilosa*, *Digitaria abyssinica*, *Conyza floribunda*, *Dyschoriste radicans* and *Imperata cylindrica*. The cultivated area mainly consisted of scattered trees of *Ficus*, *Maesopsis eminii*, *Cassia spectabilis*, and *Coffea robusta*. Some seedlings and saplings of mainly *Albizia* and *Maesopsis eminii* were observed particularly in the fenced area. The presence of these species may point to an early successional process that is reported by Langdale-Brown *et al.* (1964).

- *Kikubamutwe area*

A large section of this area is fenced and is predominantly Paper mulberry and *Lantana camara*. *Albizia* spp, *Artocarpus heterophyllus* and a typical pioneer tree species, *Trema orientalis* is fairly common. The herbaceous vegetation was dominated by *Bidens pilosa*, *Digitaria abyssinica*, *Conyza floribunda*, and *Dyschoriste radicans*. Seedlings and saplings of *Ficus*, *Albizia* and *Maesopsis eminii* were also observed in this area.

- *Itanda/Kalagala Island*

A large section of this island is planted with vegetables i.e. *Lycopersicum* sp. (tomatoes) and *Solanum* spp. Some scattered trees of *Broussonetia papyrifera*, *Coffea robusta* and *Musa paradisiaca* were also observed. The dominant indigenous trees on this island include *Markhamia lutea*, *Maesopsis eminii*, *Milicia excelsa*, *Spathodea campanulata*, *Antiaris toxicaria*, *Alchornea cordifolia*, *Chaetacme aristata*, *Cola gigantea*, *Albizia glaberrima*, *Holoptelea grandis*, *Sterculia dawei*, *Albizia gummifera* and *Pseudospondias microcarpa*. The more pristine areas are mainly on the island periphery which is less accessible or is dominated by rock, and these form habitats akin to forest.

- *Namizi Island*

This island had the least number of observed species. A large section of it is cultivated and the dominant species include *Broussonetia papyrifera*, *Albizia*, *Ficus*, *Morinda lucida* and *Antiaris toxicaria*. The herbaceous vegetation was dominated by *Bidens pilosa*, *Digitaria abyssinica*, *Conyza floribunda*, *Dyschoriste radicans*, and *Euphorbia hirta*.

- *Bujagali Islands*

These are relatively more species rich with a lot of flora characteristic of forest habitat. The islands have been cultivated for production of vegetables but the inaccessible areas, rocky shoreline and steep sections have been avoided and carry a lot of species. The characteristic species include *Capparis erythrocarpos*, *Maytenus heterophylla*, *Tapura fischeri*, *Alchornea cordifolia*, *Argomuelleria macrophylla*, *Drypetes gerrardii*, *Albizia coriaria*, *Albizia grandibracteata*, *Artocarpus heterophyllus*, *Broussonetia papyrifera* and *Lantana camara*.

- *Dumbbell Island*

The exposed island periphery is dominated by *Broussonetia papyrifera* and *Lantana camara* although the immediate inner areas have natural vegetation. They are rich in species that are relics of typical forest. The characteristic species include *Tapura fischeri*, *Alchornea cordifolia*, *Argomuelleria macrophylla*, *Drypetes gerrardii*, *Albizia coriaria*, *Albizia grandibracteata*, *Artocarpus heterophyllus*, *Manilkara obovata*, *Cola gigantea*, *Sterculia dawei*, *Chaetacme aristata*, *Urera trinervis* and *Lantana camara*. The edges of the island are dominated by the invasive species.

2.34 Site similarity

Species presence or absence was scored in the 10 sites and provided the basis for cluster analysis which, provided evidence of likeness of species assemblages among the 10 sites of the project area (Figure P2).

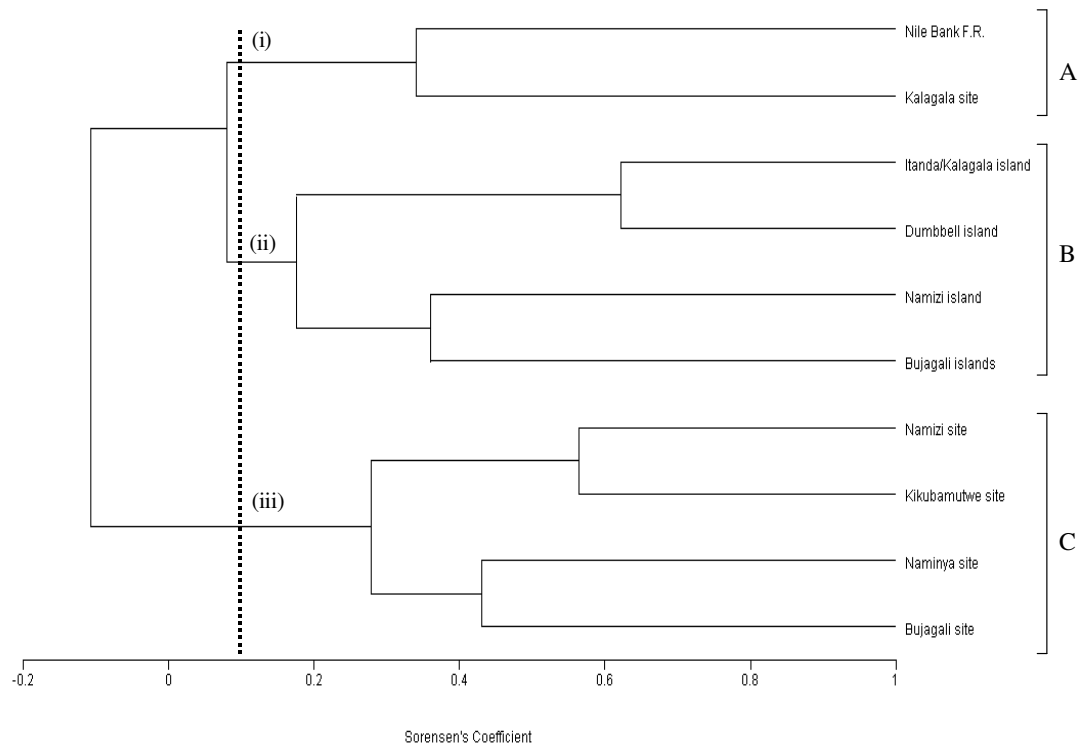


Figure P2. Cluster analysis of 10 sites of the project area based upon the presence or absence of 298 plant species. Site groupings (A, B & C) were defined using the Sorensen's coefficient of 0.1 (dashed line).

Dumbbell Island and Itanda/Kalagala Island sites had the highest Sorensen's similarity index (S) of 0.623 followed by Kikubamutwe and Namizi sites clustering with 0.565 (Table P1). Other sites clustered at lower values, and using a minimum S of 0.1 for defining clusters, the analysis produced three distinct groups of sites A, B, and C as shown in Figure P2.

Table P1. Similarity matrix (similarities expressed by the Sorensen's similarity index) of sample sites of the project area investigates. The highest values are shown in bold.

Group 1	Group 2	Similarity index (S)
Dumbbell island	Itanda/Kalagala island	0.623
Kikubamutwe site	Namizi site	0.565
Bujagali site	Naminya site	0.431
Bujagali islands	Namizi island	0.359
Kalagala site	Nile Bank FR	0.34

The cluster analysis in Figure P2 shows that Nile Bank FR and Kalagala FR are similar in terms of presence or absence of species. In cluster B, Dumbbell Island and Itanda/Kalagala Island have a higher similarity compared to the Namizi Island and Bujagali Islands pair. It is also evident in cluster C that the Namizi and Kikubamutwe sites had a higher similarity than the Naminya and Bujagali sites.

Thus the cluster analysis produced three distinct groups - Cluster A consisted of those sites which still had a lot of natural vegetation on them for example the riverbanks of Nile Bank FR and Kalagala FR which had forest patches with relatively intact natural vegetation. They also had a relatively high species richness compared to other sites in the project area. Cluster B consisted of the islands in the project area, some of which will probably be completely submerged during the dam construction phase. Although there was a lot of cultivation on these islands they supported a lot of species characteristic of forests, especially in the uncultivated areas and particularly the peripheries. The invasive exotics, *Broussonetia papyrifera* and *Lantana camara* were also quite abundant on these islands. Cluster C represented those sites that have been exposed to intense agriculture over the years. The most widespread species included mainly crops such as banana, maize and coffee. Other species that were characteristic of these areas were *Artocarpus heterophyllus* (Jack fruit tree), which is for provision of edible fruit, *Markhamia lutea* which is used in construction of houses, handles for hoes etc. The invasive exotics, *Broussonetia papyrifera* and *Lantana camara* were common in these areas especially in the seedlings growth stage. These sites had relatively low species richness since they are intensely cultivated. The weeds of agriculture such as *Bidens pilosa*, *Euphorbia heterophylla*, *Euphorbia hirta*, *Digitaria abyssinica* are abundant in the herbaceous vegetation.

2.4 Species of conservation concern

Milicia excelsa (Mvule) is categorized as Low Risk/ Near threatened by the IUCN (2000). Other restricted range species include *Ficus cordata* and *Ficus ottonifolia*. These have been recorded in only one floral region out of the four that occur in Uganda.

2.5 Management options for the Invasive exotic species

Within the project area, *Lantana camara* and *Broussonetia papyrifera* are notorious exotic invasive species. They can be described as plants that have a high rate of increase in uncrowded or otherwise favourable environments (i.e. the early stages of succession), with a manifestation of rapid growth and the production of large quantities of easily dispersed seeds, rapid germination, etc. (Whitmore, 1991; 1998). Their invasiveness may be attributed to the complex interaction between a species' reproductive biology, the local habitat, management, landscape characteristics and the established local flora.

However, it has been observed in Budongo forest reserve (Western Uganda) that the paper mulberry has been restricted to forest edges and is unable to proliferate under shade conditions. It is anticipated that as the late successional trees such *Celtis*, and *Albizia* (Langdale-Brown *et al.*, 1964) colonise the area, *Broussonetia papyrifera* and *Lantana camara* will be considerably reduced. However, to enhance regeneration with indigenous species, mechanical removal at regular intervals can help reduce their effect on the landscape and enhance natural regeneration of native species.

2.6 A comparative overview with the previous vegetation survey

About 39% (47) of the species recorded in the previous survey (see WS Atkins 2001 Report) were not recorded in the present survey. This is probably due to the fact that our survey was short, but many of the areas reported in the previous survey are agricultural and therefore became less important after people were re-settled from the west bank area by AES Nile Power, or compensation was paid for crops on the east bank and the Bujagali and Dumbbell Islands.. It is also probable that the high human population in these areas, coupled with the subsistence farming, leads to continued cutting of trees for fuel-wood, construction and clearing of land for agriculture. On the other hand, we found 178 additional species. This may be partly due to the rains that no doubt break the dormancy of seed for plants that may not necessarily be apparent in a dry season, especially the ephemerals. Together with a higher sampling effort, and more sites surveyed, this yielded a bigger species list.

In the fenced areas, particularly at Kikubamutwe, the invasive Paper mulberry and *Lantana camara* have continued to proliferate. However, indigenous species especially *Albizia* spp., *Maesopsis eminii* and *Sapium ellipticum* are regenerating, with many in the seedlings and sapling stages, even within the thick *Lantana camara* and *Broussonetia papyrifera* bushes. Therefore, with time, colonization will result into late successional species displacing the light demanding invasives.

2.8 Conclusions

There is a considerably higher species richness in the respective areas surveyed compared to the 1998 botanical survey (Kalagala offset increased numbers but nevertheless all sites including those done in 1998 recorded more species). The species assemblages vary considerably among the agriculturally affected sites, the islands and the forest reserves as can be seen in Figure P2 due to differences in

intensity of land use activities particularly for agriculture and forestry and, to some extent, accessibility of the islands. *Milicia excelsa* (Mvule) is categorised as Low Risk/Near Threatened by the IUCN (2000), however, it is widespread and with stable populations in all sites (see Appendix P1). Although natural regeneration with indigenous trees will be achieved eventually, especially in the fenced areas, controlling of the populations of Lantana and Paper mulberry would further enhance the natural regeneration process. Exclusion of human activities, particularly farming on river banks, and enrichment planting with *Albizia*, *Milicia excelsa* and *Ficus* spp. will protect the river banks from erosion. Replanting with indigenous mid and late successional species such as *Ficus ovata*, *Warburgia ugandensis*, *Albizia grandebractiata*, *Celtis africana* especially in the Kalagala forest reserve will enhance the aesthetic value of these forests and contribute to tourism.

The sites in cluster A, represent areas under the management of the NFA and therefore will theoretically be managed following the management options of NFA. Cluster B sites, which are essentially the island sites will be submerged and most of the vegetation will be lost. Some halophytic species such as those in the genus *Ficus* may survive in parts of the islands that may remain not totally submerged and could therefore still serve as important resources for some birds and mammals that would roost on them or feed on their fruits. Cluster C represents sites that are largely under subsistence agriculture with few economically important tree species, besides their food crops. It is our understanding that the local people cultivating along the riverbanks in the project area were already compensated and therefore should have stopped cultivating here. If cultivation is to be completely stopped we foresee the area regenerating with indigenous trees although in some areas enrichment planting may be necessary to enhance the regeneration.

3 LAND BIRDS

3.1 Introduction

A summary of the data, from both 1998 and 2006, is given in Appendix B1, which is arranged to compare the two years and to facilitate comparison between the various 2006 sites. In interpreting the differences between 1998 and 2006, two things are important. Firstly, the 1998 visits were in August, a comparatively dry time, whereas there had been widespread rains before the 2006 visits. Secondly, migrant birds, especially those from the Palearctic region (which is mainly Europe and northern Asia), would only just be beginning to arrive in August, the time of the 1998 surveys, but most will not have left by March, the month of the 2006 counts.

3.2 Methods

In both years, bird species were counted for one hour, several times at each site; a method known as Timed Species Counts or TSCs. TSCs are a method of rapid surveys which have been widely used in East Africa (Freeman *et al* 2004). During each one-hour count, bird species are listed in the order in which they are seen, or heard. The time is also noted at 10-minute intervals so that scores can be allocated, thus: 6 for species recorded in the first ten minutes, 5 for those recorded in minutes 11-20, and so on to 1 for those only recorded in the final ten minutes.

A commoner species will more often be recorded in the first ten minutes than a rare one, which will also be recorded in fewer counts. For this report we have used simple mean values of these TSC scores.

Various studies of birds in Uganda have classified birds according to their migratory and conservation status (if threatened, they are said to be Red-Listed; IUCN, 2000) and habitat requirement (see, for example, Bolwig *et al* 2004). The categories we have used are listed in Table B1.

Table B1. Bird descriptors. No globally-threatened species were observed. The species' preferred habitats and migratory status are also indicated in Table B1 and Appendix B1.

Threat categories	R-NT	regionally near threatened
	R-RR	species of regional responsibility
Habitat/habits	FF	forest specialist
	F	forest generalist
	F	forest visitors
	W	waterbird
	w	Bird often found near water
	G	species characteristic of grassland
	Ae	species which are predominantly aerial
Migrants	P	Palearctic migrants
	A	Afrotropical migrants, migrating with Africa

Birds at the sites adjacent to Dumbbell Island (Dam East and West) were each counted four times; those at the other sites (see Table B2) were each counted three

times (in 1998, only 3 sites were surveyed, with a total of five counts at each site). Fieldwork was undertaken between 15 and 26th March 2006. The area had received sufficient rain for plants to be actively growing, and many species of birds were beginning to nest, thereby increasing their conspicuousness.

3.3 Key results

These are given in Table B2, for each site in each year. In addition to the categories of birds listed in Table B4, we include Raptors (birds of prey), since these are ‘top predators’ and can be useful indicators of ecosystem health (Sergia *et al* 2005). The total numbers of species recorded at each site are given too.

The total numbers of species are often taken as a measure of diversity. Numbers were generally higher in 2006, partly because of the presence of Palearctic migrants, but probably also because the wet season increases the food supply for many species.

At the bottom of Table B2, we show the numbers of species recorded at each site in each year. However, some sites had more counts than others, so we also show the numbers after just three counts ($\Sigma 3$), the minimum number at any site. Of the various sites surveyed in 2006, the Forest Reserves had the most species. Of sites in the dam area, east and west banks had similar total numbers of species, as well as species of various specialities. No *globally-threatened* species were recorded, but several species of regional interest were present. However, their populations within the Bujagali are a negligible proportion of the population of the species as a whole, so that construction of the dam will not affect them significantly.

There area supports many species that need trees, and which live near water, and the development of the dam could benefit these, especially if the growing of trees is encouraged. Numbers of aerial feeders, grassland specialists and migrants were comparatively low.

3.4 Changes from 1998 to 2006

This comparison concerns the three sites counted in both years, and which are boxed in Table B2 and Appendix B1.

More species of birds were recorded in 2006, when there had been some rain. As Table B2 shows, birds associated with water, as well as migrants, were considerably more common in 2006.

The more detailed results given in Appendix B1 show that, for the three sites counted in both years, 108 species were recorded (out of 140 for all sites in both years). Of these, 61 were found in both years, whilst 16 were only recorded in 1998 and 31 only in 2006. The increase in species numbers between years, from 77 to 92, can as already indicated be largely attributed to there being virtually no migrants in 1998, whilst the rather higher scores for many species in 2006 are partly a result of wetter weather increasing the birds’ activity levels. The fencing of part of the west bank, leading to the formation of dense thickets (section 1) has also allowed some species, new to the area, to be added to the list. Examples are the Little Greenbul and Snowy-

headed Robin Chat. Thus, overall, the differences between the two years are easily explained in terms of seasons and the new enclosure.

Table B2. Summary results of bird counts at six sites: data are number of species. The sites in the shaded area for 2006 correspond to those surveyed in 1998. As seen in Appendix B1, some species fall into more than one category (e.g. they could be Palaearctic migrants that need trees – PF) whilst other belongs to none of the categories in this table. All contribute to the species totals at the foot of the table.

		1998				2006					
		Kikubamutwe	Namizi	Bujagali		Naminya	Kikubamutwe	Namizi	Bujagali	Kalagala	Itanda
Number of counts		5	5	5		3	4	4	3	3	3
HABITAT TYPE ^a		F	F	F		R	R	F	F	FR	FR
SPECIES OF CONSERVATION CONCERN	R-NT ^d	1	1	0		0	0	0	0	0	1
	R-RR	2	3	3		3	4	3	2	4	3
RAPTORS		3	4	3		7	9	6	5	6	7
HABITAT SPECIALISTS	FF	0	0	0		0	0	0	0	1 ^e	0
	F	7	7	7		4	14	13	11	11	7
	f	18	24	26		19	23	28	19	25	18
	WW	4	4	3		2	3	3	2	3	5
	W	8	7	9		15	14	12	6	10	15
	G	1	1	1		4	2	2	2	6	5
	Ae	3	3	3		3	4	7	3	4	6
MIGRANTS	P	1	0	2		5	9	8	4	6	8
	A	1	3	4		2	3	5	1	3	3
TOTAL SPECIES RECORDED	All	50	48	49		54	56	70	46	65	55
	Σ3 ^b	38	37	41		54	40	56	46	65	55

- Notes
- a F = small-scale farms, R = fenced (regenerating) areas, FR = Forest Reserves
 - b Species total after 3 counts
 - c Bujagali Falls
 - d Categories are listed in Table B1.

Twelve species, including African Hobby and Great Blue Turacco, were recorded only from one or both of the Forest Reserves, despite their highly degraded state, suggesting, as with both plants and mammals, that these areas have some potential interest.

4 WATERBIRDS

During our visits, between 15th and 26th March, opportunistic observations were made on waterbirds at various points along the river from Bujagali Falls to the Kalagala area. Of particular interest were birds that were found breeding.

4.1 Breeding records

Greater Cormorants *Phalacrocorax carbo* were breeding on two islands at Kyabirwa, with a total of about 30 nests, some with young. A further 30 or so nests were in use on small islands at the upstream end of the Itanda Falls. Both Sacred Ibis *Threskiornis aethiopicus* and Cattle Egrets *Bubulcus ibis* were resting in the same trees as the cormorants, but although they would be expected to be nesting in March (Brown & Britton 1980) they seemed not to be doing so. Several nests of the African Fish Eagle *Haliaeetus vocifer* were seen; there are at least five pairs in the area. The African Open-billed Stork *Anastromus lamelligerus* has been known to nest along this stretch of the Nile (pers obs) but they were not seen nesting this year.

A pair of the Regionally Vulnerable Rock Pratincoles *Glareola nuchalis* were seen near Dumbbell Island; they are almost certain to nest locally.

4.2 Other records

Greater Cormorants, Sacred Ibis and Cattle Egrets were also common all the way along the river.

The African Darter *Anhinga rufa* was quite common. This species is Regionally Vulnerable, largely because it gets caught (unintentionally) in fishermen's nets, and drowns. It may survive here because of the fast current in many places, where nets cannot be set.

In addition to Greaters, Long-tailed Cormorants *Phalacrocorax africanus* were numerous all along the river. Several each of Little Egret *Egretta garzetta* and Yellow-billed Stork *Mycteria ibis* were also seen; but we saw only a single Common Squacco Heron *Ardeola ralloides*. Several Common Sandpipers *Actitis hypoleucos* were noticed, presumably shortly before their departure (probably to Siberia).

4.3 Not seen

Curiously, we saw no Pied Kingfishers *Ceryle rudis* (other than two nearer to Jinja); they were common in 1998 and are indeed common throughout Uganda; however, they are known to make seasonal movements (Carswell *et al*, 2005).

4.4 Conclusion

The presence of so many fish-eating birds shows that there are currently plenty of small fish along this stretch of the Nile (even the Fish Eagle does not usually take fish above about one kilogram, and most are less than half of that (Brown et al, 1982). If the dam at Bujagali goes ahead as planned, thus creating a naturalistic lake, and trees on the islands are allowed to regenerate, we see no serious harm to waterbirds, especially if fishing is properly managed, with some no-go areas for fishermen to allow successful breeding. Downstream, reforestation of the Kalagala-Itanda offset will similarly provide much-needed nesting sites.

5 MAMMALS

5.1 Introduction

The WS Atkins International 2001 report indicated that most of the project area including the Islands contained little native vegetation due to intensive agricultural activities. The Jinja and Kagoma 1: 50,000 topographic sheets show the riverine areas from Njeru and Bujagali to as far north as Kalagala to have been forested until at least 1968. Reports from interviews with the local people have also suggested that forest clearing for cultivation and settlement in these areas happened between about 1975 to the 1980s for example in the Namizi area.

In the WS Atkins 2001 report although mammals were not specifically surveyed for, mention is made of several mammal species (the Red tailed Monkeys, Mole rats, Spot necked Otters, Straw coloured Fruit Bats, Hippopotami and Bush pigs) either as occurring in the area at the time or in previous times.

5.2 Methods

As a group, mammals were not evaluated for the Project area in the previous studies although some incidental information was gathered on six species of mammals. The present study has attempted to document in some more detail the diversity of mammals present and past in a number of areas in and around the Project area. Owing to the nature of the environment in the project area and its surroundings, it is very unlikely that larger mammals will still survive here except for a few hardy and very adaptable ones that can survive in human impacted environments. Smaller mammals on the other hand particularly those species that are not tied to very narrow ecological requirements could still survive in fairly high densities and diversity.

Trapping to assess the presence of small mammals and bats was done in the fenced area of the proposed dam site (Naminya/Kikubamutwe) and at Bujagali. These two areas are fairly representative of the surviving vegetation stands around the project area. It is expected therefore that any species of small mammals recorded in these two areas, could within limits, be expected to occur in the other nearby areas as well. A mixture of Sherman and snap traps in a line transect were used to trap and document presence and diversity of terrestrial small mammals. The line transect was preferred because it permits traversing a variety of habitat types given a short time of surveying. Mist nets were used for capturing and documenting bats, supplemented by observation of species in roosts, foraging or otherwise and signs such as skeletal material found in various locations, and scats also gave evidence of presence of one species or the other in the places investigated. In all areas visited interviews were also conducted with the local people to document the presence of any larger mammals both present now and in previous times.

The field surveys were conducted between 15 – 26th of March 2006. The nomenclature followed in this report is that of Wilson and Reeder (1993), also used in Davies & Vanden Berghe (1994).

5.3 Mammal species recorded for the project area and its surroundings

Overall eight groups of mammals (Table M1) have been recorded from the area. As would be expected the small mammals (mostly the rodents) comprise the largest proportion of the mammals recorded in the area. The results presented here are probably not a fair representation of the other two groups of small mammals (Insectivora and Chiroptera). Near complete lists of these can only be compiled following long repeated field seasons of surveying in the areas. Many more species of these would be expected in an area such surveyed for this work.

Table M1. Summary of mammal diversity in the study area

Taxonomic group	Total number of species recorded from these field surveys and of historical records from interviews with local people	Total recorded as present in March 2006
Artiodactyla (Antelopes)	5	0
Carnivora (Carnivores)	6	3
Insectivora (Insectivorous mammals)	1	1
Megachiroptera (Fruit Bats)	3	3
Microchiroptera (Insect Bats)	3	3
Primates (Monkeys)	3	2
Proboscidea (Elephants)	1	0
Rodentia (Rats, Mice Squirrels & allies)	20	20

All larger species of mammals would find it rather difficult to survive in habitats with a heavy human presence and therefore have largely disappeared.

5.4 The immediate impact area

A total of 42 species of mammals have been recorded from both interviews on what mammals used to be in these areas and actual field surveys to document presence of those that were present at the time of these surveys in the area here described as the immediate impact area (comprising of the Dam site –Kikubamutwe and Malindi, Naminya, Bujagali and Namizi although this area also includes some of the islands, they are separately discussed in a different section) of the proposed project. Ten of these species (*in Appendix M1) have long been lost from the area largely due to conversion of the formerly forested areas. The larger mammals have all been lost from this area leaving only smaller mammals that are adapting to, and surviving in, the much-changed environment. There is a likelihood though that the species list of mammals in the area could be higher than recorded here if more effort were to be invested in surveying for them.

The trapping results in the dam Site and Bujagali (Table M2) although based on a small sampling effort (90 trap-nights in the Dam Site and 45 trap-nights at Bujagali); they nevertheless present an initial indication of relative abundance of the species of small mammals recorded. Additional trapping would probably turn up more species than were recorded since several other species that would be expected in this geographical range were not recorded from these efforts.

Table M2. Relative abundance of the small mammals trapped in two of the locations.

Species	Trap rate (%)	
	Dam site	Bujagali
<i>Mastomys hildebrandtii</i>	6.7	8.9
<i>Lophuromys sikapusi</i>	10.0	11.1
<i>Lophuromys flavopunctatus</i>	6.7	11.0
<i>Aethomys kaiseri</i>	5.0	0.0
<i>Lemniscomys striatus</i>	6.7	15.0
<i>Otomys tropicalis</i>	1.7	5.0
<i>Dasymys incomtus</i>	1.7	2.2
<i>Mus minutoides</i>	5.0	4.4
Overall trap success	43.3	51.1

In both locations *M. hildebrandtii*, *L. sikapusi*, *L. flavopunctatus*, and *L. striatus*, all species of largely moist savanna type habitats, were fairly common while the rest of the species were captured in much smaller numbers.

The importance of the presence and abundance of small mammals lies in the fact that they are consumers and are also food to other animals. They therefore play vital ecological roles and their extirpation from an area would impact on the other species that are dependant on them either for food or dispersal.

The Straw-coloured Fruit Bats (*Eidolon helvum*) were reported by WS Atkins 2001 to roost on one of the Bujagali Islands in thousands. These bats were not found on the islands at the time of the 2006 surveys, although skeletal material from them was found on the islands. It was reported however from interviews with the local people cultivating on the islands that they return to the islands at different times of the year.

Although from a distance the islands (such as the Bujagali islands visited) appear forested, cultivation that is supposed to have been stopped on them continues with extensive gardens of a variety of vegetables. Therefore most of the vegetation has been cleared to give way to the growing of these crops. The only remaining fair sized trees are on the periphery of the islands. The farmers have largely depleted the tree stand inland on the islands under cultivation, reducing them as a vital resource for bats. If cultivation continues at the same rate as observed at the time of doing these surveys it is unlikely that the bats will continue to use these islands much longer.

5.5 The Kalagala-Itanda Offset Area

The Kalagala – Itanda offset was proposed as an area to be protected in perpetuity, as compensation for the reduction in river/rapids habitats and tourism values that would arise from the construction of the Bujagali Dam (Government of Uganda 2001). By 2001 both the Kalagala Falls (KFFR) and Nile Bank Forest Reserves (NBFR) were already deforested by the local people for cultivation and already an urgent need for action to stop further damage to these reserves was recommended. KFFR was

considered to have greater immediate potential for tourism development than NBFR because it was in a less degraded state at that time.

At the time of conducting the present survey (March 2006), the Nile Bank and Kalagala Falls FRs only remain forest reserves by name as most of the natural vegetation that formerly characterized them is largely depleted, particularly in the case of Nile Bank Forest reserve. This latter is now mostly covered in gardens of maize and tomatoes but part is also getting replanted with pines. The Kalagala Falls forest reserve (KFFR) on the other hand, although quite depleted as a forest, nevertheless still has some large trees surviving. The Itanda/Kalagala Islands on the other hand have a fair amount of natural vegetation still surviving, despite being impacted by the local people, who are clearing them to grow crops of tomatoes, greens, yams, pineapples, maize and bananas among others. The human pressures on the islands notwithstanding, several species of mammals were recorded present on these islands (Appendix M1).

If the Nile Bank and Kalagala Forest Reserves were to be restored, it is unlikely that they would be naturally repopulated by the larger mammals that once ranged in these areas, since their populations have long been lost from the areas outside the main Mabira forest Block. A suitable mitigation scenario would be to reintroduce such species as used to occur in the areas from elsewhere.

As a refuge for mammals, the two forest reserves in this area (Kalagala Falls & Nile Bank) are not very important anymore in the state they are today. If rehabilitated and restored, for example by re-vegetation with native species, initially populations of species of small mammals that no doubt still survive in some of these areas will recover. Re-introduction of larger mammal species, if compatible with tourism development and local farming activities, could then be done to restore some of the larger mammals that used to exist in these forests.

5.6 Bujagali, Kalagala/Itanda and Dumbbell islands

At the present time the Bujagali Islands are under intense agriculture, being used for growing the variety of crops mentioned already elsewhere in this report. A lot of the vegetation on the islands has been cleared, leaving a small peripheral ring along the edge of each island. The other islands on the other hand, although being cultivated still have a fair stand of vegetation. Appendix M1 lists the mammal species recorded for these islands. Dumbbell and Itanda/Kalagala Islands still have populations of Red tailed Monkeys in addition to which the latter also has two species of Porcupine (The Crested and Brush tailed Porcupine). Besides these the rest of the mammalian diversity recorded comprised of small mammals.

5.7 Conclusions

From interviews with the local people in the different areas visited the west and east banks of the Nile were forested to varying degrees up to about the 1980s. Settlement in, and clearance of forest was reported to date from about the late 1950s although no additional supporting evidence has been found for this. Given that the forested areas along the Nile in the project area would have been similar to that of Mabira Forest, it could be safe to assume that the mammalian composition would have been the same throughout the whole range. Several species of larger mammals were reported to have

existed in the areas visited (marked * Appendix M1) in some cases as recently as the 1980s for the Bushbucks, Elephants to 1962, and Hippos into the 1970s.

Of the species recorded to still occur in the area only the African Spot Necked Otter *Lutra maculicollis* is listed by IUCN as vulnerable (Appendix M1). The main threats to Spot-necked Otters are considered to be siltation due to erosion near the source of rivers, cultivation of bank side habitats, indiscriminate bushfires, competition for fish and hunting. The use of new nylon fishing nets has also been reported as causing the death of otters, which become tangled in them and drown. The local fisherman may also kill otters as a threat to their fish stocks - probably wrongly, as otters only take small fish and are not very numerous anyway¹.

Although faced with such a diversity of threats, this species is however still widespread in many of Uganda's large fresh water bodies of which the Victoria Nile only happens to be a small part. It is not likely either that damming the Nile will result in significant negative impacts on its survival.

6 GENERAL CONCLUSIONS

The areas described in this report have, on the whole, a high human population, especially on the east bank, so the landscapes are predominantly determined by human activity, past and present. Less than 40 years ago, however, the banks of the Nile were extensively forested. After the vector of the disease known as river blindness (the *Simulium* fly) was eradicated from the area, people progressively cut down almost all of the riverbank forest, although a few forest trees remain within the farmland, and many more on some of the islands. There is no doubt therefore that prior to this site being identified for the Hydropower project development, it had been grossly altered through anthropogenic impacts, thus lowering its value for biodiversity protection and conservation. However, several species that can survive in human impacted habits (largely agro ecosystems) are still found in these areas.

It is already evident in the fenced off area that following removal of human activities there is great potential for regeneration. In the long term this could result in vegetation similar to the original condition.

Resettlement of people and human activities from some of the areas along the Nile in the Project area, such as on some of the islands, the river banks, the fenced-off dam area and the Kalagala Offset area, could achieve several benefits:

- i. Restoring the forested habitats and attracting a richer fauna that may still be able to cross the agro ecosystems
- ii. Restoration of vegetation along the riverbanks that would counter increased soil erosion due to agriculture.
- iii. Creation of an alternative habitat that could benefit ecotourism and that would mitigate for the loss of some rapids upstream.
- iv. Restore large trees that are needed for roosting by birds and bats and nesting by larger birds such as the African Fish Eagle.

¹ http://www.amblonyx.com/otter/maculicollis/otter_conserve.htm & <http://www.redlist.org/search/details.php?species=12420>

For these and other reasons we consider the “Kalagala Offset” plan as a very positive mitigation measure. However the Nile Bank Forest Reserve that is already being replanted with exotic trees (pines) might also benefit from encouraging native trees to regenerate although this is going to depend on the management policy that NFA have for this reserve.

The only significant natural habitat conversion we envisage in the project area will result from the damming of the Nile and the resultant backwater that will flood areas of the riverbanks and islands from Dumbbell to Bujagali.

Performance Standard 6 of the International Finance Corporation spells out issues pertaining to biodiversity conservation and sustainable resource management in project development areas. As noted above there will be some negative effects on the natural environment, habitats and constituent flora and fauna which can be mitigated by ecological restoration in areas noted above.

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APPENDICES

Appendix P1. Plant species found in areas likely to be affected by the Bujagali Hydropower scheme and the Kalagala area.

Key to abbreviations:

Buj = Bujagali area; Buj Islands = Bujagali Islands; Dumbel Island = Dumbbell Island; Kiku = Kikubamutwe area; Nmy = Naminya area; Nmz Island = Mamizi Island; Nmz = Namizi area; Ita/Kala Island = Itanda/Kalagala Island; Kala FR = Kalagala Forest Reserve; N. Bank FR = Nile Bank Forest Reserve.

T = Tree; G = Grass; L = Liana/Climber; Ra = Rambler; Cr = Creeper; F = Forb; S = Shrub

* - signifies exotic (non-native) species

√ - signifies presence of a species

^a - Abundance categories include: **D** – Dominant, **A** - Abundant, **F** – Frequent, **O** – Occasional, **R** – Rare. A species is considered **Dominant** if it occurs in at least eight of the sites investigated, and **Rare** if it occurs in only one site of all those investigated.

Family	Species	Habit	Abundance	Previous survey ^a	Immediate Impact zone							Itanda/Kalagala offset		
					Buj	Buj Islands	Dumbel Island	Kiku	Nmy	Nmz Island	Nmz	Ita/Kala Island	Kala FR	N. Bank FR
Fabaceae	<i>Acacia kirkii</i>	T	R	√										√
Fabaceae	<i>Acacia polyacantha</i>	T	R											√
Euphorbiaceae	<i>Acalypha bipartita</i>	S	O										√	√
Euphorbiaceae	<i>Acalypha neptunica</i>	S	F			√	√			√		√		√
Euphorbiaceae	<i>Acalypha ornata</i>	F	R	√									√	
Acanthaceae	<i>Achyranthes aspera</i>	F	F	√	√			√			√		√	√
Passifloraceae	<i>Adenia bequaertii</i>	L	A			√	√	√		√		√	√	
Passifloraceae	<i>Adenia tricostata</i>	L	R			√							√	
Amaranthaceae	<i>Aerva lanata</i>	F	R					√						
Acanthaceae	<i>Ageratum conyzoides</i>	F	O		√			√			√			
Fabaceae	<i>Albizia coriaria</i>	T	F	√	√	√							√	√
Fabaceae	<i>Albizia glaberrima</i>	T	F							√		√	√	√
Fabaceae	<i>Albizia grandibracteata</i>	T	D	√	√	√		√	√	√	√		√	√
Fabaceae	<i>Albizia gummifera</i>	T	O		√			√						√
Fabaceae	<i>Albizia zygia</i>	T	F			√		√					√	√

					Immediate Impact zone							Itanda/Kalagala offset		
Family	Species	Habit	Abund ance	Previous survey ^a	Buj	Buj Islands	Dumbl Island	Kiku	Nmy	Nmz Island	Nmz	Ita/Kala Island	Kala FR	N. Bank FR
Euphorbiaceae	<i>Alchornea cordifolia</i>	T	F	√		√	√			√		√	√	
Sapindaceae	<i>Allophylus macrobotrys</i>	T	R		√									
Sapindaceae	<i>Allophylus sp.</i>	T	O									√	√	
Aloaceae	<i>Aloe sp.</i>	F	R										√	
Apocynaceae	<i>Alstonia boonei</i>	T	R											√
Amaranthaceae	<i>Amaranthus spinosus</i>	F	O		√						√			
Commelinaceae	<i>Aneilema spekei</i>	F	O				√					√		
Moraceae	<i>Antiaris toxicaria</i>	T	A	√	√		√		√			√	√	√
Euphorbiaceae	<i>Antidesma membranaceum</i>	T	R										√	
Euphorbiaceae	<i>Argomuelleria macrophylla</i>	S	F			√	√					√	√	√
Aristolochiaceae	<i>Aristolochia elegans</i>	F	R			√								
Annonaceae	<i>Artabotrys monteiroae</i>	L	R			√								
Annonaceae	<i>Artabotrys velutinus</i>	L	O				√					√	√	
Moraceae	<i>Artocarpus heterophyllus</i>	T	A	√	√	√		√	√		√			√
Asteraceae	<i>Aspilia africana</i>	F	O							√	√	√		
Acanthaceae	<i>Asystasia gangetica</i>	F	O	√				√					√	
Acanthaceae	<i>Asystasia schimperii</i>	F	F		√			√	√		√		√	
Fabaceae	<i>Baikiaea insignis</i>	T	R											√
Basellaceae	<i>Basella alba</i>	F	F	√		√	√					√	√	
Fabaceae	<i>Bauhinia variegata*</i>	T	R	√	√									
Asteraceae	<i>Bidens pilosa</i>	F	D	√	√	√		√	√	√	√	√	√	√
Sapindaceae	<i>Blighia unijugata</i>	T	O			√							√	√
Poaceae	<i>Brachiaria decumbens</i>	G	R										√	
Euphorbiaceae	<i>Bridelia micrantha</i>	T	O	√	√		√					√		
Moraceae	<i>Broussonetia papyrifera*</i>	T	D	√	√	√		√	√	√	√	√		√
Burseraceae	<i>Canarium scweinfurthii</i>	T	R	√				√						
Fabaceae	<i>Canavalia virosa</i>	L	F				√	√		√		√	√	
Capparaceae	<i>Capparis erythrocarpos</i>	S	F			√	√						√	√
Solanaceae	<i>Capsicum frutescens*</i>	F	O		√			√						
Sapindaceae	<i>Cardiospermum corindum</i>	L	R		√									
Sapindaceae	<i>Cardiospermum halicacabum</i>	L	R			√								
Caricaceae	<i>Carica papaya*</i>	T	A		√	√	√			√	√			√
Fabaceae	<i>Cassia bicaulsularis</i>	S	F					√	√		√		√	
Fabaceae	<i>Cassia mimosoides</i>	F	R					√						
Fabaceae	<i>Cassia occidentalis</i>	S	O								√		√	
Fabaceae	<i>Cassia siamea*</i>	T	R											√
Fabaceae	<i>Cassia spectabilis*</i>	T	O					√		√				√
Ulmaceae	<i>Celtis africana</i>	T	R	√		√								
Ulmaceae	<i>Celtis mildbraedii</i>	T	R											√
Ulmaceae	<i>Celtis wightii</i>	T	R											√

Family	Species	Habit	Abundance	Previous survey ^a	Immediate Impact zone							Itanda/Kalagala offset		
					Buj	Buj Islands	Dumbl Island	Kiku	Nmy	Nmz Island	Nmz	Ita/Kala Island	Kala FR	N. Bank FR
Umbelliferae	<i>Centella asiatica</i>	F	F		√			√	√				√	
Ulmaceae	<i>Chaetacme aristata</i>	S	F			√	√					1	√	√
Poaceae	<i>Chloris gayana</i>	G	O		√			√					√	
Poaceae	<i>Chloris virgata</i>	G	R					√						
Vitaceae	<i>Cissus oliveri</i>	L	R			√								
Vitaceae	<i>Cissus rotundifolia</i>	L	F	√			√			√		√	√	
Rutaceae	<i>Citrus limonii</i> *	T	O							√		√		√
Rutaceae	<i>Clausena anisata</i>	S	O	√							√	√		
Verbenaceae	<i>Clerodendrum fuscum</i>	L	R										√	
Rubiaceae	<i>Coffea robusta</i> *	T	F		√		√	√			√	√		
Sterculiaceae	<i>Cola gigantea</i>	T	F			√	√	√		√		√		
Combretaceae	<i>Combretum collinum</i>	T	R										√	
Combretaceae	<i>Combretum paniculatum</i>	L	F		√		√					√	√	
Commelinaceae	<i>Commelina africana</i>	F	D	√	√	√	√	√		√	√	√	√	√
Commelinaceae	<i>Commelina benghalensis</i>	F	A	√	√			√		√	√	√		√
Nyctaginaceae	<i>Commicarpus plumbagineus</i>	F	O							√		√		√
Asteraceae	<i>Conyza floribunda</i>	F	F		√			√	√		√			√
Zingiberaceae	<i>Costus afer</i>	F	R			√								
Asteraceae	<i>Crassocephalum vitellinum</i>	F	O		√			√						
Fabaceae	<i>Crotalaria aculeata</i>	S	R					√						
Fabaceae	<i>Crotalaria brevidens</i>	S	O					√			√			
Fabaceae	<i>Crotalaria sp.</i>	S	O		√				√					
Fabaceae	<i>Crotalaria spinosa</i>	S	R								√			
Euphorbiaceae	<i>Croton macrostachyus</i>	T	R								√			
Araceae	<i>Culcasia falcifolia</i>	F	O				√					√	√	
Araceae	<i>Culcasia sp. (crop)</i> *	F	O				√					√		
Araliaceae	<i>Cussonia arborea</i>	F	R			√								
Amaranthaceae	<i>Cyathula achyranthoides</i>	F	R											√
Poaceae	<i>Cynodon dactylon</i>	G	O	√				√	√					√
Cyperaceae	<i>Cyperus articulatus</i>	F	O							√		√		
Cyperaceae	<i>Cyperus cyperoides</i>	F	A		√			√	√		√		√	√
Cyperaceae	<i>Cyperus denudatus</i>	F	O				√					√		
Cyperaceae	<i>Cyperus distans</i>	F	O							√		√		
Cyperaceae	<i>Cyperus maculatus</i>	F	O		√	√	√							
Cyperaceae	<i>Cyperus papyrus</i>	F	O	√			√					√		
Vitaceae	<i>Cyphostemma adenocaulis</i>	L	R	√	√									
Fabaceae	<i>Desmodium ramosissimum</i>	S	R					√						
Fabaceae	<i>Desmodium setigerum</i>	F	R					√						
Fabaceae	<i>Desmodium sp.</i>	F	O		√						√			
Fabaceae	<i>Desmodium tortuosum</i>	F	F					√	√		√			√

Family	Species	Habit	Abundance	Previous survey ^a	Immediate Impact zone							Itanda/Kalagala offset		
					Buj	Buj Islands	Dumbl Island	Kiku	Nmy	Nmz Island	Nmz	Ita/Kala Island	Kala FR	N. Bank FR
Fabaceae	<i>Desmodium velutinum</i>	F	R										√	
Dichapetalaceae	<i>Dichapetalum ugandense</i>	L	F				√					√	√	√
Fabaceae	<i>Dichrostachys cinerea</i>	T	O					√			√			√
Poaceae	<i>Digitaria abyssinica</i>	G	F		√			√	√		√		√	
Poaceae	<i>Digitaria longiflora</i>	G	R											√
Poaceae	<i>Digitaria velutina</i>	G	O		√						√			
Sterculiaceae	<i>Dombeya mukole</i>	T	R											√
Dracaenaceae	<i>Dracaena fragrans</i>	S	F		√			√	√			√		
Caryophyllaceae	<i>Drymaria cordata</i>	F	R		√									
Euphorbiaceae	<i>Drypetes gerrardii</i>	T	O			√	√							
Acanthaceae	<i>Dyschoriste radicans</i>	F	F					√	√		√		√	√
Asteraceae	<i>Eclipta alba</i>	F	O		√				√		√			
Pontederiaceae	<i>Eichhornia crassipes</i> *	F	R	√								√		
Asteraceae	<i>Emilia integrifolia</i>	F	O		√						√			
Fabaceae	<i>Entada abyssinica</i>	T	O								√			√
Poaceae	<i>Eragrostis tenuifolia</i>	G	O	√				√	√		√			
Fabaceae	<i>Eriosema psoraleoides</i>	F	R								√			
Euphorbiaceae	<i>Erythrococca trichogyne</i>	S	R		√									
Erythroxylaceae	<i>Erythroxylum fischeri</i>	S	R									√		
Orchidaceae	<i>Eulophia sp.</i>	F	R			√								
Euphorbiaceae	<i>Euphorbia heterophylla</i>	F	F	√	√		√	√			√	√		
Euphorbiaceae	<i>Euphorbia hirta</i>	F	F		√			√	√		√			
Euphorbiaceae	<i>Euphorbia teke</i>	S	F			√	√					√	√	
Moraceae	<i>Ficus asperifolia</i>	T	R											√
Moraceae	<i>Ficus conraui</i>	T	O			√							√	
Moraceae	<i>Ficus cordata</i>	T	O			√							√	
Moraceae	<i>Ficus cyathistipula</i>	T	O							√		√		
Moraceae	<i>Ficus exasperata</i>	T	A		√	√			√	√	√	√		√
Moraceae	<i>Ficus mucuso</i>	T	A	√	√			√		√	√	√		√
Moraceae	<i>Ficus natalensis</i>	T	A	√	√	√		√	√	√	√		√	
Moraceae	<i>Ficus ottoniifolia</i>	T	R			√								
Moraceae	<i>Ficus ovata</i>	T	A	√	√	√	√					√	√	√
Moraceae	<i>Ficus platyphylla</i>	T	A				√	√	√	√		√	√	
Moraceae	<i>Ficus pseudomangifera</i>	T	A		√	√	√	√				√	√	
Moraceae	<i>Ficus saussureana</i>	T	F		√	√				√		√	√	
Moraceae	<i>Ficus sur</i>	T	O	√	√	√								√
Moraceae	<i>Ficus sycomorus</i>	T	O				√					√	√	
Moraceae	<i>Ficus thoningii</i>	T	F		√		√			√		√		
Moraceae	<i>Ficus vallis-choudae</i>	T	A	√	√			√	√	√		√	√	
Euphorbiaceae	<i>Flueggea virosa</i>	S	F		√			√	√		√			√

					Immediate Impact zone							Itanda/Kalagala offset		
Family	Species	Habit	Abund ance	Previous survey ^a	Buj	Buj Islands	Dumbl Island	Kiku	Nmy	Nmz Island	Nmz	Ita/Kala Island	Kala FR	N. Bank FR
Asteraceae	<i>Galisonga parviflora</i>	F	R		√									
Fabaceae	<i>Glycine wightii</i>	L	O					√			√			
Tiliaceae	<i>Glyphaea brevis</i>	S	O							√		√		
Tiliaceae	<i>Grewia mildbraedii</i>	S	O	√				√						√
Tiliaceae	<i>Grewia trichocarpa</i>	S	O	√		√		√					√	
Asteraceae	<i>Gynura scandens</i>	F	F			√	√					√	√	
Simaroubaceae	<i>Harrisonia abyssinica</i>	T	R											√
Rhamnaceae	<i>Helinus mystacinus</i>	L	R			√								
Malvaceae	<i>Hibiscus diversifolius</i>	F	R	√								√		
Malvaceae	<i>Hibiscus sp.</i>	F	R										√	
Malvaceae	<i>Hibiscus surattensis</i>	F	R			√								
Ulmaceae	<i>Holoptelea grandis</i>	T	F				√					√	√	√
Labiatae	<i>Hoslundia opposita</i>	S	R					√						
Umbelliferae	<i>Hydrocotyle mannii</i>	F	R					√						
Poaceae	<i>Hyparrhenia rufa</i>	G	R					√						
Labiatae	<i>Hyptis suaveolens</i>	S	R	√				√						
Poaceae	<i>Imperata cylindrica</i>	G	O					√	√		√			
Fabaceae	<i>Indigofera arrecta</i>	S	O					√			√			
Fabaceae	<i>Indigofera spicata</i>	F	F	√				√	√		√		√	
Convolvulaceae	<i>Ipomoea batatus*</i>	Cr	O	√						√		√		√
Convolvulaceae	<i>Ipomoea cairica</i>	Ra	O	√				√	√		√			
Convolvulaceae	<i>Ipomoea wightii</i>	Ra	F			√	√	√	√					
Oleaceae	<i>Jasminium eminii</i>	L	R										√	
Oleaceae	<i>Jasminum floribundum</i>	L	R										√	
Oleaceae	<i>Jasminum fluminense</i>	L	R				√							
Euphorbiaceae	<i>Jatropha curcas*</i>	T	F	√	√	√		√	√					√
Acanthaceae	<i>Justicia flava</i>	F	O	√									√	√
Cyperaceae	<i>Kyllinga alba</i>	F	O					√					√	√
Cucurbitaceae	<i>Lagenaria sphaerica</i>	L	R	√	√									
Anacardiaceae	<i>Lannea schweinfurthii</i>	T	R											√
Anacardiaceae	<i>Lannea welwitschii</i>	T	F			√		√		√		√		√
Verbenaceae	<i>Lantana camara*</i>	S	D	√	√	√	√	√	√	√	√		√	√
Verbenaceae	<i>Lantana trifolia</i>	S	O					√	√					
Urticaceae	<i>Laportea ovalifolia</i>	F	R		√									
Sapindaceae	<i>Lecaniodiscus fraxinifolius</i>	T	R			√								
Lemnaceae	<i>Lemna sp.</i>	F	R	√								√		
Labiatae	<i>Leonotis nepetifolia</i>	S	O	√					√		√			
Labiatae	<i>Leucas sp.</i>	F	R		√									
Celastraceae	<i>Loeseneriella africana</i>	L	O				√					√	√	
Cucurbitaceae	<i>Luffa cylindrica</i>	L	R	√	√									

Family	Species	Habit	Abundance	Previous survey ^a	Immediate Impact zone							Itanda/Kalagala offset		
					Buj	Buj Islands	Dumbl Island	Kiku	Nmy	Nmz Island	Nmz	Ita/Kala Island	Kala FR	N. Bank FR
Solanaceae	<i>Lycopersicum sp.</i>	F	O				√					√		
Capparaceae	<i>Maerua duchesnei</i>	S	O			√	√							√
Myrsinaceae	<i>Maesa welwitschii</i>	L	O				√					√		
Rhamnaceae	<i>Maesopsis eminii</i>	T	D	√	√	√		√		√	√	√	√	√
Anacardiaceae	<i>Mangifera indica*</i>	T	O						√		√			√
Euphorbiaceae	<i>Manihot esculentus (Cassava)*</i>	S	F		√				√		√			√
Sapotaceae	<i>Manilkara obovata</i>	T	O			√							√	
Marantaceae	<i>Marantochloa sp.</i>	F	O				√					√	√	
Bignoniaceae	<i>Markhamia lutea</i>	T	D	√	√	√	√	√	√	√	√	√	√	√
Celastraceae	<i>Maytenus heterophylla</i>	T	O			√	√						√	
Celastraceae	<i>Maytenus senegalensis</i>	S	R									√		
Celastraceae	<i>Maytenus undata</i>	S	R										√	
Asteraceae	<i>Melanthera scandens</i>	F	F			√	√	√				√		
Poaceae	<i>Melinis repens</i>	G	O					√	√					
Moraceae	<i>Milicia excelsa</i>	T	D	√	√	√		√	√	√		√	√	√
Fabaceae	<i>Mimosa pigra</i>	S	O	√					√				√	
Fabaceae	<i>Mimosa pudica</i>	S	R	√				√						
Sapotaceae	<i>Mimusops bagshawei</i>	T	O									√	√	√
Nyctaginaceae	<i>Mirabilis jalapa</i>	F	R	√	√									
Cucurbitaceae	<i>Momordica foetida</i>	L	F		√	√	√	√						
Rubiaceae	<i>Morinda lucida</i>	T	O							√			√	√
Moraceae	<i>Morus mesozygia</i>	T	F			√				√		√		√
Cucurbitaceae	<i>Mukia maderaspatana</i>	L	R					√						
Musaceae	<i>Musa paradisiaca*</i>	F	R		√									
Musaceae	<i>Musa sapientum*</i>	F	A	√	√			√	√	√	√	√		
Celastraceae	<i>Mystroxydon aethiopicum</i>	S	R										√	
Ochnaceae	<i>Ochna schweinfurthiana</i>	S	R									√		
Oxalidaceae	<i>Oxalis corniculata*</i>	F	F		√			√			√		√	
Rubiaceae	<i>Oxyanthus troupinii</i>	S	O				√					√	√	
Polygonaceae	<i>Oxygonum sinuatum</i>	F	O		√						√			√
Poaceae	<i>Panicum maximum</i>	G	D		√	√	√	√	√		√	√		√
Poaceae	<i>Panicum trichocladum</i>	G	O					√	√		√			
Fabaceae	<i>Parkia filicoidea</i>	T	O							√		√	√	
Poaceae	<i>Paspalum conjugatum</i>	G	O					√	√				√	
Poaceae	<i>Paspalum scrobiculatum</i>	G	F					√	√		√			√
Passifloraceae	<i>Passiflora edulis</i>	L	R			√								
Rubiaceae	<i>Pavetta oliveriana</i>	S	O				√					√	√	
Poaceae	<i>Pennisetum thunbergii</i>	G	R					√						
Lauraceae	<i>Persea americana*</i>	T	O		√				√					
Palmae	<i>Phoenix reclinata</i>	T	O			√				√		√		

Family	Species	Habit	Abundance	Previous survey ^a	Immediate Impact zone							Itanda/Kalagala offset		
					Buj	Buj Islands	Dumbl Island	Kiku	Nmy	Nmz Island	Nmz	Ita/Kala Island	Kala FR	N. Bank FR
Poaceae	<i>Phragmites mauritiana</i>	S	O	✓	✓					✓		✓		
Euphorbiaceae	<i>Phyllanthus amarus</i>	F	R			✓								
Euphorbiaceae	<i>Phyllanthus leucanthus</i>	F	O		✓			✓			✓			
Euphorbiaceae	<i>Phyllanthus nummulariifolius</i>	F	R						✓					
Euphorbiaceae	<i>Phyllanthus ovalifolius</i>	S	R		✓									
Euphorbiaceae	<i>Phyllanthus pseudoniruri</i>	F	O		✓								✓	
Phytolaccaceae	<i>Phytolacca dodecandra</i>	F	O	✓	✓			✓						
Urticaceae	<i>Pilea angolensis</i>	F	R					✓						
Pinaceae	<i>Pinus caribea</i> *	T	R	✓										
Plumbaginaceae	<i>Plumbago dawei</i>	S	O				✓					✓	✓	
Verbenaceae	<i>Premna angolensis</i>	T	O				✓						✓	✓
Verbenaceae	<i>Priva flabelliformis</i>	F	R		✓									
Anacardiaceae	<i>Pseudospondias microcarpa</i>	T	O			✓				✓		✓		
Myrtaceae	<i>Psidium guajava</i> *	T	O					✓	✓					✓
Rubiaceae	<i>Psychotria kraessneri</i>	S	R										✓	
Pteridaceae	<i>Pteris preussi</i>	F	R			✓								
Myrsinaceae	<i>Pycnanthus angolensis</i>	T	R			✓								
Cyperaceae	<i>Pycneus mundtii</i>	F	R	✓								✓		
Cyperaceae	<i>Pycneus polystachyos</i>	F	R										✓	
Palmae	<i>Raphia farinifera</i>	T	O				✓					✓	✓	
Vitaceae	<i>Rhoicissus tridentata</i>	L	R										✓	
Anacardiaceae	<i>Rhus natalensis</i>	S	O			✓	✓							
Anacardiaceae	<i>Rhus natalensis</i>	S	R										✓	
Fabaceae	<i>Rhynchosia ferruginea</i>	L	R					✓						
Euphorbiaceae	<i>Ricinodendron heudelotii</i>	T	R											✓
Euphorbiaceae	<i>Ricinus communis</i>	S	O		✓									✓
Violaceae	<i>Rinorea ilicifolia</i>	T	O			✓							✓	
Rubiaceae	<i>Rothmannia longiflora</i>	T	R											✓
Poaceae	<i>Rottboellia cochinchinensis</i>	G	F		✓			✓	✓		✓			
Apocynaceae	<i>Saba comorensis</i>	L	O				✓					✓	✓	
Celastraceae	<i>Salacia elegans</i>	L	R									✓		
Celastraceae	<i>Salacia erecta</i>	L	O			✓	✓							
Dracaenaceae	<i>Sansevieria intermedia</i>	S	O			✓	✓						✓	
Euphorbiaceae	<i>Sapium ellipticum</i>	T	O	✓	✓	✓		✓						
Amoryllidaceae	<i>Scadoxus multiflorus</i>	F	R			✓								
Asclepiadaceae	<i>Secamone africana</i>	L	R	✓									✓	
Asclepiadaceae	<i>Secamone sp.</i>	L	O			✓						✓	✓	
Pedaliaceae	<i>Sesamum angustifolium</i>	F	R								✓			
Fabaceae	<i>Sesbania sesban</i>	S	O		✓	✓						✓		
Poaceae	<i>Setaria sp.</i>	G	R			✓								

					Immediate Impact zone							Itanda/Kalagala offset		
Family	Species	Habit	Abund ance	Previous survey ^a	Buj	Buj Islands	Dumbl Island	Kiku	Nmy	Nmz Island	Nmz	Ita/Kala Island	Kala FR	N. Bank FR
Poaceae	<i>Setaria sphacelata</i>	G	R					✓						
Malvaceae	<i>Sida rhombifolia</i>	F	F	✓	✓			✓			✓		✓	✓
Asteraceae	<i>Sigesbeckia orientalis</i>	F	O			✓	✓							
Solanaceae	<i>Solanum mauritianum</i>	S	O		✓			✓						
Solanaceae	<i>Solanum nigrum</i>	F	R		✓									
Asteraceae	<i>Sonchus bipontini</i>	F	O					✓	✓					
Poaceae	<i>Sorghum arundinaceum</i>	G	F		✓			✓	✓		✓			
Bignoniaceae	<i>Spathodea campanulata</i>	T	A		✓			✓	✓	✓	✓	✓		✓
Poaceae	<i>Sporobolus pyramidalis</i>	G	R	✓					✓					
Sterculiaceae	<i>Sterculia dawei</i>	T	F	✓		✓	✓			✓		✓		
Loganiaceae	<i>Strychnos usambarensis</i>	L	R										✓	
Asteraceae	<i>Synedrella nodiflora</i>	F	F	✓	✓			✓	✓		✓			✓
Myrtaceae	<i>Syzygium guineense</i>	T	R											✓
Dichapetalaceae	<i>Tapura fischeri</i>	T	F			✓	✓			✓		✓		✓
Rutaceae	<i>Teclea nobilis</i>	T	R			✓								
Fabaceae	<i>Teramnus uncinatus</i>	L	R						✓					
Combretaceae	<i>Terminalia iverensis</i>	T	O		✓									✓
Euphorbiaceae	<i>Thecacoris lucida</i>	S	R			✓								
Euphorbiaceae	<i>Thevetia peruviana</i> *	S	R											✓
Acanthaceae	<i>Thunbergia alata</i>	F	R										✓	
Euphorbiaceae	<i>Tragia brevipes</i>	L	O					✓	✓					
Ulmaceae	<i>Trema orientalis</i>	T	R	✓				✓						
Rubiaceae	<i>Tricalysia bagshawei</i>	S	R										✓	
Rubiaceae	<i>Tricalysia niamniamensis</i>	S	R										✓	
Meliaceae	<i>Trichilia dregeana</i>	T	O							✓		1	✓	
Meliaceae	<i>Trichilia prieuriana</i>	T	R	✓									✓	
Asteraceae	<i>Tridax procumbens</i>	F	O	✓	✓			✓						
Tiliaceae	<i>Triumfetta macrophylla</i>	S	O							✓		✓	✓	
Tiliaceae	<i>Triumfetta rhomboidea</i>	F	O		✓			✓			✓			
Typhaceae	<i>Typha domingensis</i>	F	O				✓					✓		
Malvaceae	<i>Urena lobata</i>	S	F	✓				✓			✓		✓	✓
Urticaceae	<i>Urera trinervis</i>	L	F			✓	✓					✓	✓	
Rubiaceae	<i>Vangueria apiculata</i>	T	R										✓	
Asteraceae	<i>Vernonia amygdalina</i>	S	A	✓	✓			✓	✓		✓		✓	✓
Asteraceae	<i>Vernonia auriculifera</i>	S	O					✓			✓			
Fabaceae	<i>Vigna luteola</i>	F	R	✓								✓		
Fabaceae	<i>Vigna parkeri</i>	F	R						✓					
Fabaceae	<i>Vigna sp.</i>	F	R					✓						
Fabaceae	<i>Vigna unguiculata</i>	F	R								✓			
Verbenaceae	<i>Vitex ferruginea</i>	T	O										✓	✓

					Immediate Impact zone						Itanda/Kalagala offset			
Family	Species	Habit	Abund ance	Previous survey ^a	Buj	Buj Islands	Dumbl Island	Kiku	Nmy	Nmz Island	Nmz	Ita/Kala Island	Kala FR	N. Bank FR
Poaceae	<i>Vossia cuspidata</i>	G	O	√		√				√		√		
Canellaceae	<i>Warburgia ugandensis</i>	T	R										√	
Acanthaceae	<i>Whitfieldia longifolia</i>	S	F			√	√					√	√	√
Poaceae	<i>Zea mays</i> *	G	O								√			√
Grand Total					88	81	61	101	56	46	69	91	104	85

Appendix B1. LAND BIRDS of the BUJAGALI DAM SITE AREAS. Species are listed in the order, and using names from, the Uganda Bird Atlas (Carswell *et al* 2005). For 2006 site, the boxes in the headers group similar sites. In both years, the ‘overall’ column is the mean score for the 3 sites common to both years.

Atlas No.	Name	Red Data status and specialism ^a	1998 RESULTS				2006 RESULTS						
							Nany	Kiku	Naz	Buj	Overall	Forest Reserves	
							Regeneration						
			Kiku*	Naz	Buj	Overall		1998 Comparison				Kalagala	Itanda
									Small farms				
17	Cattle Egret <i>Bubulous ibis</i>	G	1.8	1.4	4.4	2.5	1.0		1.0	2.0	1.5	2.3	2.7
26	Black-headed Heron <i>Ardea melanocephala</i>	w		0.4		0.1	1.7	0.3	1.0		0.4	3.0	0.3
30	Open-billed Stork <i>Anastomus lamelligerus</i>	A,w,G					4.3	1.5	2.8		1.4	4.0	2.7
36	Marabou Stork <i>Leptoptilos crumeniferus</i>	w					0.3					1.0	
38	Hadada Ibis <i>Bostrychia hagedash</i>	w	0.4		1.2	0.5	1.0	0.8		1.7	0.8		
71	Honey Buzzard <i>Pernis apivorus</i>	P,F							0.8		0.3		
73	Black-shouldered Kite <i>Elanus caeruleus</i>						p ^b					0.7	0.3
75	Black Kite <i>Milvus migrans</i>	pA			0.6	0.2	3.0	3.8	1.5	3.3	2.9		1.0
77	Palm-nut Vulture <i>Gypohierax angolensis</i>							1.5			0.5	2.0	
80	Hooded Vulture <i>Neophron monachus</i>	f	0.2			0.1		1.5			0.5	1.7	
86	Brown Snake Eagle <i>Circaetus cinereus</i>	R-NT		1.0		0.3							0.7
90	African Harrier Hawk <i>Polyboroides typus</i>	f		0.8	0.2	0.3	1.7	1.3	0.3	3.0	1.5	2.0	
93	African Marsh Harrier <i>Circus ranivorus</i>	R-NT, W	p0.6 ^c			p0.2							
98	African Goshawk <i>Accipiter tachiro</i>	F		0.4		0.1		0.3		2.0	0.8		
100	Shikra <i>Accipiter badius</i>	F	1.2	1.2		0.8	1.0			2.0	0.7		
109	Lizard Buzzard <i>Kaupifalco monogrammicus</i>	F			3.0	1.0	2.0	0.8	0.5	3.3	1.5	1.3	0.7
116	Tawny Eagle (including Stepple Eagle) <i>Aquila rapax</i>											1.7	
117	Wahlberg's Eagle <i>Aquila wahlbergi</i>	A,f						1.3	1.5		0.9		
122	Long-crested Eagle <i>Lophaetus occipitalis</i>	F	1.8			0.6			2.6		0.9		P

* Kiku = Kikubamutwe Naz = Namizi Buj = Bujagali village Nany = Naminya (north of)

[illegible]

Atlas No.	Name	Red Data status and specialism ^a	1998 RESULTS				2006 RESULTS						
							Nany	Kiku	Naz	Buj	Overall	Forest Reserves	
							Regeneration						
			Kiku*	Naz	Buj	Overall		1998 Comparison				Kalagala	Itanda
									Small farms				
419	Crowned Hornbill <i>Tockus albeterminatus</i>	f		1.2		0.4						1.7	
422	Black and White Casqued Hornbill <i>Ceratogymna subcylindricus</i>	F							1.5	1.3	0.9	0.7	
426	Speckled Tinkerbird <i>Pogoniulus scolopaceus</i>	F					0.3						
431	Yellow-rumped Tinkerbird <i>Pogoniulus bilineatus</i>	F					2.0	4.8	3.3	4.0	4.0	2.7	
433	Yellow-fronted Tinkerbird <i>Pogoniulus chrysoconus</i>	f	1.2		3.6	1.6	2.3	3.3	2.3	4.7	3.4	1.7	
443	Double-toothed Barbet <i>Lybius bidentatus</i>	f			1.2	0.4			0.8		0.3		
445	Yellow-billed Barbet <i>Trachyphonus purpuratus</i>											p2.0	
477	Grey Woodpecker <i>Dendropicos goertae</i>	f		p0.2		p0.1						3.0	
498	White-headed Saw-wing <i>Psolidoprocne albiceps</i>	R-RR, f, Ae		1.0	0.4	0.5		1.3	1.5		0.9	1.7	
500	Sand Martin <i>Riparia riparia</i>	P,W,Ae					6.0	5.5	4.5	2.3	4.1	5.7	6.0
512	Angola Swallow <i>Hirundo angolensis</i>	w,Ae	1.2			0.4			3.8	0.7	1.5		0.7
513	Barn Swallow <i>Hirundo rustica</i>	P,w,Ae	0.2	1.4	0.8	0.8	2.7	1.5	1.8		0.8		3.3
515	Yellow Wagtail <i>Motacilla flava</i>	P,w,G					1.7	1.5	1.3		0.9	1.0	5.7
520	African Pied Wagtail <i>Motacilla aguimp</i>	w			1.4	0.5							0.7
538	Little Greenbul <i>Andropadus virens</i>	F					4.0	2.8			0.9		
562	Common Bulbul <i>Pycononotus barbatus</i>	f	6.0	6.0	6.0	6.0	5.7	6.0	6.0	6.0	6.0	6.0	6.0
576	White-browed Robin Chat <i>Cossypha heuglini</i>	f								1.0	0.3		
578	Snowy-headed Robin Chat <i>Cossypha niveicapilla</i>	F,w						2.0			0.7		
589	White-browed Scrub Robin <i>Cercotrichas leucophrys</i>						4.3	0.8	1.8		0.9		
593	Whinchat <i>Saxicola rubetra</i>											1.0	
612	African Thrush <i>Turdus pelios</i>	f		0.8	0.6	0.5	3.0		4.0	4.3	2.8	4.0	4.7
621	Moustached Warbler <i>Melocichla mentalis</i>						2.0				0.1	2.0	
624	Sedge Warbler <i>Acrocephalus schoenobaenus</i>	P,w					p4.0	p0.5			p0.2		p2.0
638	Red-faced Cisticola <i>Cisticola erythrops</i>	w	4.2	5.6	4.8	4.9	5.7	5.0	0.3	1.3	2.2	1.3	5.3
647	Winding Cisticola <i>Cisticola galactotes</i>	w	1.4			0.5	4.3	2.5	0.5		2.4	3.0	1.3

Atlas No.	Name	Red Data status and specialism ^a	1998 RESULTS				2006 RESULTS						
							Nany	Kiku	Naz	Buj	Overall	Forest Reserves	
							Regeneration						
			Kiku*	Naz	Buj	Overall		1998 Comparison				Kalagala	Itanda
									Small farms				
650	Croaking Cisticola <i>Cisticola natalensis</i>	G					0.3						
658	Tawny-flanked Prinia <i>Prinia subflava</i>	fw	4.8	4.0	4.8	4.5	1.7	2.0	5.0	1.3	2.8	2.0	3.3
661	White-chinned Prinia <i>Prinia leucopogon</i>	F		0.6		0.2							
677	Grey-backed Camaroptera <i>Camaroptera brachyura</i>	f	5.6	4.8	5.6	5.3	5.3	5.8	5.8	6.0	5.9	5.7	4.7
691	Red-faced Crombec <i>Sylvietta whytii</i>	F			p0.2	p0.1							
695	Willow Warbler <i>Phylloscopus trochilus</i>	P,f						2.3	2.8	3.3	2.8	3.3	5.3
701	Grey-capped Warbler <i>Eminia lepida</i>	R-RR, fw	0.4	0.6	2.6	1.2	1.7	1.8	0.3		0.7	1.7	0.7
703	Garden Warbler <i>Sylvia borin</i>	P,f					2.0	p2.0			p0.7		
704	Blackcap <i>Sylvia atricapilla</i>	P,F						1.3			0.4		
713	Northern Black Flycatcher <i>Melaenornis edoliodes</i>			0.2		0.1						2.3	1.7
720	Swamp Flycatcher <i>Muscicapa aquatica</i>	W		0.6	2.2	0.9		0.6			0.2		
732	African Blue-flycatcher <i>Elminia longicausa</i>	f		3.2	2.2	1.8		0.5	2.5	5.3	2.8	4.0	1.0
739	African-Paradise-flycatcher <i>Terpsiphone viridis</i>	f	0.8	1.0		0.6			0.5		0.2		1.3
740	Red-bellied Paradise Flycatcher <i>Terpsiphone rufiventer</i>	F						3.0	2.8	0.3	2.0		
742	Black and White Flycatcher <i>Bias musicus</i>	f								2.0	0.7		
746	Brown-throated Wattle-eye <i>Platysteira cyanea</i>	f	1.8	1.2	3.8	2.3	1.0	5.5	2.8	4.3	4.2	4.0	
761	Brown Babbler <i>Turdoides plebejus</i>						2.7						
771	Black Tit <i>Parus leucomelas</i>	f			0.6	0.2				0.7	0.2		0.3
773	African Penduline Tit <i>Anthoscopus caroli</i>	f					1.0						
781	Green-headed Sunbird <i>Chalcomitra verticalis</i>	F	0.8			0.3				2.0	0.7	1.0	
787	Scarlet-chested Sunbird <i>Chalcomitra senegalensis</i>	f	2.2	3.0	1.8	2.3	4.7	1.0	3.5	4.0	2.8	4.7	1.7
796	Olive-bellied Sunbird <i>Cinnyris chloropygia</i>	F	2.5	4.0	0.8	2.4			1.8	1.7	1.2	1.4	0.3
802	Marico Sunbird <i>Cinnyris mariquensis</i>		0.6			0.2			1.8		0.6		0.7
803	Red-chested Sunbird <i>Cinnyris erythroceria</i>	R-RR, W	6.0	5.8	5.6	5.8	6.0	6.0	4.3	5.7	5.3	5.7	3.3
808	Variable Sunbird <i>Cinnyris venusta</i>	f							1.3		0.4	1.7	

Atlas No.	Name	Red Data status and specialism ^a	1998 RESULTS				2006 RESULTS						
							Nany	Kiku	Naz	Buj	Overall	Forest Reserves	
							Regeneration						
			Kiku*	Naz	Buj	Overall		1998 Comparison				Kalagala	Itanda
									Small farms				
809	Superb Sunbird <i>Cinnyris superba</i>											0.3	
810	Copper Sunbird <i>Cinnyris cuprea</i>	f,w	0.8	1.4	0.4	2.6	1.3	1.5			0.5		0.7
811	Yellow White-eye <i>Zosterops senegalensis</i>	f	4.6	1.4	4.0	3.3	1.3	5.3	4.0	3.3	4.2	4.3	1.0
831	Brown-crowned Tchagra <i>Tchagra australis</i>		1.4	0.4	2.0	1.3		0.3	0.3		0.2		1.0
836	Northern Puffback <i>Dryoscopus gambensis</i>	F	1.2	1.2		0.8			0.8	1.0	0.6		0.3
841	Tropical Boubou <i>Laniarius aethiopicus</i>	f					1.7		0.8		0.3	1.7	
843	Black-headed Gonolek <i>Laniarius erythrogaster</i>	f					0.7						
855	Pied Crow <i>Corvus albus</i>								0.3		0.1		
871	Splendid Starling <i>Lamprotornis splendidus</i>	F	1.0	1.5	1.0	1.2			0.5		0.2	5.7	2.3
872	Ruppell's Long-tailed Glossy Starling <i>Lamprotornis purpuropterus</i>											1.0	
881	Grey-headed Sparrow <i>Passer griseus</i>		1.0			0.3		0.8	4.3	1.0	2.0		0.3
893	Baglafecht Weaver <i>Ploceus baglafecht</i>	f							1.5		0.5		
894	Slender-billed Weaver <i>Ploceus pelzelni</i>	f,W		3.2	3.2	2.1							2.7
895	Little Weaver <i>Ploceus luteolus</i>											1.7	
897	Spectacled Weaver <i>Ploceus ocularis</i>	f	1.0		0.8	0.6		1.5		2.0	1.2	0.3	
907	Vieillot's Black Weaver <i>Ploceus nigerrimus</i>	f		0.6		0.2				1.3	0.4	0.7	3.3
908	Black-headed Weaver <i>Ploceus cucullatus</i>		3.6	3.6	2.4	2.8							
910	Yellow-backed Weaver <i>Ploceus melanocephalus</i>	W	1.0	1.0		0.7	3.3	2.0	4.5		2.2	2.7	4.0
911	Golden-backed Weaver <i>Ploceus jacksoni</i>	R-RR,w					2.3	1.3		1.3	0.9	2.0	1.0
924	Red-headed Quelea <i>Quelea erythrops</i>	A							0.5		0.2		
927	Black Bishop <i>Euplectes gierowii</i>	w	0.6			0.2							
932	Fan-tailed Widowbird <i>Euplectes axillaris</i>	w					1.0	1.0			0.3		
937	Grosbeak Weaver <i>Amblyospiza albifrons</i>	f,W	0.6			0.2							
939	Grey-headed Negrofinch <i>Nigrita canicapilla</i>	F	0.4			0.1							
959	Red-billed Firefinch <i>Lagonosticta senegala</i>		1.2	1.4	0.8	1.1	1.0	1.5	1.5	0.7	1.2	0.7	3.7

Atlas No.	Name	Red Data status and specialism ^a	1998 RESULTS				2006 RESULTS						
							Nany	Kiku	Naz	Buj	Overall	Forest Reserves	
							Regeneration						
			Kiku*	Naz	Buj	Overall		1998 Comparison				Kalagala	Itanda
									Small farms				
963	African Firefinch <i>Lagonosticta rubricata</i>						1.3						
969	Waxbill <i>Estrilda astrild</i>	w,G								1.7	0.8		
970	Black-crowned Waxbill <i>Estrilda nonnula</i>	f	4.2	2.8	1.8	2.9	1.0		2.8	1.7	1.5	2.0	
974	Red-cheeked Cordon-bleu <i>Uraeginthus bengalus</i>				1.0	0.3		1.5		1.0	0.8	1.0	3.7
980	Bronze Mannikin <i>Lonchura cucullata</i>	f	1.6	0.8	4.2	2.2	5.3	3.3	4.5	3.3	3.7	2.7	2.7
981	Black and White Mannikin <i>Lonchura bicolor</i>	f	4.4		1.0	1.8	0.3	1.3	1.8		1.0		
984	Red-billed Firefinch Indigobird <i>Vidua chalybeata</i>								1.3		0.4		
985	Pin-tailed Whydah <i>Vidua macroura</i>											4.7	2.0
991	African Citril <i>Serinus citrinelloides</i>	f	4.4	0.8	0.8	2.0	2.7		1.8		0.6		0.3
995	Yellow-fronted Canary <i>Serinus mozambicus</i>		1.0			0.3	5.0	3.3	2.3	3.7	3.1	1.7	
1005	Golden-breasted Bunting <i>Emberiza flaviventris</i>												0.7
	Mean numbers of species per count		24.4	22.8	23.8		34.7	29.5	32.5	26.3		37.3	30.7

Notes: a as listed in B2.

b P indicates presence outside the time of the count

c p0.6 indicated that the birds identification was not quite certain

Appendix M1. Mammal species recorded or reported to have existed in the areas around the Proposed Dam Site and the Kalagala offset sites.

Taxonomic Group	Common name	Species	Typical/ Preferred Habitat	Status	Nature of record	Dam East	Nile Bank FR	Kalagala FR	Falls East	Dam west	Bujagali Islands	Falls West	Dumbbell Island	Itanda/Kalagala Island
Artiodactyla	Bush pig	<i>Potamochoerus porcus</i>	F & Wd		I	√*								
	Bushbuck	<i>Tragelaphus scriptus</i>	F & Wd		I	√*								
	Bush Duiker	<i>Sylvicapra grimmia</i>	Wd		I	√*								
	Buffalo	<i>Syncerus caffer</i>	F, Wd & Gg		I	√*								
	Hippopotamus	<i>Hippopotamus amphibius</i>	W		I									√*
Carnivora	Spot Necked Otters	<i>Lutra maculicollis</i>	W	Vu	I & O	√	√	√	√		√		√	√
	Marsh Mongoose	<i>Atilax paludinosus</i>	M		I & Sc			√		√	√			
	Side Striped Jackal	<i>Canis adustus</i>	F & Wd		I			√*						
	Striped Hyaena	<i>Hyaena hyaena</i>	GG & Wd		I	√*								
	Leopard	<i>Panthera pardus</i>	F & Wd		I	√*								
	Slender Mongoose	<i>Herpestes sanguineus</i>	F & Wd		I & Sc						√			
Insectivora	African Hedgehog	<i>Atelerix albiventris</i>	GG & Wd		I				√					
Megachiroptera	Little Epauletted Fruit Bat	<i>Epomophorus labiatus</i>	Wd		N & O				√	√	√			
	Straw coloured fruit Bat	<i>Eidolon helvum</i>	F & Wd		I & Sk				√	√	√			
	Bocage's Fruit Bat	<i>Rousettus angolensis</i>	F & Wd		N					√				
Microchiroptera	Banana Bat	<i>Pipistrellus nanus</i>	Go		N					√				
	Hairy slit faced Bat	<i>Nycteris hispida</i>	Wd		N						√			
	Little Free tailed Bat	<i>Chaerophon pumila</i>	Go		O				√					
Primates	Red tailed Monkey	<i>Cercopithecus ascanius</i>	F		O	√	√		√	√		√	√	√
	Baboon	<i>Papio anubis</i>	F & Wd		I	√*	√*	√*						
	Vervet Monkey	<i>Cercopithecus aethiops</i>	Wd		I	√								

Proboscidea	Elephant	<i>Loxodantra africana</i>	F & Wd	Vu	I	√*								
Rodentia	Alexander's Tree Squirrel	<i>Paraxerus alexandri</i>	F & Wd		O	√	√		√	√				√
	Red legged Sun Squirrel	<i>Heliosciurus rufobrachium</i>	F		O				√					
	African Giant Rat	<i>Cricetomys gambianus</i>	F & Wd		I	√			√	√				√
	Common thicket Rat	<i>Grammomys dolichurus</i>	F & Wd		Sk				√	√				
	Common striped grass Rat	<i>Lemniscomys striatus</i>	Gg		T				√	√				
	Nile grass rat	<i>Arvivanthis niloticus</i>	Gg		Sk				√					
	Shaggy Marsh Rat	<i>Dasmys incommutatus</i>	M		Sk				√	√	√			√
	Pygmy Mouse	<i>Mus minutoides</i>	F & Wd		P	√			√					
	Grey bellied Pygmy Mouse	<i>Mus triton</i>	Gg		P	√			√					
	Cane rats	<i>Thryonomys gregorianus</i>	Gg		I & Fs	√		√	√	√				√
	Striped Ground Squirrel	<i>Xerus erythropus</i>	Go		O	√								
	Eastern Brush furred Rat	<i>Lophuromys flavopunctatus</i>	F & Wd		T	√				√				√
	Common brush furred Rat	<i>Lophuromys sikapusi</i>	Gg & Wd		T	√				√				√
	Northern Savanna Multimammate Rat	<i>Mastomys hildebrandti</i>	W		T	√				√				
	African Common Dormouse	<i>Graphiurus murinus</i>	F & Wd		P	√								
	Kaiser's Bush Rat	<i>Aethomys kaiseri</i>	Gg		T					√				
	Tropical Groove toothed Rat	<i>Otomys tropicalis</i>	F & Wd		T					√	√			√
	Jackson's soft furred Rat	<i>Proamys jacksoni</i>	F		P						√			
	Crested Porcupine	<i>Hystrix cristata</i>	F & Wd		I									√
	Brush tailed Porcupine	<i>Atherurus africanus</i>	F		I									√

Key to acronyms in table:

Gg – Generalist in Savannas, Wd – Wooded savannas, F – Forest, Go – Generalist Open habitats, NS – Northern Savannas, W – Water, M – Marshes

I – Interview, O – Observed, Sc – Scat/faecal material, Sk – Skeletal Material, N – Netted, T – Trapped, Fs – Feeding signs, P – Probable

Vu – Vulnerable

√ - signifies record of presence of a species

* - Signifies extirpated species



Appendix C.4

Report on Tourism Impacts

BUJAGALI HYDROPOWER PROJECT, UGANDA

SOCIAL AND ENVIRONMENTAL ASSESSMENT

REPORT ON TOURISM IMPACTS

Prepared For: R.J.Burnside International Limited, Guelph, Canada

By: Fletcher Associates, Richmond, Surrey, United Kingdom

APRIL 2006

BUJAGALI HYDROPOWER PROJECT, UGANDA

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1.0 INTRODUCTION

1.1 Background

The Bujagali Hydropower Project (Bujagali HPP) is a proposed 250MW hydropower facility to be built at Dumbbell Island, located 8km downstream (north) of the town of Jinja, Uganda, on the Victoria Nile. The project is proposed by Bujagali Energy Ltd., a project specific company owned by World Power Holdings LLC, of Luxembourg and IPS (Kenya) Ltd, the ‘Project Sponsors’.

A Social and Environmental Assessment (SEA) of the Bujagali HPP needs to be undertaken for the project and then be approved by the Government of Uganda (GoU) and the International lenders (World Bank Group, African Development Bank, European Investment Bank, commercial banks under IDA PRG and other European Development Banks) involved in the project, before it proceeds to construction.

Previously, AES Nile Power (AESNP) was the Project Sponsor for the Bujagali HPP and the Environmental Impact Assessment (EIA) undertaken for them was approved by the GoU’s National Environmental Management Authority (NEMA) in 1999/2001 and by the international lenders in December 2001. AESNP, however, withdrew from the project in 2003 without commencing construction and the new Project Sponsor is now required to carry out a new Social and Environmental Assessment (SEA) as part of their due diligence / project approval process.

The Project Sponsor has appointed R.J.Burnside International Ltd. of Canada to conduct, or oversee the SEA tasks and manage the SEA process on its behalf and R.J.Burnside International Ltd has in turn appointed Fletcher Associates, a specialist UK based, international tourism development consultancy, to undertake the tourism impact assessment component within the overall SEA.

1.2 Scope of Work

The scope of work for this assignment is identified in the R.J.Burnside Terms of Reference for the SEA and in the subsequent sub-consultancy agreement between R.J.Burnside and Fletcher Associates and is presented below thus:

- Consult with appropriate central government and local government authorities and tourism operators and their association(s) to determine the present status of tourism in the proposed hydropower development area;
- Assess the potential impacts of the Bujagali Hydropower Project on tourism in the hydropower development area, including any effects on the white water rafting (WWR) industry;

- Advise on potential measures to mitigate the effects to WWR and other tourist amenities at the hydropower site and propose alternative tourist development scenarios and / or facilities that could be developed on or adjacent to the proposed reservoir. This will include an assessment of tourism opportunities that can be promoted and developed at the ‘Kalagala-Itanda Offset’ site downstream; and
- Consult with tourism operators and their association(s) and local communities and their leadership (LC1, LC3, and LC5 levels) on tourism impact mitigation measures and alternative tourism development strategies and how they can be involved in delivering future tourism services (e.g. accommodation, activities).

1.3 Conduct of the Study

The fieldwork component of the study was undertaken between 19 March and 1st April, 2006, with time spent roughly equally between the capital city of Kampala and Jinja, the town located on both the banks of Lake Victoria and the banks of the Victoria Nile where the river begins its journey to the Mediterranean Sea. Jinja is some 8km upstream (south) from the proposed Bujagali HPP and is by far the largest town in the hydropower development area.

A programme of pre-arranged and locally arranged appointments and site visits was undertaken in both Kampala and Jinja with representatives from the Government of Uganda (Ministry of Tourism, Trade and Industry, Uganda Tourist Board, NEMA, National Forestry Authority, Uganda Wildlife Authority), Local Government and local representatives of national organisations, representatives from village communities located on both banks of the Nile and representatives from the white water rafting companies and other sectors of the tourism and hospitality industry.

Two full days of site inspections were undertaken including at the Bujagali Falls location which will be submerged by the reservoir created by the building of the dam, the east and west bank locations for the construction of the dam at Dumbbell Island and both the Kalagala (west bank) and Itanda (east bank) locations within the Kalagala – Itanda Offset proposal site. These site visits were accompanied by representatives from the Project Sponsor and the World Bank / International Lenders team who were in Uganda during the first week of the fieldwork and then by representatives of the various Government of Uganda Ministries / Authorities mentioned above who have a close interest in the SEA programme.

2.0 STATUS OF TOURISM IN THE HYDROPOWER DEVELOPMENT AREA

2.1 The Historical Context

The hydropower development area may broadly be considered to encompass a geographic locale which is anchored to the south by Greater Jinja (that is the combination of the town of Jinja on the east bank of the Nile together with Njeru, essentially a suburb or satellite of Jinja, on the west bank of the Nile) and extends along both banks of the river, several kilometres deep on either side, as far north as the proposed dam construction site at Dumbbell Island.

In simple historical terms, the Jinja area (or more accurately, the town of Jinja on its own) has enjoyed a certain level of international awareness and status on account of its location as the iconic Source of the Nile, made known to the wider world by the British explorer Speke in 1862. However, translation of this historical association into meaningful tourism awareness and development as a visitor destination has arguably only been underway over the last ten to fifteen years and even then this has been as a consequence of a completely unrelated attraction – white water rafting.

Jinja emerged from an informal European settlement around 1900 to become an important transport hub with a ferry service connecting with Kisumu, a Kenyan town on Lake Victoria which had been connected to Mombasa earlier that decade by a new rail link. The local economy developed further thanks to an emerging cotton industry and a rail link with Kampala but it was the opening of the Owen Falls Dam (now called the Nalubaale Dam) and hydro-electric power station in 1954 that led to a twenty year economic boom resulting in Jinja rapidly becoming known as Uganda's principal industrial and manufacturing centre.

Proximity to a reliable (transmission distances being short) and cheap source of power attracted the brewing, cigarette, textile and other manufacturing industries to Jinja leading to a rapid rise in the local population and a level of prosperity which can still be appreciated from the planned layout of the town centre and suburban streets with their impressive domestic and local governmental architecture. However, the largely Asian owned and managed businesses were a key target during the regime of Idi Amin in the early/mid 1970's, during which the Asian population was expelled and friends of the dictator, with little business experience, were placed in control of their companies.

The resulting collapse of the local economy may still be seen in the pot-holed roads and abandoned nature of many once grand homes along some of the suburban streets. Yet this is now contrasted with other streets and other properties which have clearly been recently restored and improved, a town centre with both new and renovated commercial buildings and an industrial base which is attracting back several of the key original businesses.

Jinja, together with Njeru on the opposite side of the Nile, now has a population of in excess of 136,000, which makes it the second largest town in Uganda and although it no longer possesses an active port, it sits beside the only rail link with Kenya (entirely freight at present) and the principal road link between Kampala and Nairobi (crossing the Nalubaale Dam) which carries half of all visitor arrivals (for all purposes) to Uganda and the bulk of all international commercial/freight movements. Jinja has thus recovered its position as the major transportation hub which justified the development of the town in the first place.

2.2 The ‘Adventure Capital of East Africa’

As an important early administrative and transportation centre but more significantly, later, as Uganda’s principal industrial centre, Jinja has always attracted business visitors and thus a small number of hotels and guest houses have grown up to accommodate this particular sector of the tourism market. However, holiday or recreational tourism in Uganda which historically has been relatively small compared to neighbouring Kenya and Tanzania, was focussed on game viewing/hunting in the west and north of the country and thus largely by-passed Jinja.

Successive periods of political instability and their associated security problems since the 1970’s have resulted in a generally negative international perception of Uganda as a tourism destination while the heavy poaching of game in the wildlife areas during this period also led to a diminution in the destination’s appeal. By the early 1990’s, visitors arriving for holiday/tourism purposes were recorded as being some 10,000 out of total annual overseas arrivals of around 70,000 but the pragmatic policies of President Museveni’s first term of office were now creating stability and economic growth such that support for the development of the tourism sector could now be envisioned.

In 1993, the World Tourism Organisation, funded by the United Nations Development Programme, published an ‘Integrated Tourism Master Plan for Uganda’ which presented a strategy for the development of the tourism sector over the following ten years. This strategy built and improved upon the existing product, infrastructure and resource framework in order that a revitalised tourism sector could be delivered with relative speed and ease. Development of new tourism products and the opening of less established and remoter parts of the country were considered to be longer term objectives which left consideration of Jinja, the ‘Source of the Nile’ and the eastern side of Uganda largely in abeyance.

Tourism arrivals were extremely weak in comparison with those attracted to neighbouring Kenya and Tanzania and the Master Plan recognised that a large percentage of this number were made up of ‘overland truckers’ and independent budget travellers, the very market sectors which are essential for kick starting the awareness creation process in new or moribund visitor destinations. However, such markets are considered to be low yield as far as tourist destinations are concerned because of their traditionally low

spending nature and thus tend to be ignored by national tourist board executives and planners, as was the case in this Master Plan.

Yet it was a couple of just such intrepid travellers, albeit with a dedication to satisfying high adventure sporting pursuits who, having established successful white water rafting businesses on world class rapids on the Zambezi and in New Zealand, became aware of the essentially unknown, equally high quality series of grade 4 and 5 rapids (classification is based upon grading rapids from 1 to 5/6 with 5 being the best for regular commercial rafting purposes and 6 being too severe for normal commercial rafting) on the Victoria Nile and decided to turn their attention to offering rafting at the Source of the Nile in Uganda. Table 2.1 below presents the names and class of rapids used, in sequence, by Adrift Rafting for their one and two day rafting trips on the Victoria Nile.

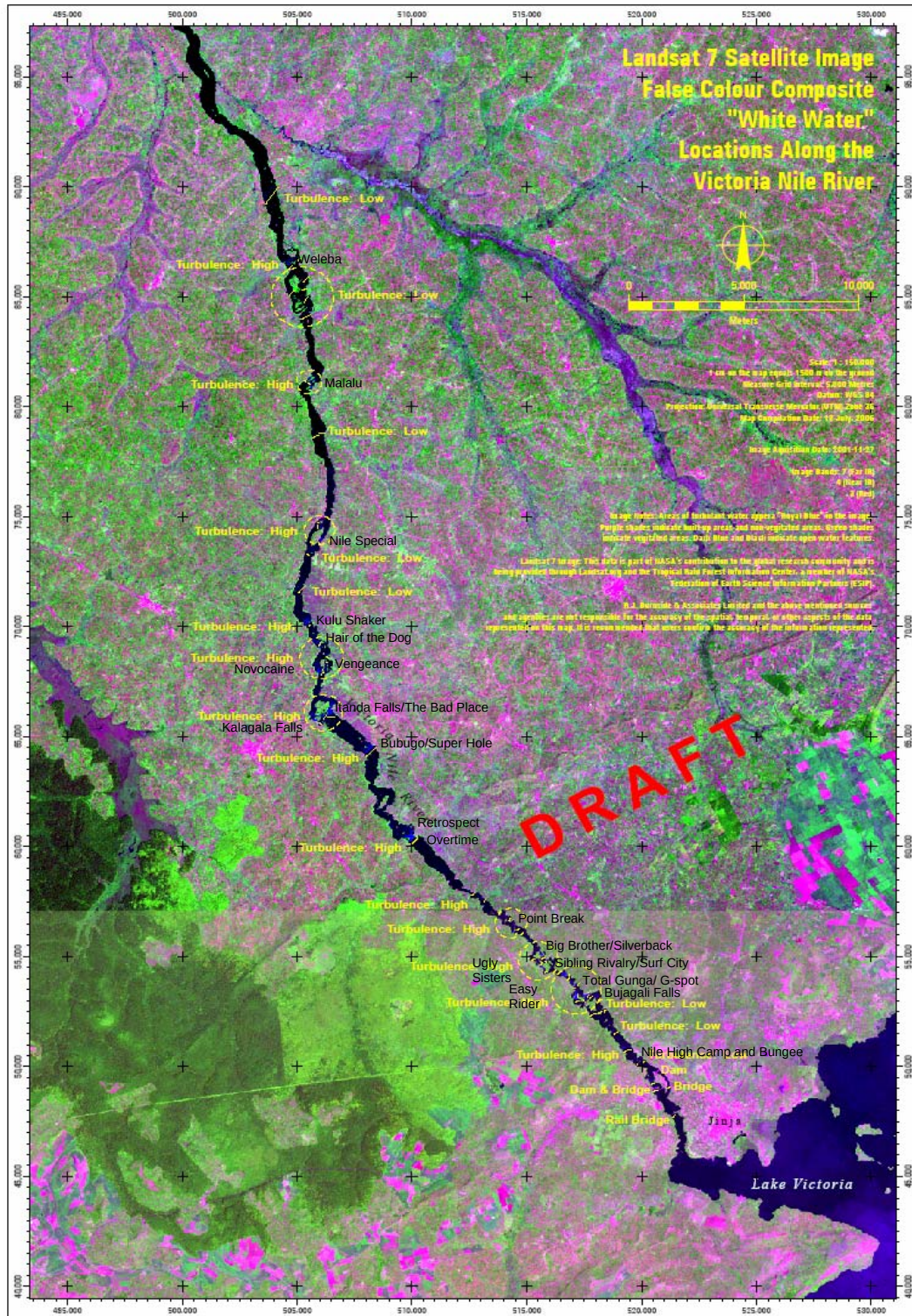
Table 2.1: Rapids Used by Adrift Rafting for Their One and Two Day Rafting Trips		
1 / 2 Day Trips	Name	Class
Day One	Bujagali	5
..	Easy Rider	3
..	Total Gunga/G.Spot	5
..	Ugly Sisters/Sibling Rivalry/Surf City	3
..	Big Brother/Silverback	5
..	Point Break	3
..	Overtime	5
..	Retrospect	4
..	Bubugo/Super Hole	3
..	Itanda/Bad Place	6/5
Day Two	Novocaine	5
..	Vengeance	4
..	Hair of the Dog	4
..	Kulu Shaker	4
..	Nile Special	4
..	Malalu	4
(Future Extension)	Weleba	3

Source: AESNP 2001 EIA Report with updates by C. McCleay (Adrift Rafting), 2006

Table 2.1 should be read in conjunction with Figure 2.1 below, which locates the position of each of the rapids described in the Table, in sequence, upon a satellite image of the Victoria Nile.

In 1996, the Bujagali Falls was simply a series of impressive rapids on an attractive stretch of the Nile some 6km downstream from Jinja. Direct access to the river at this point was possible across a little known (to international travellers) river bank site used regularly by locals for picnics and informal recreation but in August that year it also became the launching point for the first commercial white water rafting trips organised by the rafting company Adrift. Some months later in early 1997, Adrift were joined by a competitor, Nile River Explorers (NRE) who operated from a base in Jinja town and launched their rafts higher up the river from a site closer to the Nalubaale Dam.

Figure 2.1 Satellite Image of 'White Water' Locations and Named Rapids



From around 50 clients a month in the start-up period, the rafting numbers grew to an average of nearly 300 a month the following year and higher still in 1998 for Adrift, according to research conducted by DGiCo for the AES Nile Power SEA prepared in 1998. This same study concluded that between Adrift and NRE, the total estimated number of white water rafters on the Nile was somewhere between 7,000 – 8,000 per annum in 1998. Thus, from a standing start in 1996/7, the rafting companies became responsible for attracting an average of 600+ international visitors a month to Jinja, as a destination, rather than as simply the transit stop to visit the Source of The Nile, which was what it was known for before, completely independently from any Ministry of Trade and Tourism (MTTI) initiatives or plans.

The development of white water rafting was (and still is) based upon two distinct market sectors (albeit with similar general demographic characteristics) each in their own way extremely important for the wider development of Ugandan tourism through their capacity to create awareness of and stimulate interest in travel to and around the country. These sectors were on the one hand, the international overland truckers and independently mobile budget travellers passing through and on the other hand, the Ugandan based ex-pat/NGO market looking for a recreational break in the course of their stay in the country. NRE focuses more upon the transiting international market while Adrift tends to attract more of its clients from the Ugandan based ex-pat market and this approach is reflected in the nature and style of their business operations.

In 1998, these nascent business start-ups were both growing robustly and felt seriously threatened by the prospect of the AES Nile Power project submerging the Bujagali Falls and by implication destroying their business opportunity. However it was the murder of eight tourists by rebels in Bwindi Impenetrable National Park in March 1999 that almost achieved that particular result as once again instability in the country set back the developing recovery of Ugandan tourism.

The inherent resilience of the ex-pat and overland/budget markets enabled the white water rafting companies to survive on a reduced operational basis through to recovery whereupon they were joined by a third rafting operator, Equator Rafting, in early 2001 and a fourth, Nalubale Rafting, in mid 2005. This increased competition encouraged Adrift, NRE and Equator to develop their businesses beyond the simple rafting experience such that they all now offer a range of rafting trips with family options, kayaking and river boarding, bungee jumping, walking/nature tours, assistance with local community/charitable activities and an extended range of accommodation/dining options to attract new, higher value markets to their sites. Other companies have also been attracted to the area offering non-watersports activities such as quad biking, mountain biking and horse riding, enabling a critical mass of operators and activities to develop thus giving substance to the claim that Jinja/Bujagali has now earned the reputation to call itself the ‘Adventure Capital of East Africa’.

The growth of Jinja as an adventure tourism destination has been achieved through a process of organic development based upon a small number of entrepreneurial operators and although according to the AESNP 2001 EIA report, a Jinja Tourism Development

Association was facilitated and formally constituted, evidence of its contribution to the development of the tourism sector in Jinja has not been established. The organisation is understood to be inactive yet recently an inaugural meeting was held to discuss the establishment of an informal forum of tourism sector businesses where the identification of ways in which common interests in the development and promotion of Jinja might be put forward and progressed. National and regional/district public sector organisations with a remit for the tourism sector have thus far had limited resources to assist tourism development and thus it becomes important for the private sector to take appropriate initiatives in their place but ideally with their involvement.

2.3 The Emerging Conferences and Meetings Market

The original colonial era hotel in Jinja, The Ripon Falls Hotel, closed many years ago leaving the Sunset International Hotel as the principal, long-standing hotel in town, supported by the government owned Crested Crane Hotel (doubling as a hotel/tourism training college) with both being supplemented by a number of small guesthouses providing limited budget style accommodation. The provision of accommodation thus reflected the ebb and flow of Jinja's own economic fortunes until government funding built the Crested Crane college facility and in the mid/late 1990's investment in new accommodation resurfaced with a two phase development of 76 rooms at the Triangle Hotel on a prime site overlooking Lake Victoria. At the same time Nile River Explorers opened their Explorers Backpackers rafting base and accommodation facility, offering camping, dormitory and double rooms for the budget market.

The Sunset, Crested Crane and Triangle hotels are purpose-built and thus incorporate banqueting/meeting space as part of their design. Being located in Jinja town, these hotels naturally attract weddings and other social functions which use the banqueting space but having such a facility also allows the hotels to attract some meetings business which in turn often require accommodation. It is clear therefore that in addition to the usual commercial and some holiday/recreational demand for hotel accommodation there began to develop a residential related meetings market which the existing larger hotels were able to cater for. However, from around the year 2000, much more serious investment in new hotel building was underway and this was mostly outside of Jinja town. The most significant example of this development was the opening of the up-market, Kenyan owned, Jinja Nile Resort on an attractive elevated site overlooking the Nile, 1 km downstream from the Nalubaale Dam and 4 km from the centre of Jinja. This hotel was referred to as the 'Mada Hotel' in the AESNP EIA report. It was opened with 35 rooms in 2001 but doubled in size two years later and added a further 40 rooms in 2004. It has several different sized meeting rooms and can handle a 200 delegate conference.

The up-market, Australian owned guesthouse/restaurant Gately on Nile, opened in Jinja in 2000, offering seven double rooms in two renovated colonial era bungalows in attractive gardens overlooking Lake Victoria. This hotel also markets itself as a small,

high quality meetings venue/retreat for the senior corporate/government/donor community.

In 2001, the German owned, up-market, Kingfisher Safari Resort opened on an attractive elevated site overlooking the Source of the Nile, on the opposite side of the river from Jinja but some 9 km by road across the Nalubaale Dam from the town centre. The resort now has 42 thatched bandas of which 28 are single bedded, a rooms mix clearly designed to attract the commercial and residential meetings markets.

Table 2.2 below summarises the growth in supply of new higher standard hotel, guesthouse and lodge accommodation in the Jinja area between 2000 and 2004 thus:

Table 2.2: Expansion in Higher Quality Accommodation Around Jinja, 2000 - 2004 (Numbers of New Rooms Constructed per year)						
	2000	2001	2002	2003	2004	TOTAL ROOMS
Gately on Nile G/hse	7	-	-	-	-	7
Jinja Nile Resort	-	35	-	35	40	110
Kingfisher Safari Resort	-	21	14	7	-	42
Palm Tree G/hse	-	5	-	-	-	5
The Nile Porch (NRE)	-	-	-	-	10	10
Nile High Club (Adrift)	-	-	-	-	3	3
TOTAL ROOMS	7	61	14	42	53	177

Source: Consultant's Estimates

Thus in the space of a few years, (2000-2004), significant new investment, particularly in high quality accommodation, has taken place and in each instance a key market targeted by these businesses has been the residential meetings/conference sector. Further evidence for the strength of this market in both the older and newer hotels in the area was gathered from interviews with representatives from several of these properties, indicating that this market accounted for between 50 to 95 per cent of the business mix, depending upon the hotel and that overall room occupancy was running at between 50 to 70 per cent annually, again depending upon the hotel.

It is clear that the Jinja area is now successfully competing with Kampala and Entebbe in offering a destination with a distinct appeal for the meetings market - the attractive

riverside setting and the tranquillity of a destination located miles away from the urban environment of the capital city – at least for certain types and sizes of meetings and conferences. But it is also clear that the development of this particular type of business tourism is product led, that is, the market is being attracted because the quality and size of the hotel accommodation and its meeting rooms, restaurants and other facilities, matches market requirements, packaged together with a location which can also deliver its own unique quality and appeal.

2.4 Other Development Activity

The investment in high quality accommodation has also been reflected, less obtrusively, in the opening of a small number of new, moderately priced guesthouses and in the carrying out of improvements to other existing guesthouses, the opening of new bars restaurants, travel agencies and gift/curio shops. The backpacker /budget traveller market largely prefers to stay at the accommodation provided by the rafting companies which are located on individual sites overlooking the river near Bujagali Falls (although NRE also has a base in Jinja town) and in the last couple of years, the range and quality of the accommodation options on these sites has also been extended.

A further extension of this growing confidence in the Jinja area has been the strong demand for purchase of plots of land along both the east and west banks of the Nile between the Nalubaale Dam and the general location of the Bujagali HPP at Dumbbell Island. It appears that in the few years many plots of various sizes have been bought (and are still sought), by prominent Ugandan companies, ex-pat residents and overseas interests for the building of private homes or small to medium guesthouse/lodge/hotel and restaurant businesses, to the extent that the river in this area has now attracted the epithet ‘Muzungu Nile’, meaning European or white person’s Nile.

An important new development is the imminent opening of a luxury ‘eco-friendly’ lodge project located deep within the Mabira Forest Reserve some 25 km from Jinja. This development of 15 lodges is a joint venture between Inns of Uganda, a local up-market lodge operator with two existing lodges in two of the major wildlife parks in western Uganda and a Dutch eco-tourism/wildlife, specialist lodge operator with existing operations in Surinam and elsewhere in Africa. This initiative represents the first investment in the Jinja area by an experienced luxury wildlife lodge operator who has now recognised the specialist nature/wildlife tourism potential available and who, with his international partner can bring high value, particularly European, special interest natural history/wildlife visitors to Mabira Forest and beyond. This project will place the Jinja area firmly on the map as far as these niche markets are concerned and thus creates a further dimension to the available tourism product which will be given greater stimulus by the eco-tourist lodge and related proposals at the Kalagala – Itanda Offset site downstream of the Bujagali HPP dam site.

The Kalagala – Itanda Offset Proposal involves another major tourism planning initiative. This development concept, proposed by the Government of Uganda in 2001 for the

Kalagala – Itanda Falls area, is designed to create positive consequences at this location in mitigation of the effects of the planned Bujagali HPP upon the Bujagali Falls site, including effects on natural habitats and tourism. World Bank/IFC funding of the power project requires the adoption of suitable mitigation proposals and the previous sponsors of the Bujagali HPP, AES Nile Power, expressed willingness to participate in a financial partnership to realise the proposals. The concept incorporates a series of environmentally sustainable programmes which include the creation of riverside foot and cycle paths on both banks of the river between the dam and the Kalagala – Itanda Falls while the outstanding scenic beauty of the Falls area should form the basis for a range of tourism activities including, viewing areas, picnic areas, campsites, tourist lodges, cultural heritage sites, parking, toilets and other facilities. These proposals have been in abeyance since the demise of the AES Nile Power project but independently, the National Forest Authority advertised, in May 2005, an invitation for bids to be submitted for concessions to run tourism businesses on both sides of the river at Kalagala – Itanda. Adrift Rafting won the concessions with plans for a high quality lodge on Kalagala Island and campsites on two smaller islands downstream of the rapids. Negotiations are still underway between the parties to clarify the scope of the development and how it fits into the original Kalagala – Itanda Offset proposals and thus it is unclear when this development will commence.

Several major hotel projects are currently at an early stage of discussion for development in the Jinja area, including proposals by the Madvhani Group (an important local business conglomerate) to redevelop the derelict Jinja Sailing Club site which they own together with adjacent lakeside land which it is said they own and separate proposals by overseas interests to redevelop the Jinja Golf Club which occupies an attractive, elevated site overlooking the Source of the Nile. However, it is the plans of the Kampala based Speke Hotels Group (owners of Equator Rafting) for the site which they own above and overlooking Bujagali Falls, which appear to be the most advanced and arguably the most likely to proceed. Their plans, in at least two phases, will build some 200 rooms with supporting resort, sports and conference facilities at an estimated cost of \$10 million.

3.0 THE TOURISM IMPACTS OF THE BUJAGALI HPP PROJECT

3.1 The Physical Impacts of the Project

Construction of the Dam will result in the development of several permanent physical features in the landscape, most notable among which are the Dam itself, the reservoir which this structure will create and the transmission line required to connect the power station to the existing hydropower installation at the Nalubaale Dam, and to Kampala. Each of these features will result in a range of impacts and certain of those impacts can be characterised as having a tourism dimension.

The Dam

The introduction of a major man-made structure, such as a dam, into the natural landscape, represents a localised visual intrusion with an aesthetic impact which the choice of site, design and landscaping will help mitigate. The aesthetic impact will be more pronounced for sight lines immediately downstream of the Dam from where the structure itself is most visible, whereas upstream, the reservoir created behind the Dam diminishes this impact. In tourism terms, the visual intrusion will be very localised and limited to a relatively low profile stretch of the river (certainly compared with the Bujagali and Kalagala / Itanda Falls locations) which is essentially inaccessible to visitors other than those rafting the river.

The Transmission Line

The route of the transmission line, on the west bank of the Nile, essentially parallels that of the river but is located at an elevated level and set back at a distance from it. The river cuts a path through steeply rising ground along both banks for much of its course to the site of the Dam and thus sight lines from where the transmission line will be visible are principally from locations at the top of the elevated ground on the eastern bank of the river. The transmission line pylons and cabling will be partly hidden by the vegetation and tree cover through which it passes and will represent less of a visual intrusion than the existing transmission line which crosses the river close to Bujagali Falls and some of the existing and planned hotel, lodge and guesthouse development built immediately above and overlooking the river.

The Transmission Line continues from the Nalubaale Dam onwards to Kampala and passes through the northern extremity of the Mabira Forest, several kilometres away from the most heavily visited part of the Forest, in the environs of the National Forestry Authority owned and operated Mabira Forest Ecotourism Centre and Campsite. The luxury ‘eco-friendly’ Mabira Forest Lodge development currently under construction is located deep in the Forest to the south of the Jinja –Kampala road and thus is even further away from the Transmission Line. Tourism impacts consequent upon the route of the Transmission Line through Mabira Forest are therefore considered to be extremely small.

The Reservoir

The principal physical impact of the Dam as far as tourism is concerned is the creation of the reservoir and what this means in terms of the losses and gains in tourism/recreational amenity and the access to that amenity.

The project reservoir will occupy an area of 388ha, approximately 80ha of which will be newly inundated land and 308ha of which is currently occupied by the Victoria Nile. The tail of this reservoir and thus the point at which inundation levels begin declining, is located approximately at the Bujagali Falls, however the Falls themselves and the associated existing river bank picnic and recreation site will be submerged by the reservoir waters. Thus the physical inundation of the Bujagali Falls represents a loss on the one hand of the visual amenity of the Falls but on the other hand it also represents the loss of a resource which is utilised for other tourism activities such as white water rafting, picnicking and general recreation. This is discussed further in Sections 3.2 and 3.3.

Other smaller rapids, located close together on the river between Bujagali Falls and the Dam offer a distinctive feature which will also be lost for the purposes of rafting down the river but it is the spectacular nature of the Bujagali rapids, their attractive natural setting and established riverside accessibility for recreation which marks them out as essentially the only significant tourism resource utilised by a wide range of local and international visitors which is impacted by the construction of the Dam.

The creation of the reservoir lake will however represent a body of water with potential for water based leisure and sporting activities offered by existing and new leisure operators. Adrift, NRE and Speke Hotels have already indicated their interest in pursuing a variety of water based activities on the lake.

3.2 Impacts upon White Water Rafting Companies

In 1998 when the original SEA work was undertaken for the AES Nile Power project the two existing rafting companies were fledgling businesses only a year or two old but were estimated to be handling 7,000 to 8,000 rafting clients per annum. Eight years later in 2006, the original two companies have survived both a crash and a steady recovery in tourism to Uganda (and thus in their fortunes) and are now more mature and more diverse businesses. They have since been joined by two further rafting companies, one only commencing last year, while rafting passenger numbers are currently estimated to be running at around 10,000 per annum (see Table 3.1 below) with steady growth anticipated in 2006.

Adrift Rafting

Adrift was the first company to operate white water rafting in Uganda, it is owned by Cam McLeay, a New Zealander and white water rafting expert, who at the same time also operated rafting businesses in New Zealand and on the river Zambezi in Zimbabwe. Adrift, both then and now, is based in Kampala and originally brought their clients down

to Bujagali for the rafting experience and brought them back the same day whereas NRE were and are, based at Jinja/Bujagali. In mid 2003, Adrift opened the 'Nile High Club' which is a campsite with dormitory (and more recently a few thatched bandas) a bar/restaurant and 44m bungee jump located on a 32m cliff-top site overlooking the Nile.

Adrift originally launched their rafts from the riverside recreation site beside Bujagali Falls and paid a commission to an entrepreneur who held a lease for the site from the District Council. This arrangement continued until they entered a business partnership with the Kenyan Mada Hotels group, who own the Jinja Nile Resort and extensive cliff top landholdings adjacent to their hotel, upon which the 'Nile High Club' is now located and below which their rafts are now launched.

Having their base in Kampala has always meant that Adrift generated their market from amongst Kampala based ex-pats and other Ugandan based NGO employees as well as some travellers staying in Kampala as opposed to the overland truck based market. This market mix has changed a little with the building of the 'Nile High Club' and thus the availability of an accommodation base by the Nile, but reportedly, some 90 percent of their rafters still originate from Kampala sources.

Adrift, like NRE, offer several rafting options, one day, two day, family rafting etc but 90 percent of their clients take the one day trip which currently costs \$95 per person. In 1998 Adrift pushed their rafting rates up from \$65 to \$95 (NRE left theirs at \$65) per person and it appeared that their market position enabled them to sustain this, however rates fell back to \$65 in the difficult years but began their recovery around 2003/4. It is estimated that Adrift took around 4,000 clients rafting during 2005, putting it in second place behind market leaders NRE. It is likely that the entry of the fourth rafting company, Nalubale, run by a former Adrift employee, may have led to this loss of market share.

Adrift as a company has developed from being simply a white water rafting experience provider to a much more broadly based travel company offering in addition, gorilla trekking, mountain climbing, wildlife safaris and outdoor management development programmes for companies, NGO's, school groups etc. They have recently been awarded a concession from the National Forestry Authority to operate a high quality eco-tourism Lodge on Kalagala Island, within the Kalagala – Itanda Offset area, which will involve an investment of \$1million in association with international partners and thus continues the diversification of their business from its white water rafting origins.

Adrift have confirmed that they will continue to operate their white water rafting business after the Bujagali HPP is constructed and that they have no intention of moving their rafting base from the 'Nile High Club' location. Once the Dam is built, rafting trips will have to move downstream of the structure and while the reservoir created will result in the loss of one and possibly two Grade 5 rapids and removes a series of smaller, successive rapids which represent an exciting 'staircase' feature, a thrilling and exhilarating rafting experience with three Grade 5 rapids still remains. Purists will lament the loss of the more intense nature of the start of the existing trip but for probably 99 per cent of the market this will

Figure 3.1:
White Water Rafting Route and Rapids



have little significance. Most rafters will be taking this particular trip for the first time (for many it will also be their first rafting trip) and the fact that it will still include three Grade 5 rapids, confirms the seriousness of the trip as an attractive, physical and mental adventure located on a beautiful stretch of the longest river in the world. Rafting on the Nile has become an established part of the ex-pat/ NGO recreational break activity programme over the last ten years in Uganda and it is not expected that the anticipated changes to the rafting trip will alter demand from this market sector.

Figure 3.1, taken from the current Adrift brochure, shows the existing rafting route down the White Nile with the inclusion of the names (as used by Adrift) of the principal sets of rapids. Dumbbell Island is located between ‘Surf City’ and ‘Big Brother’ and thus the rapids at Bujagali Falls, ‘Easy Rider’, ‘Total Gunga’ and ‘Surf City’ will be submerged. It is possible, depending on the alignment of the Dam, that the falls at ‘Big Brother’ (also known as ‘Silverback’) may be unaffected since they will lie downstream of the structure, however, the finishing point shown on the map will have to move further downstream, probably to at least the ‘Nile Special’ rapid if the existing journey length and number of rapids is to be retained in the post – Dam era. Similarly, the two day trip will need to be extended further downstream from its indicated finish point although quite where this may be has yet to be determined. Nabuganyi, a point beyond the ‘Waleba’ rapid (see Fig 2.1 above) has been used before and is therefore a likely finishing point. ‘Total Gunga’ is the Grade 5 rapid lost while ‘Big Brother/Silverback’ may also be lost, leaving at least three Grade 5 rapids for rafting on the route, ‘Overtime’, ‘Itanda/The Bad Place’ and ‘Novocaine’ (see Table 2.1 above).

Adrift accepts the reality of the proposed Bujagali HPP and recognises that they will need to manage the change in their rafting product once the timetable for the dam construction is made public. Maintenance of the integrity, quality and thrill of the rafting experience is considered to be fundamental to the core values of the company’s operating philosophy and thus the commitment of the company to its current and future product, in marketing and promotional terms, is regarded with a similar passion which understands the need to embrace change positively.

Although Adrift will not need to relocate their rafting base, the one impact which they will suffer is the need to find a new launching point into the river somewhere below the new Dam. While such a location has not yet been researched, the suggestion of a facility shared with other rafting companies and provided as part of the impact mitigation measures was not regarded as ideal. Each operator has historically used different access points and exit points to/from the river and has a different approach to delivering their operationally distinct rafting product and will prefer to maintain their own separate site for entry to and possibly exit from the river.

Adrift employs around 40 full-time staff at their Bujagali campsite/rafting base of whom about 10 are ex-pat and the balance are Ugandan. None of these jobs are threatened by the need to move the rafting trips below the planned new dam although it is possible that new casual labour needed to help carry rafts in and out of the river may be required at the new entry and exit points.

Nile River Explorers

Nile River Explorers (NRE) was the second rafting company to operate on the Victoria Nile, commencing operations early in 1997. The company was set up by Jon Dahl, a white water rafting expert with experience developing the sport on the river Zambezi in Zimbabwe and perhaps not surprisingly, he decided to locate his rafting base and backpacker lodge in Jinja rather than in Kampala. Offering camping, dormitory and double room accommodation options, the Explorers Backpackers Hostel in Jinja became the most popular budget accommodation in Jinja before NRE and Equator Rafting both opened similar budget accommodation facilities at Bujagali whereupon staying by the river became the preferred option.

NRE's market focus was and is different from that of Adrift. The base at Jinja made it the natural stop for the overland truck based traveller market and this sector has dominated NRE's business although not to the extent that the Kampala based market dominates Adrift's business. NRE indicates that around 60 per cent of their clients are sourced through the overland truck sector and that some 40 per cent therefore come through various Kampala or Ugandan based organisations, travel agencies, ex-pats or NGO's.

The Explorers Campsite at Bujagali is located on the cliff top overlooking the Bujagali Falls and although it originally offered a bar/restaurant, camping and dormitory accommodation, in the last few years this has been supplemented with bandas, and luxury safari style tented camp facilities, a swimming pool and an a la carte style restaurant. This has enabled higher value markets to be attracted from Kampala and overseas and provides the overland truck passenger with an option to trade-up from the campsite as a treat in a very special location – and many do. The overland truck market stays three nights at the campsite which gives the travellers time to engage in a greater variety of activities, including a day devoted to working with local NGO's assisting with community based projects such as renovating school buildings or similar.

NRE have always launched their rafts from a river bank site close to the Owen Falls Dam, some kilometres up-stream from where Adrift enter the river, in order to give their clients more practice and familiarity on the raft and in the water before they decide to proceed to the rapids. Like Adrift, they also offer a range of rafting options, 1 day, 2 days, family trips etc. but once again it is the 1 day option which accounts for the large majority of rafting trips. Rafting trips cost \$95 per person, the same as Adrift, although historically, NRE prices were lower than Adrift prices. Estimates of the number of rafters handled during 2005 suggest a figure of around 5,000, which would make NRE the leading rafting company with Adrift in second place.

NRE has also developed its business along broader tourism related lines like Adrift by offering kayaking courses and tandem kayaking (instructor and pupil in one kayak) down the Nile. They have set up a separate website, www.kayakthenile.com which focuses on the much smaller and more specialist market for adventure kayaking which uses the Bujagali Falls but also uses and considers 'Itanda/The Bad Place' and the 'Nile Special' rapids as world class for kayaking. NRE is also providing an improved range and quality

of accommodation and food services and selling a variety of other tourism experiences such as gorilla trekking and wildlife safaris. Five years ago they used to operate Sundowner cruises on Lake Victoria and although that service closed down when the vessel they rented was sold, developing similar cruises on the lake created by the new reservoir is something that will be seriously considered by the company.

NRE have also confirmed that they will not be closing down their white water rafting business if the Bujagali HPP project proceeds, nor will they move from either their base in Jinja or their campsite close to Bujagali Falls. As was pointed out in the coverage of Adrift, above, the changes to the white water rafting experience consequent upon moving the trips below the new Dam are not expected to have any meaningful impact upon the markets currently attracted. What was originally considered to be a pretty extreme sport (and of course still is on many stretches of many rivers worldwide) undertaken by a hard core of skilled purists, has been controlled and made much safer (but still not without risk) by professional rafting guides and has thus become an essentially mainstream adventure sport open to all. Indeed, many holiday insurance policies, including those likely to be taken out by overland truckers, and other travellers already include cover for adventurous activities like white water rafting while additional premiums may only be sought for skiing and related winter sports cover.

For the overland truck market, Jinja and the option to raft the Nile is simply one stop and one experience among many on a tour around Uganda or an even longer trip around East Africa and thus the change to the rafting trip caused by the Bujagali HPP will not represent a make or break factor influencing that holiday choice. Contact with leading U.K. based adventure/overland trucking tour operators offering Uganda has confirmed both this position and their own commitment to including Jinja/white water rafting in their future itineraries despite any changes to the rafting trip. The tour operators indicate that around 75 percent of their clients take up the option to raft in Jinja and they do not expect this to change if the rafting trip itself changes as anticipated. The tour operators also indicate that the eastern side of Uganda which is currently little visited will become incorporated in additional new itineraries being developed involving western Kenya and that this will lead to their bringing more visitors to Jinja/Bujagali and thus potentially more clients for rafting trips.

The principal impact upon NRE's business operation once the Bujagali HPP is built is exactly the same as for Adrift, that is, the need to find new sites to enter and exit the river below the Dam. The primary concern is to have a launch site which is solely for their own use, as is the current situation, so that they can provide their clients with the distinct NRE rafting experience without distraction from other rafting companies. NRE feels that the provision of toilets and changing facilities for example, at the launch site, would be a desirable improvement on current practice, enhance the professionalism of the activity and further improve the image of Jinja as the 'Adventure Capital of East Africa'.

NRE indicates that it employs around 100 full-time staff, however, their employees are mostly paid on an as required daily basis, when rafting activities are taking place, while it is understood that Adrift pays its staff on a monthly basis no matter what level of rafting

takes place. Both figures are accurate in their own way but are not directly comparable as simply 'full-time'. If two NRE staff are considered equal to one full-time Adrift employee then this would represent 50 'full-time' staff at NRE, which considering NRE operates from two locations with accommodation, catering and management at each, then it is not unreasonable to expect more employment generated by NRE. NRE has a similar ratio of ex-pat to local employees and once again none of the employment will be lost following the relocation of rafting trips to the river below the Dam.

Equator Rafting

Equator Rafting was originally established as a joint venture between Mick Barnett, a white water rafting expert and former employee of Adrift Rafting and the Speke Hotels Group in early 2001. Mick Barnett had secured a new lease for the District Council owned Bujagali Falls tourism site and proposed the development of a new rafting company and campsite based at the site.

The partnership and performance of Equator Rafting was very successful in the early years but the partnership broke up and Equator Rafting, instead of maintaining its leading position amongst the group of rafting companies, has found itself overtaken by its competitors The Speke Camp, however, has a stunning location immediately beside the Bujagali Falls and the site doubles as a visitor recreation and picnic site as well as a campsite and rafting base. A large, attractive, open-sided and thatch roofed bar/restaurant has a prominent location by the Falls while the campsite, dormitories, kitchen, toilets, showers and other facilities are located to the rear of the site but give a poor impression and sense of neglect.

All visitors to the site are charged for entry, Ush 2,000 for a Ugandan, Ush 3,000 for a non-Ugandan and Ush 500 for a child while vehicles are charged at an additional Ush 1,000. Visitors can either bring their own food at no extra charge or use the bar/restaurant on site. Revenues from the operation of the site as a visitor picnic/recreation site alone are understood to be around Ush 130 million (some \$72,000) and this suggests annual visitor numbers of between 50,000 to 60,000.

Equator, who launch their rafts from their own campsite upstream of the Bujagali Falls, offer the same rafting options as Adrift and NRE and again find that the one day trip is the most popular choice. Their market is dominated by Kampala sourced/based ex-pats, NGO's and visitors and this is assisted by the Speke Hotels Group owning several prominent hotels in both Kampala and Entebbe. Formerly, rafting rates were the same as Adrift and NRE (\$95 per person last year) but currently Equator has dropped its price to \$75 per person. This is a significant decision and is probably related to the poor performance of the rafting business which is understood to have carried only 600 to 700 clients during 2005 and continues to operate comparatively weakly.

Equator Rafting confirmed that it is their intention to continue rafting following the completion of the Bujagali HPP but that since their existing base at Speke Camp would be submerged by the new reservoir they will need to find a new location for these activities. The Speke Hotels Group owns an extensive cliff top site above the Bujagali

Falls where it plans to build a 200 room hotel and conference centre and it may be possible to find a discrete part of this site to relocate their rafting operation to but Equator indicates that no examination of alternative sites has been undertaken so far.

The principal impacts upon Equator Rafting from the development of the Bujagali HPP are therefore related to the loss of their existing business base and associated structures, the costs of relocating these business assets to a new site and in common with other rafting companies, the need to find new entry and possibly exit points to/from the river. The original lease agreement with the District Council was signed back in 2000/2001 when the plans for the Bujagali HPP were well known and although Equator Rafting believes that Speke Hotels Group signed a purchase agreement with the Council for the site last year (and has documentary evidence of this), this is believed to be invalid because the land is Government owned and reverts to the new Project Sponsors as part of the required land take for the completion of the Bujagali HPP.

Thus the only impact issues which remain valid are associated with the costs of moving rafting, campsite and office related fixtures, fittings and equipment from Bujagali to a new rafting/camping base and the issue of providing for a new entry point to the river for their rafts.

Equator Rafting indicates that they currently employ some 35 staff at Speke Camp, 10 of which are non – Ugandan and that since they plan to relocate rather than close the rafting business once the dam is built, there will be no loss of employment.

Nalubale Rafting

Nalubale Rafting was started in mid-2005 by Ian Baillie a white water rafting specialist who formerly worked with Adrift Rafting. He is the owner of a carpentry business and opening the rafting company was his second business start-up. Both businesses are based in Kampala but the practical rafting operation operates out of rented premises in Jinja town but has no campsite or related facilities. Kampala is the source of his clientele which is a reflection of his experience with Adrift Rafting who generate most of their rafting business through Kampala based ex-pats, NGO's and other organisations.

At present, Nalubale only operates at weekends and while it offers a range of rafting trips like the other rafting companies, the majority of trips are one day in length and costs \$95. The company employs eight people in Jinja, including three ex-pats and is easily the smallest of the four rafting businesses. It is estimated that they carried around 200 – 300 clients during the six months in which the business operated in 2005.

Nalubale is quite prepared to operate rafting trips below the new dam after it is built and although it indicates that it has an operating relationship with NRE, sharing a new launching site with them is unlikely to be acceptable to NRE and they will need to find an alternative location. It may be possible for Nalubale to share a facility with Equator Rafting who expressed preparedness to share such a facility with other rafting companies.

Table 3.1 below summarises the principal characteristics of the four white water rafting companies currently operating on the Nile at Jinja / Bujagali:

Table 3.1: Summary Operational Characteristics of the Rafting Companies						
	Company Started	Market Mix	Most Popular Rafting Trip	Rafting Trip Fee (\$)	Number of Staff	Rafter Nos. in 2005 (estimate)
Adrift	Mid 1996	90% NGO / Kampala 10% Truckers	1 Day Trip (90% of clients)	\$ 95	40 F/T (10 ex-pat, 30 local)	4,000
N.R.E.	Early 1997	40% NGO / Kampala 60% Truckers	1 Day Trip (95% of clients)	\$ 95	50 F/T (10 ex-pat, 40 local)*	5,000
Equator	Early 2001	95% NGO / Kampala 5% Truckers	1 Day Trip (95% of clients)	\$ 75	35 F/T (10 ex-pat, 25 local)	600 - 700
Nalubale	Mid 2005	100% NGO / Kampala	1 Day Trip (100% of clients)	\$95	8 F/T (3 ex-pat, 5 local)	200 - 300

Source: Interviews with Rafting Companies and Mrs Sarah Muwanguzi (Itanda LC1 Representative)

3.3 Other Tourism Related Impacts

There are a number of other general and more particular tourism impacts which arise from the Bujagali HPP ranging from the removal of the additional costs experienced by tourism businesses associated with their increased use of diesel powered generators to provide electricity during load shedding, to the possible beneficial opportunity for additional business at the Hairy Lemon backpacker hostel, located downstream of the Kalagala – Itanda Falls. However, the principal other parties where tourism related impacts have a direct bearing are the local village communities on both east and west banks of the river between the

Nalubaale Dam and the Bujagali HPP. At present, the relationship which these communities have with tourism is quite distinct but this is set to change and will become more similar once the hydropower project is built.

West Bank Villages

Discussions held with community leaders established that historically their villages had not benefited at all from tourism/white water rafting since these businesses were all based

on the other side of the river and even when the rafters came downstream and stopped for lunch on their side or on mid-river islands, they were never able to sell fruits and other foodstuffs to the rafters since they brought everything with them.

The lack of any benefit from tourism thus far appeared to be keenly felt and the possibility of a change to this situation, partly as a result of the Dam, was warmly welcomed. The recent phenomenon of many ex-pat and overseas interests buying up parcels of land along the banks of the river is only just starting to result in new lodges/guesthouses and restaurants opening and thus gradually some tourism related benefits in terms of employment and the purchase of local foodstuffs will begin to become apparent.

Employment creation on the one hand and the opportunity to provide services to tourists on the other are the two main benefits identified in relation to the proposed hydropower project. Employment opportunities are primarily expected to be generated by the construction stage of the Dam although it was indicated that tourism related employment would also be likely, associated with the plans to build a visitor interpretation centre and refreshment facilities. Local villages could also supply this centre with fruit and vegetables.

The opening of the Dam together with a possible visitor and interpretation centre will undoubtedly draw its share of the increasing number of visitors arriving in Jinja for recreation or conference purposes as well as providing an important educational resource for local schools. In addition, the plans for developing the west bank elements of the Kalagala – Itanda Offset Proposals into a major eco-tourism/nature tourism attraction will further encourage more tourists to travel down the west bank of the river to visit both new facilities. The increased flow of visitors anticipated along the west bank therefore represents an opportunity for the local villages to benefit from. Some visitors may stop at roadside shops/stalls for fruit and vegetables or snacks but to benefit further, larger numbers of visitors must be encouraged to stop and one way of achieving this would be to build a museum or cultural heritage centre which would present the history, culture and artefacts of the various tribes in the area. This could be built on a site with striking views of the river and incorporate a picnic site, refreshments and a crafts/gift shop, thus generating further local employment and the sale of local foodstuffs and crafts.

The community leaders were supportive of the hydropower project and could see the employment potential from the construction phase in particular since the construction base for the project would be on their side of the river. But they were also keen to benefit from tourism and were very much in favour of developing the concept of the cultural centre/museum as a means of securing this. The fact that such a facility could be used as an educational resource for local schoolchildren and as a means of possibly safeguarding their traditions and cultural heritage for the future was warmly welcomed.

East Bank Villages

Discussions confirmed the existing participation of east bank villages in the tourism sector, principally with the various rafting companies and the businesses that have grown

up around them but also with non-rafting businesses like the Jinja Nile Resort Hotel. Tourism companies have created employment opportunities for some families and provided a market for other families to sell foodstuffs and other services to them but the rafting companies in particular have also enabled a range of small businesses to grow up around the entrances to their sites offering a range of goods and services direct to the individual visitor. These businesses will benefit from the non-relocation of the Adrift and NRE rafting bases but may suffer from the loss of the Bujagali Falls riverside recreation site if a replacement site cannot be found relatively nearby.

An apparent lack of familiarity with the current status of the Bujagali HPP and the impacts the project is likely to have on existing rafting and other tourism businesses, led to an initial uncertainty and expression of fear for the jobs and other benefits already enjoyed by east bank villages. Once reassured on those points, concern was expressed about the loss of the Bujagali Falls picnic site and recreational area as a local facility (and possible job losses), then concern also about the future quality of the road along the east bank to the Dam and beyond to Itanda given the existing standard and the expected heavy use during the construction period. In addition, as with the west bank villages, there was a desire to benefit from the increased numbers of visitors expected to be drawn down the east bank because of the land sales, plans for numerous new guesthouses, lodges and hotels and the Kalagala – Itanda Offset Proposals.

The need to try and encourage visitors to stop on their drive down the east bank mirrored the views of the west bank villages and the suggestion of building a museum/cultural centre to display the history, culture and artefacts of the tribal peoples living on the east bank as means of achieving this was positively received. This museum could also be located on a site with attractive views and also incorporate a picnic site, refreshments and a craft/gift shop to maximise the benefit from the much larger flows of visitors expected by the time the Dam has been built.

Table 3.2 below summarises the tourism impacts of the Bujagali HPP described above.

Table 3.2: Summary Tourism Impacts of the Bujagali Hydropower Project			
Stakeholder / Affected Parties	Nature of the Impact	Scale of the Impact	Financial Impact
White Water Rafting Companies	Loss of the Staircase Feature and a Grade 5 Rapid	Partial Diminution of the Existing Rafting Trip	Neutral
White Water Rafting Companies	Loss of Existing Individual Rafting Company Entry Points to the River	Need to Facilitate Replacement of Individual Entry Points to the River below the Dam	Negative but Minor
White Water Rafting Companies	Replacement / Relocation of Equipment to new Rafting Company Operational Bases	Only Equator Rafting Will Have to Relocate	Negative but Minor
White Water Rafting Company Employees	Loss of Some Part-Time Jobs Due to Re-Positioning of the Rafting Route	Limited Because Only One Company to Re-Locate and Jobs May be Created along the New Route	Neutral
East Bank Communities	Loss of Bujagali Falls Recreation/Picnic Site	Loss of a Significant Community Riverside Recreation Facility	Negative but Serious
East Bank Communities	Loss of Bujagali Falls Recreation/Picnic Site	Loss of Economic Benefit to Shops/Stalls outside Entrance to Bujagali Falls Site	Negative but Minor
East Bank Communities	Increase in Numbers of Visitors Travelling Along the East Bank	Benefits from Attracting Visitors to Stop and Spend	Positive but Moderate
East Bank Communities	Development of new rafting launch and exit Riverside locations	Possible creation of casual employment to assist rafting companies	Positive but minor
West Bank Communities	Development of new rafting launch and exit Riverside locations	Possible creation of casual employment to assist rafting companies	Positive but minor
West Bank Communities	Increase in Numbers of Visitors Travelling Along the West Bank	Benefits from Attracting Visitors to Stop and Spend	Positive but Moderate
Hairy Lemon Island Backpacker Campsite	Increase in Rafters Passing Downstream	Benefits from Attracting Rafting Company Rafts	Positive but Minor
Jinja Tourism Sector	Cessation of Electricity Load Shedding	Reduction in Energy Costs Due to Lower Diesel Generator Use	Positive but Minor

4.0 MITIGATION MEASURES

The following list of suggested mitigation measures represents a summary of suitable responses to those identified tourism impacts already discussed in the preceding sections of this report. Successful implementation of these measures however, will require a combination of facilitation and funding together with the co-operation and engagement of numerous public and private organisations and Bujagali Energy Limited, while representing a readily identifiable source of financial support and facilitation may not meet the entire costs involved and consequently other potential funding/technical assistance sources are suggested at the end of this section of the report.

MM 1: – New Launch/Exit sites: The one impact of the Bujagali HPP affecting all the white water rafting companies is the loss of their individual raft launching sites and the replacement of these is considered to be a major requirement. It will be necessary to find suitable sites downstream of the Dam and have them ready for use by the time construction work in Stage 2 of the Dam build, connecting Dumbbell Island to the eastern riverbank, gets underway since this will interfere with rafting activities. Exit points downstream on both banks will also be required although they may be shared and may need fewer facilities.

It is envisaged that the new entry/exit points will be secured through purchasing or leasing (depending on circumstance) of the sites, while further investment will be required for landscaping and the provision of facilities such as small slipways, toilets, changing rooms and storerooms.

MM 2:- Jinja Tourism Development Association: The establishment of this organisation was facilitated by AES Nile Power but it is understood to be inactive at present. However, the growing importance of tourism for the Jinja area would benefit from the availability of a forum for discussion and identification of pro-active measures which could support this trend. In the absence of a public sector led initiative to satisfy this requirement, the private sector, through either the reviving of this particular organisation or the establishment of another should take the lead. The Project Sponsors as prospective operators of a possible visitor centre at the Dam could not only facilitate the re-emergence of this body but also participate in its activities as a member and future tourism sector stakeholder.

Currently, there is evidence of growing interest amongst the private sector tourist business community for the establishment of an informal forum for the discussion of mutual interests and their promotion and thus it is likely that this mitigation measure will be positively received by these stakeholders.

MM 3: - Museum/Cultural Heritage Centres: To enable both the west bank and east bank village communities to benefit from the increased numbers of tourists expected to be travelling along either side of the Nile, a museum/cultural heritage visitor attraction

interpreting local tribal history and culture to be built in a prominent location (perhaps with views over the river) with picnic, refreshment and craft/gift shop facilities, on both sides of the river is proposed. Project implementation of the buildings, interpretive displays and fitting out of these attractions will be facilitated by the Project Sponsors and built upon local council owned land or other suitable sites which may be either leased or purchased. It is envisaged that these attractions will become self-financing and be staffed and managed by the local community who will be fully involved in their planning and execution.

Project development committees will be established in both east and west bank communities and they will include tribal elders together with appropriately skilled and experienced leading members of the community. These committees will require guidance and advice from a range of organisations including the Uganda Community Tourism Association (UCTA), the Ministry of Tourism Trade and Industry (MTTI), the National Museum of Uganda, the National Environmental Management Authority (NEMA), the National Forestry Authority (NFA) and relevant NGO's.

These museums/ cultural heritage attractions will need to be well planned and designed and thus financing of an initial feasibility study providing advice upon a suitable concept and approach to realising attractive and viable developments for both communities will be desirable. An understanding between the Project Sponsors and the Local Councils concerned will establish, at an early stage, the basis upon which facilitation of the proposals can proceed.

MM 4: – Bujagali Dam Visitor/Interpretation Centre: To assist with the development of a new tourist route along the west bank of the Nile and the creation of a new educational resource for local and regional schoolchildren, a Bujagali Dam Visitor Centre will be built. The visitor centre will tell the story of the building of the dam, explain the creation of hydroelectricity and its positive environmental character together with the important role which electricity plays in the national economy. The visitor centre will be located at the site of the hydropower plant and be designed and built following the recommendations of a feasibility study which will propose a concept and content which will both educate and entertain.

The Project Sponsors will facilitate the implementation of this attraction which will in addition provide refreshment facilities and a jetty on the lakeside for the operation of boat trips around the new lake created by the hydropower project. The feasibility study will determine whether the visitor centre should operate a policy of charging for entry and whether this includes school children or not. The project will be constructed at a suitable point in Stage 1 of the Dam build but probably not fitted out and opened until the Dam is completed unless visitor access to the west bank Dam site is deemed safe and desirable at an earlier date.

MM 5:-Bujagali Picnic Site The loss of the Bujagali Falls viewpoint, picnic and general recreation site, used by many locals and visitors will be replaced by a similar facility in the same vicinity notwithstanding the plans for the Kalagala – Itanda Offset proposals

many kilometres away. The Project Sponsors will identify a suitable riverside site which will be improved to provide a meaningful alternative to the Bujagali recreation and picnic site and may, if suitable, include the provision of a jetty for the operation of boat trips on the lake.

MM 6:- Kalagala – Itanda Offset Enhancement. The Kalagala – Itanda Offset Proposals represent an imaginative conceptual framework for sustainable tourism development along both banks of the river north of the Bujagali HPP. The concept represents the presentation of a mitigation measure which is designed to offset the loss of natural habitats, as well as the visual and recreational amenity of the Bujagali Falls picnic area. AES Nile Power indicated their preparedness to become involved with the Plan. The new Project Sponsors will adopt the same position to realise the most beneficial project for visitors and local communities alike.

Financial assistance will be required to deliver a wide range of features and facilities which will secure the unique cultural and natural integrity of the site including conservation of historic and cultural heritage locations, building of a visitor centre, footpaths, bicycle paths, trails, interpretation and signage boards, picnic areas, viewpoints, public toilets, car parking, tree planting, landscaping and related facilities. The current negotiations between NFA and Adrift over the latter's concessionary leases for an up-market lodge development on Kalagala Island and campsites on certain other islands also extends to riverbank land on both sides of the river where many of the associated cultural, eco-tourism and visitor facilities proposed in the Offset Plan are located. Thus it is likely that Adrift may additionally include certain of these features in their proposals and Project Sponsor involvement at Kalagala – Itanda will therefore support the lead and framework established by this joint NFA / Adrift initiative.

Mitigation Measures Financing Note:

While it is clear that Project Sponsor facilitation and support will be forthcoming for a range of mitigation measures such as these proposed above and potentially for others which may either develop out of those put forward or indeed from suggestions yet to be articulated, it is also the case that the budgets for implementation of these measures may not necessarily be found entirely from the Project Sponsor and thus other possible sources will require investigation.

Other possible sources of financing / co-financing could include:

1. **Government of Uganda sources** – This could involve funds/technical support from a range of Ministries/Departments including MTTI, NFA and the National Museum of Uganda.
2. **The World Bank Group** – The safeguarding of cultural and natural heritage against deterioration and loss together with their potential for delivering economic

and educational benefit is recognised and supported by the World Bank and it may be for example that aspects of the Kalagala –Itanda Offset Proposals could be supported either in isolation or as part of a wider sub-regional initiative.

3. **The European Union** – The EU has and is supporting MTTI with the preparation of a short term tourism marketing strategy together with finance and technical assistance for its implementation. It is possible that support for the development of the Ugandan eco-tourism product for example and support for tourism infrastructure development in Eastern Uganda (including Jinja) which their marketing strategy supports, may be forthcoming from current or future budget allocations.

APPENDIX 1 - LIST OF CONSULTED PARTIES

GOVERNMENT OF UGANDA

Ministry of Tourism, Trade and Industry

- Rt Hon Mr Daudi Migereko, Minister, Tourism, Trade and Industry
- Mr Justus Tindigarukayo-Kashagire, Commissioner, Tourism and Wildlife
- Mr Baguma Cuthbert Balinda, Assistant Commissioner, Tourism and Wildlife

National Environment Management Authority

- Mr Waisawa Ayazika Arnold, EIA Co-ordinator

National Forestry Authority

- Mr Olav Bjella, NFA Executive Director
- Mr Edward Mupada, Director of Corporate Affairs
- Mr Jones Ruhombe, Director Field Operations
- Mr C D Lagoya, Regional Co-ordinator, Nile Frontier
- Mr Paul Buyerah Musumali, EIA Specialist
- Mr Hudson J. Andrua, Co-ordinator, Land Management
- Mr Arinaitwe Reuben, Range Manager – Lakeshore
- Mr Jeroba, Manager, Mabira Forest Eco-Tourism Centre

Uganda Tourist Board

- Mr James Bahinguza, General Manager

Uganda Wildlife Authority

- Ms Eunice Nyiramahoro Duli, Director, Planning, Monitoring and Research
- Mr Kapere Richard, Planning and EIA Officer

LOCAL GOVERNMENT

Jinja District Council

- Mr Muganza, Trade and Tourism Development Officer

East Bank LC1

- Chairman plus numerous meeting attendees

West Bank LC1

- Chairman plus numerous meeting attendees

Itanda LC1

- Ms Sarah Muwanguzi, LC1 Representative at Itanda Falls

PRIVATE SECTOR

Acacia Adventure Holidays, UK

- Mr Heath Ashcroft, Project Manager for East Africa

Adrift Rafting, Kampala, Uganda

- Mr Cam Mcleay, Managing Director
- Mr Dennis Ntege, General Manager

Crested Crane Hotel and Tourism Training Institute, Jinja, Uganda

- Mr Barnabas Kabalisa, Principal

Equator Rafting, Jinja, Uganda

- Mr Hitesh Vora, General Manager

Explore Worlwide Ltd, UK

- Mr Peter Eshelby, Field Operations Manager

Gyelloba bv, East Africa, Kampala, Uganda

- Mr Roel van Beusekom, Director (operator of Mabira Forest Lodge)

Jinja Hospitality Industries Stakeholders Meeting, Uganda

- Numerous meeting attendees

Mabira Forest Lodge, Jinja, Uganda

- Mr Amos Otieno, Lodge Manager

Nalubale Rafting, Kampala, Uganda

- Mr Ian Baillie, Proprietor/General Manager

Nile Resort Hotel (Mada Hotels), Jinja, Uganda

- Mr Lasiti Ole Kerore, General Manager

Nile River Explorers, Jinja, Uganda

- Mr Jon Dahl, Managing Director

Palm Tree Guest House, Jinja, Uganda

- Mr Surjit Bharj, Owner

Triangle Hotel Jinja, Uganda

- Ms N. Nakazibwe, Deputy General Manager

APPENDIX 2 - REFERENCES

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BUJAGALI HYDROPOWER PROJECT, UGANDA

SOCIAL AND ENVIRONMENTAL ASSESSMENT

REPORT ON TOURISM IMPACTS

Prepared For: R.J.Burnside International Limited, Guelph, Canada

By: Fletcher Associates, Richmond, Surrey, United Kingdom

APRIL 2006

BUJAGALI HYDROPOWER PROJECT, UGANDA

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1.0 INTRODUCTION

1.1 Background

The Bujagali Hydropower Project (Bujagali HPP) is a proposed 250MW hydropower facility to be built at Dumbbell Island, located 8km downstream (north) of the town of Jinja, Uganda, on the Victoria Nile. The project is proposed by Bujagali Energy Ltd., a project specific company owned by World Power Holdings LLC, of Luxembourg and IPS (Kenya) Ltd, the ‘Project Sponsors’.

A Social and Environmental Assessment (SEA) of the Bujagali HPP needs to be undertaken for the project and then be approved by the Government of Uganda (GoU) and the International lenders (World Bank Group, African Development Bank, European Investment Bank, commercial banks under IDA PRG and other European Development Banks) involved in the project, before it proceeds to construction.

Previously, AES Nile Power (AESNP) was the Project Sponsor for the Bujagali HPP and the Environmental Impact Assessment (EIA) undertaken for them was approved by the GoU’s National Environmental Management Authority (NEMA) in 1999/2001 and by the international lenders in December 2001. AESNP, however, withdrew from the project in 2003 without commencing construction and the new Project Sponsor is now required to carry out a new Social and Environmental Assessment (SEA) as part of their due diligence / project approval process.

The Project Sponsor has appointed R.J.Burnside International Ltd. of Canada to conduct, or oversee the SEA tasks and manage the SEA process on its behalf and R.J.Burnside International Ltd has in turn appointed Fletcher Associates, a specialist UK based, international tourism development consultancy, to undertake the tourism impact assessment component within the overall SEA.

1.2 Scope of Work

The scope of work for this assignment is identified in the R.J.Burnside Terms of Reference for the SEA and in the subsequent sub-consultancy agreement between R.J.Burnside and Fletcher Associates and is presented below thus:

- Consult with appropriate central government and local government authorities and tourism operators and their association(s) to determine the present status of tourism in the proposed hydropower development area;
- Assess the potential impacts of the Bujagali Hydropower Project on tourism in the hydropower development area, including any effects on the white water rafting (WWR) industry;

- Advise on potential measures to mitigate the effects to WWR and other tourist amenities at the hydropower site and propose alternative tourist development scenarios and / or facilities that could be developed on or adjacent to the proposed reservoir. This will include an assessment of tourism opportunities that can be promoted and developed at the ‘Kalagala-Itanda Offset’ site downstream; and
- Consult with tourism operators and their association(s) and local communities and their leadership (LC1, LC3, and LC5 levels) on tourism impact mitigation measures and alternative tourism development strategies and how they can be involved in delivering future tourism services (e.g. accommodation, activities).

1.3 Conduct of the Study

The fieldwork component of the study was undertaken between 19 March and 1st April, 2006, with time spent roughly equally between the capital city of Kampala and Jinja, the town located on both the banks of Lake Victoria and the banks of the Victoria Nile where the river begins its journey to the Mediterranean Sea. Jinja is some 8km upstream (south) from the proposed Bujagali HPP and is by far the largest town in the hydropower development area.

A programme of pre-arranged and locally arranged appointments and site visits was undertaken in both Kampala and Jinja with representatives from the Government of Uganda (Ministry of Tourism, Trade and Industry, Uganda Tourist Board, NEMA, National Forestry Authority, Uganda Wildlife Authority), Local Government and local representatives of national organisations, representatives from village communities located on both banks of the Nile and representatives from the white water rafting companies and other sectors of the tourism and hospitality industry.

Two full days of site inspections were undertaken including at the Bujagali Falls location which will be submerged by the reservoir created by the building of the dam, the east and west bank locations for the construction of the dam at Dumbbell Island and both the Kalagala (west bank) and Itanda (east bank) locations within the Kalagala – Itanda Offset proposal site. These site visits were accompanied by representatives from the Project Sponsor and the World Bank / International Lenders team who were in Uganda during the first week of the fieldwork and then by representatives of the various Government of Uganda Ministries / Authorities mentioned above who have a close interest in the SEA programme.

2.0 STATUS OF TOURISM IN THE HYDROPOWER DEVELOPMENT AREA

2.1 The Historical Context

The hydropower development area may broadly be considered to encompass a geographic locale which is anchored to the south by Greater Jinja (that is the combination of the town of Jinja on the east bank of the Nile together with Njeru, essentially a suburb or satellite of Jinja, on the west bank of the Nile) and extends along both banks of the river, several kilometres deep on either side, as far north as the proposed dam construction site at Dumbbell Island.

In simple historical terms, the Jinja area (or more accurately, the town of Jinja on its own) has enjoyed a certain level of international awareness and status on account of its location as the iconic Source of the Nile, made known to the wider world by the British explorer Speke in 1862. However, translation of this historical association into meaningful tourism awareness and development as a visitor destination has arguably only been underway over the last ten to fifteen years and even then this has been as a consequence of a completely unrelated attraction – white water rafting.

Jinja emerged from an informal European settlement around 1900 to become an important transport hub with a ferry service connecting with Kisumu, a Kenyan town on Lake Victoria which had been connected to Mombasa earlier that decade by a new rail link. The local economy developed further thanks to an emerging cotton industry and a rail link with Kampala but it was the opening of the Owen Falls Dam (now called the Nalubaale Dam) and hydro-electric power station in 1954 that led to a twenty year economic boom resulting in Jinja rapidly becoming known as Uganda's principal industrial and manufacturing centre.

Proximity to a reliable (transmission distances being short) and cheap source of power attracted the brewing, cigarette, textile and other manufacturing industries to Jinja leading to a rapid rise in the local population and a level of prosperity which can still be appreciated from the planned layout of the town centre and suburban streets with their impressive domestic and local governmental architecture. However, the largely Asian owned and managed businesses were a key target during the regime of Idi Amin in the early/mid 1970's, during which the Asian population was expelled and friends of the dictator, with little business experience, were placed in control of their companies.

The resulting collapse of the local economy may still be seen in the pot-holed roads and abandoned nature of many once grand homes along some of the suburban streets. Yet this is now contrasted with other streets and other properties which have clearly been recently restored and improved, a town centre with both new and renovated commercial buildings and an industrial base which is attracting back several of the key original businesses.

Jinja, together with Njeru on the opposite side of the Nile, now has a population of in excess of 136,000, which makes it the second largest town in Uganda and although it no longer possesses an active port, it sits beside the only rail link with Kenya (entirely freight at present) and the principal road link between Kampala and Nairobi (crossing the Nalubaale Dam) which carries half of all visitor arrivals (for all purposes) to Uganda and the bulk of all international commercial/freight movements. Jinja has thus recovered its position as the major transportation hub which justified the development of the town in the first place.

2.2 The ‘Adventure Capital of East Africa’

As an important early administrative and transportation centre but more significantly, later, as Uganda’s principal industrial centre, Jinja has always attracted business visitors and thus a small number of hotels and guest houses have grown up to accommodate this particular sector of the tourism market. However, holiday or recreational tourism in Uganda which historically has been relatively small compared to neighbouring Kenya and Tanzania, was focussed on game viewing/hunting in the west and north of the country and thus largely by-passed Jinja.

Successive periods of political instability and their associated security problems since the 1970’s have resulted in a generally negative international perception of Uganda as a tourism destination while the heavy poaching of game in the wildlife areas during this period also led to a diminution in the destination’s appeal. By the early 1990’s, visitors arriving for holiday/tourism purposes were recorded as being some 10,000 out of total annual overseas arrivals of around 70,000 but the pragmatic policies of President Museveni’s first term of office were now creating stability and economic growth such that support for the development of the tourism sector could now be envisioned.

In 1993, the World Tourism Organisation, funded by the United Nations Development Programme, published an ‘Integrated Tourism Master Plan for Uganda’ which presented a strategy for the development of the tourism sector over the following ten years. This strategy built and improved upon the existing product, infrastructure and resource framework in order that a revitalised tourism sector could be delivered with relative speed and ease. Development of new tourism products and the opening of less established and remoter parts of the country were considered to be longer term objectives which left consideration of Jinja, the ‘Source of the Nile’ and the eastern side of Uganda largely in abeyance.

Tourism arrivals were extremely weak in comparison with those attracted to neighbouring Kenya and Tanzania and the Master Plan recognised that a large percentage of this number were made up of ‘overland truckers’ and independent budget travellers, the very market sectors which are essential for kick starting the awareness creation process in new or moribund visitor destinations. However, such markets are considered to be low yield as far as tourist destinations are concerned because of their traditionally low

spending nature and thus tend to be ignored by national tourist board executives and planners, as was the case in this Master Plan.

Yet it was a couple of just such intrepid travellers, albeit with a dedication to satisfying high adventure sporting pursuits who, having established successful white water rafting businesses on world class rapids on the Zambezi and in New Zealand, became aware of the essentially unknown, equally high quality series of grade 4 and 5 rapids (classification is based upon grading rapids from 1 to 5/6 with 5 being the best for regular commercial rafting purposes and 6 being too severe for normal commercial rafting) on the Victoria Nile and decided to turn their attention to offering rafting at the Source of the Nile in Uganda. Table 2.1 below presents the names and class of rapids used, in sequence, by Adrift Rafting for their one and two day rafting trips on the Victoria Nile.

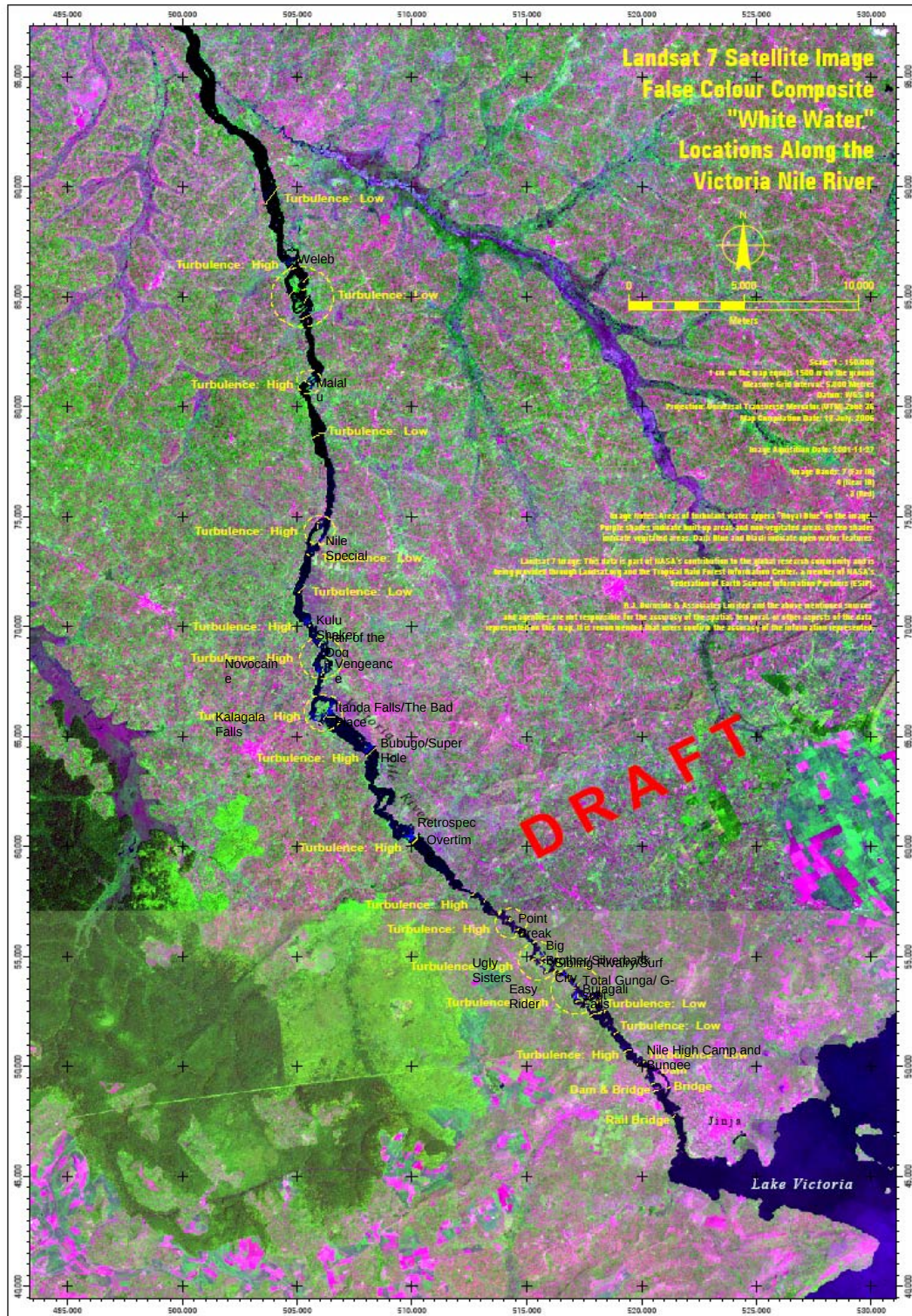
Table 2.1: Rapids Used by Adrift Rafting for Their One and Two Day Rafting Trips		
1 / 2 Day Trips	Name	Class
Day One	Bujagali	5
..	Easy Rider	3
..	Total Gunga/G.Spot	5
..	Ugly Sisters/Sibling Rivalry/Surf City	3
..	Big Brother/Silverback	5
..	Point Break	3
..	Overtime	5
..	Retrospect	4
..	Bubugo/Super Hole	3
..	Itanda/Bad Place	6/5
Day Two	Novocaine	5
..	Vengeance	4
..	Hair of the Dog	4
..	Kulu Shaker	4
..	Nile Special	4
..	Malalu	4
(Future Extension)	Weleba	3

Source: AESNP 2001 EIA Report with updates by C. McCleay (Adrift Rafting), 2006

Table 2.1 should be read in conjunction with Figure 2.1 below, which locates the position of each of the rapids described in the Table, in sequence, upon a satellite image of the Victoria Nile.

In 1996, the Bujagali Falls was simply a series of impressive rapids on an attractive stretch of the Nile some 6km downstream from Jinja. Direct access to the river at this point was possible across a little known (to international travellers) river bank site used regularly by locals for picnics and informal recreation but in August that year it also became the launching point for the first commercial white water rafting trips organised by the rafting company Adrift. Some months later in early 1997, Adrift were joined by a competitor, Nile River Explorers (NRE) who operated from a base in Jinja town and launched their rafts higher up the river from a site closer to the Nalubaale Dam.

Figure 2.1 Satellite Image of 'White Water' Locations and Named Rapids



From around 50 clients a month in the start-up period, the rafting numbers grew to an average of nearly 300 a month the following year and higher still in 1998 for Adrift, according to research conducted by DGiCo for the AES Nile Power SEA prepared in 1998. This same study concluded that between Adrift and NRE, the total estimated number of white water rafters on the Nile was somewhere between 7,000 – 8,000 per annum in 1998. Thus, from a standing start in 1996/7, the rafting companies became responsible for attracting an average of 600+ international visitors a month to Jinja, as a destination, rather than as simply the transit stop to visit the Source of The Nile, which was what it was known for before, completely independently from any Ministry of Trade and Tourism (MTTI) initiatives or plans.

The development of white water rafting was (and still is) based upon two distinct market sectors (albeit with similar general demographic characteristics) each in their own way extremely important for the wider development of Ugandan tourism through their capacity to create awareness of and stimulate interest in travel to and around the country. These sectors were on the one hand, the international overland truckers and independently mobile budget travellers passing through and on the other hand, the Ugandan based ex-pat/NGO market looking for a recreational break in the course of their stay in the country. NRE focuses more upon the transiting international market while Adrift tends to attract more of its clients from the Ugandan based ex-pat market and this approach is reflected in the nature and style of their business operations.

In 1998, these nascent business start-ups were both growing robustly and felt seriously threatened by the prospect of the AES Nile Power project submerging the Bujagali Falls and by implication destroying their business opportunity. However it was the murder of eight tourists by rebels in Bwindi Impenetrable National Park in March 1999 that almost achieved that particular result as once again instability in the country set back the developing recovery of Ugandan tourism.

The inherent resilience of the ex-pat and overland/budget markets enabled the white water rafting companies to survive on a reduced operational basis through to recovery whereupon they were joined by a third rafting operator, Equator Rafting, in early 2001 and a fourth, Nalubale Rafting, in mid 2005. This increased competition encouraged Adrift, NRE and Equator to develop their businesses beyond the simple rafting experience such that they all now offer a range of rafting trips with family options, kayaking and river boarding, bungee jumping, walking/nature tours, assistance with local community/charitable activities and an extended range of accommodation/dining options to attract new, higher value markets to their sites. Other companies have also been attracted to the area offering non-watersports activities such as quad biking, mountain biking and horse riding, enabling a critical mass of operators and activities to develop thus giving substance to the claim that Jinja/Bujagali has now earned the reputation to call itself the ‘Adventure Capital of East Africa’.

The growth of Jinja as an adventure tourism destination has been achieved through a process of organic development based upon a small number of entrepreneurial operators and although according to the AESNP 2001 EIA report, a Jinja Tourism Development

Association was facilitated and formally constituted, evidence of its contribution to the development of the tourism sector in Jinja has not been established. The organisation is understood to be inactive yet recently an inaugural meeting was held to discuss the establishment of an informal forum of tourism sector businesses where the identification of ways in which common interests in the development and promotion of Jinja might be put forward and progressed. National and regional/district public sector organisations with a remit for the tourism sector have thus far had limited resources to assist tourism development and thus it becomes important for the private sector to take appropriate initiatives in their place but ideally with their involvement.

2.3 The Emerging Conferences and Meetings Market

The original colonial era hotel in Jinja, The Ripon Falls Hotel, closed many years ago leaving the Sunset International Hotel as the principal, long-standing hotel in town, supported by the government owned Crested Crane Hotel (doubling as a hotel/tourism training college) with both being supplemented by a number of small guesthouses providing limited budget style accommodation. The provision of accommodation thus reflected the ebb and flow of Jinja's own economic fortunes until government funding built the Crested Crane college facility and in the mid/late 1990's investment in new accommodation resurfaced with a two phase development of 76 rooms at the Triangle Hotel on a prime site overlooking Lake Victoria. At the same time Nile River Explorers opened their Explorers Backpackers rafting base and accommodation facility, offering camping, dormitory and double rooms for the budget market.

The Sunset, Crested Crane and Triangle hotels are purpose-built and thus incorporate banqueting/meeting space as part of their design. Being located in Jinja town, these hotels naturally attract weddings and other social functions which use the banqueting space but having such a facility also allows the hotels to attract some meetings business which in turn often require accommodation. It is clear therefore that in addition to the usual commercial and some holiday/recreational demand for hotel accommodation there began to develop a residential related meetings market which the existing larger hotels were able to cater for. However, from around the year 2000, much more serious investment in new hotel building was underway and this was mostly outside of Jinja town. The most significant example of this development was the opening of the up-market, Kenyan owned, Jinja Nile Resort on an attractive elevated site overlooking the Nile, 1 km downstream from the Nalubaale Dam and 4 km from the centre of Jinja. This hotel was referred to as the 'Mada Hotel' in the AESNP EIA report. It was opened with 35 rooms in 2001 but doubled in size two years later and added a further 40 rooms in 2004. It has several different sized meeting rooms and can handle a 200 delegate conference.

The up-market, Australian owned guesthouse/restaurant Gately on Nile, opened in Jinja in 2000, offering seven double rooms in two renovated colonial era bungalows in attractive gardens overlooking Lake Victoria. This hotel also markets itself as a small,

high quality meetings venue/retreat for the senior corporate/government/donor community.

In 2001, the German owned, up-market, Kingfisher Safari Resort opened on an attractive elevated site overlooking the Source of the Nile, on the opposite side of the river from Jinja but some 9 km by road across the Nalubaale Dam from the town centre. The resort now has 42 thatched bandas of which 28 are single bedded, a rooms mix clearly designed to attract the commercial and residential meetings markets.

Table 2.2 below summarises the growth in supply of new higher standard hotel, guesthouse and lodge accommodation in the Jinja area between 2000 and 2004 thus:

Table 2.2: Expansion in Higher Quality Accommodation Around Jinja, 2000 - 2004 (Numbers of New Rooms Constructed per year)						
	2000	2001	2002	2003	2004	TOTAL ROOMS
Gately on Nile G/hse	7	-	-	-	-	7
Jinja Nile Resort	-	35	-	35	40	110
Kingfisher Safari Resort	-	21	14	7	-	42
Palm Tree G/hse	-	5	-	-	-	5
The Nile Porch (NRE)	-	-	-	-	10	10
Nile High Club (Adrift)	-	-	-	-	3	3
TOTAL ROOMS	7	61	14	42	53	177

Source: Consultant's Estimates

Thus in the space of a few years, (2000-2004), significant new investment, particularly in high quality accommodation, has taken place and in each instance a key market targeted by these businesses has been the residential meetings/conference sector. Further evidence for the strength of this market in both the older and newer hotels in the area was gathered from interviews with representatives from several of these properties, indicating that this market accounted for between 50 to 95 per cent of the business mix, depending upon the hotel and that overall room occupancy was running at between 50 to 70 per cent annually, again depending upon the hotel.

It is clear that the Jinja area is now successfully competing with Kampala and Entebbe in offering a destination with a distinct appeal for the meetings market - the attractive

riverside setting and the tranquillity of a destination located miles away from the urban environment of the capital city – at least for certain types and sizes of meetings and conferences. But it is also clear that the development of this particular type of business tourism is product led, that is, the market is being attracted because the quality and size of the hotel accommodation and its meeting rooms, restaurants and other facilities, matches market requirements, packaged together with a location which can also deliver its own unique quality and appeal.

2.4 Other Development Activity

The investment in high quality accommodation has also been reflected, less obtrusively, in the opening of a small number of new, moderately priced guesthouses and in the carrying out of improvements to other existing guesthouses, the opening of new bars restaurants, travel agencies and gift/curio shops. The backpacker /budget traveller market largely prefers to stay at the accommodation provided by the rafting companies which are located on individual sites overlooking the river near Bujagali Falls (although NRE also has a base in Jinja town) and in the last couple of years, the range and quality of the accommodation options on these sites has also been extended.

A further extension of this growing confidence in the Jinja area has been the strong demand for purchase of plots of land along both the east and west banks of the Nile between the Nalubaale Dam and the general location of the Bujagali HPP at Dumbbell Island. It appears that in the few years many plots of various sizes have been bought (and are still sought), by prominent Ugandan companies, ex-pat residents and overseas interests for the building of private homes or small to medium guesthouse/lodge/hotel and restaurant businesses, to the extent that the river in this area has now attracted the epithet ‘Muzungu Nile’, meaning European or white person’s Nile.

An important new development is the imminent opening of a luxury ‘eco-friendly’ lodge project located deep within the Mabira Forest Reserve some 25 km from Jinja. This development of 15 lodges is a joint venture between Inns of Uganda, a local up-market lodge operator with two existing lodges in two of the major wildlife parks in western Uganda and a Dutch eco-tourism/wildlife, specialist lodge operator with existing operations in Surinam and elsewhere in Africa. This initiative represents the first investment in the Jinja area by an experienced luxury wildlife lodge operator who has now recognised the specialist nature/wildlife tourism potential available and who, with his international partner can bring high value, particularly European, special interest natural history/wildlife visitors to Mabira Forest and beyond. This project will place the Jinja area firmly on the map as far as these niche markets are concerned and thus creates a further dimension to the available tourism product which will be given greater stimulus by the eco-tourist lodge and related proposals at the Kalagala – Itanda Offset site downstream of the Bujagali HPP dam site.

The Kalagala – Itanda Offset Proposal involves another major tourism planning initiative. This development concept, proposed by the Government of Uganda in 2001 for the

Kalagala – Itanda Falls area, is designed to create positive consequences at this location in mitigation of the effects of the planned Bujagali HPP upon the Bujagali Falls site, including effects on natural habitats and tourism. World Bank/IFC funding of the power project requires the adoption of suitable mitigation proposals and the previous sponsors of the Bujagali HPP, AES Nile Power, expressed willingness to participate in a financial partnership to realise the proposals. The concept incorporates a series of environmentally sustainable programmes which include the creation of riverside foot and cycle paths on both banks of the river between the dam and the Kalagala – Itanda Falls while the outstanding scenic beauty of the Falls area should form the basis for a range of tourism activities including, viewing areas, picnic areas, campsites, tourist lodges, cultural heritage sites, parking, toilets and other facilities. These proposals have been in abeyance since the demise of the AES Nile Power project but independently, the National Forest Authority advertised, in May 2005, an invitation for bids to be submitted for concessions to run tourism businesses on both sides of the river at Kalagala – Itanda. Adrift Rafting won the concessions with plans for a high quality lodge on Kalagala Island and campsites on two smaller islands downstream of the rapids. Negotiations are still underway between the parties to clarify the scope of the development and how it fits into the original Kalagala – Itanda Offset proposals and thus it is unclear when this development will commence.

Several major hotel projects are currently at an early stage of discussion for development in the Jinja area, including proposals by the Madvhani Group (an important local business conglomerate) to redevelop the derelict Jinja Sailing Club site which they own together with adjacent lakeside land which it is said they own and separate proposals by overseas interests to redevelop the Jinja Golf Club which occupies an attractive, elevated site overlooking the Source of the Nile. However, it is the plans of the Kampala based Speke Hotels Group (owners of Equator Rafting) for the site which they own above and overlooking Bujagali Falls, which appear to be the most advanced and arguably the most likely to proceed. Their plans, in at least two phases, will build some 200 rooms with supporting resort, sports and conference facilities at an estimated cost of \$10 million.

3.0 THE TOURISM IMPACTS OF THE BUJAGALI HPP PROJECT

3.1 The Physical Impacts of the Project

Construction of the Dam will result in the development of several permanent physical features in the landscape, most notable among which are the Dam itself, the reservoir which this structure will create and the transmission line required to connect the power station to the existing hydropower installation at the Nalubaale Dam, and to Kampala. Each of these features will result in a range of impacts and certain of those impacts can be characterised as having a tourism dimension.

The Dam

The introduction of a major man-made structure, such as a dam, into the natural landscape, represents a localised visual intrusion with an aesthetic impact which the choice of site, design and landscaping will help mitigate. The aesthetic impact will be more pronounced for sight lines immediately downstream of the Dam from where the structure itself is most visible, whereas upstream, the reservoir created behind the Dam diminishes this impact. In tourism terms, the visual intrusion will be very localised and limited to a relatively low profile stretch of the river (certainly compared with the Bujagali and Kalagala / Itanda Falls locations) which is essentially inaccessible to visitors other than those rafting the river.

The Transmission Line

The route of the transmission line, on the west bank of the Nile, essentially parallels that of the river but is located at an elevated level and set back at a distance from it. The river cuts a path through steeply rising ground along both banks for much of its course to the site of the Dam and thus sight lines from where the transmission line will be visible are principally from locations at the top of the elevated ground on the eastern bank of the river. The transmission line pylons and cabling will be partly hidden by the vegetation and tree cover through which it passes and will represent less of a visual intrusion than the existing transmission line which crosses the river close to Bujagali Falls and some of the existing and planned hotel, lodge and guesthouse development built immediately above and overlooking the river.

The Transmission Line continues from the Nalubaale Dam onwards to Kampala and passes through the northern extremity of the Mabira Forest, several kilometres away from the most heavily visited part of the Forest, in the environs of the National Forestry Authority owned and operated Mabira Forest Ecotourism Centre and Campsite. The luxury ‘eco-friendly’ Mabira Forest Lodge development currently under construction is located deep in the Forest to the south of the Jinja –Kampala road and thus is even further away from the Transmission Line. Tourism impacts consequent upon the route of the Transmission Line through Mabira Forest are therefore considered to be extremely small.

The Reservoir

The principal physical impact of the Dam as far as tourism is concerned is the creation of the reservoir and what this means in terms of the losses and gains in tourism/recreational amenity and the access to that amenity.

The project reservoir will occupy an area of 388ha, approximately 80ha of which will be newly inundated land and 308ha of which is currently occupied by the Victoria Nile. The tail of this reservoir and thus the point at which inundation levels begin declining, is located approximately at the Bujagali Falls, however the Falls themselves and the associated existing river bank picnic and recreation site will be submerged by the reservoir waters. Thus the physical inundation of the Bujagali Falls represents a loss on the one hand of the visual amenity of the Falls but on the other hand it also represents the loss of a resource which is utilised for other tourism activities such as white water rafting, picnicking and general recreation. This is discussed further in Sections 3.2 and 3.3.

Other smaller rapids, located close together on the river between Bujagali Falls and the Dam offer a distinctive feature which will also be lost for the purposes of rafting down the river but it is the spectacular nature of the Bujagali rapids, their attractive natural setting and established riverside accessibility for recreation which marks them out as essentially the only significant tourism resource utilised by a wide range of local and international visitors which is impacted by the construction of the Dam.

The creation of the reservoir lake will however represent a body of water with potential for water based leisure and sporting activities offered by existing and new leisure operators. Adrift, NRE and Speke Hotels have already indicated their interest in pursuing a variety of water based activities on the lake.

3.2 Impacts upon White Water Rafting Companies

In 1998 when the original SEA work was undertaken for the AES Nile Power project the two existing rafting companies were fledgling businesses only a year or two old but were estimated to be handling 7,000 to 8,000 rafting clients per annum. Eight years later in 2006, the original two companies have survived both a crash and a steady recovery in tourism to Uganda (and thus in their fortunes) and are now more mature and more diverse businesses. They have since been joined by two further rafting companies, one only commencing last year, while rafting passenger numbers are currently estimated to be running at around 10,000 per annum (see Table 3.1 below) with steady growth anticipated in 2006.

Adrift Rafting

Adrift was the first company to operate white water rafting in Uganda, it is owned by Cam McLeay, a New Zealander and white water rafting expert, who at the same time also operated rafting businesses in New Zealand and on the river Zambezi in Zimbabwe. Adrift, both then and now, is based in Kampala and originally brought their clients down

to Bujagali for the rafting experience and brought them back the same day whereas NRE were and are, based at Jinja/Bujagali. In mid 2003, Adrift opened the 'Nile High Club' which is a campsite with dormitory (and more recently a few thatched bandas) a bar/restaurant and 44m bungee jump located on a 32m cliff-top site overlooking the Nile.

Adrift originally launched their rafts from the riverside recreation site beside Bujagali Falls and paid a commission to an entrepreneur who held a lease for the site from the District Council. This arrangement continued until they entered a business partnership with the Kenyan Mada Hotels group, who own the Jinja Nile Resort and extensive cliff top landholdings adjacent to their hotel, upon which the 'Nile High Club' is now located and below which their rafts are now launched.

Having their base in Kampala has always meant that Adrift generated their market from amongst Kampala based ex-pats and other Ugandan based NGO employees as well as some travellers staying in Kampala as opposed to the overland truck based market. This market mix has changed a little with the building of the 'Nile High Club' and thus the availability of an accommodation base by the Nile, but reportedly, some 90 percent of their rafters still originate from Kampala sources.

Adrift, like NRE, offer several rafting options, one day, two day, family rafting etc but 90 percent of their clients take the one day trip which currently costs \$95 per person. In 1998 Adrift pushed their rafting rates up from \$65 to \$95 (NRE left theirs at \$65) per person and it appeared that their market position enabled them to sustain this, however rates fell back to \$65 in the difficult years but began their recovery around 2003/4. It is estimated that Adrift took around 4,000 clients rafting during 2005, putting it in second place behind market leaders NRE. It is likely that the entry of the fourth rafting company, Nalubale, run by a former Adrift employee, may have led to this loss of market share.

Adrift as a company has developed from being simply a white water rafting experience provider to a much more broadly based travel company offering in addition, gorilla trekking, mountain climbing, wildlife safaris and outdoor management development programmes for companies, NGO's, school groups etc. They have recently been awarded a concession from the National Forestry Authority to operate a high quality eco-tourism Lodge on Kalagala Island, within the Kalagala – Itanda Offset area, which will involve an investment of \$1million in association with international partners and thus continues the diversification of their business from its white water rafting origins.

Adrift have confirmed that they will continue to operate their white water rafting business after the Bujagali HPP is constructed and that they have no intention of moving their rafting base from the 'Nile High Club' location. Once the Dam is built, rafting trips will have to move downstream of the structure and while the reservoir created will result in the loss of one and possibly two Grade 5 rapids and removes a series of smaller, successive rapids which represent an exciting 'staircase' feature, a thrilling and exhilarating rafting experience with three Grade 5 rapids still remains. Purists will lament the loss of the more intense nature of the start of the existing trip but for probably 99 per cent of the market this will

Figure 3.1:
White Water Rafting Route and Rapids



have little significance. Most rafters will be taking this particular trip for the first time (for many it will also be their first rafting trip) and the fact that it will still include three Grade 5 rapids, confirms the seriousness of the trip as an attractive, physical and mental adventure located on a beautiful stretch of the longest river in the world. Rafting on the Nile has become an established part of the ex-pat/ NGO recreational break activity programme over the last ten years in Uganda and it is not expected that the anticipated changes to the rafting trip will alter demand from this market sector.

Figure 3.1, taken from the current Adrift brochure, shows the existing rafting route down the White Nile with the inclusion of the names (as used by Adrift) of the principal sets of rapids. Dumbbell Island is located between ‘Surf City’ and ‘Big Brother’ and thus the rapids at Bujagali Falls, ‘Easy Rider’, ‘Total Gunga’ and ‘Surf City’ will be submerged. It is possible, depending on the alignment of the Dam, that the falls at ‘Big Brother’ (also known as ‘Silverback’) may be unaffected since they will lie downstream of the structure, however, the finishing point shown on the map will have to move further downstream, probably to at least the ‘Nile Special’ rapid if the existing journey length and number of rapids is to be retained in the post – Dam era. Similarly, the two day trip will need to be extended further downstream from its indicated finish point although quite where this may be has yet to be determined. Nabuganyi, a point beyond the ‘Waleba’ rapid (see Fig 2.1 above) has been used before and is therefore a likely finishing point. ‘Total Gunga’ is the Grade 5 rapid lost while ‘Big Brother/Silverback’ may also be lost, leaving at least three Grade 5 rapids for rafting on the route, ‘Overtime’, ‘Itanda/The Bad Place’ and ‘Novocaine’ (see Table 2.1 above).

Adrift accepts the reality of the proposed Bujagali HPP and recognises that they will need to manage the change in their rafting product once the timetable for the dam construction is made public. Maintenance of the integrity, quality and thrill of the rafting experience is considered to be fundamental to the core values of the company’s operating philosophy and thus the commitment of the company to its current and future product, in marketing and promotional terms, is regarded with a similar passion which understands the need to embrace change positively.

Although Adrift will not need to relocate their rafting base, the one impact which they will suffer is the need to find a new launching point into the river somewhere below the new Dam. While such a location has not yet been researched, the suggestion of a facility shared with other rafting companies and provided as part of the impact mitigation measures was not regarded as ideal. Each operator has historically used different access points and exit points to/from the river and has a different approach to delivering their operationally distinct rafting product and will prefer to maintain their own separate site for entry to and possibly exit from the river.

Adrift employs around 40 full-time staff at their Bujagali campsite/rafting base of whom about 10 are ex-pat and the balance are Ugandan. None of these jobs are threatened by the need to move the rafting trips below the planned new dam although it is possible that new casual labour needed to help carry rafts in and out of the river may be required at the new entry and exit points.

Nile River Explorers

Nile River Explorers (NRE) was the second rafting company to operate on the Victoria Nile, commencing operations early in 1997. The company was set up by Jon Dahl, a white water rafting expert with experience developing the sport on the river Zambezi in Zimbabwe and perhaps not surprisingly, he decided to locate his rafting base and backpacker lodge in Jinja rather than in Kampala. Offering camping, dormitory and double room accommodation options, the Explorers Backpackers Hostel in Jinja became the most popular budget accommodation in Jinja before NRE and Equator Rafting both opened similar budget accommodation facilities at Bujagali whereupon staying by the river became the preferred option.

NRE's market focus was and is different from that of Adrift. The base at Jinja made it the natural stop for the overland truck based traveller market and this sector has dominated NRE's business although not to the extent that the Kampala based market dominates Adrift's business. NRE indicates that around 60 per cent of their clients are sourced through the overland truck sector and that some 40 per cent therefore come through various Kampala or Ugandan based organisations, travel agencies, ex-pats or NGO's.

The Explorers Campsite at Bujagali is located on the cliff top overlooking the Bujagali Falls and although it originally offered a bar/restaurant, camping and dormitory accommodation, in the last few years this has been supplemented with bandas, and luxury safari style tented camp facilities, a swimming pool and an a la carte style restaurant. This has enabled higher value markets to be attracted from Kampala and overseas and provides the overland truck passenger with an option to trade-up from the campsite as a treat in a very special location – and many do. The overland truck market stays three nights at the campsite which gives the travellers time to engage in a greater variety of activities, including a day devoted to working with local NGO's assisting with community based projects such as renovating school buildings or similar.

NRE have always launched their rafts from a river bank site close to the Owen Falls Dam, some kilometres up-stream from where Adrift enter the river, in order to give their clients more practice and familiarity on the raft and in the water before they decide to proceed to the rapids. Like Adrift, they also offer a range of rafting options, 1 day, 2 days, family trips etc. but once again it is the 1 day option which accounts for the large majority of rafting trips. Rafting trips cost \$95 per person, the same as Adrift, although historically, NRE prices were lower than Adrift prices. Estimates of the number of rafters handled during 2005 suggest a figure of around 5,000, which would make NRE the leading rafting company with Adrift in second place.

NRE has also developed its business along broader tourism related lines like Adrift by offering kayaking courses and tandem kayaking (instructor and pupil in one kayak) down the Nile. They have set up a separate website, www.kayakthenile.com which focuses on the much smaller and more specialist market for adventure kayaking which uses the Bujagali Falls but also uses and considers 'Itanda/The Bad Place' and the 'Nile Special' rapids as world class for kayaking. NRE is also providing an improved range and quality

of accommodation and food services and selling a variety of other tourism experiences such as gorilla trekking and wildlife safaris. Five years ago they used to operate Sundowner cruises on Lake Victoria and although that service closed down when the vessel they rented was sold, developing similar cruises on the lake created by the new reservoir is something that will be seriously considered by the company.

NRE have also confirmed that they will not be closing down their white water rafting business if the Bujagali HPP project proceeds, nor will they move from either their base in Jinja or their campsite close to Bujagali Falls. As was pointed out in the coverage of Adrift, above, the changes to the white water rafting experience consequent upon moving the trips below the new Dam are not expected to have any meaningful impact upon the markets currently attracted. What was originally considered to be a pretty extreme sport (and of course still is on many stretches of many rivers worldwide) undertaken by a hard core of skilled purists, has been controlled and made much safer (but still not without risk) by professional rafting guides and has thus become an essentially mainstream adventure sport open to all. Indeed, many holiday insurance policies, including those likely to be taken out by overland truckers, and other travellers already include cover for adventurous activities like white water rafting while additional premiums may only be sought for skiing and related winter sports cover.

For the overland truck market, Jinja and the option to raft the Nile is simply one stop and one experience among many on a tour around Uganda or an even longer trip around East Africa and thus the change to the rafting trip caused by the Bujagali HPP will not represent a make or break factor influencing that holiday choice. Contact with leading U.K. based adventure/overland trucking tour operators offering Uganda has confirmed both this position and their own commitment to including Jinja/white water rafting in their future itineraries despite any changes to the rafting trip. The tour operators indicate that around 75 percent of their clients take up the option to raft in Jinja and they do not expect this to change if the rafting trip itself changes as anticipated. The tour operators also indicate that the eastern side of Uganda which is currently little visited will become incorporated in additional new itineraries being developed involving western Kenya and that this will lead to their bringing more visitors to Jinja/Bujagali and thus potentially more clients for rafting trips.

The principal impact upon NRE's business operation once the Bujagali HPP is built is exactly the same as for Adrift, that is, the need to find new sites to enter and exit the river below the Dam. The primary concern is to have a launch site which is solely for their own use, as is the current situation, so that they can provide their clients with the distinct NRE rafting experience without distraction from other rafting companies. NRE feels that the provision of toilets and changing facilities for example, at the launch site, would be a desirable improvement on current practice, enhance the professionalism of the activity and further improve the image of Jinja as the 'Adventure Capital of East Africa'.

NRE indicates that it employs around 100 full-time staff, however, their employees are mostly paid on an as required daily basis, when rafting activities are taking place, while it is understood that Adrift pays its staff on a monthly basis no matter what level of rafting

takes place. Both figures are accurate in their own way but are not directly comparable as simply 'full-time'. If two NRE staff are considered equal to one full-time Adrift employee then this would represent 50 'full-time' staff at NRE, which considering NRE operates from two locations with accommodation, catering and management at each, then it is not unreasonable to expect more employment generated by NRE. NRE has a similar ratio of ex-pat to local employees and once again none of the employment will be lost following the relocation of rafting trips to the river below the Dam.

Equator Rafting

Equator Rafting was originally established as a joint venture between Mick Barnett, a white water rafting expert and former employee of Adrift Rafting and the Speke Hotels Group in early 2001. Mick Barnett had secured a new lease for the District Council owned Bujagali Falls tourism site and proposed the development of a new rafting company and campsite based at the site.

The partnership and performance of Equator Rafting was very successful in the early years but the partnership broke up and Equator Rafting, instead of maintaining its leading position amongst the group of rafting companies, has found itself overtaken by its competitors The Speke Camp, however, has a stunning location immediately beside the Bujagali Falls and the site doubles as a visitor recreation and picnic site as well as a campsite and rafting base. A large, attractive, open-sided and thatch roofed bar/restaurant has a prominent location by the Falls while the campsite, dormitories, kitchen, toilets, showers and other facilities are located to the rear of the site but give a poor impression and sense of neglect.

All visitors to the site are charged for entry, Ush 2,000 for a Ugandan, Ush 3,000 for a non-Ugandan and Ush 500 for a child while vehicles are charged at an additional Ush 1,000. Visitors can either bring their own food at no extra charge or use the bar/restaurant on site. Revenues from the operation of the site as a visitor picnic/recreation site alone are understood to be around Ush 130 million (some \$72,000) and this suggests annual visitor numbers of between 50,000 to 60,000.

Equator, who launch their rafts from their own campsite upstream of the Bujagali Falls, offer the same rafting options as Adrift and NRE and again find that the one day trip is the most popular choice. Their market is dominated by Kampala sourced/based ex-pats, NGO's and visitors and this is assisted by the Speke Hotels Group owning several prominent hotels in both Kampala and Entebbe. Formerly, rafting rates were the same as Adrift and NRE (\$95 per person last year) but currently Equator has dropped its price to \$75 per person. This is a significant decision and is probably related to the poor performance of the rafting business which is understood to have carried only 600 to 700 clients during 2005 and continues to operate comparatively weakly.

Equator Rafting confirmed that it is their intention to continue rafting following the completion of the Bujagali HPP but that since their existing base at Speke Camp would be submerged by the new reservoir they will need to find a new location for these activities. The Speke Hotels Group owns an extensive cliff top site above the Bujagali

Falls where it plans to build a 200 room hotel and conference centre and it may be possible to find a discrete part of this site to relocate their rafting operation to but Equator indicates that no examination of alternative sites has been undertaken so far.

The principal impacts upon Equator Rafting from the development of the Bujagali HPP are therefore related to the loss of their existing business base and associated structures, the costs of relocating these business assets to a new site and in common with other rafting companies, the need to find new entry and possibly exit points to/from the river. The original lease agreement with the District Council was signed back in 2000/2001 when the plans for the Bujagali HPP were well known and although Equator Rafting believes that Speke Hotels Group signed a purchase agreement with the Council for the site last year (and has documentary evidence of this), this is believed to be invalid because the land is Government owned and reverts to the new Project Sponsors as part of the required land take for the completion of the Bujagali HPP.

Thus the only impact issues which remain valid are associated with the costs of moving rafting, campsite and office related fixtures, fittings and equipment from Bujagali to a new rafting/camping base and the issue of providing for a new entry point to the river for their rafts.

Equator Rafting indicates that they currently employ some 35 staff at Speke Camp, 10 of which are non – Ugandan and that since they plan to relocate rather than close the rafting business once the dam is built, there will be no loss of employment.

Nalubale Rafting

Nalubale Rafting was started in mid-2005 by Ian Baillie a white water rafting specialist who formerly worked with Adrift Rafting. He is the owner of a carpentry business and opening the rafting company was his second business start-up. Both businesses are based in Kampala but the practical rafting operation operates out of rented premises in Jinja town but has no campsite or related facilities. Kampala is the source of his clientele which is a reflection of his experience with Adrift Rafting who generate most of their rafting business through Kampala based ex-pats, NGO's and other organisations.

At present, Nalubale only operates at weekends and while it offers a range of rafting trips like the other rafting companies, the majority of trips are one day in length and costs \$95. The company employs eight people in Jinja, including three ex-pats and is easily the smallest of the four rafting businesses. It is estimated that they carried around 200 – 300 clients during the six months in which the business operated in 2005.

Nalubale is quite prepared to operate rafting trips below the new dam after it is built and although it indicates that it has an operating relationship with NRE, sharing a new launching site with them is unlikely to be acceptable to NRE and they will need to find an alternative location. It may be possible for Nalubale to share a facility with Equator Rafting who expressed preparedness to share such a facility with other rafting companies.

Table 3.1 below summarises the principal characteristics of the four white water rafting companies currently operating on the Nile at Jinja / Bujagali:

Table 3.1: Summary Operational Characteristics of the Rafting Companies						
	Company Started	Market Mix	Most Popular Rafting Trip	Rafting Trip Fee (\$)	Number of Staff	Rafter Nos. in 2005 (estimate)
Adrift	Mid 1996	90% NGO / Kampala 10% Truckers	1 Day Trip (90% of clients)	\$ 95	40 F/T (10 ex-pat, 30 local)	4,000
N.R.E.	Early 1997	40% NGO / Kampala 60% Truckers	1 Day Trip (95% of clients)	\$ 95	50 F/T (10 ex-pat, 40 local)*	5,000
Equator	Early 2001	95% NGO / Kampala 5% Truckers	1 Day Trip (95% of clients)	\$ 75	35 F/T (10 ex-pat, 25 local)	600 - 700
Nalubale	Mid 2005	100% NGO / Kampala	1 Day Trip (100% of clients)	\$95	8 F/T (3 ex-pat, 5 local)	200 - 300

Source: Interviews with Rafting Companies and Mrs Sarah Muwanguzi (Itanda LC1 Representative)

3.3 Other Tourism Related Impacts

There are a number of other general and more particular tourism impacts which arise from the Bujagali HPP ranging from the removal of the additional costs experienced by tourism businesses associated with their increased use of diesel powered generators to provide electricity during load shedding, to the possible beneficial opportunity for additional business at the Hairy Lemon backpacker hostel, located downstream of the Kalagala – Itanda Falls. However, the principal other parties where tourism related impacts have a direct bearing are the local village communities on both east and west banks of the river between the

Nalubaale Dam and the Bujagali HPP. At present, the relationship which these communities have with tourism is quite distinct but this is set to change and will become more similar once the hydropower project is built.

West Bank Villages

Discussions held with community leaders established that historically their villages had not benefited at all from tourism/white water rafting since these businesses were all based

on the other side of the river and even when the rafters came downstream and stopped for lunch on their side or on mid-river islands, they were never able to sell fruits and other foodstuffs to the rafters since they brought everything with them.

The lack of any benefit from tourism thus far appeared to be keenly felt and the possibility of a change to this situation, partly as a result of the Dam, was warmly welcomed. The recent phenomenon of many ex-pat and overseas interests buying up parcels of land along the banks of the river is only just starting to result in new lodges/guesthouses and restaurants opening and thus gradually some tourism related benefits in terms of employment and the purchase of local foodstuffs will begin to become apparent.

Employment creation on the one hand and the opportunity to provide services to tourists on the other are the two main benefits identified in relation to the proposed hydropower project. Employment opportunities are primarily expected to be generated by the construction stage of the Dam although it was indicated that tourism related employment would also be likely, associated with the plans to build a visitor interpretation centre and refreshment facilities. Local villages could also supply this centre with fruit and vegetables.

The opening of the Dam together with a possible visitor and interpretation centre will undoubtedly draw its share of the increasing number of visitors arriving in Jinja for recreation or conference purposes as well as providing an important educational resource for local schools. In addition, the plans for developing the west bank elements of the Kalagala – Itanda Offset Proposals into a major eco-tourism/nature tourism attraction will further encourage more tourists to travel down the west bank of the river to visit both new facilities. The increased flow of visitors anticipated along the west bank therefore represents an opportunity for the local villages to benefit from. Some visitors may stop at roadside shops/stalls for fruit and vegetables or snacks but to benefit further, larger numbers of visitors must be encouraged to stop and one way of achieving this would be to build a museum or cultural heritage centre which would present the history, culture and artefacts of the various tribes in the area. This could be built on a site with striking views of the river and incorporate a picnic site, refreshments and a crafts/gift shop, thus generating further local employment and the sale of local foodstuffs and crafts.

The community leaders were supportive of the hydropower project and could see the employment potential from the construction phase in particular since the construction base for the project would be on their side of the river. But they were also keen to benefit from tourism and were very much in favour of developing the concept of the cultural centre/museum as a means of securing this. The fact that such a facility could be used as an educational resource for local schoolchildren and as a means of possibly safeguarding their traditions and cultural heritage for the future was warmly welcomed.

East Bank Villages

Discussions confirmed the existing participation of east bank villages in the tourism sector, principally with the various rafting companies and the businesses that have grown

up around them but also with non-rafting businesses like the Jinja Nile Resort Hotel. Tourism companies have created employment opportunities for some families and provided a market for other families to sell foodstuffs and other services to them but the rafting companies in particular have also enabled a range of small businesses to grow up around the entrances to their sites offering a range of goods and services direct to the individual visitor. These businesses will benefit from the non-relocation of the Adrift and NRE rafting bases but may suffer from the loss of the Bujagali Falls riverside recreation site if a replacement site cannot be found relatively nearby.

An apparent lack of familiarity with the current status of the Bujagali HPP and the impacts the project is likely to have on existing rafting and other tourism businesses, led to an initial uncertainty and expression of fear for the jobs and other benefits already enjoyed by east bank villages. Once reassured on those points, concern was expressed about the loss of the Bujagali Falls picnic site and recreational area as a local facility (and possible job losses), then concern also about the future quality of the road along the east bank to the Dam and beyond to Itanda given the existing standard and the expected heavy use during the construction period. In addition, as with the west bank villages, there was a desire to benefit from the increased numbers of visitors expected to be drawn down the east bank because of the land sales, plans for numerous new guesthouses, lodges and hotels and the Kalagala – Itanda Offset Proposals.

The need to try and encourage visitors to stop on their drive down the east bank mirrored the views of the west bank villages and the suggestion of building a museum/cultural centre to display the history, culture and artefacts of the tribal peoples living on the east bank as means of achieving this was positively received. This museum could also be located on a site with attractive views and also incorporate a picnic site, refreshments and a craft/gift shop to maximise the benefit from the much larger flows of visitors expected by the time the Dam has been built.

Table 3.2 below summarises the tourism impacts of the Bujagali HPP described above.

Table 3.2: Summary Tourism Impacts of the Bujagali Hydropower Project			
Stakeholder / Affected Parties	Nature of the Impact	Scale of the Impact	Financial Impact
White Water Rafting Companies	Loss of the Staircase Feature and a Grade 5 Rapid	Partial Diminution of the Existing Rafting Trip	Neutral
White Water Rafting Companies	Loss of Existing Individual Rafting Company Entry Points to the River	Need to Facilitate Replacement of Individual Entry Points to the River below the Dam	Negative but Minor
White Water Rafting Companies	Replacement / Relocation of Equipment to new Rafting Company Operational Bases	Only Equator Rafting Will Have to Relocate	Negative but Minor
White Water Rafting Company Employees	Loss of Some Part-Time Jobs Due to Re-Positioning of the Rafting Route	Limited Because Only One Company to Re-Locate and Jobs May be Created along the New Route	Neutral
East Bank Communities	Loss of Bujagali Falls Recreation/Picnic Site	Loss of a Significant Community Riverside Recreation Facility	Negative but Serious
East Bank Communities	Loss of Bujagali Falls Recreation/Picnic Site	Loss of Economic Benefit to Shops/Stalls outside Entrance to Bujagali Falls Site	Negative but Minor
East Bank Communities	Increase in Numbers of Visitors Travelling Along the East Bank	Benefits from Attracting Visitors to Stop and Spend	Positive but Moderate
East Bank Communities	Development of new rafting launch and exit Riverside locations	Possible creation of casual employment to assist rafting companies	Positive but minor
West Bank Communities	Development of new rafting launch and exit Riverside locations	Possible creation of casual employment to assist rafting companies	Positive but minor
West Bank Communities	Increase in Numbers of Visitors Travelling Along the West Bank	Benefits from Attracting Visitors to Stop and Spend	Positive but Moderate
Hairy Lemon Island Backpacker Campsite	Increase in Rafters Passing Downstream	Benefits from Attracting Rafting Company Rafts	Positive but Minor
Jinja Tourism Sector	Cessation of Electricity Load Shedding	Reduction in Energy Costs Due to Lower Diesel Generator Use	Positive but Minor

4.0 MITIGATION MEASURES

The following list of suggested mitigation measures represents a summary of suitable responses to those identified tourism impacts already discussed in the preceding sections of this report. Successful implementation of these measures however, will require a combination of facilitation and funding together with the co-operation and engagement of numerous public and private organisations and Bujagali Energy Limited, while representing a readily identifiable source of financial support and facilitation may not meet the entire costs involved and consequently other potential funding/technical assistance sources are suggested at the end of this section of the report.

MM 1: – New Launch/Exit sites: The one impact of the Bujagali HPP affecting all the white water rafting companies is the loss of their individual raft launching sites and the replacement of these is considered to be a major requirement. It will be necessary to find suitable sites downstream of the Dam and have them ready for use by the time construction work in Stage 2 of the Dam build, connecting Dumbbell Island to the eastern riverbank, gets underway since this will interfere with rafting activities. Exit points downstream on both banks will also be required although they may be shared and may need fewer facilities.

It is envisaged that the new entry/exit points will be secured through purchasing or leasing (depending on circumstance) of the sites, while further investment will be required for landscaping and the provision of facilities such as small slipways, toilets, changing rooms and storerooms.

MM 2:- Jinja Tourism Development Association: The establishment of this organisation was facilitated by AES Nile Power but it is understood to be inactive at present. However, the growing importance of tourism for the Jinja area would benefit from the availability of a forum for discussion and identification of pro-active measures which could support this trend. In the absence of a public sector led initiative to satisfy this requirement, the private sector, through either the reviving of this particular organisation or the establishment of another should take the lead. The Project Sponsors as prospective operators of a possible visitor centre at the Dam could not only facilitate the re-emergence of this body but also participate in its activities as a member and future tourism sector stakeholder.

Currently, there is evidence of growing interest amongst the private sector tourist business community for the establishment of an informal forum for the discussion of mutual interests and their promotion and thus it is likely that this mitigation measure will be positively received by these stakeholders.

MM 3: - Museum/Cultural Heritage Centres: To enable both the west bank and east bank village communities to benefit from the increased numbers of tourists expected to be travelling along either side of the Nile, a museum/cultural heritage visitor attraction

interpreting local tribal history and culture to be built in a prominent location (perhaps with views over the river) with picnic, refreshment and craft/gift shop facilities, on both sides of the river is proposed. Project implementation of the buildings, interpretive displays and fitting out of these attractions will be facilitated by the Project Sponsors and built upon local council owned land or other suitable sites which may be either leased or purchased. It is envisaged that these attractions will become self-financing and be staffed and managed by the local community who will be fully involved in their planning and execution.

Project development committees will be established in both east and west bank communities and they will include tribal elders together with appropriately skilled and experienced leading members of the community. These committees will require guidance and advice from a range of organisations including the Uganda Community Tourism Association (UCTA), the Ministry of Tourism Trade and Industry (MTTI), the National Museum of Uganda, the National Environmental Management Authority (NEMA), the National Forestry Authority (NFA) and relevant NGO's.

These museums/ cultural heritage attractions will need to be well planned and designed and thus financing of an initial feasibility study providing advice upon a suitable concept and approach to realising attractive and viable developments for both communities will be desirable. An understanding between the Project Sponsors and the Local Councils concerned will establish, at an early stage, the basis upon which facilitation of the proposals can proceed.

MM 4: – Bujagali Dam Visitor/Interpretation Centre: To assist with the development of a new tourist route along the west bank of the Nile and the creation of a new educational resource for local and regional schoolchildren, a Bujagali Dam Visitor Centre will be built. The visitor centre will tell the story of the building of the dam, explain the creation of hydroelectricity and its positive environmental character together with the important role which electricity plays in the national economy. The visitor centre will be located at the site of the hydropower plant and be designed and built following the recommendations of a feasibility study which will propose a concept and content which will both educate and entertain.

The Project Sponsors will facilitate the implementation of this attraction which will in addition provide refreshment facilities and a jetty on the lakeside for the operation of boat trips around the new lake created by the hydropower project. The feasibility study will determine whether the visitor centre should operate a policy of charging for entry and whether this includes school children or not. The project will be constructed at a suitable point in Stage 1 of the Dam build but probably not fitted out and opened until the Dam is completed unless visitor access to the west bank Dam site is deemed safe and desirable at an earlier date.

MM 5:-Bujagali Picnic Site The loss of the Bujagali Falls viewpoint, picnic and general recreation site, used by many locals and visitors will be replaced by a similar facility in the same vicinity notwithstanding the plans for the Kalagala – Itanda Offset proposals

many kilometres away. The Project Sponsors will identify a suitable riverside site which will be improved to provide a meaningful alternative to the Bujagali recreation and picnic site and may, if suitable, include the provision of a jetty for the operation of boat trips on the lake.

MM 6:- Kalagala – Itanda Offset Enhancement. The Kalagala – Itanda Offset Proposals represent an imaginative conceptual framework for sustainable tourism development along both banks of the river north of the Bujagali HPP. The concept represents the presentation of a mitigation measure which is designed to offset the loss of natural habitats, as well as the visual and recreational amenity of the Bujagali Falls picnic area. AES Nile Power indicated their preparedness to become involved with the Plan. The new Project Sponsors will adopt the same position to realise the most beneficial project for visitors and local communities alike.

Financial assistance will be required to deliver a wide range of features and facilities which will secure the unique cultural and natural integrity of the site including conservation of historic and cultural heritage locations, building of a visitor centre, footpaths, bicycle paths, trails, interpretation and signage boards, picnic areas, viewpoints, public toilets, car parking, tree planting, landscaping and related facilities. The current negotiations between NFA and Adrift over the latter's concessionary leases for an up-market lodge development on Kalagala Island and campsites on certain other islands also extends to riverbank land on both sides of the river where many of the associated cultural, eco-tourism and visitor facilities proposed in the Offset Plan are located. Thus it is likely that Adrift may additionally include certain of these features in their proposals and Project Sponsor involvement at Kalagala – Itanda will therefore support the lead and framework established by this joint NFA / Adrift initiative.

Mitigation Measures Financing Note:

While it is clear that Project Sponsor facilitation and support will be forthcoming for a range of mitigation measures such as these proposed above and potentially for others which may either develop out of those put forward or indeed from suggestions yet to be articulated, it is also the case that the budgets for implementation of these measures may not necessarily be found entirely from the Project Sponsor and thus other possible sources will require investigation.

Other possible sources of financing / co-financing could include:

1. **Government of Uganda sources** – This could involve funds/technical support from a range of Ministries/Departments including MTTI, NFA and the National Museum of Uganda.
2. **The World Bank Group** – The safeguarding of cultural and natural heritage against deterioration and loss together with their potential for delivering economic

- and educational benefit is recognised and supported by the World Bank and it may be for example that aspects of the Kalagala –Itanda Offset Proposals could be supported either in isolation or as part of a wider sub-regional initiative.
3. **The European Union** – The EU has and is supporting MTTI with the preparation of a short term tourism marketing strategy together with finance and technical assistance for its implementation. It is possible that support for the development of the Ugandan eco-tourism product for example and support for tourism infrastructure development in Eastern Uganda (including Jinja) which their marketing strategy supports, may be forthcoming from current or future budget allocations.

APPENDIX 1 - LIST OF CONSULTED PARTIES

GOVERNMENT OF UGANDA

Ministry of Tourism, Trade and Industry

- Rt Hon Mr Daudi Migereko, Minister, Tourism, Trade and Industry
- Mr Justus Tindigarukayo-Kashagire, Commissioner, Tourism and Wildlife
- Mr Baguma Cuthbert Balinda, Assistant Commissioner, Tourism and Wildlife

National Environment Management Authority

- Mr Waisawa Ayazika Arnold, EIA Co-ordinator

National Forestry Authority

- Mr Olav Bjella, NFA Executive Director
- Mr Edward Mupada, Director of Corporate Affairs
- Mr Jones Ruhombe, Director Field Operations
- Mr C D Lagoya, Regional Co-ordinator, Nile Frontier
- Mr Paul Buyerah Musumali, EIA Specialist
- Mr Hudson J. Andrua, Co-ordinator, Land Management
- Mr Arinaitwe Reuben, Range Manager – Lakeshore
- Mr Jeroba, Manager, Mabira Forest Eco-Tourism Centre

Uganda Tourist Board

- Mr James Bahinguza, General Manager

Uganda Wildlife Authority

- Ms Eunice Nyiramahoro Duli, Director, Planning, Monitoring and Research
- Mr Kapere Richard, Planning and EIA Officer

LOCAL GOVERNMENT

Jinja District Council

- Mr Muganza, Trade and Tourism Development Officer

East Bank LC1

- Chairman plus numerous meeting attendees

West Bank LC1

- Chairman plus numerous meeting attendees

Itanda LC1

- Ms Sarah Muwanguzi, LC1 Representative at Itanda Falls

PRIVATE SECTOR

Acacia Adventure Holidays, UK

- Mr Heath Ashcroft, Project Manager for East Africa

Adrift Rafting, Kampala, Uganda

- Mr Cam Mcleay, Managing Director
- Mr Dennis Ntege, General Manager

Crested Crane Hotel and Tourism Training Institute, Jinja, Uganda

- Mr Barnabas Kabalisa, Principal

Equator Rafting, Jinja, Uganda

- Mr Hitesh Vora, General Manager

Explore Worlwide Ltd, UK

- Mr Peter Eshelby, Field Operations Manager

Gyelloba bv, East Africa, Kampala, Uganda

- Mr Roel van Beusekom, Director (operator of Mabira Forest Lodge)

Jinja Hospitality Industries Stakeholders Meeting, Uganda

- Numerous meeting attendees

Mabira Forest Lodge, Jinja, Uganda

- Mr Amos Otieno, Lodge Manager

Nalubale Rafting, Kampala, Uganda

- Mr Ian Baillie, Proprietor/General Manager

Nile Resort Hotel (Mada Hotels), Jinja, Uganda

- Mr Lasiti Ole Kerore, General Manager

Nile River Explorers, Jinja, Uganda

- Mr Jon Dahl, Managing Director

Palm Tree Guest House, Jinja, Uganda

- Mr Surjit Bharj, Owner

Triangle Hotel Jinja, Uganda

- Ms N. Nakazibwe, Deputy General Manager

APPENDIX 2 - REFERENCES

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Nile River Explorers – Current brochure material

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BURNSIDE

Appendix C.5

Traffic Conditions Data

Traffic Counts, July 2006: Bridge

Site: Bridge

Date: 17/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	22	20	159	83	190	171	144	103	144	33	659	410	1069	0	1069
8-9hrs	26	21	160	91	149	78	151	147	33	28	519	365	884	0	
9-10hrs	40	33	102	91	78	72	98	99	31	29	349	324	673	0	Max In
10-11hrs	40	45	107	105	82	71	111	105	32	35	372	361	733	0	659
11-12hrs	33	36	101	88	52	76	82	98	42	35	310	333	643	0	
12-13hrs	29	44	135	30	46	72	114	94	65	36	389	276	665	0	Max Out
13-14hrs	33	32	87	101	22	51	100	93	68	63	310	340	650	0	556
14-15hrs	21	37	108	125	32	68	108	103	95	96	364	429	793	0	
15-16hrs	18	22	122	151	35	70	96	110	84	41	355	394	749	0	
16-17hrs	25	25	128	117	82	57	114	77	60	69	409	345	754	0	
17-18hrs	25	36	171	127	90	124	103	60	87	55	476	402	878	0	
18-19hrs	25	33	160	161	85	152	119	132	55	78	444	556	1000	0	
Total	337	384	1,540	1,270	943	1,062	1,340	1,221	796	598	4956	4535	9491	0	

Site: Bridge

Date: 18/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	13	4	119	75	130	46	117	87	51	33	430	245	675	0	1482
8-9hrs	13	22	124	81	128	106	111	107	29	12	405	328	733	0	
9-10hrs	24	19	119	76	120	91	103	108	36	26	402	320	722	0	Max In
10-11hrs	30	28	120	90	107	66	81	89	39	42	377	315	692	0	767
11-12hrs	34	27	119	91	149	118	120	99	67	0	489	335	824	0	
12-13hrs	40	33	112	124	96	93	107	111	60	48	415	409	824	0	Max Out
13-14hrs	33	26	85	90	80	42	90	87	0	0	288	245	533	0	715
14-15hrs	36	38	111	130	135	92	97	97	50	49	429	406	835	0	
15-16hrs	26	42	129	145	142	125	142	110	80	76	519	498	1017	0	
16-17hrs	25	31	102	111	118	127	107	120	79	80	431	469	900	0	
17-18hrs	33	28	156	170	144	151	124	141	75	124	532	614	1146	0	
18-19hrs	20	39	205	225	216	205	184	105	142	141	767	715	1482	0	
Total	327	337	1,501	1,408	1,565	1,262	1,383	1,261	708	631	5484	4899	10383	0	

Site: Bridge

Date: 19/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	16	20	122	54	127	122	61	37	95	76	421	309	730	0	744
8-9hrs	18	24	90	81	86	60	116	107	39	32	349	304	653	0	
9-10hrs	26	19	103	64	65	39	100	81	26	30	320	233	553	0	Max In
10-11hrs	28	27	123	80	42	54	88	75	51	53	332	289	621	0	421
11-12hrs	19	24	100	75	38	46	85	90	80	48	322	283	605	0	
12-13hrs	27	141	132	84	28	43	95	81	65	48	347	397	744	0	Max Out
13-14hrs	19	20	100	110	27	47	87	78	71	50	304	305	609	0	397
14-15hrs	31	27	110	101	30	44	87	75	82	36	340	283	623	0	
15-16hrs	30	36	92	93	27	34	82	77	90	65	321	305	626	0	
16-17hrs	22	28	101	91	42	37	79	81	62	61	306	298	604	0	
17-18hrs	17	27	117	115	56	53	102	91	62	51	354	337	691	0	
18-19hrs	27	26	119	110	47	57	76	93	81	76	350	362	712	0	
Total	280	419	1,309	1,058	615	636	1,058	966	804	626	4066	3705	7771	0	

Site: Bridge

Date: 20/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	42	18	122	68	198	144	177	98	47	42	586	370	956	0	956
8-9hrs	29	30	157	85	152	65	122	130	29	30	489	340	829	0	
9-10hrs	34	29	115	84	72	69	72	75	34	29	327	286	613	0	Max In
10-11hrs	23	17	113	92	58	58	132	112	23	17	349	296	645	0	586
11-12hrs	23	24	135	115	49	55	127	102	23	24	357	320	677	0	
12-13hrs	25	25	127	100	39	75	103	105	25	25	319	330	649	0	Max Out
13-14hrs	29	25	99	104	26	35	94	172	29	25	277	361	638	0	478
14-15hrs	23	29	128	101	28	55	107	97	23	29	309	311	620	0	
15-16hrs	23	25	74	132	47	47	109	88	23	25	276	317	593	0	
16-17hrs	39	32	88	122	50	51	106	106	39	32	322	343	665	0	
17-18hrs	31	36	106	168	37	17	106	116	31	36	311	373	684	0	
18-19hrs	24	33	106	124	80	135	103	153	24	33	337	478	815	0	
Total	345	323	1,370	1,295	836	806	1,358	1,354	350	347	4259	4125	8384	0	

Site: Bridge

Date: 21/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	32	15	60	58	180	132	140	98	52	40	464	343	807	0	1021
8-9hrs	28	24	120	77	128	81	143	81	55	29	474	292	766	0	
9-10hrs	29	27	99	78	86	58	183	65	33	36	430	264	694	0	Max In
10-11hrs	27	23	110	76	35	51	173	143	40	42	385	335	720	0	477
11-12hrs	27	25	113	96	33	46	190	135	61	44	424	346	770	0	
12-13hrs	23	25	101	96	33	61	128	122	55	55	340	359	699	0	Max Out
13-14hrs	18	26	110	90	47	68	87	99	56	60	318	343	661	0	544
14-15hrs	21	19	86	78	58	72	105	55	50	55	320	279	599	0	
15-16hrs	28	31	105	97	43	43	96	78	74	82	346	331	677	0	
16-17hrs	26	22	86	83	23	38	89	122	73	78	337	343	680	0	
17-18hrs	21	21	139	142	123	117	125	176	69	88	477	544	1021	0	
18-19hrs	32	33	109	95	111	103	116	118	66	111	434	460	894	0	
Total	312	291	1,238	1,066	900	870	1,575	1,292	724	720	4749	4239	8988	0	

Weekly
Average

MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way
In	Out	In	Out	In	Out	In	Out	In	Out			
27	29	116	102	81	77	112	102	56	49	392	358	750

Traffic Counts, July 2006: Iganga road

Site: Iganga Road
Date: 17/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	14	14	24	38	97	112	30	15	24	21	189	200	389	0	389
8-9hrs	14	16	35	37	58	67	24	18	17	9	148	147	295	0	
9-10hrs	14	14	27	24	39	37	24	17	6	14	110	106	216	0	Max In
10-11hrs	11	9	21	19	34	37	21	21	14	13	101	99	200	0	189
11-12hrs	9	7	25	36	34	29	21	28	13	28	102	128	230	0	
12-13hrs	6	5	29	37	28	26	22	31	18	45	103	144	247	0	Max Out
13-14hrs	6	9	24	34	29	18	17	31	35	48	111	140	251	0	200
14-15hrs	6	8	36	33	33	17	27	35	27	60	129	153	282	0	
15-16hrs	10	12	40	47	28	24	25	33	26	61	129	177	306	0	
16-17hrs	9	10	36	41	19	35	19	31	34	38	117	155	272	0	
17-18hrs	8	11	34	45	49	46	20	31	28	51	139	184	323	0	
18-19hrs	9	12	37	43	46	49	34	34	45	41	171	179	350	0	
Total	116	127	368	434	494	497	284	325	287	429	1549	1812	3361	0	

Site: Iganga road
Date: 18/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	7	6	8	17	40	33	10	4	18	19	83	79	162	0	305
8-9hrs	10	8	28	29	64	76	27	16	14	12	143	141	284	0	
9-10hrs	6	13	23	33	30	56	27	19	11	18	97	139	236	0	Max In
10-11hrs	9	12	24	33	42	28	18	16	20	20	113	109	222	0	160
11-12hrs	11	12	29	24	29	24	21	34	22	40	112	134	246	0	
12-13hrs	10	11	34	24	23	22	28	31	16	32	111	120	231	0	Max Out
13-14hrs	8	11	27	26	22	16	18	28	17	38	92	119	211	0	166
14-15hrs	9	6	41	30	34	18	36	18	38	29	158	101	259	0	
15-16hrs	7	9	36	28	29	17	18	27	36	39	126	120	246	0	
16-17hrs	8	8	32	34	27	32	16	53	27	39	110	166	276	0	
17-18hrs	7	6	47	37	41	27	19	27	46	48	160	145	305	0	
18-19hrs	16	11	48	39	51	41	21	24	21	24	157	139	296	0	
Total	108	113	377	354	432	390	259	297	286	358	1462	1512	2974	0	

Site: Iganga road
Date: 19/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	17	16	22	14	101	100	19	9	30	25	189	164	353	0	353
8-9hrs	7	13	19	38	52	65	25	9	15	18	118	143	261	0	
9-10hrs	12	9	25	29	35	41	19	14	11	14	102	107	209	0	Max In
10-11hrs	8	12	27	34	34	31	34	31	25	21	128	129	257	0	189
11-12hrs	15	7	19	42	34	18	21	23	19	46	108	136	244	0	
12-13hrs	10	12	26	48	45	18	23	30	36	55	140	163	303	0	Max Out
13-14hrs	11	7	30	26	25	7	16	25	21	50	103	115	218	0	164
14-15hrs	9	8	28	37	22	7	18	27	22	48	99	127	226	0	
15-16hrs	10	8	34	27	20	15	17	31	41	61	122	142	264	0	
16-17hrs	4	10	36	35	31	18	19	25	28	28	118	116	234	0	
17-18hrs	10	5	45	31	40	42	47	28	39	39	181	145	326	0	
18-19hrs	8	2	47	27	35	33	9	16	40	44	139	122	261	0	
Total	121	109	358	388	474	395	267	268	327	449	1547	1609	3156	0	

Site: Iganga road
Date: 20/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	13	14	23	25	104	112	25	15	27	27	192	193	385	0	385
8-9hrs	6	10	30	32	30	61	32	16	21	18	119	137	256	0	
9-10hrs	10	6	26	20	26	20	20	17	13	22	95	85	180	0	Max In
10-11hrs	11	12	37	26	37	24	26	24	23	21	134	107	241	0	192
11-12hrs	13	14	46	40	30	20	25	30	20	40	134	144	278	0	
12-13hrs	5	7	24	38	23	31	32	31	28	50	112	157	269	0	Max Out
13-14hrs	8	6	30	31	36	13	20	25	44	50	138	125	263	0	193
14-15hrs	10	5	30	38	22	12	18	32	26	65	106	152	258	0	
15-16hrs	5	4	36	28	25	20	22	36	44	39	132	127	259	0	
16-17hrs	7	6	33	34	33	34	24	38	56	35	153	147	300	0	
17-18hrs	12	12	42	28	40	36	29	31	49	41	172	148	320	0	
18-19hrs	15	9	47	30	51	47	21	25	43	33	177	144	321	0	
Total	115	105	404	370	457	430	294	320	394	441	1664	1666	3330	0	

Site: Iganga road
Date: 21/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	8	13	16	27	86	97	18	7	27	25	155	169	324	0	356
8-9hrs	5	13	26	27	44	67	25	18	13	27	113	152	265	0	
9-10hrs	3	4	19	18	39	18	27	23	10	14	98	77	175	0	Max In
10-11hrs	5	6	33	37	23	14	39	25	15	23	115	105	220	0	182
11-12hrs	13	9	31	28	23	23	26	25	20	33	113	118	231	0	
12-13hrs	7	9	40	38	21	17	29	36	24	46	121	146	267	0	Max Out
13-14hrs	3	8	28	38	23	21	26	22	22	46	102	135	237	0	176
14-15hrs	8	9	32	38	26	6	28	36	14	59	108	148	256	0	
15-16hrs	9	4	52	37	27	17	35	36	36	33	159	127	286	0	
16-17hrs	16	15	44	43	17	16	14	37	32	39	123	150	273	0	
17-18hrs	12	9	50	45	43	34	27	54	50	32	182	174	356	0	
18-19hrs	9	15	45	47	36	36	45	39	45	39	180	176	356	0	
Total	98	114	416	423	408	366	339	358	308	416	1569	1677	3246	0	

Weekly
Average

MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way
In	Out	In	Out	In	Out	In	Out	In	Out			
9	9	32	33	38	35	24	26	27	35	130	138	268

Traffic Counts, July 2006: Kayunga road

Site: Kayunga road
Date: 17/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	26	18	9	4	60	15	14	4	2	0	111	41	152	0	204
8-9hrs	38	38	13	7	55	19	11	4	11	4	128	72	200	0	
9-10hrs	34	31	8	8	35	13	10	10	2	2	89	64	153	0	Max In
10-11hrs	45	38	9	4	19	13	13	11	3	1	89	67	156	0	128
11-12hrs	38	42	7	11	11	12	6	12	0	1	62	78	140	0	
12-13hrs	64	59	10	7	12	30	9	12	0	1	95	109	204	0	Max Out
13-14hrs	31	31	12	8	7	30	8	9	1	3	59	81	140	0	114
14-15hrs	43	46	10	8	15	11	7	9	3	5	78	79	157	0	
15-16hrs	38	39	9	10	15	21	7	10	1	5	70	85	155	0	
16-17hrs	28	26	22	10	25	15	8	9	1	1	84	61	145	0	
17-18hrs	32	45	11	11	16	45	12	7	4	6	75	114	189	0	
18-19hrs	33	27	4	14	1	3	12	17	1	3	51	64	115	0	
Total	450	440	124	102	271	227	117	114	29	32	991	915	1906	0	

Site: Kayunga road
Date: 18/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	18	7	5	5	55	10	19	1	1	3	98	26	124	0	222
8-9hrs	27	20	9	9	54	14	13	5	3	1	106	49	155	0	
9-10hrs	33	25	8	1	25	15	5	8	4	1	75	50	125	0	Max In
10-11hrs	24	33	8	10	24	14	9	7	5	2	70	66	136	0	106
11-12hrs	31	30	4	6	14	12	12	11	8	7	69	66	135	0	
12-13hrs	44	37	11	18	11	16	9	7	7	3	82	81	163	0	Max Out
13-14hrs	29	36	12	5	11	15	10	7	2	2	64	65	129	0	126
14-15hrs	32	43	9	11	9	11	10	11	4	6	64	82	146	0	
15-16hrs	38	35	4	11	13	20	6	6	3	9	64	81	145	0	
16-17hrs	35	34	13	15	12	23	10	10	5	7	75	89	164	0	
17-18hrs	35	49	15	9	22	23	8	10	6	2	86	93	179	0	
18-19hrs	41	49	12	11	23	48	10	9	10	9	96	126	222	0	
Total	387	398	110	111	273	221	121	92	58	52	949	874	1823	0	

Site: Kayunga road
Date: 19/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	34	27	12	4	102	18	18	4	2	2	168	55	223	0	223
8-9hrs	35	28	10	7	37	15	13	3	4	1	99	54	153	0	
9-10hrs	40	35	8	7	25	21	10	9	3	2	86	74	160	0	Max In
10-11hrs	37	29	8	8	14	18	8	4	6	7	73	66	139	0	168
11-12hrs	34	34	9	12	16	16	7	14	1	7	67	83	150	0	
12-13hrs	26	31	7	9	13	18	8	13	4	5	58	76	134	0	Max Out
13-14hrs	39	33	7	8	13	25	11	7	9	6	79	79	158	0	135
14-15hrs	29	43	5	4	9	19	7	9	3	4	53	79	132	0	
15-16hrs	22	21	11	13	16	19	5	9	6	8	60	70	130	0	
16-17hrs	37	42	9	4	12	15	10	9	3	5	71	75	146	0	
17-18hrs	39	30	10	4	20	41	9	10	4	2	82	87	169	0	
18-19hrs	40	51	11	12	25	50	10	16	2	6	88	135	223	0	
Total	412	404	107	92	302	275	116	107	47	55	984	933	1917	0	

Site: Kayunga road
Date: 20/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	40	27	12	18	80	12	12	3	1	2	145	62	207	0	207
8-9hrs	32	25	9	8	44	40	15	3	5	1	105	77	182	0	
9-10hrs	22	24	10	9	43	14	24	8	4	8	103	63	166	0	Max In
10-11hrs	40	41	11	13	32	22	14	10	4	5	101	91	192	0	145
11-12hrs	33	34	10	7	18	20	13	6	4	6	78	73	151	0	
12-13hrs	35	33	15	10	18	23	8	9	6	7	82	82	164	0	Max Out
13-14hrs	35	32	11	12	15	19	6	8	6	2	73	73	146	0	102
14-15hrs	32	30	13	8	13	8	7	8	6	4	71	58	129	0	
15-16hrs	31	25	8	6	9	21	9	9	3	3	60	64	124	0	
16-17hrs	34	31	8	13	14	13	15	9	3	4	74	70	144	0	
17-18hrs	35	29	11	15	20	34	10	11	3	8	79	97	176	0	
18-19hrs	22	18	10	21	13	52	6	11	5	0	56	102	158	0	
Total	391	349	128	140	319	278	139	95	50	50	1027	912	1939	0	

Site: Kayunga road
Date: 21/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	30	15	10	7	109	22	16	6	1	0	166	50	216	0	238
8-9hrs	26	28	12	6	57	18	8	8	0	0	103	60	163	0	
9-10hrs	31	31	11	7	31	21	31	9	2	2	106	70	176	0	Max In
10-11hrs	37	38	3	7	11	20	31	13	6	8	88	86	174	0	166
11-12hrs	26	23	8	7	23	31	26	19	5	2	88	82	170	0	
12-13hrs	22	23	7	9	16	14	13	18	1	2	59	66	125	0	Max Out
13-14hrs	21	25	7	8	18	19	13	14	2	7	61	73	134	0	132
14-15hrs	36	31	11	7	9	17	7	10	7	6	70	71	141	0	
15-16hrs	33	33	12	11	19	12	10	11	5	4	79	71	150	0	
16-17hrs	38	40	7	9	13	27	9	9	4	6	71	91	162	0	
17-18hrs	46	45	4	10	15	30	18	20	4	6	87	111	198	0	
18-19hrs	51	49	11	8	24	34	16	35	4	6	106	132	238	0	
Total	397	381	103	96	345	265	198	172	41	49	1084	963	2047	0	

Weekly
Average

MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way
In	Out	In	Out	In	Out	In	Out	In	Out			
34	33	10	9	25	21	12	10	4	4	84	77	161

Traffic Counts, July 2006: Ivunamba road

Site: Ivunamba Road

Date: 17/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	26	22	14	15	221	27	15	6	3	0	279	70	349	0	349
8-9hrs	18	8	13	3	103	64	23	2	6	0	163	77	240	0	
9-10hrs	17	9	6	4	81	52	11	3	3	1	118	69	187	0	Max In
10-11hrs	18	16	8	8	44	69	7	9	3	1	80	103	183	0	279
11-12hrs	13	13	10	13	24	74	6	7	2	1	55	108	163	0	
12-13hrs	15	13	11	12	16	44	6	8	1	0	49	77	126	0	Max Out
13-14hrs	21	21	17	20	33	44	5	10	3	2	79	97	176	0	183
14-15hrs	10	12	8	15	13	34	4	4	3	4	38	69	107	0	
15-16hrs	14	15	10	16	16	26	6	5	0	3	46	65	111	0	
16-17hrs	17	18	7	10	30	41	8	4	3	4	65	77	142	0	
17-18hrs	26	18	18	7	37	91	11	9	0	2	92	127	219	0	
18-19hrs	14	15	15	10	38	142	6	11	2	5	75	183	258	0	
Total	209	180	137	133	656	708	108	78	29	23	1139	1122	2261	0	

Site: Ivunamba Road

Date: 18/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	5	3	6	5	45	27	7	3	1	0	64	38	102	0	209
8-9hrs	15	5	5	4	60	65	18	3	6	0	104	77	181	0	
9-10hrs	18	9	7	8	17	0	7	10	1	1	50	28	78	0	Max In
10-11hrs	14	11	14	14	61	48	9	6	0	1	98	80	178	0	104
11-12hrs	18	19	12	12	34	41	8	7	0	4	72	83	155	0	
12-13hrs	19	21	14	13	20	47	8	11	1	2	62	94	156	0	Max Out
13-14hrs	13	12	7	14	20	45	4	8	2	1	46	80	126	0	144
14-15hrs	14	19	15	15	4	9	4	9	1	2	38	54	92	0	
15-16hrs	22	20	19	7	32	19	4	3	0	1	77	50	127	0	
16-17hrs	14	18	14	14	37	42	6	4	2	3	73	81	154	0	
17-18hrs	16	15	8	16	29	57	7	11	2	3	62	102	164	0	
18-19hrs	10	18	16	8	22	109	14	9	3	0	65	144	209	0	
Total	178	170	137	130	381	509	96	84	19	18	811	911	1722	0	

Site: Ivunamba Road

Date: 19/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	21	3	5	0	219	31	15	3	1	0	261	37	298	0	298
8-9hrs	9	6	10	7	110	31	16	8	4	0	149	52	201	0	
9-10hrs	14	16	9	14	94	93	10	9	1	2	128	134	262	0	Max In
10-11hrs	11	9	10	7	39	41	10	3	1	6	71	66	137	0	261
11-12hrs	12	17	5	6	25	51	7	6	2	0	51	80	131	0	
12-13hrs	17	11	17	11	11	48	21	11	1	2	67	83	150	0	Max Out
13-14hrs	10	13	10	13	24	31	7	7	5	6	56	70	126	0	181
14-15hrs	20	20	27	22	24	32	7	19	1	3	79	96	175	0	
15-16hrs	7	7	7	8	20	19	2	3	0	1	36	38	74	0	
16-17hrs	12	18	12	12	25	46	7	4	1	4	57	84	141	0	
17-18hrs	17	16	10	13	53	77	10	8	5	2	95	116	211	0	
18-19hrs	18	18	14	9	41	144	7	8	3	2	83	181	264	0	
Total	168	154	136	122	685	644	119	89	25	28	1133	1037	2170	0	

Site: Ivunamba Road

Date: 20/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	19	8	1	1	182	18	9	6	4	1	215	34	249	0	258
8-9hrs	18	11	8	4	123	66	21	5	2	0	172	86	258	0	
9-10hrs	15	11	6	8	58	53	11	7	1	4	91	83	174	0	Max In
10-11hrs	10	6	14	12	29	38	10	10	3	6	66	72	138	0	215
11-12hrs	15	6	10	11	41	49	10	12	2	3	78	81	159	0	
12-13hrs	8	14	12	17	17	35	8	13	3	4	48	83	131	0	Max Out
13-14hrs	16	8	12	15	20	30	9	6	4	0	61	59	120	0	167
14-15hrs	15	19	15	7	26	31	5	6	1	5	62	68	130	0	
15-16hrs	13	14	16	13	21	25	5	6	2	3	57	61	118	0	
16-17hrs	15	18	10	19	43	44	8	6	1	1	77	88	165	0	
17-18hrs	20	21	13	11	39	57	6	11	4	3	82	103	185	0	
18-19hrs	18	22	13	7	22	128	17	8	4	2	74	167	241	0	
Total	182	158	130	125	621	574	119	96	31	32	1083	985	2068	0	

Site: Ivunamba Road

Date: 21/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	15	3	5	1	145	26	9	6	4	1	178	37	215	0	222
8-9hrs	15	7	11	1	111	46	19	10	2	0	158	64	222	0	
9-10hrs	16	9	7	7	67	70	18	11	2	2	110	99	209	0	Max In
10-11hrs	10	7	8	15	25	30	17	12	3	1	63	65	128	0	178
11-12hrs	16	13	15	17	15	28	15	7	1	2	62	67	129	0	
12-13hrs	10	21	16	15	21	41	10	19	2	5	59	101	160	0	Max Out
13-14hrs	7	6	9	11	9	23	5	20	0	1	30	61	91	0	118
14-15hrs	16	19	18	11	16	25	5	1	1	1	56	57	113	0	
15-16hrs	15	19	15	11	25	26	26	1	1	2	82	59	141	0	
16-17hrs	13	16	11	13	22	28	20	11	0	5	66	73	139	0	
17-18hrs	12	11	13	15	30	50	15	15	3	3	73	94	167	0	
18-19hrs	7	10	19	19	17	70	18	17	5	2	66	118	184	0	
Total	152	141	147	136	503	463	177	130	24	25	1003	895	1898	0	

Weekly
Average

MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way
In	Out	In	Out	In	Out	In	Out	In	Out			
15	13	11	11	47	48	10	8	2	2	86	83	169

Traffic Counts, July 2006: Jinja town road

Site: Jinja Town Road
Date: 17/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	71	40	106	59	329	92	130	90	12	8	648	289	937	0	1091
8-9hrs	78	60	157	70	302	130	150	115	20	9	707	384	1091	0	
9-10hrs	84	77	115	102	225	164	104	85	16	17	544	445	989	0	Max In
10-11hrs	89	76	121	76	157	143	90	80	18	27	475	402	877	0	707
11-12hrs	57	67	102	98	123	158	74	130	9	47	365	500	865	0	
12-13hrs	74	75	118	90	109	169	78	72	19	23	398	429	827	0	Max Out
13-14hrs	67	69	129	95	138	124	131	67	24	35	489	390	879	0	729
14-15hrs	50	70	104	105	108	148	125	72	26	25	413	420	833	0	
15-16hrs	65	66	93	104	105	110	73	76	30	34	366	390	756	0	
16-17hrs	57	64	108	108	92	131	79	61	23	39	359	403	762	0	
17-18hrs	72	69	125	116	116	195	85	87	34	44	432	511	943	0	
18-19hrs	68	92	9	190	122	306	91	90	22	51	312	729	1041	0	
Total	832	825	1,287	1,213	1,926	1,870	1,210	1,025	253	359	5508	5292	10800	0	

Site: Jinja Town Road
Date: 18/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	21	8	87	60	121	33	124	70	19	2	372	173	545	0	981
8-9hrs	46	50	130	90	285	90	129	88	30	4	620	322	942	0	
9-10hrs	108	74	108	87	265	114	95	92	20	18	596	385	981	0	Max In
10-11hrs	64	62	92	103	211	126	95	78	0	27	462	396	858	0	620
11-12hrs	77	73	123	98	174	130	82	64	37	29	493	394	887	0	
12-13hrs	79	70	107	115	140	140	80	83	26	20	432	428	860	0	Max Out
13-14hrs	83	65	103	98	108	128	80	73	26	16	400	380	780	0	436
14-15hrs	57	62	102	98	118	125	69	77	23	22	369	384	753	0	
15-16hrs	62	63	107	106	110	115	88	77	16	24	383	385	768	0	
16-17hrs	65	58	111	97	132	127	80	75	21	35	409	392	801	0	
17-18hrs	82	60	126	116	135	135	87	90	24	35	454	436	890	0	
18-19hrs	62	85	132	145	130	38	85	102	27	18	436	388	824	0	
Total	806	730	1,328	1,213	1,929	1,301	1,094	969	269	250	5426	4463	9889	0	

Site: Jinja Town Road
Date: 19/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	48	26	104	64	302	79	149	98	16	5	619	272	891	0	1094
8-9hrs	77	52	146	64	343	141	142	91	24	14	732	362	1094	0	
9-10hrs	71	68	133	68	327	122	107	67	15	21	653	346	999	0	Max In
10-11hrs	86	77	111	77	20	131	80	68	24	33	321	386	707	0	732
11-12hrs	69	98	99	98	138	160	73	77	24	24	403	457	860	0	
12-13hrs	65	57	122	120	106	156	72	73	28	28	393	434	827	0	Max Out
13-14hrs	72	79	110	79	118	143	76	74	28	23	404	398	802	0	633
14-15hrs	77	83	112	135	93	150	73	72	22	22	377	462	839	0	
15-16hrs	61	86	107	118	89	147	70	70	21	22	348	443	791	0	
16-17hrs	53	73	98	105	137	146	87	82	46	34	421	440	861	0	
17-18hrs	92	78	113	137	139	212	88	124	21	43	453	594	1047	0	
18-19hrs	66	69	122	141	126	241	86	147	32	35	432	633	1065	0	
Total	837	846	1,377	1,206	1,938	1,828	1,103	1,043	301	304	5556	5227	10783	0	

Site: Jinja Town Road
Date: 20/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	54	34	116	49	337	66	61	85	20	11	588	245	833	0	1039
8-9hrs	74	58	146	83	301	106	130	103	23	15	674	365	1039	0	
9-10hrs	71	62	114	77	235	115	83	75	28	31	531	360	891	0	Max In
10-11hrs	73	66	93	86	161	77	93	77	25	21	445	327	772	0	674
11-12hrs	75	49	97	81	113	79	93	60	20	30	398	299	697	0	
12-13hrs	64	62	79	92	78	118	68	69	28	38	317	379	696	0	Max Out
13-14hrs	43	38	81	83	87	82	79	46	37	34	327	283	610	0	614
14-15hrs	59	47	88	74	103	64	60	53	30	28	340	266	606	0	
15-16hrs	54	45	91	90	93	75	59	43	25	17	322	270	592	0	
16-17hrs	62	49	73	125	119	88	72	68	30	29	356	359	715	0	
17-18hrs	64	82	105	177	120	197	71	115	22	43	382	614	996	0	
18-19hrs	58	61	95	72	100	160	95	78	27	18	375	389	764	0	
Total	751	653	1,178	1,089	1,847	1,227	964	872	315	315	5055	4156	9211	0	

Site: Jinja Town Road
Date: 21/07/2006

Time	MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way	Error check	Max 2 way
	In	Out	In	Out	In	Out	In	Out	In	Out					
7-8hrs	51	29	111	46	377	64	154	106	34	10	727	255	982	0	2127
8-9hrs	84	51	156	63	441	63	179	98	27	13	887	288	1175	0	
9-10hrs	76	49	129	72	317	130	186	125	21	27	729	403	1132	0	Max In
10-11hrs	85	77	111	106	263	170	186	99	23	28	668	480	1148	0	887
11-12hrs	93	85	112	88	79	103	179	105	24	25	487	406	893	0	
12-13hrs	89	85	127	103	168	158	155	110	27	32	566	488	1054	0	Max Out
13-14hrs	78	67	115	90	110	125	110	90	27	30	440	402	842	0	1585
14-15hrs	59	65	110	115	148	105	86	82	34	23	437	390	827	0	
15-16hrs	88	61	99	80	143	99	100	88	38	35	468	363	831	0	
16-17hrs	78	67	113	115	37	113	106	97	31	40	365	432	797	0	
17-18hrs	74	92	110	148	197	170	123	1148	38	27	542	1585	2127	0	
18-19hrs	61	64	110	110	144	120	137	137	26	27	478	458	936	0	
Total	916	792	1,403	1,136	2,424	1,420	1,701	2,285	350	317	6794	5950	12744	0	

Weekly
Average

MC		PV		PC		PT		HGV		Total In	Total Out	Total 2-way
In	Out	In	Out	In	Out	In	Out	In	Out			
69	64	110	98	168	127	101	103	25	26	472	418	890



BURNSIDE

Appendix C.6

Rail Freight Volume

(Source: Appendix C.6 - AESNP Hydropower Facility

EIA, March 2001)

FREIGHT TRAFFIC BY COMMODITY (1994 & 1995)		
	TONNAGE	
COMMODITY	1994	1995
Coffee	167,700	104,100
Cement	166,500	167,100
Fuel	90,000	101,300
General Goods	169,600	160,300
Grains	82,800	130,500
Salt and Sugar	49,200	126,700
Timber	500	200
Iron & Steel	21,400	23,800
Textiles	3,400	4,400
Cotton & Seed	3,000	3,700
Chemical & Fertilisers	11,800	15,100
Others* (Parcels)	14,100	39,600
TOTAL	780,000	876,800

Source: Uganda Railway Corporation

FREIGHT TRAFFIC BY COMMODITY (1996)	
COMMODITY	TONNAGE
Cement	123,352
Chemicals & Fertilizers	7,955
Coffee	136,438
Fuel	107,087
General Goods	139,858
Grains	94,608
Iron & Steel	19,394
Lime	385
Machinery	15,180
Motor Vehicle	301
Salt	22,621
Sisal	13
Textiles	1,130
Sugar	31,475
Animal Feeds	3,770
Hides & Skin	205
Cotton	108
TOTAL	714,648

Source: Uganda Railway Corporation

FREIGHT TRAFFIC BY COMMODITY (1997)	
COMMODITY	TONNAGE
Animal Feeds	1,365
Cement	73,161
Chem & Fertilizers	16,103
Coffee	54,136
Fuel	54,540
General Goods	120,849
Iron & Steel	6,975
Salt	17,475
Sugar	26,464
Grains	173,803
Cotton	108
Machinery	22
Military Equipment	2,648
Textiles	232
Hides & Skin	612
Lime	878
Livestock	97
TOTAL	549,500

Source: Uganda Railway Corporation



BURNSIDE

Appendix C.7

Correspondence with UWA Regarding Jinja Wildlife Sanctuary

23rd November 2000



The Executive Director
Uganda Wildlife Authority
KAMPALA.

Dear Sir,

RE: CLARIFICATION ON JINJA ANIMAL SANCTUARY

AES Nile Power is in the process of developing a Hydro-Power generation facility at Bujagali on the Victoria Nile.

During the process of environmental due diligence for the project, it has come to our notice that Jinja township and an area along the banks of the Nile was delineated as an Animal sanctuary by executive order of the Governor in 1953 under Legal Notice No. 110 of 1953.

It is not clear to us what is the current status of this area in terms of the aforesaid Notice. This therefore is to request clarification on whether existing policy still recognises the delineated area as an animal sanctuary and what is the current status of the Jinja Animal sanctuary.

We do require this information in order that it may be reflected in the environmental review that has been done for the project.

Your clarification to us on this matter is highly appreciated.

Kind regards,


Titus F. Bitebekezi
Legal Officer.

Cc. The Legal Officer, Uganda Wildlife Authority.
Cc. The Planning Officer, Uganda Wildlife Authority.

AES Nile Power
P.O. Box 24401, Kampala, Uganda
Plot 2A/2B Nalufenya Road
Magwa, Jinja, Uganda
Tel: +256 (0) 43 122154 / 7, 121426 / 7
Fax: +256 (0) 43 122150, 130082
e-mail: aesnpl@infocom.co.ug

D.Fo
Please read letter and let's
put heads together for reply.
L.M @ 27/11/00.

L.M
still a wildlife
sanctuary. It should
feature in the EIA
process.

D.Fo
27/11/00

Registered in Uganda 1478662

28th November 2000

The Executive Director
Uganda Wildlife Authority
KAMPALA

Dear Sir,

L/M
P/c Handle.
H.L.
28/11/00



RE: FURTHER INFORMATION ON JINJA ANIMAL SANCTUARY

Reference is made to my earlier letter to you of 23rd November 2000 seeking clarification on the status of the Jinja Animal Sanctuary.

It has been brought to my Notice that we do require more information than I initially requested. In particular we do require an elaboration from your office on the following issues: -

1. The Uganda Wildlife Statute, 1996 in S.19 makes a distinction between a wildlife-protected area and a wildlife-management area and sets out that wildlife sanctuaries are categorized as wildlife management areas. What is the distinction between the two in terms of activity restrictions and in any other way?
2. What kinds of activities are prohibited within the Animal Sanctuary as a wildlife management area?
3. What activities are permitted within a wildlife management area and particularly a wildlife sanctuary?
4. What Animals are currently within the Jinja Sanctuary and have been declared protected species for whose protection Jinja Township [or now Municipality] and the described area has been identified to be essential as envisaged under S.19 (7) of the Uganda Wildlife Statute?
5. Do the activities relating to the establishment of the Hydro-Power facility at Bujagali affect any such protected species since some of the land to be inundated by the project may lie within a fringe of the sanctuary?
6. What are the specific coordinates and detailed boundary description of the Jinja Animal Sanctuary?
7. What are the various management policies/ directives that have applied to the Jinja Animal sanctuary since its establishment in 1953?

The additional information we do require in order that we may have a comprehensive appreciation and assessment of the implications of Bujagali Hydro-Power project on the Jinja Animal Sanctuary.

We do highly appreciate your assistance in this matter.

Yours faithfully,

A handwritten signature in dark ink, appearing to read 'Titus F. Bitebekezi', written over a horizontal line.

Titus F. Bitebekezi
Legal Officer

Cc. The Field Operations Officer, Uganda Wildlife Authority
Cc. The Legal Officer, Uganda Wildlife Authority
Cc. The Planning Officer, Uganda Wildlife Authority

December 19, 2000

The Legal Officer
AES Nile Power
P.O. Box 24401
KAMPALA

Dear Mr. Bitebezeki,

RE: INFORMATION ON JINJA WILDLIFE SANCTUARY

Please refer to your letter of November 28, 2000 seeking clarification on the status of the Jinja Animal Sanctuary. Below are some answers to the questions you raised:

1. A wildlife sanctuary is "an area identified as being essential for the protection of a species of wild animal or wild plant in which activities which are not going to be destructive to the protected species or its habitat may be permitted" (see Uganda Wildlife statute No. 14, section 19 subsection 7). In the case of Jinja Wildlife sanctuary, this was set up for the protection of animals of all kinds according to the Game (Preservation and Control) Act Statutory Instrument 226, revised edition of 1964, Section 45, second schedule which is still valid and legally binding. The difference between a Wildlife Protected Area and Wildlife Management Area is that in the former no activity may be undertaken without the authority and permission of the Executive Director while in the latter permission is not necessary provided the activity is not destructive to the protected species.
2. Activities prohibited in the animal sanctuary include
 - hunting, trapping or killing of any animal species including birds and insects
 - destruction of any animal habitat e.g. felling of trees where birds and insects may nest, clearing vegetation (grass, bushes, trees etc where animals live and feed), draining of water as in pools or ponds where frogs, toads lizards etc live and feed.
 - Submersion of island patches within the Nile or the banks of the Nile where animals live, nest, breed or feed
 - Collecting/capture of live animals or parts of animals dead or alive (e.g. eggs, feathers, nests, bones, teeth, skins etc) for any purpose
3. The activities permitted are those that do not result in any of the actions listed out under 2 above.
4. A current inventory has not been done but this would be part of the results of an EIA as required by the NEMA Statute. Otherwise the Jinja Animal Sanctuary was

established for protection of all animal species. It is known for its several bird species, reptiles and diversity of insects. In any case all wildlife is protected under Ugandan law regardless of whether it is in a Wildlife Protected Area, Wildlife Management Area, Public Land or Private Land.

5. Certainly as long as any of the activities of establishing a Hydro-Power result in any of the actions in 2 above directly or indirectly, mitigation measures must be articulated in the EIA statement and ultimately implemented to the letter.
6. The boundaries of the Jinja Animal Sanctuary are well described in the second schedule of the Game (Preservation and Control) Act cap 226 under legal notice no. 110 of 1953. Even without co-ordinates the features described are easy to identify on the ground. However, the Department of Lands, Surveys and Mapping, Entebbe could be contacted for the co-ordinates including a re-survey if deemed necessary.
7. Management policies since the declaration of the Jinja Wildlife sanctuary have centred around providing information to the population about these areas and the species being protected therein as well as their importance as part of the biodiversity and our natural heritage.

I hope you find this information useful. Please do not hesitate to contact us again for a discussion if need be, even at the site.

Best regards

Yours Sincerely

Arthur Mugisha

For: EXECUTIVE DIRECTOR

Cc: Director Planning Monitoring and Research
Legal Officer, UWA



Appendix C.8

Archaeological Assessment Report

**Phase I Archaeological Assessment for the Proposed Bujagali
Hydropower Site and Inundation Area, Uganda**

By D. Kiyaga- Mulindwa and E R Kamuhangire
November 2006

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Introduction

An Impact Assessment of development project is a requirement of the National Environment Management Authority (NEMA) in Uganda (Ug. Govt 1995). It is also requirement of other development funding agencies such as World Bank (WB 1994). This exercise is one aspect in the overall fulfillment of impact Assessment requirement for the proposed Bujagali Hydropower project.

The main objective of this exercise was to determine if there was any possible adverse impact of the project-related activities to the archaeological resource in the direct impact zone. This survey was restricted to the area of Bujagali Hydropower site and inundation area in Uganda. The following is our observations and assessment in line with the main objective of the study during and after the archaeological impact assessment survey.

Study team

1. Professor D. Kiyaga- Mulindwa, Professor of History, Kyambogo University, Uganda. Archaeologist, Museologist with specific Research interest in African Cultural History and several publications in these areas, especially the African Iron Age.
2. Dr. Ephraim R Kamuhangire, Commissioner Museums and Monuments of Uganda. A Historian with specific interest in Ethno- Archaeology.
3. Nelson A. Abiti, Photographer and Conservator, specific interest in visual history and heritage management.

Methods

Methods of recognizing sites with evidence of heritage resources are varied. The general idea is to be able to recognize surface indicators of what could lie in sub- surface levels to warrant further investigation through opening up test excavations. We did not redo the maps of the Bujagali area because technical maps already exist, clearly showing the areas to be inundated once the dam is put in place.

Similarly, especially on the west bank, all the infrastructure areas are already in place and our brief indicated nothing new to be done in these activity areas.

Since earlier Impact Assessment work concentrated on the west bank villages, our effort was focused on the villages of Bujagali, Kyabirwa and Namizi on the eastern bank of the river. We used GPS to fix the coordinates of the areas we investigated and so reference can be made to these locations.

Surface or reconnaissance survey was carried out to locate archaeological features and to recover surface pottery scatter as indicator where human activity might have taken place. This was done by walking narrow transects by the three members of the team and each noting if any of these indicators was in his transect. Where these were noted, the spot was immediately recorded and entered in a GPS and photographs taken.

The foot survey sought out features such as mounds, ash patches, stone cairns, trenches and artifacts, particularly potsherds. Both the physical extent and concentration of the pottery scatter are obvious indicators of the physical extent of the site as well as the concentration of human activity in that particular area.

Specific locations that seem to point to the concentration of human activity such as pottery scatter or heaps / mounds of soils or patches of ash, normally call for further investigation, such as test excavation to check on what could be lying in the sub-terrain levels . Excavations produce artifacts *in situ* and are also instrumental in displaying stratigraphic accumulation of cultural deposits which could give the chronological sequence of the occupation of that site.

Results.

1. Namizi Village.

Namizi village is at the head of the project site on the eastern bank where the road will connect to the dam. The entire area of activity on the eastern side of the river has been fenced off with posts and barbed wire. At Namizi village a few areas were looked at during an earlier survey where 20 sherds were recovered. The current exercise concentrated on areas which were not visited earlier. This is the area covered by a ridge which runs from the corner of the river at Namizi to the point where the dam and road will be meeting. A thorough foot survey was carried out on all the hillocks of this low ridge and no evidence of settlement was observed. The nature of the ground, terrain and gradient all show that the area must have been used mainly for agriculture and not settlement. There are several stone cairns on the top of these hillocks, most of them about half a metre across and lying low. Only one of them seemed long, measuring about 3 metres in length, 1.5 metres wide and heaped to about 50 cm. This was suspected to be a grave and was plotted out and a top section of it excavated to 75 cm below surface. Stones stopped at ground level and there was no indication at all that there was any pit continuing below the stone heap. Our interpretation of these cairns is that they are heaps of stones collected by cultivators in preparation of their gardens; a very common practice in areas which are stony. We noted nothing archaeologically important that will be adversely impacted in the Namizi area due to inundation or other project activity.

2. Kyabirwa.

At Kyabirwa village the approach to the river bank is so steep that no human activity could have been possible there even at the maximum levels of inundation. However we carried out a foot survey along the banks of the river in a zigzag fashion from the river's edge to the steep slopes and back. These investigations yielded nothing that we can report on archaeologically. We feel that further investigation is unnecessary at Kyabirwa since there is no apparent threat to any archaeological resource there.

3. Bujagali/ Ivunamba.

There has been quite a bit of disturbance due to tourist activity at Bujagali. At Ivunamba, the approach to the river is almost the replica of that noted at

Kyabirwa. The technical maps projecting inundation at Bujagali show that large areas lower down in the current tourist site will be submerged. We concentrated our survey here, in spite of the disturbance. Using trowel scoops two potsherds were recovered from Bujagali. These were apparently from bowls and were uniquely decorated with dragged channeling on the inside; a rare very motif location. These internally decorated bowls have however been recorded elsewhere around the shores of Lake Victoria and in the islands of Sesse and Bussi. In our judgment it would seem that very little or no adverse effect to the archaeological resource is likely to take place at Bujagali or the adjacent Ivunamba village.

4. Naminya

On the western bank, in Mukono District, the village of Naminya has been visited. This village is the new settlement site of families which were relocated from *Malindi* and *Kikubamutwe*. Both the infrastructure in the form of roads, sewerage pits and houses etc. are already in place. No more damage can be done to any potential archaeological resource in this village due to project activity than what has already been done due to earlier activity.

5. Malindi and Kikubamutwe

The major Bujagali dam construction and other related activities areas will mainly impact the villages of Kikubamutwe and Malindi. Earlier archaeological impact assessment had concentrated in these two villages and a lot of archaeological material was retrieved from carefully- conducted excavations. Fauna, lithics and ceramic materials were recovered from the excavations and they present a sizeable representation of the archaeological heritage along the banks of the Nile. As many as 18,432 potsherds of which 2,133 were diagnostic were recovered in the earlier survey and are currently curated at the National Museum. With the benefit of the earlier study, the current study was carried out in places which had not yet been surveyed. Shovel pits and trowel scoops were used to check points in those unsurveyed sites. Some of the test pits yielded nothing, but the few that produced artifacts; were not any different from those obtained in earlier excavations. The activity area in the west bank is now cordoned off with wire mesh. We have also mentioned above that most of the infrastructure structures such as roads are already in place and nothing is likely to cause any more disturbances in the area. The consultants feel that there is already a good representative sample of the archaeological resource of the area of proposed Bujagali Hydropower Project in Jinja and Mukono.

Discussion

Generally the western approach to the river is more gradual and has plateaus and extensive plateaus which attracted settlement. The eastern banks along the project impact zone are made up of very sharp and steep gradients that seemed to have forced settlement and other human activity, other than agriculture much further back from the river. The two sherds mentioned at Bujagali are unique but have been recovered elsewhere. They have been found in the Lake Victoria island's collection and some in Kenya, where they have been referred to as *Ndereti* of the Pastoral- Neolithic phase that has not yet been dated in Uganda.

These artifacts fitted in well, both in the larger picture of the eastern African interlacustrine chronology relating to early, and late Iron Age. The early study also produced some radio carbon dates showing that the area has been settled from as early as 410 AD, a date much earlier than what all information available at the time was indicating.

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Appendix-A Photos



Kikubamutwe Pottery



Kikubamutwe Pottery



Kikubamutwe Pottery



Kikubamutwe Pottery



Malindi Pottery



Malindi Pottery



Malindi Pottery



Malindi Pottery



Bujagali



Bujagali with interior decoration



Namizi foot survey



Namizi test excavation



Malindi foot survey