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

Monitoring No. 10 and Reservoir Baseline

Date: 23th – 30th April 2012

Monitoring carried out by:

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On behalf of :
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1.0 BACKGROUND

The results reported on were from a monitoring survey No. 10 undertaken between 23 rd and 29th April 2012 during construction period of the Bujagali Hydropower Project (BHPP). Two pre-construction, baseline surveys in April 2000 and April 2006 were conducted and so far, during construction phase of the project, nine monitoring surveys have been undertaken i.e. in September 2007, April 2008, April 2009, October 2009, April 2010, September 2010, April 2011, September 2011and the present one, in April 2012. 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)

During this survey, baseline assessment of the above mentioned studies was conducted in the reservoir behind the dam, including studies on algae, zooplankton and benthic macro-invertebrates which had been restrained since April 2008. The findings of baseline assessment of the reservoir are also contained in this report and are compared with those obtained from Transect 1(Upstream) and Transect 2 (Downstream).

2.0 GENERAL METHODOLOGY AND DATA COLLECTION

2.1. Materials and Methods

For seven surveys including one during April 2012, 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. The initial assessment survey of the reservoir for the same parameters as at the upstream and downstream transects was also undertaken during this monitoring period, in addition to assessment of algae, zooplankton and benthic macro-invertebrates.

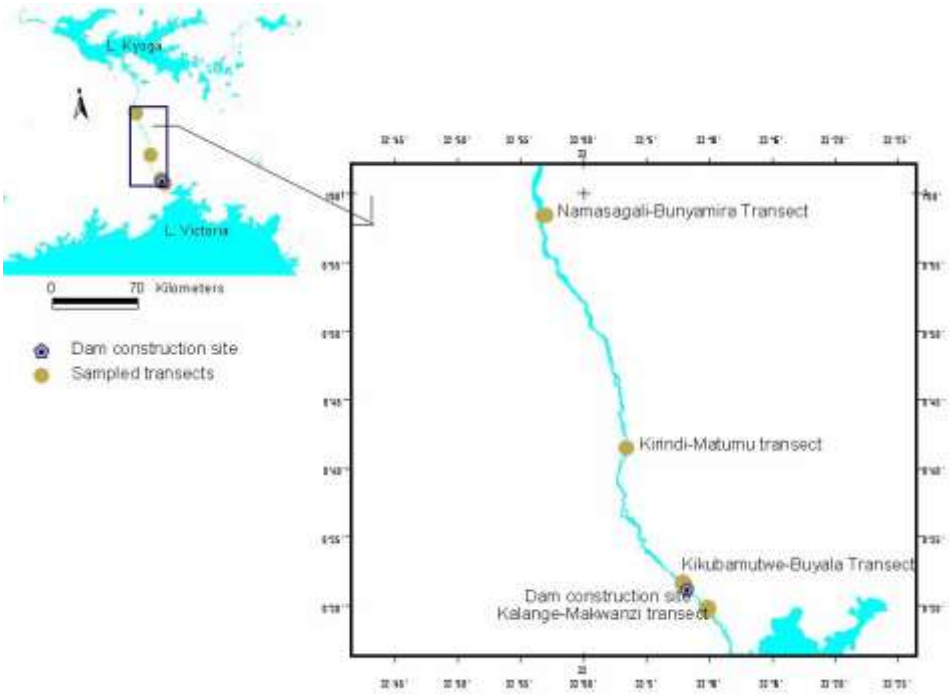

Figure 2.1a *A map showing the Upper Victoria Nile where the BHPP is located and river segments where baseline as well as monitoring samples were taken*



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. 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 at an upstream river transect-Kalange-Makwanzi, downstream transect- Buyala-Kikubamutwe and the reservoir

Parameter	Site	Monitoring Dates									
		1	2	3	4	5	6	7	8	9	10
		Aga-01	Sept. 07	Aga-08	Aga-09	Oct-09	Aga-10	Sep-10	Aga-11	Sep-11	Aga-12
Dissolved Oxygen (mg/L)	u/s	4.2	7.2	5.6	4.5	5.9	6.7	5.4	4.8	6.5	5.9
	d/s	6.5	7.7	7	7.2	7.2	9.5	7.8	7.1	7.5	7.5
	Reservoir										5.2
	NEMA Std	3	3	3	3	3	3	3	3	3	3
pH	u/s	7	7.5	8.2	6.7	7.6	6.8	7.1	7.4	7	8.5
	d/s	7.4	7.4	7.7	6.8	7.4	7	7	7.5	7	8.2
	Reservoir										8.2
	Upper NEMA Std	8	8	8	8	8	8	8	8	8	8
	Lower NEMA Std	6	6	6	6	6	6	6	6	6	6
Temperature (°C)	u/s	26.7	26.1	26.2	26.4	25.7	25.6	24.8	26.4	24.9	25.9
	d/s	26.4	25.7	26.9	26.8	25	25.8	25.4	26.9	26.5	26.1
	Reservoir										26.1
	Upper NEMA Std	35	35	35	35	35	35	35	35	35	35
	Lower NEMA Std	20	20	20	20	20	20	20	20	20	20
Conductivity (µS/cm)	u/s	105	112	83.1	95.5	96.9	87.5	108	178.6	105	92.5
	d/s	88.5	134	82.6	97.6	97.7	86.1	182.4	ND	115.7	94.6
	Reservoir										97.4
Secchi Visibility (m)	u/s	1.9	1.6	1.9	2.2	2.2	2.5	2.2	2.2	ND	1.5
	d/s	1.7	1.8	1.8	2.5	1.9	1.9	2.1	2.5	1.5	1.4
	Reservoir										1.7
Total Suspended Solids (mg/L)	u/s	2	2.7	4.2	7.9	5.7	5.5	2.9	5	2.4	5.1
	d/s	2	4.2	5.6	5.4	5.6	5.2	2.5	4.9	4.5	5.2
	Reservoir										3.6
	NEMA Std	100	100	100	100	100	100	100	100	100	100
Oil & Grease (mg/L)	u/s	0.6	0.1	0.005	0.02	0.05	0.04	0.06	0.07	0.1	0.17
	d/s	0.9	0.8	0.007	0.06	0.52	0.05	0.05	0.05	0.15	0.22
	Reservoir										0.21
	NEMA Std	10	10	10	10	10	10	10	10	10	10

Key:
Transect 1 (u/s): Kalange-Makwanzi
Transect 2 (d/s): Buyala-Kikubamutwe

The mean concentrations of dissolved oxygen (DO) at Kalange-Makwanzi and Buyala-Kikubamutwe continue to be comparable over the monitoring period (Table3.1.1). The mean concentrations varied from 5.2 mgL^{-1} in the revservoir to 7.2 mgL^{-1} at Buyala-Kikubamutwe during this monitoring period. The minimum standard set by National Environment Management Authority (NEMA) for survival of most aquatic organisms is 3 mgL^{-1}.

The mean pH at all sites was slightly alkaline and comparable to that of Lake Victoria. This pH, which had a variance of 0.3 units, was slightly above the NEMA permissible range of 6 to 8.

Water temperatures were also comparable with the previous data and were within the permissible NEMA range of 20ºC to 35ºC for the two transects and the reservoir.

Electrical conductance was slightly higher in the reservoir (97.4 µS/cm) than at the upstream (92.3 µS/cm) and downstream (94.8 µS/cm) transects, but was comparable with previous data. This slight deviation in electrical conductance was however, within acceptable ranges since the records for unpolluted sites of Lake Victoria waters are ≤ 120µS/cm.

Water clarity was higher in the reservoir compared to the upstream (1.5m), while this was lowest at the lower transect (1.4m).

The reservoir had a slightly higher concentration (3.6mg/L) of Total Suspended Solids (TSS) compared to that at the upstream (3.1 mg/L) and downstream (3.2 mg/L) transects. Despite this, the concentration of TSS was far below the permissible NEMA standard of 100 mg/L. The concentration of oil and grease was relatively constant (~ 0.2 mg/L) at the three sampling zones, and remained far below the NEMA permissible upper limit of 10 mg/L.

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

The concentration of ammonium-nitrogen (NH_4-N) has consistently remained low, with minimal deviations at the three zones. Throughout the monitoring period, the concentration of NH_4-N remained far below the NEMA permissible upper limit of 10,000 µg/L. The relatively low nitrite-nitrogen (NO_2-N) is attributble to the rapid oxidation of the nitrite species to nitrate-nitrogen, and the concentration during the current survey was comparable with the previous ones. The concentration of nitrate-nitrogen (NO_3-N) 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. Total Nitrogen (TN) concentration also decreased along the stream, with the upstream transect having the highest concentration, though all zones had less than the permissible NEMA upper limit of 10,000μg/L. During this April 2012 survey, the concentration of soluble reactive phosphorus (SRP) was slightly higher at the reservoir (7.0 µg/L) compared to the upstream (6.4 µg/L) and downstream (6.6 µg/L), but all were by far below the permissible NEMA upper limit of 5,000 µg/L. Total Phosphorus (TP) concentration was slightly higher at the downstream transect, but all zones had TP concentration far below the permissible NEMA upper limit of 10,000μg/L. Although the concentration of Soluble Reactive Silica (SRSi) continued to drop till September 2011, its concentration picked during this April 2012 survey, with a relatively higher concentration in the reservoir (268.1 µg/L) as compared to the upstream (176.8

µg/L) and downstream (248.1 µg/L). Algal biomass (Chlorophyll-a) was comparable to that determined during April 2006 (3.7 – 4.0 µg/L), September 2007 (5.3 – 5.7 0 µg/L) and April 2008 (4.4 – 7.0 µg/L), with no algal blooms detected even in the reservoir.

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

Parameter	Site	Monitoring Dates									
		1	2	3	4	5	6	7	8	9	10
		Aug-01	Sept.-07	Aug-08	Aug-09	Oct-09	Aug-10	Sep-10	Aug-11	Sep-11	Aug-12
Ammonium Nitrogen, NH4-N (µg/l)	u/s	42.3	20.2	79.4	8.8	18.6	137.2	75.3	5.8	1.5	8.7
	d/s	29.5	24	97.9	79.4	13.7	111.8	68.2	45.8	2	10.6
	Reservoir										10.5
	NEMA Std	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Nitrite-Nitrogen, NO2-N (µg/l)	u/s	8.7	9.5	4	3.1	3	4.2	7.3	4.7	2.9	5.8
	d/s	8.7	2.8	6.1	2.6	4	5.3	4.1	4.3	4	6.6
	Reservoir										6.3
Nitrate-Nitrogen, NO3-N(µg/l)	u/s	12.5	3.6	146.3	26.4	11.4	120.8	47.4	36.1	46.9	55.7
	d/s	12.6	9.4	182.5	3.5	7.6	148.6	49.2	54.7	61.2	51.5
	Reservoir										50.4
	NEMA Std	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)	u/s	117.4	208.5.5	192.5	306.7	2,36.2	1046.6	666.7	219.63	147.1.1	1,187.60
	d/s	111.2.5	213.8.8	249.23	216.7	2,42.1	299.1.8	597.3	210.8.7	245.0.3	1,464.70
	Reservoir										1,606.90
	NEMA Std	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)	u/s	10.8.6	5.4.5	5.8.5	6.0.3	3.6	18.6.3	8.4.6	3.0.3	3.2.2	6.5.2
	d/s	10.0.8	4.8.7	7.6.3	4.7.3	4.5	27.1.9	8.8.8	6.4.1	3.5.6	10.7.7
	Reservoir										4.1.8
	NEMA Std	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)	u/s	1.9	2.4.2	1.1.7	6.9	2.7	1.5.7	2.1.1	3.1.6	9.8	6.4
	d/s	1.9.2	2.7.7	1.8.9	1.6.6	3.2	2.4.8	2.5.6	2.0	1.1.7	6.6
	Reservoir										7
	NEMA Std	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)	u/s	3.1.9.9	5.3.0.7	2.5.8.4	5.0.1.2	8.5.9	5.2.1.1	2.6.5.9	1.4.9.6	2.3.8	1.0.6.8
	d/s	3.0.9.4	5.3.0.7	2.8.2.8	4.9.6.7	8.4.7	5.2.1.7	2.0.1.5	6.8.8	4.3.8	2.4.8.1
	Reservoir										2.6.8.1
Chlorophyll-a	u/s										5.1
	d/s										6
	Reservoir										5.6

Key:
Transect 1 (u/s): Kalange-Makwanzi
Transect 2 (d/s): Buyala-Kikubamutwe

3.1.3 Aquatic macrophytes and weeds

Due to reduced flow rate and high water levels at the upstream transect and in the reservoir, most of the original shore macrophytes, other than the emergent growth forms (e.g. *Vossia cuspidata*)

were no more as a result of submergence. Relatively stable waters had resulted into more water hyacinths that dominated the shores, with a cover abundance that varied between 35 and 50 % at various locations. The emergent *V.cuspidata* (Hippo grass) was frequently encountered and its cover abundance was in the range of 10 to 30 %. *Phragmintes* sp, another emergent macrophyte, was occasional in occurrence and only found at Makwanzi with a cover abundance of 25 %. Vegetation on small islands at this transect had withered due to flooding.

Apart from water hyacinth that was a common feature in sheltered nooks and stable waters, aquatic macrophytes had not established along the shores of the reservoir hence the banks were still devoid of any water plants. Water hyacinth constituted between 40 and 90% of aquatic macrophytes along the shores of the reservoir, with others being *Vossia cuspidata* (5%) and *Leersea hexadra* (5%). Along the shores of the reservoir were some terrestrial herbs and shrubs, with the original aquatic vegetation along the original river bank submerged and in most cases eroded away due to the remarkable rise in the water level as a result of the impoundment.

As a result of regulation of water flows at the new dam, the composition of shoreline macrophytes at the downstream transect had not significantly changed from that observed in 2007 during the initial survey. Approximately three quarters of the river bank had been cultivated down to the shoreline thus leaving little room for establishment of aquatic plants. Despite this, water hyacinth was the dominant aquatic weed/macrophyte whose abundance was in the range of 10 to 35%.

In summary, other than water conductance, water clarity, soluble reactive silica, and algal biomass (Chl-a) whose environmental discharge standards are not given, the rest of the parameters conform to NEMA discharge standards. Despite this observation, regular monitoring is essential in determining the trends in water quality and associated variables especially algal biomass and aquatic macrophytes. It is through regular monitoring that corrective environmental management measures can be designed to correct any deviation, if any occurs.

3.1.4 Zooplanton (Water column micro-invertebrates)

In general, the community was constituted by 6-7 copepod, 5-6 cladoceran and 8-13 rotiferan species (Table 3.1.4.1). Four constituent copepod genera were *Mesocyclops, Thermocyclops, Tropocyclops* and *Thermodiaptomus*. Cladoceran genera were *Daphnia Macrothrix, Chydorus, Ceriodaphnia, Diaphanosoma, Moina* and *Bosmina* while rotiferan *genera were Asplanchna, Ascomorpha, Euclanis, Brachionus, Filinia, Polyarthra, Keratella, Trichocerca, Lecane* and *Synchaeta.* The different species within each Genus were present regardless of the time (year) of sampling. The rotifer community supported somewhat higher species number (13) at the newly created dam. Five out of the 6 copepod species were recovered at all three field sites; while the same was true for 2 cladoceran and six rotiferan species. There were no major differences in species diversity between the field stations (upstream, downstream of the dam and the reservoir) and sampling times i.e. April 2006 and May 2012.

Table 3.1.4.1. Numerical abundance (ind. m^{-2}) of zooplankton species at three sites of BEL, April 2012.

Taxa	Species	Upstream		Reservoir	Downstream	
		Apr-06	Apr-12	Apr-12	Apr-06	Apr-12
Copepoda	*Thermocyclops incisus*		55	510	54	69
	Mesocyclops sp.	555	217	225	77	361
	Thermocyclops annae	1,213	222		22	208
	Tropocyclops confinis	2,458	402	1,021	177	985
	Thermodiaptomus galebiodes	3,649	1,586	827	423	1,156
	Thermocyclops neglectus	6,086	3,648	2,835	197	1,216
	Tropocyclops tenellus	8,585	4,498	4,871	1,201	5,927
	Cyclopoid copepodite	46,139	13,604	17,786	8,449	8,482
	Calanoid copepodites	6,808	1,401	2,843	531	1,724
	Nauplius larvae	109,016	56,689	72,696	27,844	25,701
Total copepods		184,511	82,323	103,613	38,975	45,828
Total copepod species		6	7	6	7	7
Cladocera	*Daphnia lumholtzi*				9	
	Daphnia longispina		42			
	Macrothrix sp.				20	
	Chydorid sp.	29		42	7	37
	Daphnia lumbortzi (falm.)	243	23	14	17	
	Ceriodaphnia cornuta	58	23	147		203
	Diaphanosoma excisum	287	462	297		190
	Moina micrura	679	361	497	28	227
	Bosmina longirostris	859	254	330	213	319
Total cladocerans		2,156	1,165	1,326	293	976
Total cladoceran species		6	6	6	6	5
Rotifera	*Asplanchna* sp.			22		
	Anuraeopsis sp.			42		
	Euclanis sp.	19		28		14
	Brachionus falcatus			33	11	
	Filinia longiseta	116	23	42		
	Polyarthra sp.	204				
	Filinia opoliensis	19	37	180		
	Brachionus calyciflorus	165	18	14	68	37
	Keratella cochlearis	173	74	164	30	83
	Trichocerca cylindrica	105	92	333	13	
	Brachionus angularis	213	46	164	95	97
	Lecane bulla	289	379	732	79	166
	Synchaeta sp.	617	587	644	42	291
	Keratella tropica	565	240	752	659	647
Total rotifers		2,485	1,498	3,148	997	1,336
Total rotiferan species		11	9	13	8	7
Total abundance		189,151	84,986	108,088	40,266	48,140

Abundance patterns

The common copepod species with higher numerical abundance were *Thermocyclops neglectus* and *Tropocyclops tenellus* (Table 3.1.4.1). However, equally numerically important were the three juvenile stages of copepods i.e. copepodites and nauplius larvae. Highest copepod abundance estimates were recorded upstream in April 2006 and the lowest was downstream also in 2006. Nonetheless, the low density estimates for April 2006 and April 2012 downstream were quite comparable (i.e. 38,975 and 45,828 respectively). The reservoir notably had a copepod density estimate just over 100,000 ind. m^{-2}, a figure higher than elsewhere except the Upstream record for 2006 (184, 511 ind. m^{-2}) while the April 2012 estimate for Upstream was much lower than the corresponding value for April 2006.

Total cladoceran abundance estimates were generally much lower than those of copepods. Estimates for Upstream April 2006 and April 2012 and those of the reservoir

showed minimum variation (1,165-2,156) but were in sharp contrast with much lower estimates for the downstream site for both 2006 and 2012.

Similarly, the rotifer community although the most diverse group, registered generally low density estimates (997-3,148 ind.m^{-2}) at the different sample sites. Notably the reservoir had the highest rotifer density estimate.

Overall density estimates ranged from 84,140 ind.m^{-2} Downstream in April 2012 to 189,151 ind.m^{-2} at the upstream site in April 2006 while the reservoir registered 108,088 ind.m^{-2}.

The zooplankton species composition and distribution trends at the new dam are generally comparable to those of earlier records (2006 BEL data) and Lake Victoria (Mwebaza-Ndawula et al. 2005; Mwebaza-Ndawula et al. 2003; Kiggundu et al 2012) where the River Nile originates. The dominant role of the copepods and the general scarcity and low abundance levels of the cladocerans and rotifers in the lake (Victoria) and river (Nile) systems are key areas of comparison between the sites (upstream and downstream) and over the years (2006 & 2012). Although somewhat higher diversity of species was observed at the reservoir, it remains to be seen if such a small difference can be sustained over time. The occurrence of nearly similar keystone species between 2006 (upstream and downstream) and 2012 at the newly created reservoir indicates a general stability of the zooplankton community which appears to have sustained its community structure even after the recent drastic ecological changes from running water to now standing water conditions at the reservoir. The newly created reservoir is intended for, among other things, development of a commercial fishery.

One of the key factors that drive development of a sustainable fishery is the occurrence in abundance of key natural fish food organisms for fish babies, juveniles and adult fishes. Invertebrates are one such key food items. As such the presence and wide distribution of a diversity of zooplankton species (Table 1) and in relatively high numerical abundance (> 100,000 ind. m^{-2}) (Table 2) offers promise for a vibrant pelagic fishery at the reservoir. The dominant copepods are on record for their resilience even when faced with changing planktivory regimes in Lake Victoria (Mwebaza-Ndawula & Schiemer, 1997; Mwebaza-Ndawula, 1998). Thus the occurrence of a zooplankton community that is comparable to that of Lake Victoria in the reservoir and the two upstream and downstream sites is an assurance that a reservoir-based mukene fishery is possible. Since all baby fishes depend on zooplankton for their nutrition, it is also possible that other non-planktivorous fishes can also thrive in the reservoir to create a multispecies fishery.

Some members of the zooplankton community, especially among rotifers, are also commonly used as biological indicators of water quality. Thus the occurrence of a wide diversity of zooplankton at the reservoir offers possibilities of early detection of water quality deterioration for timely mitigation measures.

3.1.4 Benthic macro-invertebrates

Table 3.1.4: The different taxa of benthic macroinvertebrates recovered overtime at the upstream (u/s)-Kalange-Makwanzi and the down stream (d/s)- Buyala-Kikubamutwe transects and the Reservoir

Major taxa	English name	Species name	Site	Monitoring dates			
				1	2	3	10
				Apr. 2008	Sep. 2008	Apr. 2009	Apr. 2012
Gastropoda	Water snails	*Bellamya unicolor*	u/s	33	173	5	33
			reservoir				
			d/s	98	126	11	42
		Melanoides tuberculata	u/s	28	107	257	14
			reservoir				
			d/s	33	224	100	121
		Biomphalaria choanomphala	u/s	0	14	5	0
			reservoir				2
			d/s		19	11	
		Anisus natalensis	u/s	0	0	0	0
			reservoir				
			d/s				5
		Gyraulus sp.	u/s	0	0	0	5
			reservoir				
			d/s				
		Segmentorbis sp.	u/s	0	0	0	0
			reservoir				
			d/s				47
		Gabbia humerosa	u/s	0	79	5	0
			reservoir				
			d/s			121	1027
		Bulinus sp	u/s	5	9	5	0
			reservoir				
			d/s	5	5	5	0
		Pila ovata	u/s	0	0	0	
			reservoir				7
			d/s			5	
Bivalvia	Clams/ mussels	*Byssanodonta parasitica*	u/s	79	145	252	61
			reservoir				23
			d/s	0	19	63	317
		Corbicula africana	u/s	56	126	182	47
			reservoir				5
			d/s	65	131	205	65
		Caelatura spp	u/s	149	93	229	79
			reservoir				9
			d/s	37	61	63	37
		Pisidium victoriae	u/s	0	5	0	0
			reservoir				
			d/s			32	19
		Mutela sp	u/s	0	0	0	5
			reservoir				
			d/s	5	5	16	
		Sphaerium victoriae	u/s	5	51	14	0
			reservoir				2
			d/s		19		23
		Sphaerium stuhlmanni	u/s	0	0	0	9
			reservoir				5
			d/s				9
		Aspatharia sp	u/s	9	9	5	5
			reservoir				
			d/s	5			0
		Etheria elliptica	u/s	0	0	0	
			reservoir				
			d/s			5	5

Major taxa	English name	Species name	Site	Monitoring dates			
				1	2	3	10
				Apr. 2006	Sep. 2007	Apr. 2008	Apr. 2012
Decapoda	Shrimps	*Caridina nilotica*	u/s	0	5	0	5
			reservoir				7
			d/s		5	32	
Ephemeroptera	Mayflies	*Povilla adusta*	u/s	19	163	9	28
			reservoir				5
			d/s	5	9	63	28
		Bastis sp.	u/s	5	9	0	0
			reservoir				
			d/s	23	5		
		Cloeon sp.	u/s	19	75	19	5
			reservoir				
			d/s		9	26	37
		Cloeon sp.	u/s	0	0	0	0
			reservoir				
			d/s	37			
		Leptophlebiidae	u/s	0	14	0	0
			reservoir				
			d/s				
			u/s	0	89	0	0
			reservoir				
			d/s				5
Odonata	Dragonflies/damsels	*Hagenius* sp.	u/s	19	0	9	0
			reservoir				
			d/s	5			5
		Gomphoides sp.	u/s	5	0	5	0
			reservoir				
			d/s		19		
		Libellulidae	u/s	9	93	0	5
			reservoir				2
			d/s		5	37	5
		Paragyrion sp.	u/s	0	0	0	0
			reservoir				
			d/s	5		5	
		Protomeniidae	u/s	0	9	9	0
			reservoir				
			d/s				
Trichoptera	Caddisflies	Hydropsychidae	u/s	0	0	0	0
			reservoir				
			d/s		19	16	5
		Brachycentridae	u/s	0	0	0	0
			reservoir				
			d/s				2
		Psychomyiidae	u/s	0	2	0	0
			reservoir				
			d/s				5
		Leptoceridae	u/s	0	0	0	0
			reservoir				
			d/s		2	3	
Hemiptera	Water bugs	Nepidae	u/s	0	0	5	0
			reservoir				
			d/s				
Coleoptera	Beetles/ weevils	Elmidae	u/s	0	5	0	0
			reservoir				
			d/s				

Major taxa	English name	Species name	Site	Monitoring dates			
				1	2	3	10
				Apr. 2009	Sep. 2007	Apr. 2008	Apr. 2012
Diptera	Tsetse flies	Chironominae	u/s	271	991	238	201
			reservoir				201
			d/s	84	56	58	84
		Tanypodinae	u/s	19	93	23	5
			reservoir				
			d/s	23	42	5	26
		Chaoborus sp	u/s	9	23	9	9
			reservoir				
			d/s	5	5		65
		Ceratopogonidae	u/s	5	14	0	9
			reservoir				
			d/s		5		
Oligochaeta	Earthworms	*Nais* sp.	u/s	0	5	5	14
			reservoir				
			d/s		93	11	9
Ostracods	Seed shrimps		u/s				
			reservoir				229
			d/s				
Number of taxa			u/s	18	26	20	18
			reservoir				12
			d/s	15	22	22	23

Nine species of water snails have been recorded over the monitoring period (Table 3.1.4). The most common water snails are: *Bellamya unicolor and Melanoides tuberculata* and occurred at both upstream and downstream transects over the monitoring periods. These snails are also common in Lake Victoria. *B. unicolor's* highest density of 173 ind. m^{-2} was recorded upstream in 2007 and that of *M. tuberculata* of 224 ind. m^{-2} downstream in 2007. On the nine species so far recorded, two were encountered in the reservoir, namely *Biomphalaria choanomphala* and *Pila ovate,* the former being a vector of bilharzia. The other Bilharzia vector snail, *Bulinus* was encountered at both upstream and downstream transect over the monitoring periods except in the April 2012 survey. The *B. choanomphala* was recorded in surveys of 2007 and 2008 both in the upstream and down stream.

Similarly, nine species of bivalves have been recorded at the sampling sites. The most common of these included *Byssanodonta parasitica, Corbicula Africana and Caelatura* sp. and have occurred at both upstream and downstream sites over the monitoring period. *B. parasitica* registered a density of 317 ind. m^{-2} at the upstream during the current survey, April 2012 while *C. Africana* and *Caelarura* sp registered highest densities of 182 ind. m^{-2} and 229 ind. m^{-2}at a downstream transect in April 2008 respectively.These clams were encountered in the reservoir too but at very densities. In the previous surveys, *Mutela* and *S. victoriae* occurred at the downstream and upstream transects respectively except during current one, April 2012. For all surveys so far, *Aspatharia* sp. has been encountered at the upstream transect. The shrimp, *Caradina nilotica* was recovered both at the upstream and downstream in 2007, only downstream in 2008 and in the 2012 it was recovered at the upstream and the reservoir.

For the insect types, mayfly nymphs, mainly *Povila adust*a and *Caenis* sp were encountered at the upstream and downstream transects. In the reservoir, P. *adusta* was the only mayfly registered. The caddis flies occurred at the downstream transect for sampling periods 2007, 2008 and 2012. The true fly larvae included the Chironomidae, Chaoboridae and Ceratopogonidae but of these, the chironomids were the most common and occurred in all transects including the reservoir at a density of 201 ind. m^{-2} . The chaoborids were absent downstream in 2008 and were missing the reservoir during this survey. The aquatic worms were recorded at both the upstream and downstream transects during the sampling dates in 2007, 2008 and 2012. They were absent in the reservoir.. The density of seed shrimps at 229 ind.m^{-2} was the highest of all the benthos in the reservoir.

3.2 Fish Species Composition and Relative Abundance

3.2.1 Catch composition

A total of 11fish species (haplochromines were taken as a single taxon group) were recorded at the three transects along the river compared to 8 in September 2011, 10 in April 2011, and 10 in September 2010 (Table 4.1). 8 species were recorded from the upstream station at Kalange, 10 from the reservoir and 8 species from the downstream at Buyala. No new species was added to the list of fishes so far recovered from the study transects (Table 4.2). Thus 63 fish species of which 43 are haplochromines have so far been recovered from the two transects.

All recognised keystone species (*Barbus altianalis, Lates niloticus, Mormyrus kannume, Oreochromis niloticus* and the haplochromines) were recovered. *O. niloticus* was recovered only from the upper transect at Kalange while *L. niloticu*s and *M. kannume* and the haplochromines were got at all transects.

Quantities of *O. niloticus* continue to decline probably as a result of fishing pressure. The native tilapiine *Oreochromis variabilis* which has persisted at Kalange was also recorded from both the reservoir and Buyala. The upstream transect Kalange has consistently recorded higher densities of fish (8.2) than Buyala (3.1) fish per net per night. Haplochromines dominated the catch by both numbers and weight at the two stations up and downstream but *Lates* dominated in the reservoir.

From all gears, 8, (8, 8, 7, 9,) species were recorded at Kalange (Transect 1) and 8, (5, 4, 10, 6,) at Buyala (Transect 2) (Numbers in brackets are for the number of species caught during the September 2011, April 2011, September 2010, and April 2010 surveys respectively). *Bagrus docmak, C. gariepinus* and *Synodontis victoriae* were recovered only from the reservoir while *O. niloticus* was only caught at Kalange.

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3.2.2 The Haplochromines

17 species belonging to 11 genera of haplochromines were recovered during the survey (Table 4.2). The upstream transect - Kalange-Makwanzi yielded the highest haplochromine species diversity (14 species). The reservoir and the downstream transect

Buyala-Kikubamutwe each had 4 species. Over the last five surveys, haplochromine diversity and abundance have consistently been highest at Kalange. *Astatotilapia brownae* contributing 88% of the haplochromines was the commonest haplochromine at the three stations followed by *Neochromis rufocaudalis* at 21.9%., *Mbipia mbipi* 18.6%, and *Astatotilapia "purple dorsum"* 8.2%. The rest of the species each contributed less than 5%.

Table 3.2.1 *Fish species recorded overtime at upstream (Kalange-Makwanzi) and downstream (Buyala-Kikubamutwe) transects and for the baseline of the reservoir.*

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

Key:
Transect 1 (u/s): Kalange-Makwanzi
Transect 2 (d/s): Buyala-Kikubamutwe

Table 3.2.2 *Haplochromine species recorded over time at the upstream (Kalange – Makwanzi) and downstream (Buyala – Kikubamutwe) transects.*

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

Key:
Transect 1 (u/s): Kalange-Makwanzi
Transect 2 (d/s): Buyala-Kikubamutwe

3.2.3 Catch rates / biomass estimates

Catch rates i.e. catch per net per night was used to determine relative abundance of fish species from transects under survey. Catch rates by numbers were highest upstream in Kalange (8.2) and lowest downstream at Buyala (3.1) (Table 4.1). By weight, rates were highest in the reservoir (443g) (Table 4.3). Haplochromines recorded the highest rates in both numbers and weight (11.1 and 167.5g respectively.) upstream. The reservoir recorded the lowest quantities of haplochromines. Colonization of the reservoir by haplochromines is in the initial phase. Of the 4 species recorded from this station, 3 of them are known rock dwelling species. This ideal rock habitat was created by the blasting and embankment during dam construction. The presence of large sized species *Bagrus docmak, Barbus altianalis* and *Mormyrus kannume* is responsible for the dominance by weight in the reservoir. Catches were generally better upstream during this survey than the previous one. At the two sites where comparative data exists, overall catch rates increased from 3.36 to 8.2 fish upstream and from 1.5 to 3.1 downstream. By weight however the rates increased upstream (102 to 290g) but declined downstream (102 to 73g).

3.2.4 Fish species recovery

No new fish species was recovered during this survey. The total number of species so far recorded from the two transects previously under investigation remained at 63. All large sized fish species expected at these transects have been recovered. Figure 4.1 indicates that further species recovery is unlikely. The reservoir created has so far registered 10 species. Further colonisation of this reservoir by new species is to be monitored in subsequent surveys.

Table 3.2.3 *Catch rates (numbers) of fish species caught over time by gillnets at the upstream (Kalange-Makwanzi) and downstream (Buyala-Kikubamutwe) transects, and in the baseline of the reservoir*

Family name	Scientific Species name	English common/local name (language)	Site	Monitoring dates									
				1	2	3	4	5	6	7	8	9	10
				Apr. 2008	Sep. 2011	Apr. 2008	Apr. 2008	Sep. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2011	Apr. 2012
Bagridae	*Bagrus docmak*	Catfish(Tanzanian)	u/s		0.03			0.08					
			reservoir										0.03
			d/s		0.07		0.04						
Centropomidae	*Lates niloticus*	Nile perch/Mputa	u/s	0.19	3.1	3.32	2.3	9.76	0.32	0.58	**1.15**	**0.15**	**2.85**
			reservoir										3.06
			d/s	1.12	1.68	1.86	2.29	2.57	0.35	0.4	**0.16**	**0.72**	**0.85**
Cichlidae	*Bogutus jacksoni*	(Ningu)	u/s										
			reservoir										
			d/s	0.04									
	B. mellori	(Ningu)	u/s	0.04									
			reservoir										
			d/s										
	Oreochromis niloticus	Nile tilapia(Ngege - Isiluli)	u/s	0.04	0.33	0.1		0.2			**0.01**	**0.01**	**0.07**
			reservoir										
			d/s	0.07	0.41	0.04	0.04	0.1		0.1			**0.19**
	O. leucostictus	Black tilapia(Ngege)	u/s	0.04	0.09								
			reservoir										
			d/s	0.06	0.08								
	O. variabilis	Tilapia(Ngege)	u/s	0.17	0.91	0.43	0.45	1.52	0.06	0.17	**0.19**		**0.89**
			reservoir										0.03
			d/s	0.13	0.08		0.17			0.02	0.02	**0.05**	**0.05**
	Tilapia zillii	Red-belly tilapia(Ngege)	u/s	0.1	0.17	0.17		0.17	0.04	0.1	**0.15**		**0.89**
			reservoir										0.05
			d/s	0.88	0.46	0.04	0.43	0.1		0.04			**0.16**
	Haplochromines	(Nkejje)	u/s	9	10.46	6.63	19.04	15.5	5.83	4.5	**12.7**	**18.6**	**11.1**
			reservoir										0.25
			d/s	16.83	4.27	6.36	8.32	6.47	0.78	1.62	**2.85**	**1.56**	**6.15**
Claridae	*Clarias gariepinus*	Mudfish/ (Mbu)	u/s			0.03	0.17						
			reservoir										0.02
			d/s	0.01		0.25	0.07		0.03			**0.07**	
Cyprinidae	*Barbus altianalis*	Barbel fish/ (Kiringa)	u/s	0.02	0.1	0.17	0.03		0.01				**0.07**
			reservoir										0.06
			d/s	0.1	0.11	0.04	0.04		0.01	0.01		**0.07**	**0.07**
	Barbus paludinosus	Barbel fish/ (Kiringa)	u/s										
			reservoir										
			d/s	0.04									
	Labeo victorianus	(Ningu)	u/s										
			reservoir										
			d/s		0.09					0.02			
Lepidosirenidae	*Protopterus aethiopicus*	Lung fish (Mundu)	u/s						0.01				
			reservoir										
			d/s				0.04						
Mochokidae	*Synodontis afrofischeri*	Tiger fish (Ntalanga)	u/s	0.21	0.63	0.08	0.42	1.46	0.46	0.33	**0.15**	**0.58**	**0.75**
			reservoir										0.75
			d/s		0.27	1.09	0.37	3.58	0.28	0.1		**1.07**	**0.86**
	S. victoriae	Tiger fish (Ntalanga)	u/s			0.08		0.21	0.29		**0.17**		
			reservoir										0.05
			d/s										
Mormyridae	*Marcusenius kannumensis*	Elephant snout fish (Kamalakasasi)	u/s	0.32	0.8	1.83	0.7	0.08	0.23	0.18	**0.22**	**0.04**	**0.55**
			reservoir										0.82
			d/s	0.68	0.86	2.25	0.39	0.38	0.15	0.25	**0.18**	**0.17**	**0.87**
OVERALL RATES			u/s	2.89	5.48	4.39	7.54	10.01	2.87	2.41	**4.58**	**5.56**	**8.2**
			reservoir										4.4
			d/s	6.45	3.28	3.91	3.71	4.28	0.81	1.21	**0.95**	**1.5**	**5.1**

Key:
Transect 1 (u/s): Kalange-Makwanzi
Transect 2 (d/s): Buyala-Kikubamutwe

Table 3.2.4 *Catch rates (weight (g)) of fish species caught over time by gillnets at the upstream (Kalange - Makwanzi)*

Family name	Scientific Species name	English name/local name (language)	Site	Monitoring dates									
				1 Aye. 2008	2 Aug. 2010	3 Aye. 2008	4 Aye. 2009	5 Aug. 2009	6 Aye. 2010	7 Aug. 2010	8 Aye. 2011	9 Aug. 2011	10 Aye. 2012
Bagridae	*Bagrus docmak*	Catfish(Tamutamuka)	u/s		37.53			28.58					
			reservoir										14.1
			d/s		22.50		0.6.93						
Centropomidae	*Lates niloticus*	Nile perch/Mputa	u/s	15.75	271.27	371.00	114.13	250.84	49.44	35.86	**11.6**	**8.6**	**156.7**
			reservoir										197.6
			d/s	108.21	107.79	159.07	111.00	171.43	28.81	39.28	**16.4**	**44.5**	**58.7**
Cichlidae	*Hyperopisus jacksoni*	(Ningu)	u/s										
			reservoir										
			d/s	3.25									
	H. modlesti	(Ningu)	u/s	0.75									
			reservoir										
			d/s										
	Oreochromis niloticus	Nile tilapia(Ngege - black)	u/s	1.80	7.42	28.93		20.08			**8.5**	**6.7**	**1.7**
			reservoir										
			d/s	4.53	0.18	3.93	0.93	5.05		0.83			**5.8**
	O. leucostictus	Black tilapia(Ngege)	u/s	3.67	6.61								
			reservoir										
			d/s	5.75	6.75								
	O. variabilis	Tilapia(Ngege)	u/s	33.54	49.04	63.30	44.73	82.76	14.87	19.54	**76.1**		**18.4**
			reservoir										1.7
			d/s	11.58	12.08		8.17			4.04	**11.5**	**15.6**	**8.1**
	Tilapia zillii	Red belly tilapia(Ngege)	u/s	6.92	15.65	21.65		7.92	7.71	32.17	**71**		**18.1**
			reservoir										7.2
			d/s	81.85	19.08	7.33	42.26	7.90		2.71			**6.1**
	Haplochromines	(Nkejje)	u/s	303.92	191.92	168.08	534.33	383.24	167.67	113.11	**168**	**246**	**167.5**
			reservoir										4.1
			d/s	284.88	51.27	206.00	187.05	167.90	15.78	40.38	**57.7**	**15.5**	**86.9**
Clariidae	*Clarias gariepinus*	Mudfish/ (Mdd.u)	u/s			6.27	69.33						
			reservoir										9.4
			d/s	9.20		52.93	89.36		33.58			**5.1**	
Cyprinidae	*Barbus altianalis*	Barbel fish/ (Kisinja)	u/s	19.27	403.33	501.13	7.27		2.31				**8.6**
			reservoir										51.3
			d/s	48.88	22.93	95.57	9.36		4.03	5.73		**17.8**	**8.5**
	Barbus gabiusensis	Barbel fish/ (Kisinja)	u/s										
			reservoir										
			d/s	0.50									
	Labeo victorianus	(Ningu)	u/s										
			reservoir										
			d/s		38.91					14.80			
Lepidosirenidae	*Protopterus aethiopicus*	Lung fish (Mamba)	u/s						15.92				
			reservoir										
			d/s				26.21						
Mochokidae	*Synodontis afrofischeri*	Tiger fish (Nile lungu)	u/s	10.92	49.50	4.58	14.92	56.79	59.63	18.75	**7.2**	**28.8**	**61.1**
			reservoir										15.6
			d/s		19.09	30.64	10.42	111.58	12.89	2.38		**17.4**	**1.5**
	S. victorius	Tiger fish (Nile lungu)	u/s			12.50		17.92	39.33		**28.1**		
			reservoir										6.8
			d/s										
Mormyridae	*Mormyrus kannume*	Elephant snout fish (Kamakamu)	u/s	110.16	250.47	511.47	95.75	14.72	49.01	77.49	**59.7**	**7.5**	**4.5**
			reservoir										157.5
			d/s	217.37	89.54	175.64	185.00	51.62	9.22	33.36	**15.6**	**15.9**	**1.5**
OVERALL RATES			u/s	242.00	473.90	635.87	299.47	296.77	212.59	185.74	**141**	**182**	**298**
			reservoir										443
			d/s	502.77	137.22	257.05	241.69	170.83	82.81	104.11	**49.9**	**182**	**75**

Key:
Transect 1 (u/s): Kalange-Makwanzi
Transect 2 (d/s): Buyala-Kikubamutwe

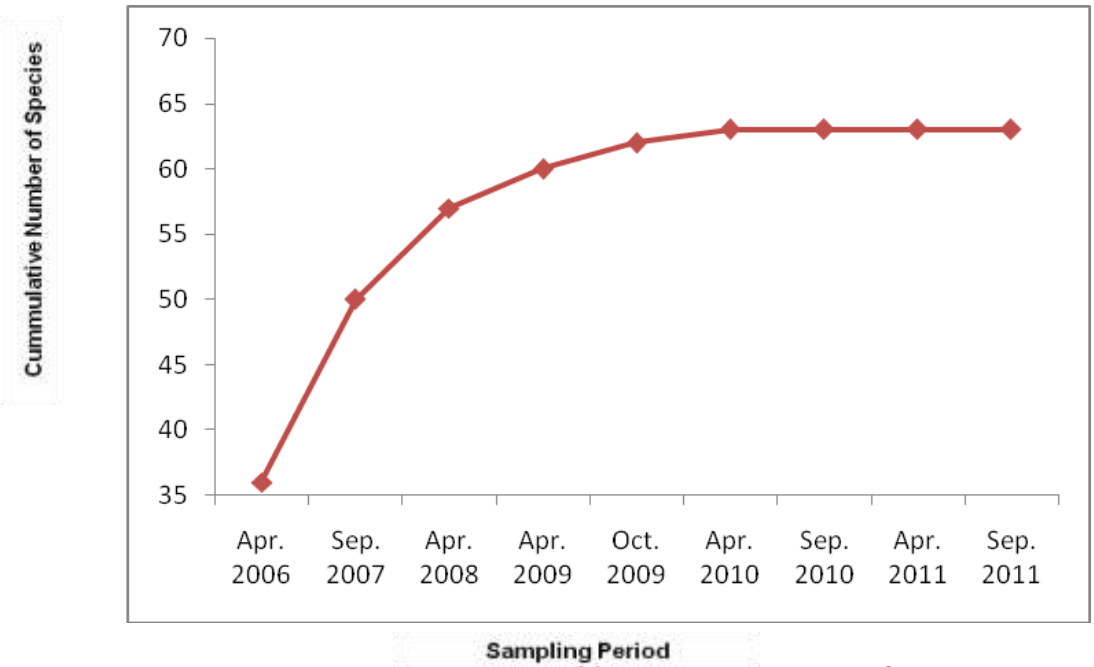

Figure 3.2.1 Cumulative *number of fish species recovered from the study transects on the Upper Victoria Nile between April 2006 and April 2012.*

3.3 The Food and Trophic Ecology of the Fishes

In april 2012 survey, *Lates niloticus* from Transect 1 ingested mostly fish (90.2%) dominated by Haplochromines (55.9%) in addition to Mukene (23.0%), tilapia (4.3%) and unidentifiable fish material (7.0%). Other prey items included *Caridina* (4.4%), Odonata (4.3%) and molluscs (1.1%). In Transect 2, *Lates niloticus* ingested only fish which comprised of haplochromines, mukene, tilapia and unidentifiable fish material. The dominance of fish prey in diet of Nile perch in the two transects was also observed in the previous survey of September 2012.

The diet of *Oreochromis variabilis* in April 2012 was dominated by blue-green algae (64.7%) in addition to detritus (15.0%), green algae (11.0%), diatoms (4.3%), insects (3.3%) and zooplankton (1.7%). The dominance of blue-green algae was also observed in the survey of April 2012 but differ from those of September 2012 in which the species had only ingested insects (Ephemeroptera). In Transect 2, the diet of *O. variabilis* in April 2012 was also dominated by blue-green algae (80%). Other food items included *Caridina* (5%), zooplankton (5%), chironomids (5%) and detritus (5%). Specimens of *O. variabilis* from Transect 2 had empty stomachs in the previous survey of September 2012. Variation in diet of *O. variabilis* is due to seasonal changes in abundance of the food items ingested by the species.

Molluscs (90%) were the dominant food for *Oreochromis niloticus* in Transect 1 in April 2012. Other food items included fish (5%) and Ephemeroptera (5%). However, in the previous survey of September 2011, *O. niloticus* from the same transect ingested a

variety of food items that comprised mainly of detritus (32.1%), Ephemeroptera (26.6%), water plants (21.5%) and algae. Molluscs were recorded in small quantities. In Transect 2, *O. niloticus* ingested mainly insects (32.7%), followed by detritus (32.0%), blue-green algae (23%), green algae (3.5%) and water plants (2%) in April 2012. In September 2011 there was no *O. niloticus* in the experimental fish catches from Transect 2.

In the survey of April 2012 the diet of *Mormyrus kannume* from Transect 1 was dominated by insects (99.8%) that comprised of Ephemeroptera (60.9%), chironomids (37.2%) and Odonata (1.7%). Other food items included Caridina (0.2%). Specimens of *M. Kannume* from Transect 2 had empty stomachs.. Dominance of insect prey in the diet of the species in both transects was also observed in the previous surveys of April and September 2011

The diet of *S. afrofischeri* from Transect 1 in the April 2012 survey was dominated by molluscs (66.4%) in addition to chironomids (25.6%) Ephemeroptera (5.4%) and unidentifiable insect material (2.7%) whereas in September 2011 the diet of the species comprised of only insects. In Transect 2, stomachs of *S. afrofischeri* were empty in April 2012 although in the previous survey of September 2011 the species had ingested only insect prey that included chironomids and Odonata. Thus insects are still the major prey ingested by *S. afrofischeri* although some variation in diet occur as a result of seasonal changes in abundance of the food items ingested by the species.

In April 2012, a preliminary study on the biology and ecology of the dominant fishes occurring in the Bujagali reservoir was carried out. Two main aspects were studied i.e. feeding ecology and sexual maturity and breeding. Stomach content analysis was based on the point method (Hynes 1950) while gonad maturity stages were determined based on a 7-point scale as outlined by Bagenal & Braum (1978) and LVFO (2006). The results were compared with those obtained from Transect 1(Upstream) and Transect 2 (Downstream) as indicated in Tables 3.3.1 & 3.3.2. The fish specimens for the study were obtained by experimental gillnetting.

Food of dominant fish species in the reservoir

Seven fish species recorded from the reservoir were examined to determine the food items ingested. The species included *Lates niloticus, Bagrus docmac, Barbus altianalis, Mormyrus kannume, Synodontis afrofischeri, S. victoriae,* and *Clarias gariepinus (*Table 3.3.1).

Fish (53.1%), dominated by *Rastrineobola argentea* (50%) was the main food item ingested by *L. niloticus* in addition to *Synodontis sp*.(0.8%) and unidentifiable fish material (3.1%). Other prey included *Caridina* (38.9%), crabs (4.3%) and insects (3.0%). *B. docmac* had ingested fish (*Synodontis* sp) while *B. altianalis* had ingested insects. In *M. kannume*, the diet comprised of insects (81.2%), detritus (10.9%), *Caridina* (0.5%) and ostracods (2.3%). The insect prey included Ephemeroptera (49.8%) and chironomids (31.4%). *S. afrofischeri* ingested had ingested insects while the diet of *S. victoriae* consisted of molluscs only.

Table 3.3.1 *Dominant food types of common fish species caught over time at the upstream (Kalange - Makwanzi) and downstream (Buyala-Kikubamutwe) Transects, and in the reservoir for the baseline*

Family name	Scientific Species name	English/local (Luganda) name	Site	Monitoring dates									
				1	2	3	4	5	6	7	8	9	10
				Apr. 2006	Sep. 2001	Apr. 2008	Apr. 2009	Sep. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2011	Apr. 2012
Bagridae	*Bagrus docmac*	Semotondo	u/s										FR
			Reservoir										Syn
			d/s										
Centropomidae	*Lates niloticus*	Nile perch/ (Mpota)	u/s	FR	HAP	HAP	HAP	FR	HAP	HAP	HAP	HAP	HAP
			Reservoir										RAS
			d/s	FR	CAR	FR	CAR	ODT	RAS	RAS	CHR	HAP	FR
Cichlidae	*Oreochromis niloticus*	Nile tilapia/ (Ngege-Kibati)	u/s	E	HPM	BGA	HPM	E	E	DTR	IR	DETR	MOL
			Reservoir										
			d/s	E				E	DTR	E	DETR		INS
	O. variabilis	(Ngege)	u/s	BGA	GRA	BGA	HPM	GRA	BGA	BGA	BGA	EPH	BGA
			Reservoir										
			d/s	BGA	E		HPM				E	E	BGA
	Tilapia zillii	Red-belly tilapia /(Ngege)	u/s	MOL	HPM	E		E	IR	HPM	IR		EPH
			Reservoir										INS
			d/s	HPM	CAR	E	HPM	E	HPM	HPM			EPH
Clariidae	*Clarias gariepinus*	Mudfish/(Male)	u/s			FR	FR				EPH		
			Reservoir										EPH
			d/s			HAP	EPH		E			CHR	
Cyprinidae	*Barbus altianalis*	Barbelfish/(Kinioja)	u/s	E	INS	INS	INS		MOL	E	IR	CHR	DETR
			Reservoir										INS
			d/s	E	INS	INS			E	MOL		CHR	
Mochokidae	*Synodontis afrofischeri*	Tigerfish/(Nkolongo)	u/s	CHR	EPH		CAR	CHR	EPH	CHR	EPH	INS	MOL
			Reservoir										INS
			d/s		CHR	CHR	INS	CHR	INS	CHR		INS	
Mormyridae	*Mormyrus kannume*	Elephant Snoutfish/(Kanokbana)	u/s	INS	EPH	EPH	INS	EPH	EPH	EPH		CHR	EPH
			Reservoir										EPH
			d/s	INS	EPH	INS	EPH	CHR	CHR	INS	EPH	INS	E

Key:Transect 1 (u/s): Kalange-Makwanzi
Transect 2 (d/s): Buyala-Kikubamutwe

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

Family name	Scientific Species name	English/local(Luganda) name	Site	Monitoring dates									
				1 Apr. 2009	2 Sep. 2009	3 Apr. 2010	4 Apr. 2010	5 Sep. 2010	6 Apr. 2011	7 Sep. 2011	8 Apr. 2012	9 Sep. 2012	10 Apr. 2013
Bagridae	*Bagrus docmac*	Semutundu	u/s	0	0	0	0	0	0	0	0	0	0
			Reservoir										50
			d/s	0	0	0	0	0	0	0	0	0	0
Centropomidae	*Lates niloticus*	Nile perch/ (Mputa)	u/s	0	0	0	0	0	0	0	0	0	0
			Reservoir										1
			d/s	0	0	0	0	0	0	0	0	0	0
Cichlidae	*Oreochromis niloticus*	Nile tilapia/ (Nyege-Kibati)	u/s	0	0	71.4	0	0	50	54.5	38.5	70	0
			Reservoir										
			d/s	0				0		0	0		0
	O. variabilis	(Nyege)	u/s	12.5	0	22.2	55.2	0	50	38.1	46.3	50	0
			Reservoir										0
			d/s	0	0		0			0	0	100	0
	Tilapia zilli	Red belly tilapia /(Nyege)	u/s	0	0	0		0	0	83.3	42.9		33.3
			Reservoir										0
			d/s	7.1	25	100	0	0		0			0
Clariidae	*Clarias gariepinus*	Mud fish/(Male)	u/s			0	0				**100**		
			Reservoir										0
			d/s			0	0		0			0	
Cyprinidae	*Barbus altianalis*	Barbel fish/(Kimiga)	u/s	100	100	80	100		64.7	0	**64.3**	100	0
			Reservoir										50
			d/s	12.5	100	100			0	100		100	
Mochokidae	*Synodontis afrofischeri*	Tiger fish/(Nsulungi)	u/s	20	100		70	91.7	90	88.9	**100**	87.5	7.9
			Reservoir										6.7
			d/s		75	36.4	50	100	100	100		100	0
Mormyridae	*Marcusenius kannume*	Elephant Snout fish/(Kasukubwa)	u/s	44.1	58.3	43.5	23.8	50	56.7	72.2	**50.3**	50	17.6
			Reservoir										25
			d/s	37.5	41.7	27.1	54.5	33.3	0	33.3	**18.8**	20	0

Key:Transect 1 (u/s): Kalange-Makwanzi
Transect 2 (d/s): Buyala-Kikubamutwe

3.4. THE COMMERCIAL FISHERY

3.4.1 Fishing effort in the fishery

Assessment of fishing effort is an important parameter that not only shows importance of the resource to the riparian communities but also leads to estimation of periodic yield from the fishery. Fishery yield is of paramount importance in guiding 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 2012, the number of fishing boats upstream at Kalange-Makwanzi dropped from 32 in September 2011 to 15 in April 2012. An equal number was recorded on the reservoir which could imply movement into the reservoir that was newly opened to fishing. Likewise, the number of active fishing boats downstream at Buyala-Kikubamutwe more than doubled from 15 September 2011 to 34 in the current survey (Table 3.4.1). There are observable changes within the upper and downstream transects however the total number of boats in the two transects appear to have no significant change over time a possiblibity of migration of fishers between the transects Fishers also appear to have been attracted to this area by incentives of the dam construction project which included free fishing boats and gears around 2008 and 2009. They may have reverted to the original businesses they were doing before as catch rates reduced and the given nets and boats aged. There are no signs of new boats entering the fishery. Gillnets remained the main fishing gear upstream at Kalange-Makwanzi where one third of the boats used the gear. Downstream at Buyala-Kikubamutwe the use of gillnets was insignificant while long lines and hand lines remained to be the dominant gear in use and was used by more than three quarters of the fishing boats. The large gillnets of 6 inch mesh size supplied earlier by Bujagali Energy Limited (BEL) to the fishers at Buyala-Kikubamutwe were no longer in use. BMUs attribute their limited use to their low catches, an indication of lower stocks of large fishes.

Large sized gillnets (≥ 5") were only recorded on the reservoir which could be as a result of deep waters in the resourvior compared to the upstream and downstream transects. At the upstream transect (Kalange-Makwanzi), about 70% of gillnets used were of ≥4 inch and the rest were 3.5 inches unlike ≤2.5 inch mesh encountered in the consecutive previous 4 surveys. At the downstream transect (Buyala-Kikubamutwe) all the 13 gillnets used were of 3 – 3.5 inch sizes. At the upstream transect (Kalange-Makwanzi), the total number of gillnets were comparable to the previous survey in September 2011 while the number of long line hooks significantly dropped from 500 in September 2011 to 70 recorded in this survey (table 3.4.1). The number of long lines hooks increased from about 480 in September 2011 to 520 in this survey at Buyala-Kikubamutwe. The reservoir registered 50 long line hooks which could just be one boat. The other dominant fishing gears e.g. Cast nets and hand lines increased 7 – 10 times downstream over the same period. The number of hand line hooks however reduced substantially at Kalange-Makwanzi. No monofilaments were recorded both upstream and downstream except on the reservoir. The boats targeting Mukene at both transects were more prominent on the reservoir. 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 at

the two study sites. Information generated from this survey indicates there are migrations even across the dam site through lifting boats over land downstream.

Table 3.4.1. *The trend in numbers of fishing boats and fishing gears, upstream (US) at Transect 1 (Kalange-Makwanzi) and downstream (DS) at Transect 2 (Buyala-Kikubamutwe) from April 2006 to April 2012.*

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
Number fishing boats	US	9	10	7	22	18	23	23	18	32	15
	Reservoir										16
	DS	13	17	23	26	32	23	15	12	15	34
Number of boats using gillnets	US		9	7	10	6	7	13	6	8	9
	Reservoir										13
	DS		7	18	7	6	1	2		1	4
Number of boats using long line hooks	US		1	2	3	1	2	2	0	2	1
	Reservoir										1
	DS		10	8	6	6	13	6	3	7	10
Number of boats using cast nets	US					5	4	1	1	5	1
	Reservoir										0
	DS			1	6	3	1	1	3	0	7
Number of boats of boats using Hand line hooks	US			7	9	5	4	2	6	8	3
	Reservoir										1
	DS			15	9	14	9	2	2	3	12
Number of boats using scarp nets	US					1	6	4	4	4	1
	Reservoir										6
	DS			2	1	1		1	2	1	1
Number of fishing gears by mesh size											
Gillnets - 2 2/6"	US		3			1			4		2
	Reservoir										0
	DS			1		10		2			0
Gillnets 3"	US					3	1	6			8
	Reservoir										0
	DS			1	4			9			10
Gillnets 3 1/6"	US		3			1	1	4		5	16
	Reservoir										0
	DS			25							3
Gillnets 4"	US		30		21	8	2	26	20	20	10
	Reservoir										0
	DS		20	4			1			13	0
Gillnets 4 1/6"	US			21	5			2	2	12	4
	Reservoir										0
	DS		3	12		6	1				0
Gillnets 5"	US		2	25	12	1					1
	Reservoir										14
	DS		5	47						5	0
Gillnets 5 1/6"	US										
	Reservoir										
	DS										
Gillnets 6"	US							4		8	
	Reservoir										22
	DS			5	18	15					
Gillnets >6"	US										
	Reservoir										
	DS			4							
Total gillnets	US		38	46	38	20	24	42	28	43	41
	Reservoir										36
	DS		28	99	22	37	4	11		18	13
Long line hooks	US		300	330	550	200	650	200		500	70
	Reservoir										50
	DS		510	405	277	180	380	142	110	482	525
Beach seines	US										
	Reservoir										
	DS			1							
Cast nets	US					5	4	1	1	5	1
	Reservoir										0
	DS			1	6	3	1	1	3		7
Hand line hooks	US			91	105	124	26	3	18	88	35
	Reservoir										6
	DS			394	97	152	32	16	8	5	51
Scarp nets	US					1	6	4	4	4	1
	Reservoir										6
	DS			2	1	1		1	2	1	1
Mosquitoes nets	US										0
	Reservoir										21
	DS										0

3.4.2. Fish catch composition and catch rates

Eleven fish taxa including *Bagrus docmak, Lates niloticus, Oreochromis niloticus, Oreochromis variabilis, Tilapia zillii, Barbus altianalis, Synodontis afrofscheri, Mormyrus kannume, Clarias gariepinus, Protopterus aethiopicus* and Haplochromines, were landed at Transect 1 (Kalange-Makwanzi). The downstream transect recorded 3 species less than the upstream transect. The reservoir recorded 10 species but also had *Rastrineobola argentea* which wasn't caught at the downstream and upstream transects. Although haplochromines appear in insignificant proportions in the catch at the two landing sites, they are mainly harvested for bait to catch the large predatory Nile perch and *Bagrus*.

The current survey showed slight increase of catch rates for six key commercial fish species i.e. *L. niloticus, B. altianalis, B. docmak, O. niloticus, O. variabilis,* and *M. kannume* at Upstream transect (Kalange-Makwanzi) compared with the September 2011 survey. On the other hand, the catch rates of three key commercial species (*Bagrus docmak, O. niloticus* and *Mormyrus kannume*) caught downstream at Buyala-Kikubamutwe decreased between the September 2011 and the current survey with an increase in *L. niloticus* and *B. altianalis* in the same period. *B.altialis* recorded the highest ever recorded catch rate in both transects of about (6.05 kg/boat/day) which could be associated with the rise in water level and increase in the speed of water. *B. altianlis* inhabits fast moving water and gets more active diving in fast moving water which could increase their catch rates.

Comparison of catch rates of key commercial fish species in the current survey with the last survey in a similar season April 2011 showed a large increase upstream at Kalange-Makwanzi. For instance, *L. niloticus* catch rates increased from 0.52 to 1.76kg/boat/day; *M. kannume* (0.25 to 5.47 kg/boat/day) and *B. altianalis* (1.66 to 6.05 kg/boat/day) however a notable decrease for *O. niloticus* (0.48 to 0.06 kg/boat/day) was noted. Apart from a slight increase in catch rates of *B. altialis* (1.13 to 1.40) and *B. dockmak* (0.83 to 0.94) *(*the key commercial species recorded decreases in catch rates in April 2012 compared to April 2011 at the downstream transect (Buyala-Kikubamutwe).

Results from the current survey indicate a general increase in fish catch rates at the upstream transect and a decrease at the downstream. This could be associated to changes in water levels at both the sites. There has been a general increase at the upstream site following the raising of water levels upstream in the course of building the reservoir. This is evidenced in the high catches of fishes that like high and fast moving waters like *B. altianalis* and existence of large sized gillnets in the upstream and reservoir areas. Throughout all the surveys conducted at Transects 1 and 2 since September 2007, the fish catches at Kalange-Makwanzi have been characterised by higher species numbers and higher overall catch rates at both transects unlike in the current survey where most of the key commercial species recorded lower catch rates downstream compared all the earlier surveys.

Apparently there is no clear trend of fish catch rates at both the upstream and downstream transects. This scenario could be attributed to the continuous change in fishing gears that

tend to target different fish species and/or sizes of fish. Throughout all the surveys conducted at Transects 1 and 2 since September 2007, the fish catches at Kalange-Makwanzi have been characterised by higher species numbers and higher overall catch rates unlike in the current survey where most of the key commercial species recorded lower catch rates compared all the earlier surveys. However the overall fisheries production could have been affected by inactivity of the Mukene fishers in both transects. Unlike earlier surveys most key commercial fish species indicated an increase in catch rates downstream compared to upstream.

Table 3.4.2 *Trend of fish catch rates (kg/boat/day) with all gears pooled, of the main fish taxa, upstream (US), at Transect 1 (Kalange-Makwanzi) and downstream (DS), at Transect 2 (Buyala-Kikubamutwe) from September 2007 to April 2012.*

Family	Species/taxa	Transect	Monitoring Period								
			Sep. 2007	Apr. 2008	Apr. 2009	Oct. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2011	Apr. 2012
Engraulidae	*Stolothrissa tanganicae*	US	0.05	0.11	0.4	0.17	0.06	0.15	0.00	0.5	0.53
		Reservoir									0.18
		DS	0.20	0.1	0.08	0.11	0.17	0.05	0.03	0.16	0.04
Centropomidae	*Lates stappersii*	US	1.11	1.36	0.72	1.17	0.64	0.76	0.52	0.11	1.30
		Reservoir									0.43
		DS	0.52	0.15	1.01	0.20	1.3	0.32	1.07	1.52	1.41
Clupeidae	*Limnothrissa miodon*	US									
		Reservoir									
		DS									
	Stolothrissa tanganicae	US									
		Reservoir									
		DS									
Cichlidae	*Oreochromis niloticus*	US	1.5	1.08	0.05	1.81	1.16	0.1	0.48	1.17	0.05
		Reservoir									0.3
		DS	0.08	0.63	0.05	0.14		0.14	0.04	0.08	0.16
	Oreochromis leucostictus	US			0.01	0.13	0.01				
		Reservoir									
		DS									
	Oreochromis tanganicae	US	1.15	1.43	1.44	0.08	1.03	0.02	0.23	0.01	0.05
		Reservoir									0.48
		DS				0.06	0.15	0.1	1.07		
	Tilapia rendalli	US	0.02	0.9	0.13	1.04	0.11	0.12		0.12	0.20
		Reservoir									1.13
		DS	0.05	0.28		0.01	0.15	0.04			
	Hybrid oreochromis	US	0.12		0.02	0.04	0.01	0.01	0.01	0.15	0.08
		Reservoir									0.01
		DS		0.1		0.01		0.02	0.1	0.01	
Claroteidae	*Chrysichthys auratus*	US	0.02	1.12	0.12	0.07		0.04		0.12	1.17
		Reservoir									1.35
		DS		0.13	0.12						
Cyprinidae	*Barbus altianalis*	US	2.02	6.72	2.02	5.11	2.17	2.17	1.66	0.32	6.05
		Reservoir									0.95
		DS	2.12	0.25	1.17	0.51	2.1	1.52	1.13	2.02	1.4
	Barbus paludinosus	US									
		Reservoir									
		DS									
	Labeo victorianus	US									
		Reservoir									
		DS									
	Rastrineobola argentea	US					11.4	2.06	34.5		
		Reservoir									11.5
		DS		1.02	5.3			2.05	50		
Cyprinodontidae	*Aplocheilichthys spilauchen*	US									
		Reservoir									
		DS									
Lepidosireniidae	*Protopterus aethiopicus*	US		0.10	0.05		0.05	0.42			0.05
		Reservoir									
		DS									
Mochokidae	*Synodontis afrofischeri*	US	0.04		0		0.02	0.01		0.01	0.2
		Reservoir									0.06
		DS	0				0.01				
Mormyridae	*Mormyrus kannume*	US	2.21	6.77	2.02	0.43	1.04	2.02	0.25	0.7	5.47
		Reservoir									1
		DS	0.12	0.21	0.13	0.10	0.10	0.05	1.04	0.01	

3.4.3. Estimates of total fish catches

The total monthly catch estimates at Transect 1 increased from 2.8 t in September 2011 to 4.5 t in the current survey (Table 3.4.3). Comparing the similar period (April 2011) with the current survey (April 2012), the total monthly landing at the upstream transect were comparable while a 50% reduction is noted at the downstream transect from 3.3 to 1.6 t over a period of one year. The contribution of Mukene (*R. argentea*) that was only captured at the reservoir in the current survey influenced the total production of the reservoir. Although there was a reduction in monthly fish catches at upstream transect over the same period of the previous year (April 2011), the catches at the downstream transect over the two similar periods are comparable.

Table 3.4.3 *Trends of total monthly fish catch estimates (kg), upstream (US), at Transect 1 (Kalange-Makwanzi) and downstream (DS) atTransect 2 (Buyala-Kikubamutwe) between September 2007 and April 2012.*

Family	Species/Taxa	Transect	Monitoring dates								
			Sep. 2007	Apr. 2008	Apr. 2009	Oct. 2009	Apr 2010	Sept. 2010	Apr. 2011	Sept. 2011	Apr. 2012
Bagridae	*Bagrus docmac*	US	11.3	33.1	182.3	88.4	52.8	59.8	55.9	355.1	139.8
		Reservoir									68.4
		DS	198.5	67.6	24.4	191.6	109.9	25.8	195.3	73.5	396.7
Centropomidae	*Lates niloticus*	US	252.6	232.4	361.5	332.2	422.1	303.1	193.1	78.5	473.6
		Reservoir									383.1
		DS	265.5	89.2	741.2	707.8	840.8	185.5	463.5	1612.5	552.7
Characidae	*Brycinus jacksonii*	US					-	-			
		Reservoir									
		DS					-	-			
	Brycinus sadleri	US					-	-			
		Reservoir									
		DS					-	-			
Cichlidae	*Oreochromis niloticus*	US	315	162.1	395.6	703.7	761.1	89.9	179	7.5	14.8
		Reservoir									112.8
		DS	95.5	378.5	696.7	124.4	-	60.2	197	907.8	70
	Oreochromis leucostictus	US			3.5	32.4	6.6	-			
		Reservoir									
		DS			-		-	-			
	Oreochromis variabilis	US	261.7	224.1	665.5	221.8	679.4	271.2	623.6	434.9	172.6
		Reservoir									184.2
		DS			-	52.3	161.7	48	53.9		
	Tilapia zillii	US	185.8	140.6	107.4	261.5	138.5	87.7	88.9	87.7	103.5
		Reservoir									429.5
		DS	28.5	227.1	-	5	97	17.2	52.9	2.1	
	Haplochromines	US	46.8		7.9	9.8	6.8	4	4.88	108.3	8.7
		Reservoir									8.5
		DS		62.2	-	7.5	-	8.6	24.5	9	
Clariidae	*Clarias gariepinus*	US	17.8	191.5	80.8	17	-	16			467
		Reservoir									515.5
		DS		538.1	135.5		-	-		139	-
Cyprinidae	*Barbus altianalis*	US	805.8	1,033.10	1,837.80	1,282.50	1,497.20	1,144.30	436.4	200.8	1,597.80
		Reservoir									382.7
		DS	1388.3	210.9	863.2	482.8	1,357.90	679.7	266.6	1341	515.5
	Barbus paludinosus	US					-	-			
		Reservoir									
		DS					-	-			
	Labeo victorianus	US					-	-			
		Reservoir									
		DS					-	-			
	Rastrineobola argentea	US		1,243.80	-		8,465.80	2,109.50	2,152.80		
		Reservoir									13,328
		DS			2,873.70		-	880.4	1,960.00		
Cyprinodontidae	*Aplocheilichthys pumilus*	US					-	-			
		Reservoir									
		DS					-	-			
Lepidosirenidae	*Protopterus aethiopicus*	US		50.5	23.4		33	191.4			12
		Reservoir									
		DS			-		-	-			
Mochochidae	*Synodontis afrofischeri*	US	8.1		1.8		13.2	4		10.4	52.8
		Reservoir									22.8
		DS	0.6		-		6.5	-			
Mormyridae	*Marcusenius kannume*	US	463.6	1,060.10	1,552.50	106.9	1,215.60	809.5	389.6	900.1	1,444.10
		Reservoir									381.8
		DS	141.7	183.9	170.5	169.2	202.2	25.8	57.8	276	
TOTAL		US	2148.5	5,107.40	7,021.80	5,238.30	11,291.90	5,040.40	4,097.30	2842	6,484.50
		Reservoir									15,417.20
		DS	2114.2	5,001.30	5,503.00	1,740.70	3,825.80	2,004.20	5,247.00	3313.6	1,647.30

3.4.4. Estimates of total beach value of the catch

Just the monthly catch rates, the gross beach value of the fish landed at transects 1 and the landing site on the reservoir were estimated as UShs 10 and 8 million respectively (Table 3.4.4). The downstream transect at Buyala-Kikubamutwe recorded a fourfold reduction from the value estimated in September 2011 to the current survey (20 m to 5 m respectively, Table 3.4.4).

Table 3.4.4. *Trend of monthly gross value of fish catches (shs) at Transect 1 (Kalange-Makwanzi) and downstream (DS) at Transect 2 (Buyala-Kikubamutwe) between Septermber 2007 and April 2012.*

Family	Species/Taxa	Transect	Monitoring dates								
			Sep. 2007	Apr. 2008	Apr. 2009	Oct. 2009	Apr. 2010	Sep. 2010	Apr. 2011	Sep. 2011	Apr. 2012
Hepsidae	*Hepsetus odoe*	TS	142,012	34,450	155,450	238,840	216,600	264,050	192,700	1,048,512	488,400
		Reservoir									226,200
		DS	388,888	222,852	67,562	423,540	388,800	45,222	582,945	882,288	1,252,800
Centropomidae	*Lates niloticus*	TS	84,882	228,288	866,765	967,785	791,760	568,252	884,722	524,640	1,588,800
		Reservoir									667,600
		DS	455,576	262,562	1,552,764	1,882,572	1,852,258	588,650	1,148,888	22,222,888	1,852,640
Cichlidae	*Bogotia jacksoni*	TS									
		Reservoir									
		DS									
	Bogotia sulkei	TS									
		Reservoir									
		DS									
	Oreochromis niloticus	TS	224,522	268,855	222,852	278,528	1,588,288	82,262	274,850	1,588,62	22,288
		Reservoir									256,200
		DS	222,272	288,888	1,662,882	288,862		228,822	288,888	28,728	288,888
	Oreochromis leucostictus	TS			5,288	22,276	22,288				
		Reservoir									
		DS			–						
	Oreochromis variabilis	TS	262,288	278,882	284,888	277,262	1,288,888	288,728	282,828	1,288,784	278,888
		Reservoir									602,000
		DS		–	–	78,888	282,788	282,252	52,888		
	Tilapia zillii	TS	278,888	282,288	282,222	287,278	272,888	272,852	288,888	272,224	262,888
		Reservoir									1,000,000
		DS	28,882	288,262	–	2,882	22,888	24,228	22,888	4,288	
	Hydrocynus	TS	48,848	–	5,258	4,882	2,288	2,882	2,744	24,224	
		Reservoir									
		DS		22,288	–			8,422	22,888	2,288	
Claroteidae	*Chrysichthys grahami*	TS	22,784	284,258	88,262	22,288		22,882		222,888	2,222,262
		Reservoir									1,248,900
		DS		788,884	278,862			–			
Cyprinidae	*Barbus altianalis*	TS	224,222	2,888,222	2,222,888	2,222,728	2,262,888	2,222,882	272,252	222,428	4,222,862
		Reservoir									1,001,000
		DS	2,262,222	222,282	2,288,872	842,222	2,288,828	2,882,262	782,888	8,242,888	2,252,288
	Barbus gabiniensis	TS									
		Reservoir									
		DS									
	Labeo victorianus	TS									
		Reservoir									
		DS									
	Rastrineobola argentea	TS		–	–		2,222,222	884,022	2,722,262		
		Reservoir									2,262,600
		DS		228,828	2,628,862			422,222	2,288,888		
Cyprinidae	*Aplocheilichthys pumilus*	TS									
		Reservoir									
		DS									
Lepidosiren	*Protopterus aethiopicus*	TS		22,222	22,222		22,288	224,224			22,888
		Reservoir									
		DS		–	–			–			
	Synodontis afrofischeri	TS	2,222	–	224		2,888	2,884		22,888	22,888
		Reservoir									22,900
		DS	222	–	–		–	–			
Mormyridae	*Mormyrus kannume*	TS	288,288	272,222	2,222,224	88,228	2,262,262	2,288,272	284,224	428,282	2,282,288
		Reservoir									228,000
		DS	288,288	288,222	278,228	228,288	282,782	22,888	24.4	222,288	
TOTAL		TS	2,228,224	4,222,282	2,222,228	4,222,724	22,222,242	2,228,288	4,282,288	8,282,222	22,888,888
		Reservoir									7,282,222
		DS	2,222,222	2,288,224	8,222,888	2,222,222	4,222,888	2,248,248	4,222,224	22,222,228	4,222,888

The aggregated average unit cost price for the key commercial fish species at Transects 1 and 2 plus the reservoir, indicate a reduction in unit price in the current survey compared to the previous one (Table 3.4.5). However, apart from *M. Kannume* whose average price increased, average price of all the other key commercial species reduced. The reduction in mean price could indicate harvest of smaller fishes that fetch low market price. For instance a kilo of an adult Nile perch could be about 3 times a kilo of juvenile Nile perch at the same location.

Table 3.4.5. *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 2012.*

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

3.4.5 Estimated total catches and revenue of individual fishing units

The estimated mean monthly catch and revenue per fishing unit have consistently been higher upstream at Kalange-Makwanzi than downstream at Buyala-Kikubamutwe throughout all surveys from September 2007 to April 2011 (Table 3.4.6) but in the two most recent surveys (September 2011 and April 2012). During this survey, the average monthly catch per boat at the downstream transect was higher (275 kg/boat/month) more than five times that of the upstream (47 kg/boat/month) but was still lower than that of April 2011 (329 kg/boat/month). The reservoir recorded higher catch rates per boat probably due to Mukene. Post-harvest handling and processing of Mukene could greatly raise its economic value. BEL could consider supporting the mukene fishery with inputs such as drying racks to add value to the product since it is becoming important on the reservoir.

Table 3.4.6 *Trend of monthly total catches and revenue of individual fishing units at Transect 1 (Kalange-Makwanzi) and downstream (DS) at Transect 2 (Buyala-Kikubamutwe) between September 2007 and April 2012.*

Parameter rate	Site	Monitoring Dates								
		Sep-07	Apr-08	Apr-09	Oct-09	Apr-10	Sep-10	Apr-11	Sep-11	Apr-12
Total catch (Kg/boat/month)	US	215	444	228	180	418	219	467	89	47
	Reservoir									307
	DS	124	130	212	55	123	134	329	221	275
Total revenue (Shs/boat/month)	US	223,625	589,698	359,679	245,707	388,009	253,508	298,445	286,118	188,500
	Reservoir									1,227,000
	DS	139,943	117,150	254,273	116,604	216,161	143,217	410,225	1,331,810	1,098,000

3.4.6 Socio-economic aspects of the fishery

Non-commercial uses of fish

At the upstream transect, on average 1.2 kg (approximately 13% of the catch) and 0.8 kg (about 14%) at Transect 2, at the reservoir about 50% of the catch was retained by fishers for domestic consumption (Table 3.4.7). This is a substantial proportion of the catch and may imply that fishing at the two sites is not entirely for commercial purposes but for subsistence as well and makes direct nutritional contribution to the families of the fishers.

Table 3.4.7. *Trends of the average weight of fish (kg/boat/day) retained by fishers for domestic use between September 2007 and April 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
US	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%)
Reservoir									1.5 (50 %)
DS	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%)

Fishery related jobs

Fishing remained the most prominent job engaging 25 persons Transects 1 and 15 at Transect 2 in April 2012 (Table 3.4.8). Fishing was exclusively a male activity. On the other hand, the women dominated fish mongering and food vending. Like in the previous surveys, more fish traders were encountered at Transect 1 in the current survey (16 women and 2 men) than at Transect 2 (5 women and 1 man). Transect 1 has higher catch rates and is near the urban centre therefore having higher number of fish mongers than the more remote transect 2. Other fishery related jobs show only very slight change between the September 2011 and April 2012.

Table 3.4.8. *The numbers of people by gender (Male/ Female) engaged in different jobs at landing sites at Transect 1 (Kalange-Makwanzi) and downstream (DS), at Transect 2 (Buyala-Kikubamutwe) between April 2006 and April 2012*

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
Boat builder/repairer	US	M	2	1	3	3	3	1	2	3	3	2
		F										
	Reservoir	M										
		F										
	DS	M	5	2	4	2	2	3		1	1	3
		F										
Food vendors	US	M				1	1	2	4	1	1	1
		F	4	3	5	4	2	4		3	3	3
	Reservoir	M										
		F										
	DS	M										3
		F		2								
Net repair(s)	US	M			5	4	4		3	5	5	3
		F										
	Reservoir	M										
		F										
	DS	M		2		1			3			8
		F										
Cleaner fish landing	US	M										
		F										
	Reservoir	M										
		F										
	DS	M										
		F										
Fisher(s)	US	M	57	20	32	43	37	30	38	25	25	25
		F										
	Reservoir	M										
		F										
	DS	M	26	30	42	47	46	30	34	30	30	15
		F										
Fish trader(s)	US	M	11	3	2	3	6	4	4	6	6	
		F	12	9	13	10	20	16	16	30	30	
	Reservoir	M										
		F										
	DS	M	5	2		2	2	2	2			
		F	8	2		4	3	5	5	5	5	
Fish processor(s)	US	M										2
		F										15
	Reservoir	M										
		F										
	DS	M			3							1
		F			5							5
Fish cleaner	US	M										
		F										
	Reservoir	M										
		F										
	DS	M										
		F										
Chairperson landing	US	M	1	1	1	1	1	1	1	1	1	1
		F										
	Reservoir	M										
		F										
	DS	M		1	1	1	1	1	1	1	1	1
		F										
BMU committee member(s)	US	M				6		4	5			7
		F				3		5	4			2
	Reservoir	M										
		F										
	DS	M				4	2	2	3	3	3	4
		F				2	1					1
Landing site askali	US	M	1									
		F										
	Reservoir	M										
		F										
	DS	M										
		F										

3.5 SCHISTOSOMIASIS, RIVERBLINDNESS AND SANITATION STUDIES

3.5.1 Parasitological analysis of bilharzias in humans

Parasitological prevalence and intensity of Bilharziasis infection in the three transects of Kalange-Makwanzi (Upstream) and Kikubamutwe-buyala. (Downstream) and the new reservoir formed as a result of the completion of the Bujagalli dam construction were assessed.

A total of 162 stool samples were collected from a population of 518 people. Of the 162 samples, 32 people (19.7%) were infected with Schistosomiasis. All infections were by the intestinal Schistosomiasis (*Schistosoma mansoni*)

Infection with Schistosomiasis was higher at the reservoir (20.5%) and lowest at Kalange_Makwanzi transect (18.6%) though its worth noting that the difference was very small. None of the 162 samples tested positive for *Schistosoma haematobium*, a urinary Schistosomiasis.

Table 3.5.1 *Trend of Schistomiasis infection prevalence and intensity, schistosomiasis vector numbers, coliform counts among sample of people at Kalange-Makwanzi and Kikubamutwe-Buyala during monitoring survey April 2006 to April 2012 and baseline for the reservoir*

Parameter	Variety	Site	Monitoring dates									
			April 06	Sept 07	April 08	April 09	Oct 09	April 10	Sept 10	April 11	Sept 11	Apr 12
Schistosomiasis Prevalence	*Mansoni*	US	53	46	56	28	49	21	21.8	[illegible]	[illegible]	[illegible]
		Reservoir										20.5
		DS	48	43	40	22	33	19	16.7	[illegible]	[illegible]	[illegible]
	Haematobium	US	0	0	0	0	0	0	0	*	*	0
		Reservoir										0
		DS	0	0	0	0	0	0	0	*	*	0
Schistosomiasis Intensity	*Mansoni*	Light	32	60.8	59	35	77	83	86	[illegible]	[illegible]	[illegible]
		Moderate	50	27.5	32	12	4	17	13.6	[illegible]	[illegible]	[illegible]
		Heavy	18	11.8	10	3	4	0	0	*	*	[illegible]
Prevalence by water contact	*Mansoni*	Fishing	71.4	94.4	60	68	79	62	31.4	[illegible]	[illegible]	[illegible]
		Fetching water	18.1	38.4	36.6	30.9	48	0	6.5	[illegible]	[illegible]	[illegible]
		Bathing/swimming	70	93.4	54.5	54.8	63	15	18.6	[illegible]	[illegible]	[illegible]
		Fish mongers	60	42.8	16.6	15	33	8	14.3	[illegible]	[illegible]	[illegible]
Snail Species abundance	*Bulinus sp.*	US	10	21	14	8	23		19	[illegible]	[illegible]	[illegible]
		Reservoir										11
		DS	13	11	50	8	83		9	[illegible]	[illegible]	[illegible]
	Biomphalaria sp.	US	22	31	26	25	20		63	[illegible]	[illegible]	[illegible]
		Reservoir										68
		DS	11	9	65	74	122		62	[illegible]	[illegible]	[illegible]
	Others	US	127	39	51	135	67		101	[illegible]	[illegible]	[illegible]
		Reservoir										13
		DS	50	37	52	188	91		118	[illegible]	[illegible]	[illegible]
Coliforms in water	Shallow	US	200	73	63	105	15	50	50	[illegible]	[illegible]	[illegible]
		Reservoir										79
		DS	50	87	73	100	10	87	80	[illegible]	[illegible]	[illegible]
	Deep	US	40	10	43	15	1	1	1	[illegible]	[illegible]	[illegible]
		Reservoir										1
		DS	10	21	70	22	1	1	1	[illegible]	[illegible]	[illegible]

In the reservoir, a prevalence rate of 20.5% was recorded. The majority of infected persons at all sites had light intensity (75%). Heavy intensity of infection was 0% in the last 4 sampling periods but rose to 6.2% during this survey.

Fishing remains the biggest predisposing factor to Schistosomiasis infection contributing 28%, followed by Fetching water at 20.5% and lastly fish mongers had the lowest predisposal rate at 13.3%. All residents found positive were treated under Directly Observed treatment (DOTs) (Plate 3.5.1).



Plate 3.5.1. A team member administers praziquantal under DOTs

Faecal matter were observed littered in so many places at the reservoir banks (Plate 3.5.2) probably due to lack of toilet facilities in the vicinity.



Plate 3.5.2 Faecal matter littered on o the reservoir rocky bank

3.5.2 Snail vector abundance

Of the vector snail species *Bulinus sp*, continues to be the most abundant. In the previous survey, *Bulinus sp* contributed 25.4% while in the current one 54.8% of the vector snails at Kalange transect. accounting for 54.8% of the total *Bulinus sp* snails collected from the three transects. Non-vector snail numbers show a reduction in the current survey compared to the previous one, in Septemberl 2011. In the previous survey at the downstream transect, two vector snail specimens of *Biomphalaria sp* were found with Cercaria. In this survey at the same transect, the abundance *Biomphalaria sp* was much higher than in the previous survey probably due to very low water levels that were observed (Plate 3.5.3). Three of the vector snail specimens of *Biomphalaria sp* collected at the reservoir transect shed Cercaria, while one *Bulinus sp* at Kikubamutwe transects shed cercaria. Cercaria shedding by the snails is an indicator of active transmission is taking place, which makes a good case for health education, MDA and improved sanitation.



Plate 3.5.3. Many rocks exposed due to very low water levels at Kikubamutwe

3.5.3 Faecal coliforms

As regard faecal coliforms concentrations, shallow waters registered more than ten colonies per ml, considered unsafe for human consumption. There were 57 colonies per ml upstream, 79 colonies per ml in the Reservoir and 82 Colonies per ml downstream, indicating heavy contamination. As evidenced in Plate 3.5.2, poor disposal of faecal matter is a major contributor to this problem. Water from the deep middle part of the river has consistently remained low, registering between 1 and 6 colonies per ml of water. The micro-organisms of medical importance were predominantly *Salmonella sp* and *Shigell*a *sp.*

3.5.4 River-blindness vectors

To date, no medically important species of *Simulium sp.* (Black flies or commonly called Mbwa flies) have been found, implying the risk of transmission of river blindness (Onchocerciasis) is non-existent. 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 their species and sub species. Interviews with locals (35) suggested that the Glossina flies (Tsetse fly) are present. This will need further investigation.

4.1 CONCLUSIONS AND RECOMMENDATIONS

4.1.2 Conclusions

1. Most water quality parameters (pH, Dissolved oxygen, Total phosphorus, Total nitrogen, Total suspended solids, Oil and grease) conformed to NEMA discharge

standards. Though water quality parameters e.g. conductivity, water clarity, and soluble reactive silica lack discharge standards for NEMA, they were similar to values observed in Lake Victoria.

2. The community of zooplankton at the reservoir, upstream and downstream of the dam has ecological features comparable to the Lake Victoria community from which the Nile originates. On assumption of ecological resilience observed in Lake Victoria, this community offers potential to support vibrant pelagic and other non-pelagic fisheries in the reservoir. The zooplankton community can in addition, be used as a tool for environmental bio-monitoring purposes of the reservoir ecosystem.

3. Over the sampling periods, the most dominant benthic macroinvertebrates at the upstream and downstream transects included two water snails; *Bellamya unicolor* and *Melanoides tuberculata*, three mussels; *Byssanodonta prasitica*, *Corbicula africana* and *Caelatura* sp. and chironomids. In the reservoir, only chironomids and mayfly nymphs, *Povilla adusta* had comparable density as that registered at the upstream and downstream transects. The common water snails and mussels at both transects were absent in the reservoir.

4. River-blindness has not been detected since monitoring started. A downward trend of Schistosomiasis infection has been observed, probably due to BEL intervention of mass chemotherapy that has been provided to patients.

5. *Lates niloticus* and *Bagrus docmac* were the major predatory fishes in both the reservoir and the 2 transects (Upstream and Downstream).

6. In Transect 1, there was variation in the diet of *O. niloticus* from dominance of detritus in September 2011 to molluscs in the survey of April 2012. The diet of *S. afrofischeri* also varied from a dominance by insects in the previous surveys to molluscs in the survey of April 2012. However, in the reservoir, insects were still the dominant food item for the species.

7. The number fish species showing breeding activity was higher in the reservoir (5) than in Transect 1 (3) and Transect 2 (0). This indicates that the reservoir Transect 1 is breeding grounds for most of the keystone fish while Transect 2 is a nursery ground.
8. Fish species diversity and catch rates have improved upstream and continue to decline downstream between September 2011 and April 2012.

9. 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.
10. The reservoir created by the Bujagali Dam appears to have caused the apparent improvement of fish catches upstream. Popular table-fish species (*B. altianalis* and *M. kannume*) are quickly establishing their populations in the reservoir.

10. Colonization of the reservoir by fish species is still in initial stages. Many especially the haplochromine species are yet to inhabit the reservoir. Biomass of large table fishes has improved and a thriving fishery is already in existence.

11. The number of fishing boats increased from 18 in April 2011 to 32 in September 2011 and number of gears increased e.g. long lines increased from 280 in September 2010 to 500 in September 2011, cast nets increased from 18 in April 2011 to 88 in September 2011

12. There was an increase in *Biomphalaria sp* at the downstream transect which needs to be monitored closely.

4.1.2. Recommendations

1. The process of colonisation of the réservoir by fish species seems not yet complete. Entry in the reservoir fishery should still be restricted until more information on fish stocks in this water body is available.

2. Continue monitoring surveys until a clear picture on the state especially of the reservoir is established.

3. Regular monitoring is essential in determining the direction in which the quality of the water is heading to so that corrective environmental management measures can be designed to correct any negative change. 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 community. Regular environment monitoring of the dam will be useful for early detection of water quality changes and timely institution of remedial measures.

4. Future monitoring surveys should reveal how different fish populations are coping with changes and provide insight into changes in the ecological and biological status of the keystone fish species due to dam construction.

5. Mass chemotherapy and behaviour change communication should be continually strengthened at both banks to avoid the risk of recurrence of heavy intensities of Schistosomiasis infection.

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

7. Sampling for Glossina densities should be undertaken during the next sampling period

8. There is need to intensify the control efforts especially the mass drug administration and health education in order to get the prevalence of Schistosomiasis dropping again.

9. In case the *Biomphalaria sp* vector abundance is unchanged at the next sampling, we may have to consider sampling further downstream to rule out seasonal variations.

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