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Aquatic Ecology Monitoring: Water quality, fish, fish catch, sanitation and disease vectors

Monitoring No. 12

Date: 25th – 30th April 2013

Monitoring carried out by:

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On behalf of :
Bujagali Energy Limited (BEL)

Date of Report June 2013

1.0 BACKGROUND

Bujagali hydropower dam construction is now completed and a reservoir behind the dam has been created, extending all the way up to Kalange-Makwanzi, an upstream transects. During the 10th monitoring survey-April 2012, a third transect was established in the mid of the reservoir where it runs up to 30 m deep and sampled similarly as at the two original sampling transects, Kalange-Makwanzi and Buyala-Kikubamutwe for comparative purposes.
This monitoring survey No. 12 undertaken between 25th and 30th April 2013 is the third one to be conducted after completion of construction of Bujagali Hydropower Dam. Two pre-construction baseline surveys in April 2000 and April 2006 were conducted and during construction phase, eight monitoring surveys (September 2007, April 2008, April 2009, October 2009, April 2010, September 2010, April 2011, September 2011) were conducted.

Since 2009 biannual monitoring surveys have been conducted at an upstream and a downstream transect of the BHPP with emphasis on the following aspects:
water quality determinants, biology and ecology of fishes and food webs, fish stock and fish catch including economic aspects of catch and sanitation/vector studies (bilharzias and river blindness). In the post-construction monitoring surveys, the assessments of algae, zooplankton and benthic macro-invertebrates which had been restrained since April 2008 were also included.

2.0 GENERAL METHODOLOGY AND DATA COLLECTION

2.1. Materials and Methods

For nine surveys including one during April 2013, Kalange-Makwanzi and Buyala-Kikubamutwe, upstream and downstream transects respectively have been sampled for water quality, fish abundance, diversity and distribution, fish biology, fish catch, sanitation conditions, bilharzia and river blindness vectors. Due to reservoir conditions created from the dam up to transect 1, a third transect was created in between, from which assessment of parameters as at the upstream and downstream transects was also undertaken including assessment of algae, zooplankton and benthic macro-invertebrates.

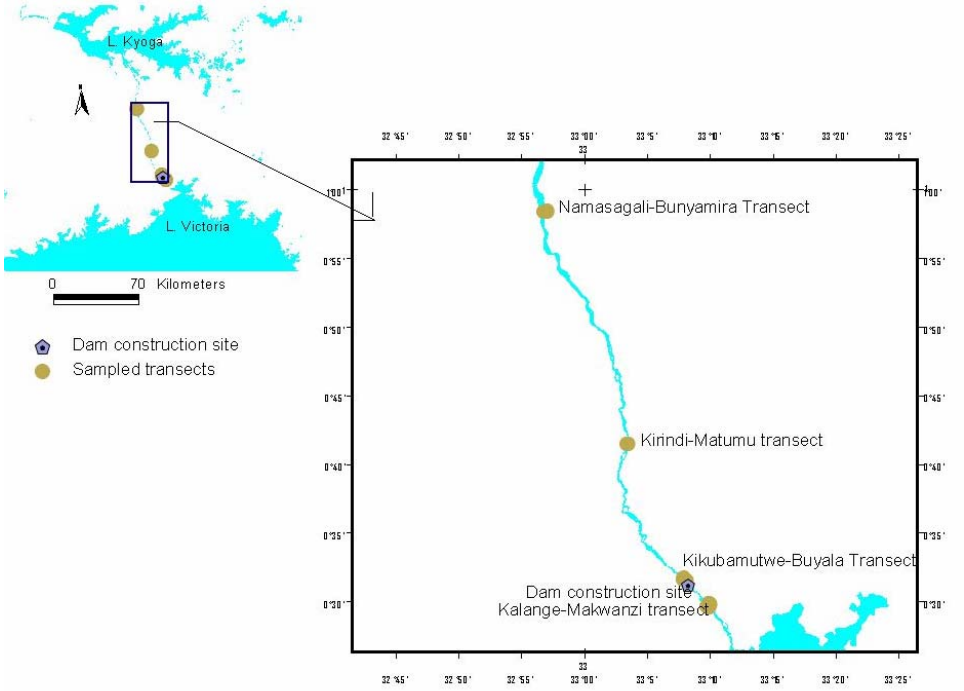


Figure 2.1a *A map showing the Upper Victoria Nile where the BHPP is located and river segments where baseline as well as monitoring samples were taken*

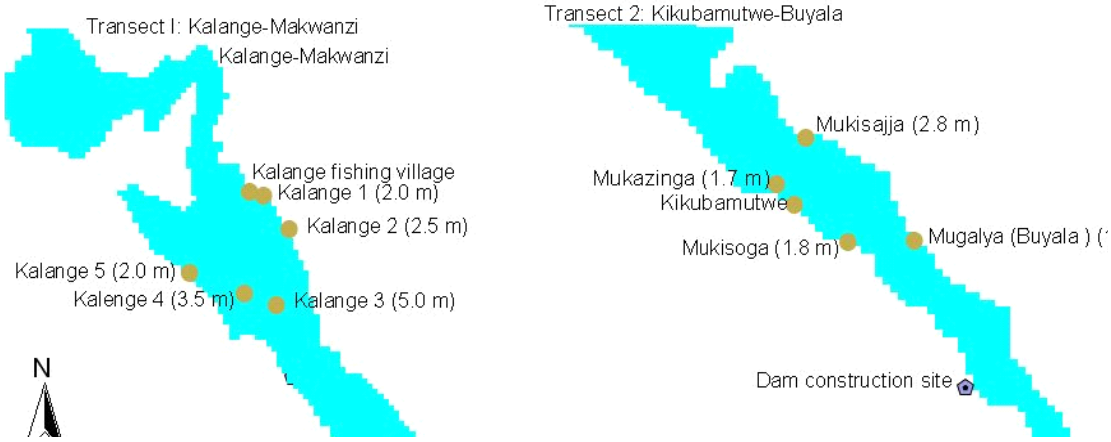


Figure 2.1b *Detailed maps of the two sampled transects: Transect 1 = Kalange-Makwanzi and Transect 2 = Buyala-Kikubamutwe and associated locations on the Upper Victoria Nile.*

Sampling, analytical procedures and techniques used in the previous surveys were followed. Sampling of zooplankton was done at designated field stations using conical plankton net of 0.25 metre mouth diameter and 60 µm mesh, towed vertically through the water column from just above the bottom sediments to the surface. Three tows taken at

each sampling point were combined to make a composite sample, preserved in 4% sugar-formalin in a clean, labelled, plastic sample bottle. Species identification was done with the help of available published taxonomic keys (Boxshall & Braide, 1991; Korinek, 1999; Korovchinsky, 1992; Koste, 1978; Rutner-Kolisko, 1974) each species separately counted and recorded. Species numbers were noted and areal density estimates calculated for each station in conjunction with the diameter of the sample net and depth of sampling. Benthic macro-invertebrates were identified and classified using keys from Merrit & Cummins 1997, Pennak 1989 and Mandahl-Barth 1954, and enumerated as mean numbers per square meter.

3.0 RESULTS

3.1 Status of Water Quality

3.1.1. Physico-chemical parameters

Table 3.1.1 *Trends in mean values of water physico-chemical parameters upstream at Kalange-Makwanzi, mid section of the reservoir and downstream at Buyala-Kikubamutwe*

Parameter	Site	Monitoring Dates											
		1	2	3	4	5	6	7	8	9	10	11	12
		Apr-06	Sept. 07	Apr-08	Apr-09	Oct-09	Apr-10	Sep-10	Apr-11	Sep-11	Apr-12	Sep-12	Apr-13
Dissolved Oxygen (mg/L)	Kalange-Makwanzi	4.2	7.2	5.6	4.5	5.9	6.7	5.4	4.8	6.3	5.9	6.3	7.7
	Mid section of the Reservoir										5.2	6.4	7.02
	Buyala-Kikubamutwe	6.3	7.7	7	7.2	7.2	9.3	7.8	7.1	7.5	7.5	5.9	7.5
	NEMA Std	3	3	3	3	3	3	3	3	3	3	3	3
pH	Kalange-Makwanzi	7	7.3	8.2	6.7	7.6	6.8	7.1	7.4	7	8.5	7.1	7
	Mid section of the Reservoir										8.2	7.5	7.4
	Buyala-Kikubamutwe	7.4	7.4	7.7	6.8	7.4	7	7	7.3	7	8.2	7.4	7.17
	Upper NEMA Std	8	8	8	8	8	8	8	8	8	8	8	8
	Lower NEMA Std	6	6	6	6	6	6	6	6	6	6	6	6
Temperature (℃)	Kalange-Makwanzi	26.7	26.1	26.2	26.4	25.7	25.6	24.8	26.4	24.9	25.3	25.9	26.9
	Mid section of the Reservoir										26.1	25.4	26.9
	Buyala-Kikubamutwe	26.4	25.7	26.9	26.8	25	25.8	25.4	26.9	26.5	26.1	25.3	27.1
	Upper NEMA Std	35	35	35	35	35	35	35	35	35	35	35	35
	Lower NEMA Std	20	20	20	20	20	20	20	20	20	20	20	20
Conductivity (µS/cm)	Kalange-Makwanzi	103	112	81.1	95.5	96.9	87.3	100	129	105	92.3	90.0	101.4
	Mid section of the Reservoir										97.4	95.0	101.6
	Buyala-Kikubamutwe	88.5	114	82.8	97.6	97.7	86.1	102	N/D	114	94.8	100.0	101.5
Secchi Visibility (m)	Kalange-Makwanzi	1.9	1.6	1.9	2.2	2.2	2.3	2.2	2.2	N/D	1.5	2.1	1.72
	Mid section of the Reservoir										1.7	2.1	1.62
	Buyala-Kikubamutwe	1.7	1.8	1.8	2.3	1.9	1.9	2.1	2.5	1.3	1.4	1.5	1.63
Total Suspended Solids (mg/L)	Kalange-Makwanzi	2	2.7	4.2	7.9	3.7	3.5	2.9	3	2.4	3.1	3.3	1.92
	Mid section of the Reservoir										3.6	3.3	1.5
	Buyala-Kikubamutwe	2	4.2	3.6	5.4	3.6	3.2	2.5	4.9	4.3	3.2	2.8	1.67
	NEMA Std	100	100	100	100	100	100	100	100	100	100	100	100
Oil & Grease (mg/L)	Kalange-Makwanzi	0.6	0.1	0	0.02	0.08	0.04	0.06	0.07	0.1	0.17	0.18	0.12
	Mid section of the Reservoir										0.21	0.17	0.14
	Buyala-Kikubamutwe	0.9	0.8	0	0.06	0.52	0.08	0.08	0.08	0.13	0.22	0.18	0.1
	NEMA Std	10	10	10	10	10	10	10	10	10	10	10	10

The mean concentrations of dissolved oxygen at Kalange-Makwanzi (Upstream Transect) and Buyala-Kikubamutwe (Downstream Transect) were comparable over the monitoring period (Table 3.1.1). Spatial variations of the physical-chemical parameters along the transects were slight and above the permissible National Environment Management Authority (NEMA) lower limit of 3 mgL^{-1}, which is the minimum concentration required for survival of most aquatic organisms including fish.

The mean pH was neutral (7.0) at Kalange-Makwanzi, weakly alkaline in the mid reservoir (7.5) and at Buyala-Kikubamutwe (7.2); and was within the NEMA permissible range of 6 to 8. Water temperatures were slightly higher than those of September 2012 but within the permissible NEMA range of 20ºC to 35ºC.

Electrical conductance was within a narrow range (101.4 to 101.6 μS/cm). This slight variation in electrical conductance was within values recorded for unpolluted sites of Lake Victoria waters (i.e. ≤ 120μS/cm). Water clarity ranged between 1.62 m in the mid reservoir and 1.72 m at Kalange-Makwanzi. This range was higher than the values recorded in September 2012. At all sites, the concentration of Total Suspended Solids (TSS) were about twice less than what was noted in September 2012. Least concentration of TSS (1.50 mg/L) was recorded in the mid reservoir due to longer residence time that allows TSS to settle. Despite the observed variation, the concentration of TSS was far below the permissible NEMA standard of 100 mg/L. The concentration of oil and grease at all sites was less than what was observed in September 2012 (range 0.10 to 0.14 mg/L) at the three sampling zones, and remained far below the NEMA permissible upper limit of 10 mg/L.

Vertical profiles for the water column temperature, dissolved oxygen and conductivity in the mid reservoir were determined using a CTD profiler at three separate locations (code named 1, 2 & 3) that varied in depth (Figure 3.1.1).

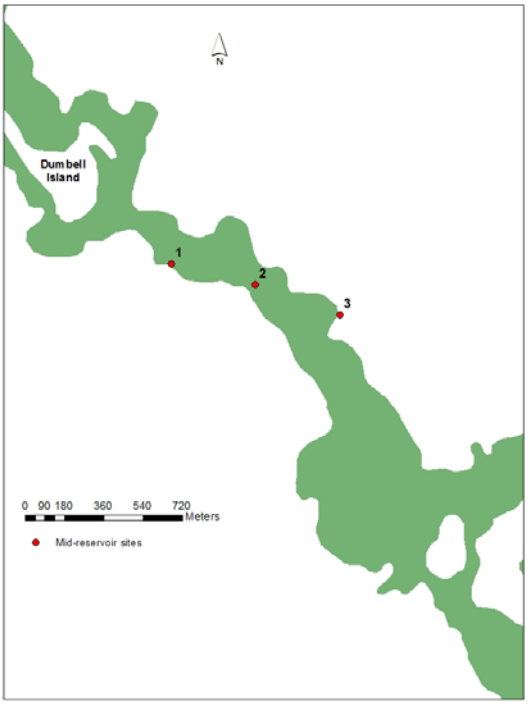


Figure 3.1.1 *Sampled points (1, 2, 3) on the section of the river where depth profiles of temperature, dissolved oxygen and conductivity were taken*. (*NB: Base map used was before dam construction*)

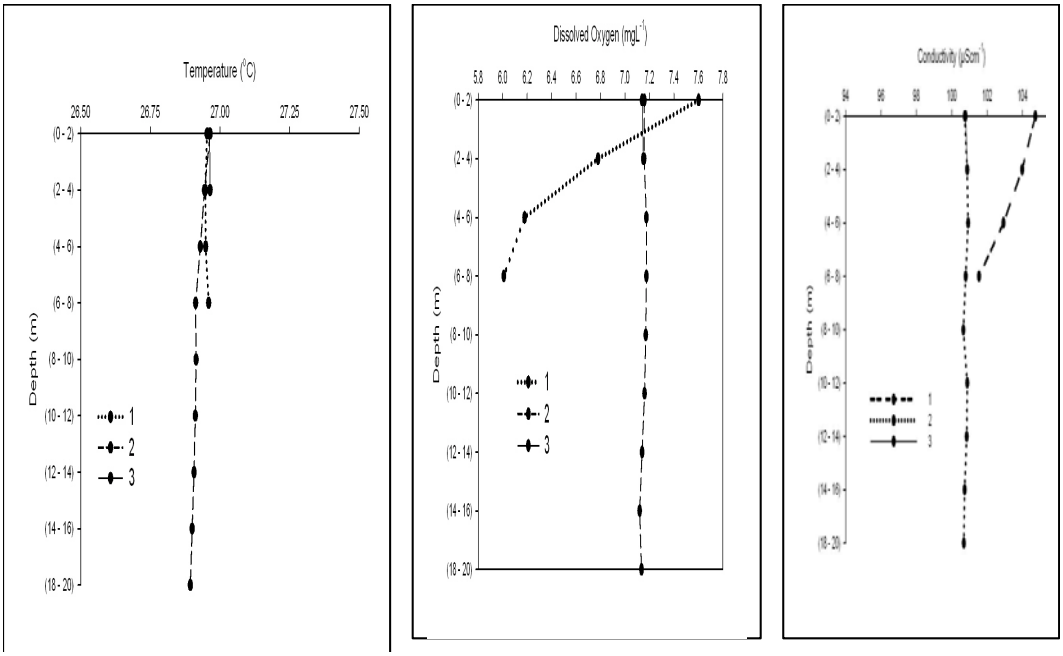


Figure 3.1.2 *Vertical profiles of some physico-chemical parameters in the BEL reservoir*

The deepest points sampled in the mid reservoir were in the range of 18 to 20m, while those in the shallow zones were 2 to 8m deep. Surface waters were relatively warmer

than bottom zones and the deeper zones were relatively cooler than the shallower ones. Deeper waters were relatively more homogenous with reference to temperature compared to the shallower peripheral zones. In the deeper zone, the thermocline (temperature discontinuity) was in the depth range of 6 to 8 m. The water column, irrespective of the zones sampled, was well oxygenated, with the lowest concentration being 6 mg/L of dissolved oxygen in the eastern zone of the reservoir. Surface waters were relatively more oxygenated compared to bottom waters. Additionally, the middle zone had a more homogeneous distribution of dissolved oxygen along the water column compared to the peripheral zones of the reservoir. This implies the reservoir had the capacity to sustain biotic organisms that require ample concentrations of oxygen. Due to the short codes of the pH probe, it was not possible to determine profiles of this parameter along the water column of the reservoir

3.1.2 Nutrient (nitrogen, phosphorus and silica) concentrations in water

The concentration of ammonium-nitrogen (NH_4-N) remained low, with narrow deviations at the three zones ie range 6.1 – 7.6 μg/L (Table 3.1.2). Throughout the monitoring period, the concentration of NH_4-N has remained far below the NEMA permissible upper limit of 10,000µg/L. The concentration of nitrite-nitrogen (NO_2-N) has been low throughout the sampling periods due to the rapid oxidation of the nitrite species to nitrate-nitrogen. However, the concentration during this reporting period was notably higher than any previous figures since April 2006 (range 10.5 – 10.6 μg/L). Nitrate-nitrogen (NO_3-N) concentration remained relatively lower than the permissible NEMA upper limit of 20,000μg/L, and slightly decreased in the downstream direction probably due to reduced flows hence enhanced uptake by algae. Mean concentration of Total Nitrogen (TN) was highest at Kalange-Makwanzi (1,853.7 ± 245 μg/L) and lowest in the mid reservoir (1,335.2±272 μg/L). All zones recorded less than the permissible NEMA upper limit of 10,000μg/L. During this April 2013 survey, the concentration of soluble reactive phosphorus (SRP) at all transects was more less similar and far below the permissible NEMA upper limit of 5,000 µg/L. Total Phosphorus (TP) concentration was highest at Kalange-Makwanzi (48.3 ± 6.8 μg/L) and lowest in the mid reservoir (33.9 ±7.6 μg/L). All transects had TP concentration that was much below the permissible NEMA upper limit of 10,000μg/L. The concentration of Soluble Reactive Silica (SRSi) reduced along the stream flow, with the highest mean concentration at Kalange-Makwanzi (309.4 ± 24.3 μg/L), while lowest mean at Buyala-Kikubamutwe (238.8 ± 24.7 μg/L). Algal biomass (Chlorophyll-a) was higher at Kalange-Makwanzi (10.2 ± 3.3 μg/L) and lowest in the mid reservoir (5.6 ± 0.8 μg/L). Although high algal biomass was theoretically expected in the mid reservoir, the low water clarity likely did not favour algal productivity.

Table 3.1.2 *Trends in mean concentrations of nutrients and algal biomass in water at upstream, Kalange-Makwanzi, mid of the reservoir and downstream, Buyala-Kikubamutwe*

Parameter	Site	Monitoring Dates											
		1	2	3	4	5	6	7	8	9	10	11	12
		Apr-06	Sept. 07	Apr-08	Apr-09	Oct-09	Apr-10	Sep-10	Apr-11	Sep-11	Apr-12	Sep-12	Apr-13
Ammonium Nitrogen, NH_4-N (μg/L)	Kalange-Makwanzi	42.3	20.2	79.4	88	186	137.2	75.3	58	1.5	8.7	11.4	7.59
	Mid section of the Reservoir										10.5	4.9	7.4
	Buyala-Kikubamutwe	29.5	24	97.9	79.4	137	111.8	68.2	45.8	2	10.6	3.2	6.11
	NEMA Std	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Nitrite-Nitrogen, NO_2-N (μg/L)	Kalange-Makwanzi	8.7	9.5	4	3.1	3	4.2	7.3	4.7	2.9	5.8	2	10.6
	Mid section of the Reservoir										6.3	2.8	10.6
	Buyala-Kikubamutwe	8.7	2.8	6.1	2.6	4	5.3	4.1	4.3	4	6.6	3.8	10.46
Nitrate-Nitrogen, NO_3-N (μg/L)	Kalange-Makwanzi	12.5	36	146.3	26.4	114	120.8	47.4	36.1	46.9	55.7	20.2	44.79
	Mid section of the Reservoir										50.4	18.4	54.72
	Buyala-Kikubamutwe	12.6	94	182.5	35	76	148.6	49.2	54.7	61.2	51.5	18.6	55.38
	NEMA Std	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total-Nitrogen, TN (μg/L)	Kalange-Makwanzi	1174	2093.5	1925	306.7	2,362	1047	666.7	2196.3	1471.1	1,817.60	2,382.70	1,853.70
	Mid section of the Reservoir										1,606.90	4,337.30	1,335.20
	Buyala-Kikubamutwe	1193	2138.8	2492	216.7	2,421	2992	597.3	2103.7	2450.3	1,464.70	2,485.10	1,594.47
	NEMA Std	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Total Phosphorus, TP (μg/L)	Kalange-Makwanzi	108.6	54.5	58.5	60.3	36	186.3	84.6	30.3	32.2	65.2	106.4	48.3
	Mid section of the Reservoir										41.8	107.6	33.9
	Buyala-Kikubamutwe	100.8	48.7	76.3	47.3	45	271.9	88.8	64.1	35.6	107.7	112.0	41.1
	NEMA Std	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Soluble Reactive Phosphorus, SRP (μg/L)	Kalange-Makwanzi	19	24.2	11.7	6.9	27	15.7	21.1	31.6	9.8	6.4	20.0	12.7
	Mid section of the Reservoir										7	17.6	12.7
	Buyala-Kikubamutwe	19.2	27.7	18.9	16.6	32	24.8	25.6	20	11.7	6.6	21.4	12.7
	NEMA Std	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Soluble Reactive Silica, SRSi (μg/L)	Kalange-Makwanzi	319.9	539.7	238.4	501.2	859	521.1	265.9	149.6	23.8	176.8	146.9	309.4
	Mid section of the Reservoir										268.1	268.5	256.8
	Buyala-Kikubamutwe	309.4	530.7	282.8	496.7	847	521.7	201.5	68.8	43.8	248.1	244.6	238.8
Chlorophyll-a (µg/L)	Kalange-Makwanzi										5.1	6.3	10.2
	Mid section of the Reservoir										5.6	10.1	5.6
	Buyala-Kikubamutwe										6	9.7	6

3.1.3 Algae and aquatic macrophytes/weeds

Algal species composition was variable at all transects (Table 3.1.3). Major taxa encountered were the blue-greens (Cyanophyta), greens (Chlorophyta) and the diatoms (Bacillariophyta). The mid reservoir had the least number of algal species (26) while Buyala-Kikubamutwe t had the highest (30).

Table 3.1.3 *Occurrence of major algal types and the number of species at the three sites, September 2012 and April 2013*

Taxonomic group	Kalange-Makwanzi		Mid section of the Reservoir		Buyala-Kikubamutwe	
	Sept.2012	Apr. 2013	Sept.2012	Apr. 2013	Sept.2012	Apr. 2013
Bluegreen (Cyanopytes)	9	15	20	14	19	18
Green (Chlorophytes)	4	8	7	8	7	7
Diatoms (Bacillariophytes)	4	4	6	3	2	5
Euglenophytes	0	0	1	0	1	0
Dinoflagellates	0	0	0	0	1	0
Total number of species	**17**	**27**	**34**	**25**	**30**	**30**

Table 3.1.4 *Major Algal types and species composition at the three sites, September 2012 and April 2013 (P denotes presence).*

Major algal types/species	Kalange-Makwanzi		Mid section of the Reservoir		Buyala-Kikubamutwe	
	Sept.2012	Apr. 2013	Sept.2012	Apr. 2013	Sept.2012	Apr. 2013
Bluegreen (Cyanopytes)						
Planktolyngbya limnetica		P	P	P	P	P
P.tallingii			P	P	P	
P.undulata			P		P	
P.contotum			P	P		
P.circumreta		P	P	P	P	P
Aphanocapsa sp	P		P		P	
Aphanocapsa nubilium		P		P		P
Aphanocapsa holistica		P		P		
Aphanocapsa elachista					P	P
Aphanocapsa incerta				P	P	
Aphanocapsa holistica	P				P	P
Aphanocapsa delicatissima	P	P	P	P	P	P
Cylindropermopsis africana		P	P	P	P	
Cylindropermopsis cuspis			P			
Cylindrospermopsis racibosskii			P			
Merismopedia teniussima	P	P	P	P	P	
Merismopedia gluaca	P	P	P		P	P
Merismopedia elegans		P		P		P
Microcystis aeruginosa		P		P		P
Pseudoanabeana			P			P
Chroococcus limneticus	P	P	P	P		P
Chroococcus turgidus	P		P			
Chroococcus aphanocapsiodes					P	
Chroococcus dispersus					P	
Cyanodyction spp		P		P		P
Ceolospherums .kt				P		
Ceolomoron sp	P		P			
Anabeanopsis tanganyikae	P	P				P
Anabeana sp					P	
Anabaena floa-saque		P		P		
Anabeana circinalis		P	P	P		P
Pico Blues			P			
Green (Chlorophytes)						
Actinastrum hantzschii				P		
Ankistrodesmus fusiformis		P	P			
Ankistrodesmus falcatus	P	P			P	P
Ankistrodesmus stegala			P			
Monoraphidium contortum			P		P	
Chodetella	P					
Crucigenia fenestrate						P
Kirchnriella obesa		P		P		P
Monorophidium contortum		P		P		P
Cosmorium sp			P		P	
Cloesterium spp				P		P
Stuarastrum sp		P	P	P	P	
Pediastrum simplex		P				P
Pediastrum duplex			P		P	
Scenedesmus acuminatus	P		P			
Scenedesmus perforatus		P		P		P
Scenedesmus curvatus					P	
Scenedesmus castato	P				P	P
Oocysistis borgi				P		
Diatoms (Bacillariophytes)						
Navicula gastrum				P	P	P
Nitzschia nyassae		P		P		
Nitzschia acicularis	P	P		P	P	P
Rhizosolenia victoriae	P				P	
Nitzschia fonticola		P	P	P	P	P
Synedra cunnigtonii	P	P		P	P	P
Cyclotella sp	P		P		P	
Euglenophytes						
Euglena acus			P			
Phacus sp					P	
Dinoflagellates						
Glenedinuim sp	P					

Unlike results of September 2012, during the April 2013 survey, Euglenophytes and Dinoflagellates were not encountered (Table 3.1.3 and Table 3.1.4).

Aquatic macrophytes

Due to increased water levels, most of the aquatic macrophytes that once existed along the shores of Kalange-Makwanzi have not recovered. Crops grown along the original river bank had withered due to flooding**.** Water hyacinth, a free floating waterweed, dominated the shores, with a cover abundance of 1ha at Nava and the rest of the sites (Mukikonko, Hudson and Kalange) had a cover abundance of less than 1ha. The duckweed (*Lemna minor*), another floating waterweed was also encountered but in rare occurrences with a cover abundance of < 0.03 ha. The emergent hippograss (*Vossia cuspidata*) was occasionally encountered and its cover abundance was < 0.04 ha. The common reed (*Phragmites* sp.) had a cover abundance of 0.0001 ha, water primrose (*Ludwigia peploides*) covered ~0.0002 ha, while Bermudagrass (*Cynodon dactylon*) covered ~ 0.12 ha. Due to the remarkable rise in the water level as a result of damming, in addition to increase in rain water, terrestrial plants/trees and crops that were along the river banks elsewhere in the reservoir, had withered due to submergence. The river banks were still devoid of most aquatic macrophytes other than water hyacinth that was occasionally encountered and covered approximately < 0.2 ha. Emergents such as *Cyperus papyrus* (0.001 ha)*, Vossia cuspidate* (0.006 ha)*, Ludwigia* sp. (0.003 ha), *Commelina banghalesis* (0.00 2ha) and *Cynodon dactylon* (0.002 ha) were rare.

At Buyala-Kikubamutwe transect, 60% of the river bank had been cultivated down to the highest water mark, and trees such as Eucalyptus had been grown thus leaving little room for establishment of both emergent and floating aquatic macrophytes. Despite this, *Vossia cuspidata* was the dominant aquatic macrophyte with the highest cover abundance (0.4 ha) at a site called Ofono, with the rest of the locations having a cover abundance of < 0.03 ha. Water hyacinth was occasionally encountered and its total cover abundance was < 0.02 ha in all locations. Dayflower (*Commelina banghalesis*), *Ludwigia* sp and *Cynodon dactylon* and were rare, with a cover abundance of < 0.003 ha.

3.2 Zooplanton (Water column micro-invertebrates)

Species diversity and distribution trends

The zooplankton community composition remained comparable with observations made earlier in April 2006, April 2012 and September 2012 (Table 3.2.1). As previously observed, the highest contributor of species richness/diversity in all the three sections of the study area (Kalange-Makwanzi, mid- reservoir and Buyala-Kikubamutwe) was Rotifera with 9, 12, 9 respectively compared with 7, 7,5 and 5,5,3 for Copepoda and Cladocera respectively. The mid reservoir area registered higher rotiferan taxa (12) compared to the other study areas. Copepoda and Cladocera showed comparable number of species in the upstream and downstream sections (7 and 5 respectively), which decreased to 5 and 3 respectively at the downstream site. On the other hand, total species richness increased from 21upstream to 24 in the reservoir, decreasing to 17 downstream.

The species distribution trends are comparable to those observed in April 2012 and September 2012 monitoring surveys; with the exception of lower total species numbers (15) in the upstream and downstream sites during the September 2012 survey which appears to have recovered in the present (April 2013) survey (Table 3.2.1).

Abundance patterns

The common copepod species with higher numerical abundance were *Thermocyclops neglectus* and *Tropocyclops tenellus*; a trend which is comparable to the April and September 2012 data (Table 3.2.1). Similarly, the three juvenile stages of copepods i.e. copepodites and nauplius larvae were common and consistently registered high abundance in the 3 study sites between April 2006 through April to September 2012. Copepoda and Rotifera registered peak abundance at the reservoir (Table 3.2.1) and total zooplankton abundance data followed a similar trend. While this trend was generally a repeat of the April 2012 data, it was quite different from the September 2012 data (Table 3.2.1). Cladoceran species abundance was always lower than that of both Copepoda and Rotifera (Table 3.2.1). The numerical abundance data indicates the dominant position of copepods at all the three study sites.

Table 3.2.1. *Numerical abundance (ind. m^{-2}) of zooplankton species at three sites of BEL, September 2012.*

Taxa	Species	Kalange-Makwanzi				Mid section of the Reservoir			Buyala-Kikubamutwe			
		Apr-06	Apr-12	Sep-12	Apr-13	Apr-12	Sep-12	Apr-13	Apr-06	Apr-12	Sep-12	Apr-13
Copepoda	*Thermocyclops incisus*		55			510			54	69		
	Mesocyclops sp.	555	217	173	339	225	63	505	77	361		55
	Thermocyclops emini	1,213	222	94	1,123		259	2,403	22	208		
	Tropocyclops confinnis	2,458	402	582	3,440	1,021	660	7,087	177	985	356	1,600
	Thermodiaptomus galeboides	3,649	1,586	550	1,255	827	1,218	4,087	423	1,156	451	1,077
	Thermocyclops neglectus	6,086	3,648	1,258	7,204	2,835	1,077	6,160	197	1,216	906	343
	Tropocyclops tenellus	8,585	4,498	1,336	11,497	4,871	762	11,147	1,201	5,927	802	5,636
	Cyclopoid copepodite	46,139	13,604	20,749	55,645	17,786	14,194	72,754	8,449	8,482	12,214	19,679
	Calanoid copepodites	6,808	1,401	1,808	4,436	2,843	2,122	9,234	531	1,724	859	2,487
	Nauplius larvae	109,016	56,689	17,165	110,662	72,696	14,108	229,029	27,844	25,701	12,670	99,546
Total copepods		**184,509**	**82,322**	**43,715**	**195,601**	**103,614**	**34,463**	**342,406**	**38,975**	**45,829**	**28,258**	**130,423**
Total copepod species		**6**	**7**	**6**	**7**	**6**	**6**	**7**	**7**	**7**	**4**	**5**
Cladocera	*Daphnia lumholtzi*								9			
	Daphnia longispina		42									
	Macrothrix sp.								20			
	Chydorid sp.	29				42			7	37		
	Daphnia lumhortzi (helm.)	243	23		108	14		36	17			
	Ceriodaphnia cornuta	58	23	63	1,118	147	181	584		203	89	45
	Diaphanosoma excisum	287	462		1,292	297	94	921		190	73	674
	Moina micrura	679	361	63	1,934	497	118	932	28	227	31	67
	Bosmina longirostris	859	254	31	444	330	212	564	213	319	110	
Total cladocerans		**2,155**	**1,165**	**157**	**4,896**	**1,327**	**605**	**3,037**	**294**	**976**	**303**	**786**
Total cladoceran species		**6**	**6**	**3**	**5**	**6**	**4**	**5**	**6**	**5**	**4**	**3**
Rotifera	*Asplanchna* sp.					22	55					
	Ascomorpha sp.					42	24					
	Euclanis sp.	19		16		28	24	225		14		90
	Brachionus falcatus				45	33		90	11			
	Filinia longiseta	116	23		264	42	16	797				355
	Polyarthra sp.	204					79					
	Filinia opoliensis	19	37		145	180	39	712			16	225
	Brachionus forticula				135							
	Brachionus bidentatus							34				
	Brachionus calyceforous	165	18	79		14	39		68	37		135
	Keratella cochlearis	173	74			164	24	258	30	83	16	
	Trichocerca cylindrica	105	92	267		333	487	292	13		168	262
	Brachionus angularis	213	46		90	164	55		95	97	131	
	Hexathra sp.				45			67				
	Lecane bulla	289	379	534	835	732	409	2,439	79	166	419	337
	Lecane luna							1,880				269
	Synchaeta sp.	617	587	550	853	644	487	1,758	42	291	634	748
	Keratella tropica	565	240	346	1,506	752	330	3,734	659	647	346	1,054
Total rotifers		**2,485**	**1,496**	**1,792**	**3,918**	**3,150**	**2,068**	**12,286**	**997**	**1,335**	**1,730**	**3,475**
Total rotiferan species		**11**	**9**	**6**	**9**	**13**	**13**	**12**	**8**	**7**	**7**	**9**
Total abundance		**189,149**	**84,983**	**45,664**	**204,415**	**108,091**	**37,136**	**357,729**	**40,266**	**48,140**	**30,291**	**134,684**

The community composition data for the four study periods (April 2006, April 2012, September 2012 and April 2013 indicates occurrence of nearly the same species belonging to the three taxonomic categories (Copepoda, Cladocera and Rotifera). The species assemblage is generally similar to that of Lake Victoria where the River Nile originates. Comparison of the pre- and post- reservoir composition data indicates that not a single species may have been lost since the creation of the reservoir, which means continuity of stable environment conditions (at least for the zooplankton community). Rotifera takes species richness precedence over other zooplankters in the near-shore areas of the lake (Mwebaza-Ndawula *et al.* 2003) and therefore it is not surprising that this role

in still maintained in the three study areas (Table 3.2.1). The data shows rotifer-driven species richness attaining peak numbers in the mid reservoir (Table 3.2.1), an area representing more quiescent conditions and with most likely greater residence time. The data therefore demonstrates the stability of the zooplankton community over time (years of study) and space (the 3 study sites) despite radical transformation involving creation of the reservoir heralding change from riverine (running water) to a more or less lake (standing water) conditions (although a fair amount of flow- through is retained).

It is clear that zooplankton densities in the entire study site are driven by copepods, in particular, Cyclopoid copepods. The most contributing species and groups have remained the same over the survey years, namely *Thermocyclops neglectus, Tropocyclops tenellus* and the two juvenile stages of Copepoda: copepodites and nauplius larvae (Table 3.2.1). These observations do not deviate to those made in Lake Victoria and earlier work in Upper Victoria Nile (Mwebaza-Ndawula *et al*. 2005). As is the case with species richness, the peak abundance is attained in the reservoir (Table 3.2.1) as shown by data from the last three surveys (April 2012, September 2012, April 2013) since the reservoir was created. The data therefore indicates that the reservoir is an ecologically rich environment which can sustain both high species diversity and density (of zooplankton). Both these attributes are key drivers of fishery production, which is one of the expectations from creation of the reservoir. In Lake Victoria, high and sustained abundance of cyclopoid copepods have been shown to sustain a key pelagic and commercial fish species, *Rastrineobola argentea* a (Mwebaza-Ndawula 1998) which also exists in Upper Victoria Nile.

3.3 Benthic macro-invertebrates

Table 3.3.1 *Trends of benthic density and number of species of macroinvertebrates at upstream-Kalange-Makwanzi, mid section of the reservoir and downstream, Buyala-Kikubamutwe*

Taxa	Species	Kalange-Makwanzi						Mid section of the Reservoir			Buyala-Kikubamutwe					
		Apr-06	Sep-07	Apr-08	Apr-12	Sep-12	Apr-13	Apr-12	Sep-12	Apr-13	Apr-06	Sep-07	Apr-08	Apr-12	Sep-12	Apr-13
Gastropoda (Water snails)	*Bellamya unicolor*	33	173	5	33					4	98	126	11	42	65	285
	Melanoides tuberculata	28	107	257	14	19	5			77	33	224	100	121	33	33
	Biomphalaria choanomphala		14	5				2				19	11		5	
	Anisus natalensis													5		
	Gyraulus sp.				5											47
	Segmentorbis sp.								3					47	9	23
	Gabbia humerosa		79	5			5			4			121	1,027	677	135
	Bulinus sp	5	9	5							5	5	5		19	65
	Choanomphala			14				2		4		19	11		5	9
	Pila ovata		5	5				7					5			5
Total Gastropoda density		**66**	**387**	**296**	**52**	**19**	**10**	**11**	**3**	**89**	**136**	**393**	**264**	**1242**	**813**	**602**
Number of Gastropod species		**3**	**6**	**6**	**3**	**1**	**2**	**2**	**1**	**4**	**3**	**4**	**6**	**5**	**6**	**8**
Bivalvia (Clams/mussels)	*Byssanondota parasitica*	79	145	252	61	75	42	23	95	686		19	63	317	9	117
	Corbicula africana	56	126	182	47	219	514	5	25	196	65	131	205	65	28	79
	Caelatura sp	149	93	229	79	79	47	9	20	28	37	61	63	37	5	5
	Pisidium victoriae		5			9							32	19	5	
	Mutela sp				5	5					5	5	16			
	Sphaerium victoriae	5	51	14				2				19		23		
	Sphaerium stuhlmanni				9			5	146	18				9	5	
	Aspantharia sp	9	9	5	5	5	5				5					
	Etheria eliptica												5	5		
Total Bivalvia density		**298**	**429**	**682**	**206**	**392**	**608**	**44**	**286**	**928**	**112**	**235**	**384**	**475**	**52**	**201**
Number of Bivalvia species		**4**	**5**	**4**	**5**	**6**	**4**	**4**	**4**	**4**	**3**	**4**	**5**	**6**	**5**	**3**
Diptera (Midge larvae)	Chironominae	271	331	238	201	47	117	201	73	98	84	56	58	84	9	75
	Tanipodinae	19	33	23	5	14	33		8	42	23	42	5	26		14
	Chaoborus sp	9	23	9	9		28			53	5	5		65		
	Ceratopogonidae	5	14		65							5				
Total dipteran density		**304**	**401**	**270**	**280**	**61**	**178**	**201**	**81**	**193**	**112**	**108**	**63**	**175**	**9**	**89**
Number of dipteran types		**4**	**4**	**3**	**4**	**2**	**3**	**1**	**2**	**3**	**3**	**4**	**2**	**3**	**1**	**2**
Oligochaeta (water worms)	*Nais sp*		5	5	14					11		33	11	9		
Ostracoda (seed shrimps)								229								
Hirudinea (Leeches)															5	
Decapoda (Fresh water shrimps)	*Caridina nilotica*		5		5			7	3			5	32			
Ephemeroptera (May Flies)	*Povilla adusta*	19	163	9	28		14	5	3	144	5	9	63	28	5	37
	Baetis sp.	5	9	0	0				3		23	5			5	
	Caenis sp.	19	75	19	5					7		9	26	37	9	313
	Cloeon sp.										37				9	9
	Leptophlebidae		14													5
	Trichorythidae		89											5		19
Total Ephemeroptera density		**43**	**350**	**28**	**33**	**0**	**14**	**5**	**6**	**151**	**65**	**23**	**89**	**70**	**28**	**383**
Number of ephemeropteran types		**3**	**5**	**2**	**2**	**0**	**1**	**1**	**2**	**2**	**3**	**3**	**2**	**2**	**4**	**5**
Odonata (Dragon/damsel Flies)	*Hagenius sp.*	19		9		5			3		5			5	5	
	Gomphoides sp.	5		5								19				
	Libellulidea	9	33	0	5		14	2		18		5	37	5	5	14
	Coenagrion sp.										5		5			
	Protoneuridae		9	9												
Total odonates density		**33**	**42**	**23**	**5**	**5**	**14**	**2**	**3**	**18**	**10**	**24**	**42**	**10**	**10**	**14**
Number of odonate types		**3**	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
Trichoptera (Caddis Flies)	Hydropsychidae											19	16	5		9
	Brachycentridae													2		
	Psychomyiidae		2				5		3	4				5		
	Leptoceridae						5					2	3			5
Total Tricoptera density			**2**				**10**		**3**	**4**		**21**	**19**	**12**		**14**
Number of tricopteran types			**1**				**2**		**1**	**1**		**2**	**2**	**3**		**2**
Hemiptera (True bugs)	Nepidae	0	0	5	0											
Coleoptera (Beetles)	Elmidae	0	5	0	0											
Total benthic macro-invertebrate density (ind.m-2)		**744**	**1626**	**1309**	**595**	**477**	**834**	**499**	**385**	**1394**	**435**	**842**	**904**	**1993**	**917**	**1303**

The water snails abundance at Kalange-Makwanzi transect have declined since the reservoir was established. In the previous September survey, only one snail species, *Melanoides tuberculata* was encountered. In the current one (April 2013), two species (*M. tuberculata* and *Gabbia humerosa*) were recorded at a very low density of 5 ind.m^{-2} (Table 3.3.1). Snail density (10 ind.m^{-2}) was lowest at Kalange-Makwanzi, increased to 89 ind.m^{-2} in the mid reservoir and peaked at Buyala-Kikubamutwe (602 ind.m^{-2}).

Unlike water snails, the density of bivalves has increased since establishment of the reservoir. At Kalange-Makwanzi, density increased from 392 ind.m^{-2} in September 2012 to 608 ind.m^{-2} in April 2013. During the same period, density in the mid reservoir rose from 286 to 928 ind.m^{-2} while at Buyala-Kikubamutwe, it increased from 52 to 201 ind.m$^{-2.}$

For the insect types, mayfly nymph's density was highest (383 ind.m^{-2}) at Buyala-Kikubamutwe with Caenis *sp* as the most dominant by 82%. In the mid reservoir, P. *adusta* density has increased from 3 ind.m^{-2} in September 2012 to 144 ind.m^{-2} in April 2013. During the April 2013 survey, the midge larvae density was 193 ind.m^{-2} in the mid reservoir, 178 ind.m^{-2} at Kalange-Makwanzi and just 89 ind.m^{-2} at Buyala-Kikubamutwe. The density of these midge larvae has increased at all transects from the previous survey, September 2012 (Table 3.3.1). Between September 2012 and April 2013, total benthic macro-invertebrate density has increased from 477 to 834 ind.m^{-2}at Kalange-Makwanzi, 385 to 1394 ind.m^{-2}in the mid reservoir and 917 to 1303 ind.m^{-2}at Buyala-Kikubamutwe respectively.

3.4 Fish Species Composition and Relative Abundance

3.4.1 Catch composition

During this monitoring survey, 11 fish species (haplochromines taken as a single taxon) were recorded at the three transects along the river compared to 12 in September 2012, 11 in April 2012, 8 in September 2011 and 10 in April 2011 (Table 4.1). Eight species were recorded respectively at the upstream station- Kalange and in the mid reservoir. Downstream at Buyala, 7 species were recorded.

Keystone species (*Lates niloticus, Oreochromis niloticus, Barbus altianalis, Mormyrus kannume* and the haplochromines) were recovered during this survey. The Nile perch (*L. Niloticu)s*, elephant snout fish (*M. kannume*) and *Synodontis afrofischeri* were recovered at the three transects. The tilapiine, *Oreochromis variabilis;* the African catfish, *Clarias gariepinus* and *Synodontis victoriae* were each recovered at only Kalange transect.

The native tilapiine *O. variabilis* has persisted at the upstream transect Kalange. The highest densities of fish by numbers were at the upstream transect Kalange where 67% of the fish were caught, 12% in the main reservoir and 19% at Buyala transect. The haplochromines which have been dominant by numbers at all stations, were overtaken by *S. afrofischeri* both upstream and downstream while *M. kannume* dominated in the mid reservoir just like in the September 2012 monitoring survey. By weight, *S. afrofischeri*

was dominant upstream, *Bagrus docmak* in the mid reservoir and *B. altianalis* downstream.

Species recovered from all gears were, 8 (8, 8, 8, 8, 7) species were recorded at Kalange Transect 8 (7, 10) in the mid reservoir and 7 (7, 8, 5, 4, 10) at Buyala Transect (Numbers in brackets are for the number of species caught during the September 2012, April 2012, September 2011, April 2011 and September 2010 surveys respectively).
From all gears, 8 (8, 8, 8, 7) species were recorded at Kalange (Transect 1) 7 (10) in the main reservoir and 7 (8, 5, 4, 10) at Buyala (Transect 2) (Numbers in brackets are for the number of species caught during the April 2012, September 2011, April 2011 and September 2010 surveys respectively).

3.4.2 The Haplochromines

Six species belonging to 4 genera were recovered during this survey (Table 4.2). The Buyala transect yielded 5 species while the Kalenge transect had 3 species. In the mid reservoir, 2 species were recorded unlike in September 2012 when none was recovered. During the current monitoring, Buyala transect recorded the highest diversity and abundance but over the last 6 surveys, Kalange transect had the richest haplochromine community. The most common species were *Astatotilapia brownae* contributing 56.8% followed by *Astatotilapia sp* contributing 25% and *Astatotilapia "purple dorsum"* contributing 9.6%. Others contributed less than 5%.

Table 3.4.1 *Fish species recorded overtime at upstream (Kalange-Makwanzi), mid of the reservoir and downstream (Buyala-Kikubamutwe) transects.*

Family names	Scientific names	English names/local names (Luganda)	Sites	Monitoring Dates											
				1	2	3	4	5	6	7	8	9	10	11	12
				Apr. 2006	Sep 2007	Apr. 2008	Apr. 2009	Oct. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2011	Apr. 2012	Sep. 2012	Apr. 2013
Bagridae	*Bagrus docmak*	Catfish/(Semutundu)	Kalange-Makwanzi		P			P							
			Mid section of the Reservoir										P	P	P
			Buyala-Kikubamutwe		P		P								P
Centropomidae	*Lates niloticus*	Nile perch/Mputa	Kalange-Makwanzi	P	P	P	P	P	P	P	P	P	P	P	P
			Mid section of the Reservoir										P	P	P
			Buyala-Kikubamutwe	P	P	P	P	P	P	P	P	P	P	P	P
Characidae	*Brycinus jacksonii*	(Nsoga)	Kalange-Makwanzi												
			Mid section of the Reservoir												
			Buyala-Kikubamutwe	p											
	B. sadleri	(Nsoga)	Kalange-Makwanzi	p											
			Mid section of the Reservoir												
			Buyala-Kikubamutwe												
Cichlidae	*Oreochromis niloticus*	Nile tilapia/(Ngege -kibati)	Kalange-Makwanzi	P	P	P		P			P	P	P		
			Mid section of the Reservoir												P
			Buyala-Kikubamutwe	P	P	P	P	P		P			P	P	P
	O. leucostictus	Black tilapia/(Ngege)	Kalange-Makwanzi	P	P										
			Mid section of the Reservoir												
			Buyala-Kikubamutwe	P	P		P								
	O. variabilis	Tilapia/(Ngege)	Kalange-Makwanzi	P	P	P	P	P	P	P	P		P	P	P
			Mid section of the Reservoir										P		
			Buyala-Kikubamutwe	P	P		P			P	P	P	P		
	Tilapia zillii	Red-belly tilapia/(Ngege)	Kalange-Makwanzi	P	P	P	P	P	P	P	P		P	P	P
			Mid section of the Reservoir										P		P
			Buyala-Kikubamutwe	P	P	P	P	P		P			P	P	
	Haplochromines	(Nkejje)	Kalange-Makwanzi	P	P	P	P	P	P	P	P	P	P	P	P
			Mid section of the Reservoir										P		P
			Buyala-Kikubamutwe	P	P	P	P	P	P	P	P	P	P	P	P
Clariidae	*Clarias gariepinus*	Mudfish/ (Male)	Kalange-Makwanzi			P	P							P	P
			Mid section of the Reservoir										P	P	
			Buyala-Kikubamutwe			P	P		P			P			
Cyprinidae	*Barbus altianalis*	Barbel fish/ (Kisinja)	Kalange-Makwanzi	P	P	P	P		P				P		
			Mid section of the Reservoir										P	P	P
			Buyala-Kikubamutwe	P	P	P	P		P	P		P	P		P
	B. paludinosus	Barbel fish/ (Kisinja)	Kalange-Makwanzi												
			Mid section of the Reservoir												
			Buyala-Kikubamutwe	P											
	Labeo victorianus	(Ningu)	Kalange-Makwanzi												
			Mid section of the Reservoir												
			Buyala-Kikubamutwe		P					P					
	Rastrineobola argentea	Silver fish/(Mukene)	Kalange-Makwanzi							P					
			Mid section of the Reservoir												
			Buyala-Kikubamutwe	P	P		P			P					
Cyprinodontidae	*Aplocheilichthys pumilus*	Gambusia	Kalange-Makwanzi												
			Mid section of the Reservoir												
			Buyala-Kikubamutwe		P										
Lepidosirenidae	*Protopterus aethiopicus*	Lung fish (Mamba)	Kalange-Makwanzi						P						
			Mid section of the Reservoir												
			Buyala-Kikubamutwe				P								
Mochokidae	*Synodontis afrofischeri*	Tiger fish (Nkolongo)	Kalange-Makwanzi	P	P	P	P	P	P	P	P	P	P	P	P
			Mid section of the Reservoir										P		P
			Buyala-Kikubamutwe		P	P	P	P	P	P		P	P	P	P
	S. victoriae	Tiger fish (Nkolongo)	Kalange-Makwanzi			P		P	P		P			P	P
			Mid section of the Reservoir										P	P	
			Buyala-Kikubamutwe											P	
Mormyridae	*Mormyrus kannume*	Elephant snout fish (Kasulubana)	Kalange-Makwanzi	P	P	P	P	P	P	P	P	P	P	P	P
			Mid section of the Reservoir										P	P	P
			Buyala-Kikubamutwe	P	P	P	P	P	P	P	P	P	P	P	
Total No. of species			Kalange-Makwanzi	10	10	10	8	9	9	7	8	5	8	8	8
			Mid section of the Reservoir										10	7	8
			Buyala-Kikubamutwe	11	13	8	12	6	6	10	4	7	8	7	7

Table 3.4.2 *Haplochromine species recorded over time at the upstream (Kalange – Makwanzi) mid of the reservoir and downstream (Buyala – Kikubamutwe) transects*.

Genus	Species name	Site	Monitoring dates											
			1	2	3	4	5	6	7	8	9	10	11	12
			Apr. 2006	Sep. 2007	Apr. 2008	Apr. 2009	Sep. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2011	Apr. 2012	Sep. 2012	Apr. 2013
Astatoreochromis	*A. alluaudi*	Kalange-Makwanzi	P	P	P	P	P	P	P	P	P	P	P	P
		Mid section of the Reservoir												
		Buyala-Kikubamutwe	P	P	P	P	P			P				
Astatotilapia	*A. brownae*	Kalange-Makwanzi	P	P	P	P	P	P	P	P	P	P	P	P
		Mid section of the Reservoir										P		
		Buyala-Kikubamutwe		P	P	P	P	P	P	P	P	P	P	P
	A. "cylindrical"	Kalange-Makwanzi			P									
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
	A. "elongate"	Kalange-Makwanzi	P	P	P	P	P	P	P					
		Mid section of the Reservoir										P		
		Buyala-Kikubamutwe			P		P				P			
	A. "purple dorsum"	Kalange-Makwanzi		P								P		
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												P
	A. "red dorsum"	Kalange-Makwanzi				P	P		P		P		P	
		Mid section of the Reservoir												
		Buyala-Kikubamutwe					P	P	P					
	Astatotilapia sp.	Kalange-Makwanzi			P	P	P			P				P
		Mid section of the Reservoir												P
		Buyala-Kikubamutwe		P	P	P	P				P			P
Gaurochromis	*Gaurochromis sp*	Kalange-Makwanzi		P										
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
Haplochromis	*H. lividus*	Kalange-Makwanzi									P			
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
Harpagochromis	*H. guiarti*	Kalange-Makwanzi	P	P	P	P	P		P	P	P	P		
		Mid section of the Reservoir												
		Buyala-Kikubamutwe	P		P	P	P		P			P	P	
	H. serranus	Kalange-Makwanzi												
		Mid section of the Reservoir												
		Buyala-Kikubamutwe	P											
Labrochromis	*L. humilior*	Kalange-Makwanzi		P										
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
Lithochromis	*Lithochromis sp*	Kalange-Makwanzi		P		P	P							
		Mid section of the Reservoir												
		Buyala-Kikubamutwe					P							
Lipochromis	*L. microdon*	Kalange-Makwanzi					P							
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
	L. parvidens	Kalange-Makwanzi			P			P						
		Mid section of the Reservoir												
		Buyala-Kikubamutwe							P			P		
Mbipia	*M. mbipi*	Kalange-Makwanzi	P	P	P	P	P	P	P	P	P	P	P	
		Mid section of the Reservoir										P		
		Buyala-Kikubamutwe	P	P	P	P	P	P	P	P	P	P	P	
Neochromis	*N. "elongate"*	Kalange-Makwanzi										P		
		Mid section of the Reservoir												
		Buyala-Kikubamutwe						P						
	N. greenwoodi	Kalange-Makwanzi	P							P				
		Mid section of the Reservoir												
		Buyala-Kikubamutwe		P										
	N. rufocaudalis	Kalange-Makwanzi		P	P	P	P	P	P	P		P		
		Mid section of the Reservoir										P		
		Buyala-Kikubamutwe		P										
Paralabidochromis	*P. "black para"*	Kalange-Makwanzi				P			P			P		
		Mid section of the Reservoir												
		Buyala-Kikubamutwe			P						P			
	P. cyaneus	Kalange-Makwanzi												
		Mid section of the Reservoir												
		Buyala-Kikubamutwe	P											
	P. "earthquake"	Kalange-Makwanzi	P				P			P				
		Mid section of the Reservoir												
		Buyala-Kikubamutwe	P											
	P. flavus	Kalange-Makwanzi												
		Mid section of the Reservoir												
		Buyala-Kikubamutwe					P				P			
	P. rock kribensis	Kalange-Makwanzi					P				P			
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
	P. "scarlet anal"	Kalange-Makwanzi	P						P	P	P	P		
		Mid section of the Reservoir												
		Buyala-Kikubamutwe					P							
	P. "yellow"	Kalange-Makwanzi												
		Mid section of the Reservoir												
		Buyala-Kikubamutwe	P											
	Paralabidochromis sp	Kalange-Makwanzi	P											
		Mid section of the Reservoir												
		Buyala-Kikubamutwe	P	P	P									
Prognathochromis	*P. "shovel mouth"*	Kalange-Makwanzi	P	P			P	P	P	P	P			
		Mid section of the Reservoir												
		Buyala-Kikubamutwe				P			P			P	P	
Psammochromis	*P. aelocephalus*	Kalange-Makwanzi		P					P					
		Mid section of the Reservoir												
		Buyala-Kikubamutwe		P					P					
	P. riponianus	Kalange-Makwanzi	P	P	P	P	P		P	P		P	P	
		Mid section of the Reservoir												P
		Buyala-Kikubamutwe	P		P		P		P				P	P
Ptyochromis	*P. sauvagei*	Kalange-Makwanzi	P		P		P			P	P	P		
		Mid section of the Reservoir												
		Buyala-Kikubamutwe	P		P				P					P
Pundamilia	*P. "black"*	Kalange-Makwanzi		P	P	P	P	P	P	P	P			
		Mid section of the Reservoir												
		Buyala-Kikubamutwe					P	P						
	P. "orange anal"	Kalange-Makwanzi		P										
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
	P. igneopinnis	Kalange-Makwanzi										P		
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
	P. macrocephala	Kalange-Makwanzi										P		
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
	P. "orange tail"	Kalange-Makwanzi		P						P				
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
	P. pundamilia	Kalange-Makwanzi										P		
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
	P. "red tail"	Kalange-Makwanzi	P			P								
		Mid section of the Reservoir												
		Buyala-Kikubamutwe				P								
	Pundamilia sp	Kalange-Makwanzi		P										
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
Xystichromis	*X. phytophagus*	Kalange-Makwanzi	P			P		P	P					
		Mid section of the Reservoir												
		Buyala-Kikubamutwe									P			
Unindentified	Haplochromines	Kalange-Makwanzi				P								
		Mid section of the Reservoir												
		Buyala-Kikubamutwe												
Total Number of Species		Kalange-Makwanzi	15	16	12	14	16	9	14	15	11	14	4	3
		Mid section of the Reservoir										4		2
		Buyala-Kikubamutwe	11	8	10	9	12	5	9	3	6	4	8	5
		Total									14	17	8	6

3.2.3 Catch rates / biomass estimates

Catch rate (catch per net per night) was used as a proxy for relative abundance of fish. Catch rates by numbers (23.7 fish per net per night) were highest at Kalange and lowest (4.2 fish per net per night) in the mid reservoir (Table 4.1). By weight, rates were highest in the mid reservoir (1919.8 g) (Table 4.3). *S. afrofischeri* recorded the highest rates both by numbers (53.8 fish) and weight (1542.5 g) at Kalange. By weight, *B. docmak* (834.6 g) dominated in the mid reservoir followed by *L. niloticus* (532.3 g) while at Buyala transect *B. altianalis* dominated (407.7 g) followed by Haplochromines (226.3 g). Overall *S. afrofischeri* was dominant by numbers (19.3 fish) and by weight (550 g).

During the current monitoring survey, the mid reservoir recorded 2 haplochromine species compared to none in September 2012 and 4 species during April 2012 survey. The haplochromines that had been previously disturbed by the changes in the water habitats (from lotic to lentic) have started to recover. These environmental changes are also manifested in numbers and quantities of haplochromines recovered from the upstream transect Kalange. Only 3 haplochromine species were caught during this survey compared to 4 in September and 14 in April 2012.

Catch rates have started to increase 0.4 to 8.7 haplochromines per net per night. Catches were generally better upstream during this survey than the previous one. The overall catch rates increased from 1.3 to 23.7 fish at Kalange, 1.8 to 4.2 in the mid reservoir and 2.3 to 6.6 fish per net at Buyala. By weight, catches in the mid reservoir increased from 573 g to 1919 g during this survey. The presence of large sized species *L. niloticus, B. docmak, B. altianalis* and *M. kannume* contributed for the dominance by weight in the main reservoir.

3.2.4 Fish species recovery

Since the April 2010 survey, no new species has been added to the species list. The total number of species so far recorded has remained at 63. All large sized fish species expected at these transects have been recovered. The reservoir created has so far registered 13 species. Further colonisation of this reservoir by new species is to be monitored in subsequent surveys. The resurgence of the haplochromines in the main reservoir has been noted and should be monitored.

Table 3.4.3 *Catch rates (numbers) of fish species caught over time by gillnets at the upstream (Kalange-Makwanzi), mid of the reservoir and downstream (Buyala-Kikubamutwe) transects*

Family name	Scientific Species name	English names/local names (Luganda)	Site	Monitoring dates											
				1	2	3	4	5	6	7	8	9	10	11	12
				Apr. 2006	Sep. 2007	Apr. 2008	Apr. 2009	Sep. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2011	Apr. 2012	Sep. 2012	Apr. 2013
Bagridae	*Bagrus docmak*	Catfish/(Semutundu)	Kalange-Makwanzi		0.03			0.08							
			Mid section of the Reservoir										0.03	0.1	0.38
			Buyala-Kikubamutwe		0.07		0.04								0.08
Centropomidae	*Lates niloticus*	Nile perch/Mputa	Kalange-Makwanzi	0.19	3.1	3.32	2.3	9.76	0.32	0.58	1.13	0.15	2.83	0.5	1.62
			Mid section of the Reservoir										3.06	0.7	1.08
			Buyala-Kikubamutwe	1.12	1.68	1.86	2.29	2.57	0.35	0.4	0.16	0.72	0.83	0.2	0.85
Characidae	*Brycinus jacksonii*	(Nsoga)	Kalange-Makwanzi												
			Mid section of the Reservoir												
			Buyala-Kikubamutwe	0.04											
	B. sadleri	(Nsoga)	Kalange-Makwanzi	0.04											
			Mid section of the Reservoir												
			Buyala-Kikubamutwe												
Cichlidae	*Oreochromis niloticus*	Nile tilapia/(Ngege -kibati)	Kalange-Makwanzi	0.04	0.33	0.1		0.2			0.01	0.01	0.02		
			Mid section of the Reservoir												0.08
			Buyala-Kikubamutwe	0.07	0.41	0.04	0.04	0.1		0.1			0.19	0.04	0.38
	O. leucostictus	Black tilapia/(Ngege)	Kalange-Makwanzi	0.04	0.09										
			Mid section of the Reservoir												
			Buyala-Kikubamutwe	0.06	0.08										
	O. variabilis	Tilapia/(Ngege)	Kalange-Makwanzi	0.17	0.91	0.43	0.45	1.52	0.06	0.17	0.19		0.09	0.04	0.31
			Mid section of the Reservoir										0.03		
			Buyala-Kikubamutwe	0.13	0.08		0.17			0.02	0.02	0.03	0.03		
	Tilapia zillii	Red-belly tilapia/(Ngege)	Kalange-Makwanzi	0.1	0.17	0.17		0.17	0.04	0.1	0.13		0.09	0.09	0.13
			Mid section of the Reservoir										0.05	0.05	0.25
			Buyala-Kikubamutwe	0.88	0.46	0.04	0.43	0.1		0.04			0.16	0.16	
	Haplochromines	(Nkejje)	Kalange-Makwanzi	9	10.5	6.63	19	15.5	5.83	4.5	12.7	10.6	11.1	0.4	11.8
			Mid section of the Reservoir										0.25		0.5
			Buyala-Kikubamutwe	16.8	4.27	6.36	8.32	6.47	0.78	1.62	2.05	1.36	6.13	2.3	13.8
Clariidae	*Clarias gariepinus*	Mudfish/ (Male)	Kalange-Makwanzi			0.03	0.17							0.01	0.08
			Mid section of the Reservoir										0.02	0.03	
			Buyala-Kikubamutwe	0.01		0.25	0.07		0.03			0.02			
Cyprinidae	*Barbus altianalis*	Barbel fish/ (Kisinja)	Kalange-Makwanzi	0.02	0.1	0.17	0.03		0.01				0.02		
			Mid section of the Reservoir										0.06	0.1	0.38
			Buyala-Kikubamutwe	0.1	0.11	0.04	0.04		0.01	0.01		0.02	0.02		0.15
	Barbus paludinosus	Barbel fish/ (Kisinja)	Kalange-Makwanzi												
			Mid section of the Reservoir												
			Buyala-Kikubamutwe	0.04											
	Labeo victorianus	(Ningu)	Kalange-Makwanzi												
			Mid section of the Reservoir												
			Buyala-Kikubamutwe		0.09					0.02					
Lepidosirenidae	*Protopterus aethiopicus*	Lung fish (Mamba)	Kalange-Makwanzi						0.01						
			Mid section of the Reservoir												
			Buyala-Kikubamutwe				0.04								
Mochokidae	*Synodontis afrofischeri*	Tiger fish (Nkolongo)	Kalange-Makwanzi	0.21	0.63	0.08	0.42	1.46	0.46	0.33	0.13	0.38	4.75	1.8	53.8
			Mid section of the Reservoir										0.75		1.5
			Buyala-Kikubamutwe		0.27	1.09	0.37	3.58	0.28	0.1		1.07	0.06	3.7	2.5
	S. victoriae	Tiger fish (Nkolongo)	Kalange-Makwanzi			0.08		0.21	0.29		0.17			0.1	3.25
			Mid section of the Reservoir										0.05	0.04	
			Buyala-Kikubamutwe											0.1	
Mormyridae	*Gnathonemus longibarbis*	Kasulubana	Kalange-Makwanzi												
			Mid section of the Reservoir											0.04	
			Buyala-Kikubamutwe												
	Mormyrus kannume	Elephant snout fish (Kasulubana)	Kalange-Makwanzi	0.32	0.8	1.83	0.7	0.08	0.23	0.18	0.22	0.04	0.33	0.1	0.46
			Mid section of the Reservoir										0.82	0.9	1.46
			Buyala-Kikubamutwe	0.68	0.86	2.25	0.39	0.38	0.15	0.25	0.18	0.17	0.02	0.1	0.15
OVERALL RATES			Kalange-Makwanzi	2.89	5.48	4.39	7.54	10.01	2.87	2.41	4.54	3.36	8.2	1.3	23.6
			Mid section of the Reservoir										4.4	1.8	4.2
			Buyala-Kikubamutwe	6.45	3.28	3.91	3.71	4.28	0.81	1.21	0.95	1.5	3.1	2.3	6.6

Table 3.4.4 *Catch rates (weight (g) of fish species caught over time by gillnets at the Upstream,Kalange – Makwanzi; mid of the reservoir and downstream, Buyala-Kikubamutwe*

Family name	Scientific Species name	English names/local names (Luganda)	Site	Monitoring dates											
				1	2	3	4	5	6	7	8	9	10	11	12
				Apr. 2006	Sep. 2007	Apr. 2008	Apr. 2009	Sep. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2011	Apr. 2012	Sep. 2012	Apr. 2013
Bagridae	*Bagrus docmak*	Catfish/(Semutundu)	Kalange-Makwanzi		37.53			28.58							
			Mid section of the Reservoir										14.1	27.7	835
			Buyala-Kikubamutwe		22.50		0.6.93								13.8
Centropomidae	*Lates niloticus*	Nile perch/Mputa	Kalange-Makwanzi	15.75	271.27	371.00	114.13	250.84	49.44	35.86	11.6	8.6	156	63.3	141
			Mid section of the Reservoir										198	140	532
			Buyala-Kikubamutwe	108.21	107.79	159.07	111.00	171.43	28.81	39.28	16.4	44.5	30.2	18	36.8
Characidae	*Brycinus jacksonii*	(Nsoga)	Kalange-Makwanzi												
			Mid section of the Reservoir												
			Buyala-Kikubamutwe	3.25											
	B. sadleri	(Nsoga)	Kalange-Makwanzi	0.75											
			Mid section of the Reservoir												
			Buyala-Kikubamutwe												
Cichlidae	*Oreochromis niloticus*	Nile tilapia/(Ngege -kibati)	Kalange-Makwanzi	1.80	7.42	28.93		20.08			0.5	6.7	1.2		
			Mid section of the Reservoir												9.2
			Buyala-Kikubamutwe	4.53	0.18	3.93	0.93	5.05		0.83			5.8	1.7	205
	O. leucostictus	Black tilapia/(Ngege)	Kalange-Makwanzi	3.67	6.61										
			Mid section of the Reservoir												
			Buyala-Kikubamutwe	5.75	6.75										
	O. variabilis	Tilapia/(Ngege)	Kalange-Makwanzi	33.54	49.04	63.30	44.73	82.76	14.87	19.54	26.1		18.4	8.7	122
			Mid section of the Reservoir										1.7		
			Buyala-Kikubamutwe	11.58	12.08		8.17			4.04	11.5	13.6	8.1		
	Tilapia zillii	Red-belly tilapia/(Ngege)	Kalange-Makwanzi	6.92	15.65	21.65		7.92	7.71	32.17	21		10.1	2.8	18.8
			Mid section of the Reservoir										7.2		21.3
			Buyala-Kikubamutwe	81.85	19.08	7.33	42.26	7.90		2.71			6.1	2.1	
	Haplochromines	(Nkejje)	Kalange-Makwanzi	303.92	191.92	168.08	534.33	383.24	167.67	113.11	160	246	168	8.5	219
			Mid section of the Reservoir										4.1		22.5
			Buyala-Kikubamutwe	284.88	51.27	206.00	187.05	167.90	15.78	40.38	37.7	15.3	86.9	32.3	226
Clariidae	*Clarias gariepinus*	Mudfish/ (Male)	Kalange-Makwanzi			6.27	69.33							8.9	100
			Mid section of the Reservoir										9.4	48.7	
			Buyala-Kikubamutwe	9.20		52.93	89.36		33.58			3.1			
Cyprinidae	*Barbus altianalis*	Barbel fish/ (Kisinja)	Kalange-Makwanzi	19.27	403.33	501.13	7.27		2.31				0.6		
			Mid section of the Reservoir										51.3	199	266
			Buyala-Kikubamutwe	48.88	22.93	95.57	9.36		4.03	5.73		12.8	0.3		408
	Barbus paludinosus	Barbel fish/ (Kisinja)	Kalange-Makwanzi												
			Mid section of the Reservoir												
			Buyala-Kikubamutwe	0.50											
	Labeo victorianus	(Ningu)	Kalange-Makwanzi												
			Mid section of the Reservoir												
			Buyala-Kikubamutwe		38.91					14.80					
Lepidosirenidae	*Protopterus aethiopicus*	Lung fish (Mamba)	Kalange-Makwanzi						15.92						
			Mid section of the Reservoir												
			Buyala-Kikubamutwe				26.21								
Mochokidae	*Synodontis afrofischeri*	Tiger fish (Nkolongo)	Kalange-Makwanzi	10.92	49.50	4.58	14.92	56.79	59.63	18.75	7.2	28.8	61.1	64.2	1543
			Mid section of the Reservoir										15.6		62.5
			Buyala-Kikubamutwe		19.09	30.64	10.42	111.58	12.89	2.38		17.4	1.3	87.3	45
	S. victoriae	Tiger fish (Nkolongo)	Kalange-Makwanzi			12.50		17.92	39.33		28.1			7.3	278
			Mid section of the Reservoir										6.8	3.6	
			Buyala-Kikubamutwe											9.6	
Mormyridae	*Mormyrus kannume*	Elephant snout fish (Kasulubana)	Kalange-Makwanzi	110.16	250.47	511.47	95.75	14.72	49.01	77.49	39.7	7.5	44.5	27.7	114
			Mid section of the Reservoir										158	156	238
			Buyala-Kikubamutwe	217.37	89.54	175.64	185.00	51.62	9.22	33.36	15.6	15.9	1.3	7.8	209
OVERALL RATES			Kalange-Makwanzi	242.00	473.90	635.87	299.47	296.77	212.59	185.74	141	102	290	132	1116
			Mid section of the Reservoir										443	573	1920
			Buyala-Kikubamutwe	502.77	137.22	257.05	241.69	170.83	82.81	104.11	49.9	102	73	68.6	955

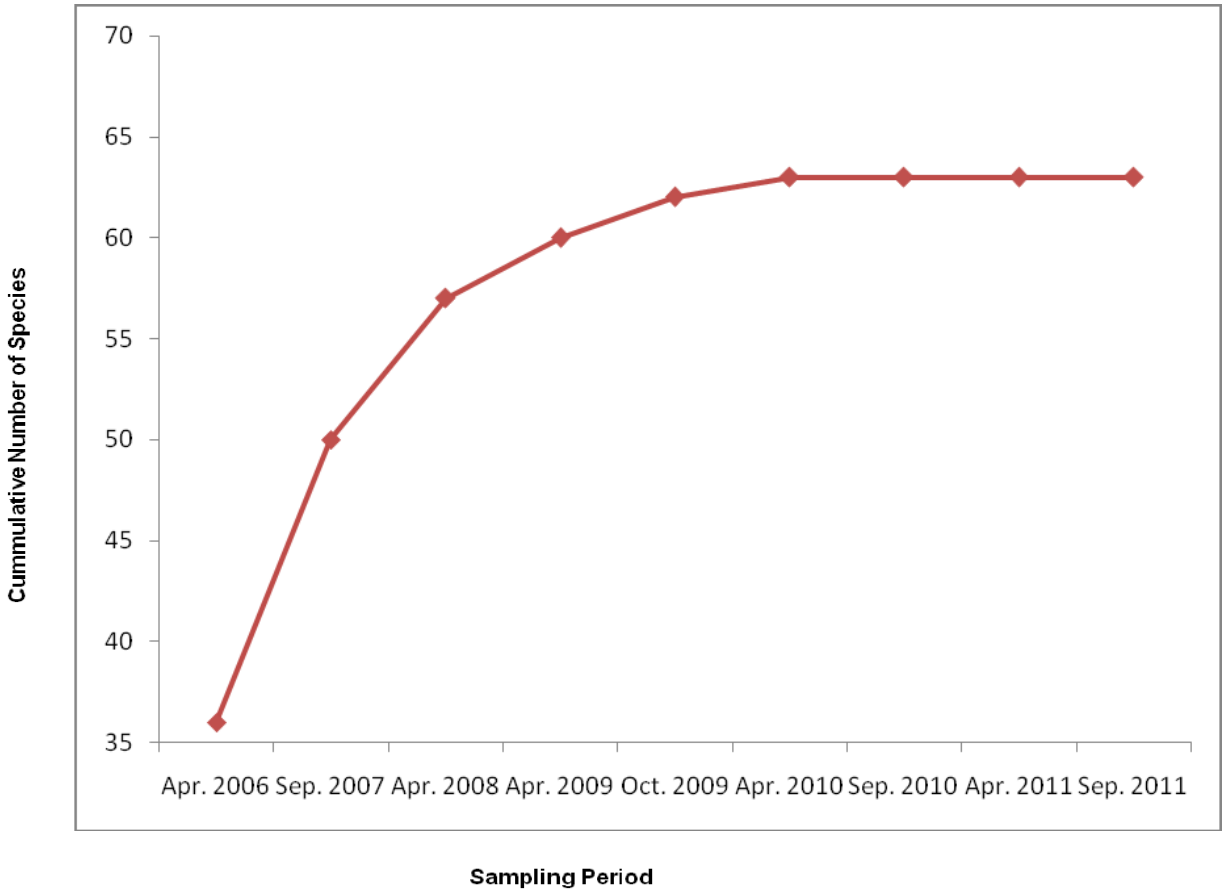


Figure 3.4.1 Cumulative *number of fish species recovered from the study transects on the Upper Victoria Nile between April 2006 and September 2012.*

3.5 The Food and Trophic Ecology of the Fishes

In April 2013 survey, the diet of *Lates niloticus* from Kalange transect was dominated by fish (54.9%) comprising of juvenile Nile perch (50.9%) and unidentifiable fish material (4.0%). Other prey items included insects (43.1%) and *Caridina nilotica* (2%). The results vary from those of September 2012 in which the food of Nile perch from the same transect was dominated by insects but are similar to those recorded in the previous surveys in which Nile perch diet comprised mostly of fish dominated by haplochromines.

At Buyala transect, fish (67.7%) dominated the diet of Nile perch in the survey of April 2013. The fish prey comprised of haplochromines (51.6%), *Rastrineobola argentea*-Mukene (3.2%) and unidentifiable fish material (12.9%). The non-fish prey comprised of Chironomid larvae (32.3%). The results differ from those recorded in the previous survey of September 2012 in which the diet of Nile perch was dominated by crabs in addition to fish and *Caridina* but are similar to those recorded in April 2012 in which, fish dominated by *R. argentea*, was the major prey item.

Fish, mostly Mukene (88.3%) dominated the diet of Nile perch in the mid reservoir during the survey of April 2013. Other prey items included *C. nilotica* (11.7%). The results differ from those recorded in the previous survey of September 2012 in which *C. nilotica* was the dominant prey of Nile perch but are similar to the observations recorded in the April 2012 survey.

Oreochromis variabilis was only recorded from Kalange transect and blue-green algae (60.9%) were the dominant food item in the survey of April 2013. Other food items included detritus (12.5%), green algae (3.8%), diatoms (8.8%), water plants (6.3%), rotifers (1.3%) insects (2.8%), rotifers (2.1%) and copepods (2.9%). The Dominance of blue-green algae in the diet of *O. variabilis* recorded from this transect was also observed in the previous surveys of April and September 2012.

In the survey of April 2013, *O. niloticus* was recorded from Kalange transect and in the mid reservoir. Chaoborids (78%) dominated the diet of this fish in the mid reservoir. Other food items included copepods (7%), detritus (7%), insect material (5%) and green algae (3%). At Buyala transect, the species ingested insects, mainly May fly nymphs. The results are similar to those obtained in September 2012 but vary from those of April 2012 in which the diet of *O. niloticus* at this transect was dominated by molluscs

Mormyrus kannume was recorded from all the three transects during the April 2013 survey. At Kalange transect, Ephemeroptera nymphs (48.1%) were the main food item of this fish followed by Odonata (33.5%) and chironomids (18.5%). In the mid reservoir, the diet of *M. kannume* comprised of chironomids (55.8%), Ephemeroptera (33.5%), *Caridina* (5.9%) and Trichoptera (4.8%). Insects were only food type identified from the guts of *M. kannume* from Buyala transect. The dominance of insects in the diet of *M.kannume* in the three transects was also observed in the survey of April and September 2013,

In the survey of April 2013, *S. afrofischeri* was recorded from all the three transects. At Kalange transect, the diet of the species comprised of insects dominated by chironomids (84.9%) and then Ephemeroptera (15.1%). In the mid reservoir, the species also had an insectivorous diet comprising of may fly nymphs (52%) and dragon fly nymphs (48%). May fly nymphs (66.7%), chironomids (30.7%) and molluscs (2.7%) were the food items recorded from the guts of *S. afrofischeri* at Buyala transect. Dominance of insects in the diet of the species was also observed in the previous survey of September 2013 in all transects.

Food of dominant fish species in the reservoir

In April 2013 survey, breeding intensity among the fish species examined was low. At Kalange transect, four out of the eight fish species examined showed signs of breeding and these included *M. kannume* (45.5%), *O. variabilis* (14.3%), *S. afrofischeri* (34.0%) and *S. victoriae* (30.6%). In the mid reservoir four out of the seven species recorded also showed signs of breeding at a low intensity. They included *M. kannume* (42.1%), *Bagrus docmac* (40.0%), S. *afrofischeri* (16.7%) and *L. niloticus* (7.1%). Breeding intensity was

highest at Buyala transect in which five out of seven species examined were breeding and they included *Barbus altianalis* (50%), *M. kannume* (100%), *O. niloticus* (60%) and *S. afrofischeri* (70%). A low breeding intensity was also observed in the previous surveys of April and September 2013.

Most of the specimens of *Lates niloticus* recorded from the experimental catches were found to be immature. Only one specimen of *L. niloticus* out of the one hundred specimens recorded from the Reservoir, was mature and breeding

Table 3.5.1 *Dominant food types of common fish species caught over time at the upstream (Kalange - Makwanzi), mid of the reservoir and downstream (Buyala-Kikubamutwe) Transects*

Family name	Secientific Species name	English/local (Luganda) name	Site	Monitoring dates											
				1	2	3	4	5	6	7	8	9	10	11	12
				Apr. 2006	Sep. 2007	Apr. 2008	Apr. 2009	Sep. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2011	Apr. 2012	Sep. 2012	Apr. 2013
Bagridae	*Bagrus docmac*	Semutundu	Kalange-Makwanzi (upstream of the reservoir)										FR		E
			Mid section of the Reservoir										SYN	CAR	SYN
			Buyala-Kikubamutwe (downstream)												
Centropomidae	*Lates niloticus*	Nile perch/ (Mputa)	Kalange-Makwanzi (upstream of the reservoir)	FR	HAP	HAP	HAP	FR	HAP	HAP	HAP	HAP	HAP	ODT	LN
			Mid section of the Reservoir										RAS	CAR	RAS
			Buyala-Kikubamutwe (downstream)	FR	CAR	FR	CAR	ODT	RAS	RAS	CHR	HAP	FR	CRB	HAP
Cichlidae	*Oreochromis niloticus*	Nile tilapia/ (Ngege-Kibati)	Kalange-Makwanzi (upstream of the reservoir)	E	HPM	BGA	HPM	E	E	DTR	IR	DETR	MOL		
			Mid section of the Reservoir												CHAO
			Buyala-Kikubamutwe (downstream)	E				E	DTR	E	DETR		INS	EPH	EPH
	O. variabilis	(Ngege)	Kalange-Makwanzi (upstream of the reservoir)	BGA	GRA	BGA	HPM	GRA	BGA	BGA	BGA	EPH	BGA	BGA	BGA
			Mid section of the Reservoir												
			Buyala-Kikubamutwe (downstream)	BGA	E		HPM				E	E	BGA		
	Tilapia zillii	Red-belly tilapia /(Ngege)	Kalange-Makwanzi (upstream of the reservoir)	MOL	HPM	E		E	IR	HPM	IR		EPH	E	HPM
			Mid section of the Reservoir										INS		E
			Buyala-Kikubamutwe (downstream)	HPM	CAR	E	HPM	E	HPM	HPM			EPH	HPM	
Clariidae	*Clarias gariepinus*	Mudfish/(Male)	Kalange-Makwanzi (upstream of the reservoir)			FR	FR				EPH			E	MOL
			Mid section of the Reservoir										EPH	EPH	
			Buyala-Kikubamutwe (downstream)			HAP	EPH		E			CHR			
Cyprinidae	*Barbus altianalis*	Barbelfish/(Kisinja)	Kalange-Makwanzi (upstream of the reservoir)	E	INS	INS	INS		MOL	E	IR	CHR	DETR		
			Mid section of the Reservoir										INS	MOL	MOL
			Buyala-Kikubamutwe (downstream)	E	INS	INS			E	MOL		CHR			MOL
Mochokidae	*Synodontis afrofischeri*	Tigerfish/(Nkolongo)	Kalange-Makwanzi (upstream of the reservoir)	CHR	EPH		CAR	CHR	EPH	CHR	EPH	INS	MOL	EPH	EPH
			Mid section of the Reservoir										INS		CHR
			Buyala-Kikubamutwe (downstream)		CHR	CHR	INS	CHR	INS	CHR		INS		EPH	INS
Mormyridae	*Mormyrus kannume*	Elephant Snoutfish/(Kasulubana)	Kalange-Makwanzi (upstream of the reservoir)	INS	EPH	EPH	INS	EPH	EPH	EPH		CHR	EPH	CHR	
			Mid section of the Reservoir										EPH	EPH	
			Buyala-Kikubamutwe (downstream)	INS	EPH	INS	EPH	CHR	CHR	INS	EPH	INS	E	ODT	

Food types: *HAP = Haplochromines, FR = Unidentifiable fish remains, CAR = Caridina nilotica, MOL = Mollusk, BGA = Blue-green algae, GRA = Green algae, EPH = Ephemeroptera, INS = Unidentifiable insect material, HPM = High plant material (water weeds), E = Empty stomachs, ODT = Odonata*

3.3.1 Maturity and Breeding

In April 2012 survey, the fish breeding intensity in Transect 1was lower (3 out of 8 species) when compared to observations of September 2011 survey in which five fish species out of the seven encountered in the transect were in breeding condition (Table 3.3.2). In *O. niloticus, O. variabilis*, *B. altianalis*, S. *afrofischeri* and *M. kannume*, the proportion of breeding adults was high (>50%) in comparison to the other species examined in the same transect. In Transect 2 no breeding was observed in the in the six species encountered in the survey of April 2012 although in the survey of September 2011I breeding was recorded in three species (*S. afrofischeri, B. altianalis* and *O.variabilis*) out of the six species examined. Higher breeding intensity in the Upstream when compared to the Downstream transect was also observed in the previous surveys of April 2011 and September 2011. All the specimens of *Lates niloticus* recorded from the experimental catches were found to be immature. Similar observations were made in the previous surveys.

The proportions of the mature fishes that were in breeding condition in the reservoir were generally low (< 50%) as indicated in Table 3.3.2. Breeding was recorded in all the species examined except *C. gariepinus* which was immature. Breeding intensity was highest in *B. docmac* (50%) and *B. altianalis* (50%), then *M. kannume* (25%), *S. afrofischeri* (6.7%) and *L. niloticus* (1%).

Table 3.5.2 Proportion *(%) of breeding fishes over time among commonly encountered fish species at the upstream (Kalange-Makwanzi), mid of the reservoir and downstream (Buyala-Kikubamutwe) Transects*

Family name	Scientific Species name	English/local (Luganda) name	Site	Monitoring dates											
				1	2	3	4	5	6	7	8	9	10	11	12
				Apr. 2006	Sep. 2007	Apr. 2008	Apr. 2009	Sep. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2012	Apr. 2012	Sept. 2012	Apr. 2013
Bagridae		Semutundu	Kalange-Makwanzi (upstream of the reservoir)												0
			Mid section of the Reservoir										50	25	40
			Buyala-Kikubamutwe (downstream)												0
Centropomidae	*Lates niloticus*	Nile perch/ (Mputa)	Kalange-Makwanzi (upstream of the reservoir)												0
			Mid section of the Reservoir										1		7.1
			Buyala-Kikubamutwe (downstream)												0
Cichlidae	*Oreochromis niloticus*	Nile tilapia/ (Ngege-Kibati)	Kalange-Makwanzi (upstream of the reservoir)			71.4			50	54.5	38.5	70			
			Mid section of the Reservoir												
			Buyala-Kikubamutwe (downstream)												60
	O. variabilis	(Ngege)	Kalange-Makwanzi (upstream of the reservoir)	12.5		22.2	55.2		50	38.1	46.3	50			14.3
			Mid section of the Reservoir												
			Buyala-Kikubamutwe (downstream)									100			
	Tilapia zillii	Red-belly tilapia /(Ngege)	Kalange-Makwanzi (upstream of the reservoir)							83.3	42.9		33.3	33.3	0
			Mid section of the Reservoir												0
			Buyala-Kikubamutwe (downstream)	7.1	25	100									
Clariidae	*Clarias gariepinus*	Mudfish/(Male)	Kalange-Makwanzi (upstream of the reservoir)								100				
			Mid section of the Reservoir												
			Buyala-Kikubamutwe (downstream)												
Cyprinidae	*Barbus altianalis*	Barbelfish/(Kisinja)	Kalange-Makwanzi (upstream of the reservoir)	100	100	80	100		64.7		64.3	100			
			Mid section of the Reservoir										50	50	
			Buyala-Kikubamutwe (downstream)	12.5	100	100				100		100			50
Mochokidae	*Synodontis afrofischeri*	Tigerfish/(Nkolongo)	Kalange-Makwanzi (upstream of the reservoir)	20	100		70	91.7	90	88.9	100	87.5	7.9	35.3	34
			Mid section of the Reservoir										6.7	12.5	16.7
			Buyala-Kikubamutwe (downstream)		75	36.4	50	100	100	100		100			70
Mormyridae	*Mormyrus kannume*	Elephant Snoutfish/(Kasulubana)	Kalange-Makwanzi (upstream of the reservoir)	44.1	58.3	43.5	23.8	50	56.7	72.2	59.3	50	17.6	33.3	45.5
			Mid section of the Reservoir										25	44.2	42.1
			Buyala-Kikubamutwe (downstream)	37.5	41.7	27.1	54.5	33.3		33.3	18.8	20		33.3	100

3.6. THE COMMERCIAL FISHERY

3.6.1 Fishing effort in the fishery

Variation in fishing effort and catchability coefficients (a measure of fishing mortality) has been used to assess trends in stocks of natural fish populations for decades (Arreguín-Sánchez, 1996). Assessment of dynamics in fishing effort has provided a firm basis to

investigate periodic yield from the fishery the upper Victoria Nile alongside the dam construction project. The relationship between fishing effort and fishery yield has been explored along the process. Fishery yield in turn guides formulation of management advice. Changes in the numbers of fishing fleet in a given system reflect the migratory nature of fishers that go with trends in catches. Fishers will always move to areas rumoured to have higher catches. During the survey conducted in April 2013, the number of fishing boats upstream at Kalange-Makwanzi remained fairly constant at 19 boats (Table 3.4.1), a decrease by one boat but increased by 38.5% (five boats) and 47.4% (nine boats) at both the Reservoir and downstream (Buyala-Kikubamutwe) stations. The increase in the downstream station is still below the highest number of 34 boats recorded in April 2012. Although there was an observed increase in the number of boats within station, the overall number in all the three stations has remained fairly constant in the last three surveys, recording 65 boats in April 2012, 52 boats in September 2012 and 65 boats in April 2012, an indication of fishers migrating from one station to another in search for better catches.

The basket trap fishery downstream which emerged in the last survey (September 2012) has continued to expand explosively. The number of boats using traps downstream increased from 11 boats 20 boats, representing a percentage increase of 82% while the number of traps increased by about 170% from 56 traps in September 2012 to 151 in April 2013. The fishery targets mainly *Mormyrus* that is marketed live to fishers on lakes Victoria and Kyoga for use as bait in the long line fishery. A total of 11 boats with an estimated 56 traps were recorded at the downstream transect. The observed increase is probably associated to the high demand for bait for targeting Nile perch, Clarias and Protopterus on both lakes.

The number of boats using gillnets remained fairly constant upstream and in the reservoir but significantly increased from two boats in September 2012 to seven boats in April 2013. Although the overall number of gillnet boats at all sites increased from 14 to 18 boats in the last two survey, it is still below the highest record of 26 boats registered in April 2012 (Table 3.4.1). There was a significant shift from large to smaller mesh size gillnets. The number of smaller mesh size gillnets ≤2.5 inches downstream increased from zero to twelve while that of the larger mesh size of 3.5 inches decreased by 267% from eleven to three. This trend may be an indication of decline in the large size fish stocks due to both environmental and human stressors. The longline boats increased upstream but were absent downstream and the reservoir, indicating 100% decline at the downstream station. The number of long line hooks however, decreased from 800 in the September 2012 survey to 687 in this survey. The 100% decrease in longline boats downstream in this survey may be associated to the rapid expansion of the bait fishery of *Mormyrus kanume,* whereby fishers may have crossed over from longlines to basket traps. The other dominant fishing gears e.g. Cast nets decreased from two to zero downstream but increased from zero to three upstream. Although the number of monofilaments decreased from 25 to 15 upstream, it increased by about the same value to 13 in the reservoir, indicating a migratory pattern of fishers who shift between stations in search for improved catches. Horizontal migrations of fishers along the river with their fishing boats and gears appear to be the main causes of fluctuations in these indicators of

fishing effort observed above. Information generated from this survey indicates there are migrations even across the dam site through lifting boats over land downstream and vice versa. The number of boats targeting Mukene at the reservoir significantly increased from 3 to 12, representing a 300% increment. The increase may be attributed to better catches of Mukene at the reservoir resulting from change in lunar phase.

Table 3.6.1. *The trend in numbers of fishing boats and fishing gears, upstream at Kalange-Makwanzi, mid section of the reservoir and downstream at Buyala-Kikubamutwe.*

Number of common gears in use	Transect	Monitoring dates											
		Apr-06	Sep-07	Apr-08	Apr-09	Oct-09	Apr-10	Sep-10	Apr-11	Sep-11	Apr-12	Sep-12	Sep-13
Number of fishing boats	Kalange-Makwanzi	9	10	7	22	18	23	23	18	32	15	20	19
	Mid section of the Reservoir										16	13	18
	Buyala-Kikubamutwe	13	17	23	26	32	23	15	12	15	34	19	28
Number of boats using gillnets	Kalange-Makwanzi		9	7	10	6	7	13	6	8	9	9	7
	Mid section of the Reservoir										13	3	4
	Buyala-Kikubamutwe		7	18	7	6	1	2		1	4	2	7
Number of boats using long line hooks	Kalange-Makwanzi		1	2	3	1	2	2	0	2	1	4	6
	Mid section of the Reservoir										1	0	0
	Buyala-Kikubamutwe		10	8	6	6	13	6	3	7	10	7	0
Number of boats using cast nets	Kalange-Makwanzi					5	4	1	1	5	1	0	3
	Mid section of the Reservoir										0	0	0
	Buyala-Kikubamutwe			1	6	3	1	1	3	0	7	2	0
Number of boats using Hand line hooks	Kalange-Makwanzi			7	9	5	4	2	6	8	3	3	1
	Mid section of the Reservoir										1	7	3
	Buyala-Kikubamutwe			15	9	14	9	2	2	3	12	5	2
Number of boats using scoop nets	Kalange-Makwanzi					1	6	4	4	4	1	2	3
	Mid section of the Reservoir										6	3	12
	Buyala-Kikubamutwe			2	1	1		1	2	1	1	0	0
Number of fishing gears by mesh size													
Gillnets - ?2½"	Kalange-Makwanzi		3			1			4		2	0	0
	Mid section of the Reservoir										0	0	0
	Buyala-Kikubamutwe			1		10		2			0	0	12
Gillnets 3"	Kalange-Makwanzi					3	1	6			8	0	0
	Mid section of the Reservoir										0	4	0
	Buyala-Kikubamutwe			1	4			9			10	0	0
Gillnets 3½"	Kalange-Makwanzi		3			1	1	4		5	16	0	0
	Mid section of the Reservoir										0	3	0
	Buyala-Kikubamutwe			25							3	11	3
Gillnets 4"	Kalange-Makwanzi		30		21	8	2	26	20	20	10	0	0
	Mid section of the Reservoir										0	0	0
	Buyala-Kikubamutwe		20	4			1			13	0	0	0
Gillnets 4½"	Kalange-Makwanzi			21	5			2	2	12	4	0	0
	Mid section of the Reservoir										0	0	0
	Buyala-Kikubamutwe		3	12		6	1				0	0	0
Gillnets 5"	Kalange-Makwanzi		2	25	12	1					1	0	0
	Mid section of the Reservoir										14	0	0
	Buyala-Kikubamutwe		5	47						5	0	0	0
Gillnets 5½"	Kalange-Makwanzi											0	0
	Mid section of the Reservoir											0	0
	Buyala-Kikubamutwe											0	0
Gillnets 6"	Kalange-Makwanzi							4		8		2	2
	Mid section of the Reservoir										22	0	0
	Buyala-Kikubamutwe			5	18	15						0	9
Total gillnets	Kalange-Makwanzi		38	46	38	20	24	42	28	43	41	2	8
	Mid section of the Reservoir										36	7	0
	Buyala-Kikubamutwe		28	99	22	37	4	11		18	13	11	24
Long line hooks	Kalange-Makwanzi		300	330	550	200	650	280		500	70	800	687
	Mid section of the Reservoir										50	0	0
	Buyala-Kikubamutwe		510	445	277	180	380	142	110	482	525	420	0
Beach seines	Kalange-Makwanzi												
	Mid section of the Reservoir												
	Buyala-Kikubamutwe			1									
Cast nets	Kalange-Makwanzi					5	4	1	1	5	1	0	
	Mid section of the Reservoir										0	0	
	Buyala-Kikubamutwe			1	6	3	1	1	3		7	2	
Hand line hooks	Kalange-Makwanzi			91	105	124	26	3	18	88	35	4	
	Mid section of the Reservoir										6	14	
	Buyala-Kikubamutwe			394	97	152	32	16	8	5	51	24	2
Scoop nets	Kalange-Makwanzi					1	6	4	4	4	1	2	3
	Mid section of the Reservoir										6	3	12
	Buyala-Kikubamutwe			2	1	1		1	2	1	1	0	0
Monofilament nets	Kalange-Makwanzi										0	29	15
	Mid section of the Reservoir										21	0	13
	Buyala-Kikubamutwe										0	0	0
Traps	Kalange-Makwanzi											0	0
	Mid section of the Reservoir											0	0
	Buyala-Kikubamutwe											56	151

3.6.2. Fish catch composition and catch rates

Ten fish species including *Bagrus docmak, Lates niloticus, Oreochromis niloticus, Oreochromis variabilis, Tilapia zillii, Barbus altianalis, Rastrineobola argentia, Protopterus aethiopicus, Mormyrus kannume* and *Clarias gariepinus* were recorded along the three transects (Table 3.4.2). The upstream transect (Kalange-Makwanzi) registered the highest number (ten) of species, followed by the downstream site (eight species) while the reservoir (five) registered the least number of species. Only four species (*Bagrus docmak, Lates niloticus, Oreochromis niloticus, and Mormyrus kannume*) were common at all the three study sites. Both *Rastrineobola argentia* (Kalange-Makwanzi) and *Oreochromis variabilis* (Reservoir) were recorded at only one study site.

With the exception of *Mormyrus kanume* whose catch rates at the downstream site increased from 2.3 to 4.07 Kg/boat/day, the current survey shows a decline in the catch rates of four key commercial species (*L. niloticus, B. docmak, Rastrineobola argentia* and *O. niloticus*). The increase in the catch rates of *Mormyrus kannume* caught downstream (Buyala-Kikubamutwe) is probably due to the expansion of the basket trap fishery for bait. On the other hand, the decline in catch rates of the other four commercial fish species may be attributed to declines in fish stocks due to increase in fishing factors (fishers and fishing gears).

However, the catch rates of key commercial fish species of *Bagrus docmak, Lates niloticus, Oreochromis niloticus, Protopterus aethiopicus* and *Oreochromis variabilis* upstream at Kalange-Makwanzi in the current survey are comparable to those obtained in the same period in the last survey April 2012, an indication that variations are caused by seasonality.

Results from the current survey indicate a general increase in the catch rates of *Mormyrus Kanume* (2.30 to 4.07 kg/boat/day) at the downstream transect and a decrease (4.7 to 0.96 kg/boat/day) at the reservoir. This could be associated to the movement (migration) of fishers from the reservoir to downstream site. Generally, since September 2007, the fish catches at Kalange-Makwanzi have been characterised by higher species numbers and higher overall catch rates than the other study sites.

Table 3.6.2 *Trend of fish catch rates (kg/boat/day) with all gears pooled, of the main fish taxa at the upstream, Kalange-Makwanzi mid of the reservoir and downstream at Buyala-Kikubamutwe.*

Familiy	Species/taxa	Transect	Monitoring Period										
			Sep. 2007	Apr. 2008	Apr. 2009	Oct. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2011	Apr. 2012	Sep. 2012	Apr. 2013
Bagridae	*Bagrus docmac*	Kalange-Makwanzi	0.05	0.21	0.4	0.27	0.08	0.15	0.09	0.5	0.53	0.9	0.46
		Mid section of the Reservoir									0.18	6	0.2
		Buyala-Kikubamutwe	0.39	0.1	0.03	0.21	0.17	0.06	0.83	0.16	0.94	1	0.5
Centropomidae	*Lates niloticus*	Kalange-Makwanzi	1.11	1.36	0.78	2.12	0.64	0.76	0.52	0.11	1.79	1.8	1.56
		Mid section of the Reservoir									0.43	3.5	0.81
		Buyala-Kikubamutwe	0.52	0.15	1.01	0.79	1.3	0.38	1.97	3.58	1.41	1.5	0.56
Characidae	*Brycinus jacksonii*	Kalange-Makwanzi											
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
	Brycinus sadleri	Kalange-Makwanzi											
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
Cichlidae	*Oreochromis niloticus*	Kalange-Makwanzi	1.5	1.03	0.86	2.81	1.16	0.1	0.48	1.27	0.06		0.6
		Mid section of the Reservoir									0.3	0.3	0
		Buyala-Kikubamutwe	0.18	0.64	0.95	0.14		0.14	0.84	0.02	0.16	0.6	0.2
	Oreochromis leucostictus	Kalange-Makwanzi			0.01	0.13	0.01						
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
	Oreochromis variabilis	Kalange-Makwanzi	1.25	1.43	1.44	0.88	1.03	0.68	0.23	0.61	0.65	0.4	0.66
		Mid section of the Reservoir									0.48	0.1	0
		Buyala-Kikubamutwe				0.06	0.25	0.1	1.67				
	Tilapia zillii	Kalange-Makwanzi	0.88	0.9	0.23	1.04	0.21	0.22		0.12	0.39	0.1	0.11
		Mid section of the Reservoir									1.13	0.1	
		Buyala-Kikubamutwe	0.06	0.38		0.01	0.15	0.04					0.02
	Haplochromines	Kalange-Makwanzi	0.22		0.02	0.04	0.01	0.01	0.01	0.15	0.03		
		Mid section of the Reservoir									0.01		
		Buyala-Kikubamutwe		0.1		0.01		0.02	0.1	0.01			
Clariidae	*Clarias gariepinus*	Kalange-Makwanzi	0.08	1.22	0.18	0.07		0.04		0.22	1.77	0.5	0.18
		Mid section of the Reservoir									1.35		
		Buyala-Kikubamutwe		0.83	0.18								0.03
Cyprinidae	*Barbus altianalis*	Kalange-Makwanzi	2.88	6.72	3.98	5.11	2.27	2.87	1.66	0.28	6.05	0.1	0.24
		Mid section of the Reservoir									0.95		
		Buyala-Kikubamutwe	2.72	0.35	1.17	0.54	2.1	1.58	1.13	2.98	1.4	1.5	
	Barbus paludinosus	Kalange-Makwanzi											
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
	Labeo victorianus	Kalange-Makwanzi											
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
	Rastrineobola argentea	Kalange-Makwanzi					11.4	2.96	34.5			43	43
		Mid section of the Reservoir									115	23.5	4.29
		Buyala-Kikubamutwe		1.92	5.3			3.05	50				
Cyprinodontidae	*Aplocheilichthys pumilus*	Kalange-Makwanzi											
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
Lepidosirenidae	*Protopterus aethiopicus*	Kalange-Makwanzi		0.19	0.06		0.05	0.48			0.05		0.05
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											0.04
Mochochidae	*Synodontis afrofischeri*	Kalange-Makwanzi	0.04		0		0.02	0.01		0.01	0.2		
		Mid section of the Reservoir									0.06		
		Buyala-Kikubamutwe	0				0.01						
Mormyridae	*Mormyrus kannume*	Kalange-Makwanzi	2.21	6.77	2.93	0.43	1.84	2.03	0.25	0.7	5.47	1.5	1.35
		Mid section of the Reservoir									1	4.7	0.96
		Buyala-Kikubamutwe	0.28	0.31	0.23	0.19	0.39	0.06	1.04	0.61		2.3	4.07

3.63. Estimates of total fish catches

The total monthly catch estimates at transect 2 (Buyala-Kikubamutwe) significantly increased from 1.3 t in September 2012 to 4.5 t in the current survey (Table 3.4.3). Total monthly landing at both the upstream transect and reservoir are comparable to that

recorded in the previous survey September 2012. The significant increase in total monthly landing downstream is associated to the increase in catch rates of *Mormyrus kanume* due to expansion of the fishery in terms of fishing effort (numbers of fishing boats and basket traps) involved in this fishery. The concern with this fishery however, is that it targets and crops young fish for bait, which fetch low market prices and leaves little for consumption that could easily cause nutritional problems. The contribution of Mukene (*R. argentea*) that was first captured at the reservoir in the last survey September 2012 has continued to influence the total production of the reservoir. The total monthly catch estimate of Mukene rose from 1.48 t in September to 1.63 t in the current survey. This increase could be related to the seasonal nature of Mukene fishing that utilizes light to attract and concentrate fish in darkness and is thus influenced by the lunar cycle.

Table 3.6.3 *Trends of total fish catch estimates (kg), upstream at Kalange-Makwanzi, mid section of the reservoir and downstream at Buyala-Kikubamutwe*

Family	Species/Taxa	Transect	Monitoring dates										
			Sep. 2007	Apr. 2008	Apr. 2009	Oct. 2009	Apr 2010	Sept. 2010	Apr. 2011	Sept. 2011	Apr. 2012	Sept. 2012	Apr. 2013
Bagridae	*Bagrus docmac*	Kalange-Makwanzi	11.3	33.1	182.5	68.4	52.8	59.8	33.9	355.1	139.8	381.7	267.7
		Mid section of the Reservoir									68.4	481.5	74.5
		Buyala-Kikubamutwe	198.3	67.6	24.4	191.6	109.9	25.8	195.3	73.5	396.7	128.6	397.0
Centropomidae	*Lates niloticus*	Kalange-Makwanzi	232.6	212.4	361.5	532.2	422.1	303.1	193.1	78.3	473.6	870.7	948.7
		Mid section of the Reservoir									163.1	248.7	305.7
		Buyala-Kikubamutwe	263.5	89.2	741.2	707.8	840.6	163.5	463.5	1612.5	592.7	117.1	449.6
Characidae	*Brycinus jacksonii*	Kalange-Makwanzi					-	-					
		Mid section of the Reservoir											
		Buyala-Kikubamutwe					-	-					
	Brycinus sadleri	Kalange-Makwanzi					-	-					
		Mid section of the Reservoir											
		Buyala-Kikubamutwe					-	-					
Cichlidae	*Oreochromis niloticus*	Kalange-Makwanzi	315	162.1	395.6	705.7	765.1	39.9	179	7.5	14.6		
		Mid section of the Reservoir									112.8	25.5	0.0
		Buyala-Kikubamutwe	93.5	378.5	696.7	124.4	-	60.2	197	907.8	70	10.3	161.6
	Oreochromis leucostictus	Kalange-Makwanzi			3.5	32.4	6.6	-					
		Mid section of the Reservoir											
		Buyala-Kikubamutwe			-		-	-					
	Oreochromis variabilis	Kalange-Makwanzi	261.7	224.1	665.3	221.8	679.4	271.2	623.6	434.9	172.6	352.0	380.4
		Mid section of the Reservoir									184.2	8.0	
		Buyala-Kikubamutwe			-	52.3	161.7	43	53.9				
	Tilapia zillii	Kalange-Makwanzi	185.8	140.6	107.4	261.5	138.5	87.7	88.9	87.7	103.5	96.2	62.4
		Mid section of the Reservoir									429.5	6.4	0.0
		Buyala-Kikubamutwe	28.3	227.1	-	5	97	17.2	52.9	2.1			16.8
	Haplochromines	Kalange-Makwanzi	46.8		7.9	9.8	6.6	4	4.68	108.3	6.7		0.2
		Mid section of the Reservoir									3.5		
		Buyala-Kikubamutwe		62.2	-	7.5	-	8.6	24.5	3			
Clariidae	*Clarias gariepinus*	Kalange-Makwanzi	17.8	191.5	80.9	17	-	16			467	109.2	102.8
		Mid section of the Reservoir									515.5		
		Buyala-Kikubamutwe		538.1	135.5		-	-		159	-	-	23.9
Cyprinidae	*Barbus altianalis*	Kalange-Makwanzi	605.8	1,053.10	1,837.60	1,282.50	1,497.20	1,144.50	436.4	200.6	1,597.80	30.0	141.7
		Mid section of the Reservoir									362.7		
		Buyala-Kikubamutwe	1388.3	210.9	863.2	482.8	1,357.90	679.7	266.6	1341	515.5	209.4	
	Barbus paludinosus	Kalange-Makwanzi					-	-					
		Mid section of the Reservoir											
		Buyala-Kikubamutwe					-	-					
	Labeo victorianus	Kalange-Makwanzi					-	-					
		Mid section of the Reservoir											
		Buyala-Kikubamutwe					-	-					
	Rastrineobola argentea	Kalange-Makwanzi		1,243.80	-		6,463.80	2,109.50	2,152.80			1,105.7	
		Mid section of the Reservoir									13,128	1,480.5	1,627.6
		Buyala-Kikubamutwe			2,873.70		-	980.4	1,960.00				
Cyprinodontidae	*Aplocheilichthys pumilus*	Kalange-Makwanzi					-	-					
		Mid section of the Reservoir											
		Buyala-Kikubamutwe					-	-					
Lepidosirenidae	*Protopterus aethiopicus*	Kalange-Makwanzi		30.5	25.4		33	191.4			12		26.4
		Mid section of the Reservoir											
		Buyala-Kikubamutwe			-		-	-					
Mochochidae	*Synodontis afrofischeri*	Kalange-Makwanzi	8.1		1.8		13.2	4		10.4	52.8		31.9
		Mid section of the Reservoir									22.9		
		Buyala-Kikubamutwe	0.6		-		6.5	-					
Mormyridae	*Mormyrus kannume*	Kalange-Makwanzi	463.6	1,060.10	1,352.50	106.9	1,213.60	809.5	389.6	500.1	1,444.10	357.6	783.2
		Mid section of the Reservoir									381.8	374.7	365.5
		Buyala-Kikubamutwe	141.7	183.9	170.3	169.2	252.2	25.8	57.8	276		842.1	3,248.0
TOTAL		Kalange-Makwanzi	2148.5	3,107.40	5,021.80	3,238.30	11,291.90	5,040.40	4,097.30	2842	4,484.50	3,308.1	3,141.0
		Mid section of the Reservoir									15,417.20	2,625.2	2,400.4
		Buyala-Kikubamutwe	2114.2	3,001.30	5,505.00	1,740.70	2,825.80	2,004.20	3,247.00	3315.6	1,647.30	1,309.3	4,468.7

3.6.4. Estimates of total beach value of the catch

Similar to the monthly catch rates, the downstream transect (Buyala-Kikubamutwe) recorded the highest monthly gross beach value (28.5 million) of the fish landed up from 3.6 million in the previous survey of September 2012 (Table 3.4.4). The observed increase in gross beach value is again associated with the new expanding bait fishery of *Mormyrus kanume* whose value was estimated at 24.3 million shillings (86%) of the downstream total beach value. Five commercial fish species including *Lates niloticus*, *Mormyrus kanume*, *Oreochromis variabilis*, *Oreochromis niloticus* and *Bagras docmac* significantly contributed to the monthly gross beach value at transect 1 (Kalange-Makwanzi) while that of the reservoir was dominated by two species; *Rastrineobola argentia* and *Lates niloticus*. In general except for *Mormyrus kanume* (all transects), *Bagras docmac* (downstream), *Oreochromis niloticus* (upstream) and *Lates niloticus* (reservoir and downstream), the contribution of individual fish species to the monthly gross income in the current survey reduced. This could be associated to reductions in catch rates and sizes of the commercial species landed across the study area.

Table 3.6.4. *Trend of monthly gross value of fish catches (shs) upstream at Kalange-Makwanzi; mid of the reservoir and downstream at Buyala-Kikubamutwe*

Family	Species/Taxa	Transect	Monitoring dates										
			Sep. 2007	Apr. 2008	Apr. 2009	Oct.	Apr.	Sep.2010	Apr.2011	Sep.2011	Apr.2012	Sep.201	Apr.2013
Bagridae	*Bagrus docmac*	Kalange-Makwanzi	10,313	74,417	912,450	136,800	158,400	104,676	101,790	1,065,257	462,400	1,365,321	802,998
		Mid section of the Reservoir									226,200	1,564,791	230,418
		Buyala-Kikubamutwe	180,880	152,093	97,541	431,200	109,900	45,173	585,942	661,500	1,312,000	450,000	1,488,853
Centropomidae	*Lates niloticus*	Kalange-Makwanzi	66,602	336,182	644,702	997,785	759,780	549,553	868,725	274,040	1,299,000	3,294,523	2,189,276
		Mid section of the Reservoir									447,400	746,126	1,089,138
		Buyala-Kikubamutwe	415,276	141,247	2,223,704	1,887,573	1,821,328	296,450	1,100,908	12,255,000	1,625,400	385,714	2,248,492
Characidae	*Brycinus jacksonii*	Kalange-Makwanzi											
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
	Brycinus sadleri	Kalange-Makwanzi											
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
Cichlidae	*Oreochromis niloticus*	Kalange-Makwanzi	374,535	240,015	553,823	776,226	1,530,200	83,741	179,010	2,269.43	33,200		
		Mid section of the Reservoir									256,300	76,526	
		Buyala-Kikubamutwe	111,172	560,620	1,045,083	186,667		126,485	196,980	18,750	159,000	30,857	323,208
	Oreochromis leucostictus	Kalange-Makwanzi			5,198	32,376	13,200						
		Mid section of the Reservoir											
		Buyala-Kikubamutwe			-								
	Oreochromis variabilis	Kalange-Makwanzi	245,206	378,091	964,656	277,305	1,358,800	650,786	623,610	1,159,794	376,400	1,048,522	1,024,216
		Mid section of the Reservoir									402,000	23,914	
		Buyala-Kikubamutwe		-	-	78,400	161,700	103,253	53,900				
	Tilapia zillii	Kalange-Makwanzi	170,908	161,368	161,123	167370	277,000	175,457	88,920	175,314	241,000	265,586	149,851
		Mid section of the Reservoir									1,000,000	19,131	
		Buyala-Kikubamutwe	26,067	260,740	-	7,467	97,000	34,418	52,920	4,200			
	Haplochromines	Kalange-Makwanzi	46,846	-	2,356	4,902	3,300	2,991	3,744	54,154			
		Mid section of the Reservoir											
		Buyala-Kikubamutwe		62,189	-			6,453	19,600	1,500			
Clariidae	*Clarias gariepinus*	Kalange-Makwanzi	17,769	284,350	86,240	17,100		31,901		635,886	1,131,500	327,600	256,865
		Mid section of the Reservoir									1,248,900		
		Buyala-Kikubamutwe		799,034	270,947			-					
Cyprinidae	*Barbus altianalis*	Kalange-Makwanzi	674,221	1,660,815	3,215,809	1,923,750	2,245,800	1,823,982	872,820	501,429	4,411,000	75,056	481,904
		Mid section of the Reservoir									1,001,000	633,000	
		Buyala-Kikubamutwe	1,545,215	332,592	1,366,671	801,522	2,580,010	1,083,347	799,680	6,705,000	1,623,300		
	Barbus paludinosus	Kalange-Makwanzi											
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
	Labeo victorianus	Kalange-Makwanzi											
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
	Rastrineobola argentea	Kalange-Makwanzi		-	-		2,352,823	894,417	1,722,240			514,286	
		Mid section of the Reservoir									2,863,600	945,000	813,815
		Buyala-Kikubamutwe		216,418	1,436,842			415,671	1,568,000				
Cyprinodontida	*Aplocheilichthys pumilus*	Kalange-Makwanzi											
		Mid section of the Reservoir											
		Buyala-Kikubamutwe											
Lepidosirenidae	*Protopterus aethiopicus*	Kalange-Makwanzi		15,231	38,115		23,100	350,914			36,000		52,690
		Mid section of the Reservoir											
		Buyala-Kikubamutwe		-	-			-					63,844
	Synodontis afrofischeri	Kalange-Makwanzi	1,615	-	554		9,900	1,994		10,400	52,000	4,992	
		Mid section of the Reservoir									22,900		
		Buyala-Kikubamutwe	113	-	-		-	-					
Mormyridae	*Mormyrus kannume*	Kalange-Makwanzi	328,240	977,422	1,327,914	89,110	1,743,943	1,160,277	389,610	450,082	1,959,800	572,083	1,391,402
		Mid section of the Reservoir									518,000	374,657	749,354
		Buyala-Kikubamutwe	100,300	169,522	170,310	338,488	201,760	36,999	14.4	331,200		2,105,357	24,360,327
TOTAL		Kalange-Makwanzi	2,236,254	4,127,892	7,912,939	4,422,724	10,476,246	5,830,689	4,850,469	6,595,785	10,003,000	7,467,968	7,162,475
		Mid section of the Reservoir									7,987,000	3,750,146	2,882,725
		Buyala-Kikubamutwe	2,379,023	2,694,454	6,611,098	3,731,317	4,971,698	2,148,249	4,377,944	19,977,150	4,720,000	3,604,929	28,484,724

With the exception of *Mormyrus kanume*, whose average unit price per kilogram increased by 113%, the aggregated average unit cost price for the key commercial fish species across all the study sites in this study is comparable to that in the previous survey (Table 3.4.5). The unit price per kilogram weight of *Oreochromis niloticus* however, reduced to shillings 2250 from shillings 3000 resulting probably from increased supply through improved monthly catch estimates of the species observed above (Table 3.4.3). There was a slight increase of 10% in the unit price per kilogram of *Lates niloticus* which may indicate a general increase in the national price index as result of inflation.

Table 3.6.5. *Trends of the mean unit prices (shs/kg) of the most common fish species at the beach level along the upper Victoria Nile between April 2006 and April 2013.*

Species/Taxa	Monitring Dates											
	Apr-06	Sep-07	Apr-08	Apr-09	Oct-09	Apr-10	Sep-10	Apr-11	Sep-11	Apr-12	Sep-12	Apr-13
Lates niloticus	900	1576	1583	2188	2423	2000	1813	3286	6429	2750	2785	3063
Oreochromis niloticus	750	1189	1481	1409	1189	2000	2100	1000	2500	2300	3000	2250
Barbus altianalis	800	1113	1577	1666	2250	1722	1594	2250	4000	2760	3370	3400
Mormyrus kannume	786	708	922	983	1416	1310	1433	667	986	1400	1825	3886
Oreochromis variabilis	550	937	1687	1450	1357	1929	2400	1000	2667	2200	2860	2692

3.6.5 Estimated total catches and revenue of individual fishing units

The estimated mean monthly catch downstream more than doubled while that at the reservoir registered a 61% decrease (Table 3.4.6). The increase observed downstream is attributed to the increase in catches from *Mormyrus kanume* while the decline at the reservoir may be attributed to the low catches from the dominant Mukene fishery at this site. The observed fluctuations between surveys may be brought about by differences in seasonality for the two surveys. The mean monthly revenue per fishing unit significantly increased across all study sites along the River but was highest downstream (Buyala-Kikubamutwe) due to the booming Mormyrus fishery

Table 3.6.6 *Trend of monthly total catches and revenue of individual fishing units upstream at Kalange-Makwanzi, the mid section of the reservoir and downstream at Buyala-Kikubamutwe*

Parameter rate	Site	Monitoring Dates										
		Sep-07	Apr-08	Apr-09	Oct-09	Apr-10	Sep-10	Apr-11	Sep-11	Apr-12	Sep-12	Apr-13
Total catch (Kg/boat/month)	Kalange-Makwanzi	215	444	228	180	418	219	467	89	47	144	158
	Mid section of the Reservoir									307	389	150
	Buyala-Kikubamutwe	124	130	212	55	123	134	329	221	275	66	154
Total revenue (Shs/boat/month)	Kalange-Makwanzi	223,625	589,698	359,679	245,707	388,009	253,508	298,445	206,118	188,500	418,986	7,162,475
	Mid section of the Reservoir									1,227,000	883,296	2,882,725
	Buyala-Kikubamutwe	139,943	117,150	254,273	116,604	216,161	143,217	410,225	1,331,810	1,098,000	187,657	28,484,724

3.6.6 Socio-economic aspects of the fishery

Non-commercial uses of fish

In this survey, there was a general decrease in the average quantity of fish retained by fishers for domestic consumption upstream (Table 3.4.7). However, compared to the previous survey (September 2012) where none of the fishers sampled on the reservoir and downstream had part of the catch retained for domestic consumption, this survey registered 1.1% and 3.2% as quantities retained at the two sites respectively. The observed changes suggest a shift in the nutritional contribution of the fisheries to the families of the fishers at the three study sites. The smallest percentage retained at the reservoir is explained by the Mukene fishery, generally processed as feed for animal industry while the reduction in quantity retained downstream is explained by dominant bait fishery targeting mainly *Mormyrus* species, which are less favoured for human consumption.

Table 3.6.7. *Trends of the average weight of fish (kg/boat/day) retained by fishers for domestic use between September 2007 and September 2012. In brackets the weight of fish retained is expressed as a percentage of the overall average weight of fish caught per boat.*

Sites	Monitoring dates										
	Sep-07	Apr-08	Apr-09	Oct-09	Apr-10	Sep-10	Apr-11	Sep-10	Apr-12	Sep-12	Apr-13
Kalange-Makwanzi	0.3 (2.9%)	1.1 (5.5%)	0.4 (3.7%)	3.5 (27.1%)	2.2 (11.8%)	1.5 (16.8%)	1.4 (30.7%)	2.1 (60.0%)	1.2 (12.8%)	1.2 (20.4%)	0.1 (2.58%)
Mid section of the Reservoir									1.5 (50 %)		0.1 (1.1%)
Buyala-Kikubamutwe	0.7 (16.9%)	0.1 (2.1%)	0 (0%)	1.4 (71.8%)	1.3 (29.7%)	0.8 (16.5%)	1.2 (23.8 %)	3.0 (45.8%)	0.8 (14.4%)		0.2 (3.2%)

Fishery related jobs

Fishing remained the most prominent job engaging a total of 77 people in the entire study area and was exclusively a male activity. This is the highest number of fishers recorded since April 2010. In the current survey, the number of fishers at US transect remained constant at 25 person but significantly increased from 9 to 28 at DS transect and 13 to 24 in the reservoir (Table 3.4.8). The increase in fishers within the reservoir is attributed to Mukene fishery while that in the downstream transect may be associated to the expanding bait fishery of *Mormyrus kanume*. Women on the other hand have continued to dominate the fish trade (mongering) business, constituting 94% of all fish traders. Food vending is not any different where the women dominated by 86%. Although more fish traders were encountered at US transect in the current survey (9 women and 1 man) than at the DS transect (6 women), the number significantly reduced from 18 in the survey of September 2012 to 10 in the current survey. The higher number of fish traders at the US transect could however be explained by its strategic location near the urban centre and the relatively higher catch rates. The number of net repairers increased upstream from 3 in September 2012 to 7 in the current survey but drastically reduced to zero downstream over the same period. The decrease downstream is associated to the increase in numbers

of fishers and traps involved in the bait fishery of *Mormyrus kanume*. The other fish related jobs do not show significant variations from the previous surveys.

Table 3.6.8. *The numbers of people by gender (Male/ Female) engaged in different jobs at landing sites upstream at Kalange-Makwanzi, mid of the reservoir and downstream and downstream at Buyala-Kikubamutwe*

Job description	Transect	Sex	Monitoring Dates											
			Apr-06	Sep-07	Apr-08	Apr-09	Oct. 09	Apr. 10	Sep. 10	Apr. 11	Sep. 11	Apr. 12	Sep. 12	Apr. 13
Boat builders/repairers	Kalange-Makwanzi	M	2	1	3	3	3	1	2	3	3	2	2	3
		F												
	Mid section of the Reservoir	M												
		F												
	Buyala-Kikubamutwe	M	5	2	4	2	2	3		1	1	3	3	
		F												
Food vendors	Kalange-Makwanzi	M				1	1	2	4	1	1	1	1	
		F	4	3	5	4	2	4		3	3	3	3	2
	Mid section of the Reservoir	M												1
		F											2	4
	Buyala-Kikubamutwe	M										3	3	
		F		2										
Net repair(s)	Kalange-Makwanzi	M			5	4	4		3	5	5	3	3	7
		F												
	Mid section of the Reservoir	M												
		F												
	Buyala-Kikubamutwe	M		2		1			3			6	6	
		F												
Cleaner fish landing	Kalange-Makwanzi	M												
		F												
	Mid section of the Reservoir	M												
		F												
	Buyala-Kikubamutwe	M												
		F												
Fisher(s)	Kalange-Makwanzi	M	57	20	32	43	37	30	38	25	25	25	25	25
		F												
	Mid section of the Reservoir	M											13	24
		F												
	Buyala-Kikubamutwe	M	26	30	42	47	46	30	34	30	30	15	9	28
		F												
Fish trader(s)	Kalange-Makwanzi	M	11	3	2	3	6	4	4	6	6		2	1
		F	12	9	13	10	20	16	16	30	30		16	9
	Mid section of the Reservoir	M											2	1
		F											5	1
	Buyala-Kikubamutwe	M	5	2		2	2	2	2				1	
		F	8	2		4	3	5	5	5	5		3	6
Fish processor(s)	Kalange-Makwanzi	M												
		F												
	Mid section of the Reservoir	M												
		F												
	Buyala-Kikubamutwe	M			3							1	1	
		F			5							5	5	
Fish cleaner	Kalange-Makwanzi	M												
		F												
	Mid section of the Reservoir	M												
		F												1
	Buyala-Kikubamutwe	M												
		F												
Chairperson landing	Kalange-Makwanzi	M	1	1	1	1	1	1	1	1	1	1	1	1
		F												
	Mid section of the Reservoir	M												1
		F												
	Buyala-Kikubamutwe	M		1	1	1	1	1	1	1	1	1	1	1
		F												
BMU committee member(s)	Kalange-Makwanzi	M				6		4	5			7	7	5
		F				3		5	4			2	2	1
	Mid section of the Reservoir	M												5
		F												3
	Buyala-Kikubamutwe	M				4	2	2	3	3	3	4	4	4
		F				2	1					1	1	1
Landing site askali	Kalange-Makwanzi	M	1										1	1
		F												
	Mid section of the Reservoir	M												
		F												
	Buyala-Kikubamutwe	M											1	1
		F												

3.7 SCHISTOSOMIASIS, RIVERBLINDNESS AND SANITATION STUDIES

3.7.1 Parasitological analysis of bilharzias in humans

Sampling for parasitological prevalence and intensity of Bilharziasis infection were maintained at Kalange-Makwanzi, an upstream transect and downstream, Kikubamutwe-Buyala. For comparative purposes, given the extent of the reservoir, a third transect was established in the mid reservoir where it runs up to 30 m deep and sampled similarly as at the other two transects.

Table 3.7.1 *Trend of Schistomiasis infection prevalence and intensity, schistosomiasis vector numbers, coliform counts among sample of people at Kalange-Makwanzi, mid of the reservoir and Kikubamutwe-Buyala*

Parameter	Variety	Site	Monitoring dates											
			Apr.06	Sept. 07	Apr. 08	Apr.09	Sept. 09	Apr. 10	Sept.10	Apr.11	Sept.11	Apr.12	Sept.12	Apr.13
Schistosomiasis Prevalence	*Mansonii*	Kalange-Makwanzi	53	46	56	28	49	21	21.8	16	18	18.6	17	25
		Mid section of the Reservoir										20.5	16.7	18.5
		Buyala-Kikubamutwe	48	43	40	22	33	19	16.7	18.6	21.8	19.6	20	17.5
	Haematobium	Kalange-Makwanzi	0	0	0	0	0	0	0	0	0	0	0	0
		Mid section of the Reservoir										0	0	0
		Buyala-Kikubamutwe	0	0	0	0	0	0	0	0	0	0	0	0
Schistosomiasis Intensity	*Mansonii*	Light	32	60.8	59	35	77	83	86	87	86.3	75	67	79.2
		Moderate	50	27.5	32	12	4	17	13.6	15	13.7	18.1	33	16.7
		Heavy	18	11.8	10	3	4	0	0	0	0	6.2	0	4.1
Prevalence by water contact	*Mansonii*	Fishing	71.4	94.4	60	68	79	62	31.4	21.9	24	28	27.8	25.8
		Fetching water	18.1	38.4	36.6	30.9	48	0	6.5	14.3	20	20.5	18	17.6
		Bathing/swimming	70	93.4	54.5	54.8	63	15	18.6	20	46	20.4	23	34
		Fish mongers	60	42.8	16.6	15	33	8	14.3	5	14	13.3	11	18
Snail Species abundance	*Bulinus sp.*	Kalange-Makwanzi	10	21	14	8	23		19	37	85	17	251	20
		Mid section of the Reservoir										11	30	10
		Buyala-Kikubamutwe	13	11	50	8	83		9	51	18	3	5	7
	Biomphalaria sp.	Kalange-Makwanzi	22	31	26	25	20		63	182	33	26	26	47
		Mid section of the Reservoir										68	67	67
		Buyala-Kikubamutwe	11	9	65	74	122		62	80	60	200	167	22
	Others	Kalange-Makwanzi	127	39	51	135	67		101	455	81	8	72	39
		Mid section of the Reservoir										13	15	63
		Buyala-Kikubamutwe	50	37	52	188	91		118	96	57	71	105	87
Coliforms in water	Shallow	Kalange-Makwanzi	200	73	63	105	15	50	50	48	70	57	60	60
		Mid section of the Reservoir										79	80	94
		Buyala-Kikubamutwe	50	87	73	100	10	87	80	82	81	82	76	80
	Deep	Kalange-Makwanzi	40	10	43	15	1	1	1	1	2	79	80	80
		Mid section of the Reservoir										1	1	5
		Buyala-Kikubamutwe	10	21	70	22	1	1	1	1	1	6	1	1

A total of 117 stool samples were collected from a population of 520 people. Out of 117 samples, 24 (20.5%) were infected with Schistosomiasis, *Schistosoma mansoni* which was a small increase. Infection with Schistosomiasis was higher at the Upstream site (25%) and lowest at the reservoir (Dam wall) transect (17.5%). None of the 117 samples tested positive for *Schistosoma haematobium,* a urinary type of Schistosomiasis.

Schistosomiasis prevalence at Buyala-Kikubamutwe continues to decline while at Kalange-Makwanzi slightly increased (Table 3.7.1). Light intensity infection of the disease stood at 79.1% and while heavy intensity one was at 16.7%. From samples taken at mid reserviour, heavy intensity slightly increased.

In the current and previous surveys, bathing and swimming were major t predisposing factors to Schistosomiasis infection, contributing 34 % and 23 % respectively. Predisposition to the disease through fishing and fetching of water accounted for 25.8%, 17.6% respactively.

As a corporate social responsibility, infected residents were treated under directly observed treatment (DOTs) by the sanitation team.

Status of snail vectors

Vector snail species namely, *Bulinus sp* and *Biomphalaria sp* declined except at Kalange-Makwanzi. Of the two vectors, *Biomphalaria sp* was more abundant, accounting for 29.8% of the total samples. *Bulinus sp* contributed 11.4% of the total

Two specimens of *Biomphalaria sp* and four of *Bulinus sp* collected at the Buyala-Kikubamutwe shed Cercaria, while none at Kalange-Makwanzi shed cercaria. In the mid reservoir, three snails shed Cercaria. Cercaria shedding by the vector snails is an indicator of active transmission taking place at the site of collection.

Faecal coli forms

The contamination of water with faecal coliforms at ahallow human-water contact points was 72 colonies per ml upstream at Kalange-Makwanzi, 80 colonies per ml in the mid reservoir and 94 Colonies per ml at Buyala-Kukubamutwe. Water from the deep middle part of the river had a low coliform count of 5 colonies per ml, indicating high dilution and a low predisposition risk level (1-10 colonies per 10 ml of water); Water with ten colonies per ml and above is considered unsafe for human consumption. The micro-organisms of medical importance were predominantly *Salmonella sp* and *Shigell*a *sp.*

Blackfly/*Mbwa Fly* Sampling

Medically important species of *Simulium* flies mostly live in sheltered areas of the river/stream in fast moving waters where they breed on crabs and Twigs depending on species and sub species. None of these blackflies were detected in the area. Therefore, the risk of river blindness (onchocerciasis) is non-existent in this area.

3.8.1 Conclusions

1. Composition, species richness and density of zooplankton show that the creation of the reservoir has so far not caused discernible negative ecological changes in this section of the Upper Victoria Nile, but has instead enhanced the potential for aquatic production (zooplankton and pelagic fishes) in mid reservoir compared to both upstream and downstream sites. The community of zooplankton at the reservoir and downstream of the dam has ecological features comparable to the Lake Victoria community from which the Nile originates. The community offers potential to support pelagic and other non-pelagic fisheries in the reservoir while maintaining the riverine fisheries in the upstream and downstream sites as well.

2. The reservoir created by the Bujagali Dam appears to have caused the apparent improvement in catches of table-fish species upstream. Popular species (*B. altianalis* and *M. kannume*) have been quickly established and their biomass is on the increase especially in the main reservoir next to the dam thus supporting a thriving local fishery.

3. The list of fish species expected from this section of the river (Upper Victoria Nile) appears to have been exhausted and new recoveries are least expected.

4. The diet of Nile perch at Kalange-Makwanzi has changed from dominance of haplochromine cichlids in the previous surveys to insects dominated by Odonata in the survey of September 2012, to Juvenile Nile perch in the April 2013 survey. The change in diet of the species is attributed to scarcity of haplochromines in transect as reflected in the data recorded from the experimental gillnet catches of September 2012 and April 2013 (Refer to section on Fish Species Diversity). In the April 2013 survey, *B. docmac* was also piscivorous, feeding mostly on *S. afrofischeri* as in April 2012 although in September 2012, *Caridina* was the dominant prey of the species.

5. Breeding intensity of keystone fish species was higher in April 2013 than in the previous survey of September 2012. This was attributed to seasonal variations in the breeding cycles of the fish species

3.8.2 Recommendations

1. There is need to take measures to prevent development of eutrophication and pollution of the reservoir because these processes are known to cause drastic environmental changes that can disrupt key ecological functions of the zooplankton and other aquatic communities.

2. Continue monitoring surveys until a clear picture especially on the fate of haplochromines in the main reservoir is established, to determine the response of

the keystone fish species and detect water quality and other biotic changes for timely institution of remedial measures.

3. The problem of disposal of faecal matter around the reservoir should be addressed urgently through appropriate health education and establishment of latrines.

4. There is need to intensify the control efforts especially the mass drug administration and health education in order to get the prevalence of Schistosomiasis reducing to nil.

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Journal of environmental management **ISSN** 0301-4797 **CODEN** JEVMAW 2004, vol. 72, n°3, pp. 189-194 [6 page(s) (article)] (26 ref.)

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