

DIVERSITY, RELATIVE ABUNDANCE AND BIOLOGY OF FISHES IN
BELES AND GILGEL BELES RIVERS, ABAY BASIN,
ETHIOPIA

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In partial fulfillment of the requirements for the Degree of Master of Science
in Biology (Fishery and Aquatic Sciences)

By

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**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES**

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Abbreviations: -

ABH - Anal base height	DBL - Dorsal fin base length
ABL - Anal base length	DBR- Dorsal fin -branched rays
ABL - 1 - Anterior barbell length	DSR - Dorsal fin-simple rays
ASR - Anal fin- simple rays	DBAD - Dorsal base to adipose fin distance
ABR - Anal fin-branched rays	DSp - Dorsal spine
AdFL - Adipose fin length	ED - Eye diameter
AdFH - Adipose fin height	E-VL - Eye to ventral fin length
BD - Body depth	GRN - Gill raker number
CD- Caudal peduncle depth	HB - Head breadth
C-DL - Caudal peduncle to dorsal fin base length	HL - Head length
CL- Caudal peduncle length	HPL- Humeral process length
CS - Scale around caudal peduncle	HPD- Humeral process depth
DBH - Dorsal fin base height	IMnBL - Inner mandibular barbell length
	IOW - Inter orbital width

LLS - Lateral line scale	SAb - Scale between lateral line and center of belly
LLSP- Length of longest dorsal spine	SALL - Scale between lateral line and origin of dorsal
MW - Mouth width	SBILL - Scale between lateral line and origin of dorsal line
MxBL- Maxillary barbell length	SL - Standard length
MTB - Premaxillary teeth band broad	SnL - Snout length
MTL- Premaxillary teeth band length	Sn - VL - Snout to ventral fin length
NBL- Nasal Barbell length	T- Teeth number
OMnBL- Outer mandibular barbell length	V_CL - Ventral fin to caudal peduncle length
PBL - Posterior barbell length	VTB - Vomerine teeth band broad
PcFL - Pectoral fin length	VTL - Vomerine teeth band length
PrDL - Predorsal length	UJT- Upper jaw teeth
PIFL - Pelvic fin length	LJT- Lower jaw teeth

Abstract

*Diversity, relative abundance and biology of fish species of Beles and Gilgel Beles Rivers were studied during November 2005 to May 2006. Physical and chemical parameters were also measured during this study. Fishes were sampled using gill nets of various stretched mesh sizes, and hooks and lines. Identification of fish was made to species level by comparing the sample characters with taxonomic keys found in literatures and specimens deposited. An index of relative importance (IRI) and Shannon diversity index (H') were used to evaluate relative abundance and species diversity of fishes, respectively. Mean temperature, river width and secchi depth showed apparent longitudinal trends. A total of 1124 individual fishes belonging to 5 orders, 7 families, 13 genera and 23 species were caught in Beles and Gilgel Beles Rivers. Cyprinidae was best-represented family with the highest number of fish species in the rivers while Labeo and Labeobarbus were the best-represented genera. A higher number of species were recorded in the Beles River (22 species) than in the Gilgel Beles River (5 species). *L. nedgia*, *L. forskalii*, *L. intermedius* and *O. niloticus* were found in both rivers. The diversity index was higher in the Beles River ($H'=2.43$) than in the Gilgel Beles River ($H' = 0.88$). Among sampling sites, diversity index was highest at Babizenda ($H' = 2.32$) and lowest at College ($H' = 0.76$). Cyprinidae was the most dominant family in Beles and Gilgel Beles Rivers. *L. intermedius* was the most abundant species according to IRI (38.86%), while *L. forskalii* was second (24.68%) and *L. bynni* third (18.36%) in total catch. *L. intermedius* was the most abundant species in the total catch during the wet season, while *L. forskalii* in the dry season. *L. intermedius* had better mean % IRI in Gilgel Beles River than in Beles River ($P < 0.05$). However, there was no significant difference in % IRI between the two rivers for *L. nedgia*, *L. forskalii* and *O. niloticus* ($P > 0.05$). *L. forskalii* showed isometric growth while *L. intermedius* exhibited positive allometric growth in Beles and Gilgel Beles Rivers. *L. forskalii* and *L. intermedius* were found to be in better condition in both rivers (ANOVA < 0.05). Females were in better condition than males in both rivers. *L. forskalii* had a better condition factor (FCF) in the dry than in the wet season*

(ANOVA < 0.05). However, L. intermedius had better mean FCF in wet than in dry season (ANOVA > 0.05). Females were more numerous than males in the total sexed specimens. Absolute fecundity of L. intermedius increased with an increase in fish size, and ranged from 1535 to 13864 with a mean of 3173 eggs. In general, Beles River is richer than Gilgel Beles River, in terms of total numbers of fish caught and number of species recorded. In order to have a better knowledge of the fish populations in the study area, further studies are required on diversity, abundance and biology of the fishes.

Key words/phrases: Rivers, Beles, Gilgel Beles, relative Abundance, diversity,

Length-weight relationship, Fulton condition factor, Fecundity, Sex ratio.

1.2 Exploration, number and forms of fish species in Ethiopia.

The first information about an Ethiopian fish probably appeared in the narrative of the Portuguese Embassy sent to Ethiopia in 1520 (Beckingham and Hunting Ford, 1961 cited in Golubtsov and Mina, 2003). In the sixties, seventies and early eighties, there was little progress in discovering new fishes in the Ethiopian inland waters (Golubtsov *et al.*, 1995). Although research on freshwater fish diversity in Ethiopia started in the late eighteenth century, the first noted explorer was Rüppell, who described a number of species in the mid-1830's (Abebe Getahun, 2005b). There was substantial progress in the studies of Ethiopian ichthyofauna between the first and second world wars. After a long pause following World War II, the fish diversity studies in the inland waters of Ethiopia was reinitiated in the 1960's. However, explorers did not find any more new species than those made in the first half of the 20th century (Golubtsov and Mina, 2003).

In the last three decades knowledge of the ichthyofauna of Ethiopian lakes and rivers has been expanded by Ethiopian authors. Substantial ichthyofaunal information appeared in publication on Biology, Limnology and Ecology of the commercially important fish species in lakes and rivers: Lake Afdera (Abebe Getahun, 2001), Lake Ziway (Eyualet Abebe and Getachew Teferra, 1992), Lake Awassa (Demeke Admassu, 1994; Demeke Admassu and Elias Dadebo, 1997), Lake Chamo (Demeke Admassu, Seyoum Mengistou and Yirgaw Teferi, 2000), Lake Hayq (Elizabeth Kebede *et al.*, 1992), Lake Tana (Eshete Dejen, 2003; Tesfaye Wudneh, 1998; Zenebe Tadesse, 1997), eco-regions, diversity and conservation of the freshwater fish fauna of Ethiopia (Abebe Getahun, 2005a, 2005b) and introduction and translocation of freshwater fish species in Ethiopia (Shibru Tedla and Fisseha H/Meskel, 1981). In addition, projects of the Joint Ethio-Russian Biological Expedition (JERBE) and the Wageningen Agricultural University, The Netherlands have explored the ichthyofauna of Lake Tana and surrounding rivers (Nagelkerke *et al.*, 1994). Although the exact number of fish species of Ethiopia has not yet been settled, different authors estimated the number of fish species in the country. In 1973, Shibru Tedla published ‘‘the Freshwater Fishes of Ethiopia.’’ It was the first fundamental

ichthyological work, as well as the first and the only complete review of the Ethiopian ichthyofauna. Shibru Tedla (1973) has listed and described about 94 species of fishes in Ethiopia. However, the number of fish species was under estimated because at that time many species had not yet been explored. Though extensive review work is in progress, Abebe Getahun (2005b) reported that there are about 153 valid indigenous species included in 25 families so far known from Ethiopian freshwaters. According to Abebe Getahun (2005b) there are about 38 species and two sub-species endemic to Ethiopia. Abay drainage basin, including Lake Tana harbors larger number of endemic species of the country. Most of these species occur exclusively in the Lake Tana basin (18 forms) (Abebe Getahun, 2005b). Golubtsov and Mina (2003) assessed fish diversity in the six main drainage systems using original data on fish species composition. According to them the total number of valid fish species currently known from Ethiopian waters is between 168 and 183 including 37-57 countrywide endemics (Table 1). According to Golubtsov and Mina (2003) the number of indigenous species and endemics (in percentage) are as follows: 106 (12 %) in the white Nile system within the limits of Ethiopia, 64 (36 %) in the Blue- Nile system (including the Lake Tana basin), 32 (few) in the Atbara – Tekeze system, 79 (19 %) in the Omo- Turkana system (including Lake Turkana itself), 31(19 %) in the Ethiopian Rift Valley and 31 (61 %) in the Wabishebele – Juba system (Table 1). There are also about 10 exotic fish species introduced from abroad into Ethiopian fresh waters (Shibru Tedla and Fisseha H/Meskel, 1981). The Rift valley is the region of Ethiopia with highest number of introduced fish species. In sum, there are about 25 fish families reported in Ethiopia (Abebe Getahun, 2005b; Golubtsov and Mina, 2003) (Appendix 1). Mormyridae, Characidae, Bagridae, Cyprinidae, Schilbeidae, Mochokidae and Cichlidae are reported in all drainage basins. Unlike these families, Anabantidae and Protopteridae are reported in White Nile drainage basin whereas Gobidae in Wabishebele-Juba drainage basins (Golubtsov and Mina, 2003).

Table 1. Fish diversity and endemcity in the six main drainage systems of Ethiopia (Golubtsov and Mina, 2003).

Drainage system	Families	Genera	Indigenous	Endemic Species	Introduced species
White Nile	23	55	106	13	0
Blue Nile	12	28	64	23	1
Atbara_Tekeze	9	22	32	1?	1-2
Omo-Turkana	19	42	79	15	0?
Rift valley	10	18	28-31	5-6	4
WabiShebele-Juba	11	19	31	19	3

The freshwater fish fauna of Ethiopia contains a mixture of Nilo Sudanic, highland East African and Endemic forms (Bănărescu, 1995; Boulenger, 1905; Nichols and Griscom, 1917; Roberts, 1975; Abebe Getahun and Stiassny, 1998). The Nilosudanic forms are the dominant forms in terms of diversity and represented by a large number of species found in the Baro- Akobo, Omo-Gibe, Tekeze and Abay drainage basins (e.g. the genera *Alestes*, *Bagrus*, *Citharinus*, *Hydrocynus*, *Hyperopisus*, *Labeo*, *Mormyrus* etc.) (Abebe Getahun, 2002). These forms dominate the Nile basin fishes (Abebe Getahun, 2002). De Graff (2002) has described some of the elements of the Nilosudanic species from the Southern Rift valley lakes (Chamo and Abaya). These include the families Mormyridae, Cyprinidae, Bagridae, Clariidae and Mockokidae. Recently, Golubtsov and Mina (2003) have reported Nilosudanic fish genera from the Southern Rift valley lakes (e.g. *Mormyrus*, *Hydrocynus*, *Bagrus*, *Clarias*, and *Synodontis*). The Shebelle-Genale basins also have elements of Nilosudanic forms (Abebe Getahun, 2002). The Nilosudanic forms are related to West African fishes and this too is believed to be due to past connections of Nile to Central and West African river systems (Nichols and Griscom, 1917; Nichols, 1928; Abebe Getahun, 2002).

The highland East African forms are found in the northern Rift valley lakes (e.g. Awassa, Ziway and Langano), highland lakes (e.g. Tana and Hayq) and associated river systems, and Awash drainage basin. These include the Genera *Barbus*, *Clarias*,

Garra, *Oreochromis*, and *Varicorhinus* (Abebe Getahun, 2002). Fish fauna of Ethiopian highlands is dominated by the family Cyprinidae (Roberts, 1975). *Garra* species are wide spread in the lakes and rivers of Ethiopian highlands. Like *Garra* spp, *Varicorhinus beso* Rüppell 1836 is common and generally distributed in the rivers and lakes of Ethiopian highlands (Eshete Dejen, 2003). Despite the fact that Ethiopian highlands are presently separated from both East African and the South Arabian mountains, the riverine fauna resembles that of East and South Africa (Tudorancea *et al.*, 1999). There are fish groups (e.g. *Garra*) common to the Ethiopian highlands and the Arabian Peninsula. They are related to fishes of eastern and southern Africa. According to Abebe Getahun (2005b) and Golubtsov and Mina (2003) endemicity of fresh water fishes in Ethiopia seems to be highest in Abay and Awash drainage basins. Most of the endemic species in Abay basin are found in Lake Tana. The genus *Labeobarbus* (e.g. *Labeobarbus megastoma* Nagelkerke & Sibbing 1997, *Labeobarbus brevicephalus* Nagelkerke & Sibbing 1997 and *Labeobarbus dainellii* Bini 1940), genus *Garra* (e.g. *Garra tana* Getahun 2000 and *Garra microstoma* Getahun 2000) and *Nemacheilus abyssinicus* Boulenger 1902 are some of the endemic species that are found in Lake Tana (Abebe Getahun, 2000; Nagelkerke and Sibbing, 2000; Golubtsov and Mina, 2003). Beyond the Lake Tana basin, a few fish species endemic to Ethiopia are found in Abay basin: *Labeobarbus zaphiri* Boulenger 1906, *V. beso* and some *Garra* (Golubtsov and Mina, 2003). The fish fauna of the Ethiopian Rift valley are naturally impoverished, at the same time it includes relatively high number of the Ethiopian endemics: *V. beso*, *Danakilia franchetti* Vinciguerra 1931, *Lebias stiassnyae* Getahun & Lazara 2000, *Barbus ethiopicus* Zolezzi 1939 and *Garra makiensis* Boulenger 1904 (Golubtsov and Mina, 2003). *V. beso* and *Garra ignesti* Gianferrari 1926 are also endemic fishes from Atbara-Tekeze system (Golubtsov and Mina, 2003).

There are also exotic fish species that were introduced from abroad in to Ethiopian freshwaters bodies. *Gambusia holbrooki* Girard 1856 and *Esox lucius* Linnaeus 1758 were the first exotic species that were brought from Italy during the late 1930s. These species were introduced into Lake Tana (Shibru Tedla and Fisseha H/Meskel, 1981).

However, the effort to increase the fish diversity in the lake was unsuccessful. At the same time (in 1936-1940) common carp *Cyprinus carpio* Linnaeus 1758 was successfully introduced into Aba Samuel Reservoir in Akaki River, Rift valley system (Shibru Tedla and Fisseha H/Meskel, 1981). The Rift valley is also the region of Ethiopia with highest number of introduced fish species (e.g. *Carassius* sp., *Cyprinus carpio*, *Tilapia zillii* Gervais 1848, and *Tilapia rendalii* Boulenger 1896) (Abebe Getahun and Stiassny, 1998; Shibru Tedla and Fisseha H/Meskel, 1981).

Generally, the highest species diversity in Ethiopia has been recorded from Baro basin, followed by Abay, Wabishebele and Omo- Gibe basins. It appears that high diversity is attributed by the presence of diverse and rich habitats, past connection with other systems and also due to relatively higher degree of exploration and collection done on these water bodies (Abebe Getahun, 2002). However, endemism seems to be highest in Abay and Awash basins. This is attributed, in the former case, by the endemic species flock of *Labeobarbus* in Lake Tana (Abebe Getahun, 2002). At the moment, we have no clear and complete list and description of the diversity of the fish fauna of Ethiopia since many of the drainage basins, especially the rivers, are not exhaustively explored (Abebe Getahun, 2002).

1.3 Spatial distribution pattern of Ethiopian fishes

There are important patterns in the spatial distribution of Ethiopian fish diversity common to all the drainage systems. The number of fish species appears to be negatively correlated with altitude (Golubtsov and Mina, 2003). The decrease in number of fish species from lower to upper reaches is typical of most river systems of the world (Nikolsky, 1963; Sydenham, 1977). In Ethiopia, this decrease is especially pronounced because of steep altitudinal gradients and occurrence of rich lowland faunas in most basins (Golubtsov and Mina, 2003). The distribution of fish communities typical to lowlands or highlands along the river gradient is modified by the amount of water discharge. In larger watercourses, the lowland fishes tend to occur at higher altitudes than small ones (Golubtsov and Mina, 2003). For instance, Golubtsov and Mina (2003) found the following four typical Nilotic species at an

altitude of 1700-1800 m a.s.l, just 4-5 km down stream from Tis Issat falls separating the Lake Tana basin from the middle reaches of the Blue Nile: the Morymrid *Morymurs hasslequistii* Valenciennes 1846, the cyprinids *Labeo forskalii* Rüppell 1836 and *Raiamas senegalensis* Steindachner 1870, and the cat fish *Bagrus docmak* Forsskall 1775, which are absent in the Lake Tana basin. At the same time, in small tributaries of the Didessa River they found only typical highland species (*Labeobarbus intermedius* Rüppell 1835, *Barbus paludinosus* Peters 1852 and *Garra cf hirticeps*) at an altitude of just 1250-1300 a.s.l.

Justification

Species diversity and abundance reflect the quantity and quality of the available habitat. The decline in abundance of freshwater fish in the world has been of concern for over one hundred years. Since the twentieth century, many fish species have suffered continuing declines in abundance and distribution, some at alarming levels. This includes many of the smaller species as well as all of the species targeted by inland commercial and recreational fisheries. These declines in abundance are commonly attributed to factors such as general habitat degradation (Llewellyn, 1983), modified patterns of stream flow (Gehrke *et al.*, 1995), interrupted migratory pathways (Mallen-Cooper *et al.*, 1995), reduced water quality and pollution (Mallen-Cooper, 1993), introduction of alien fish and diseases (Koehn and O'Connor, 1990), illegal fishing and commercial over fishing (Brown, 1992) and altered biotic interactions (Schiller *et al.*, 1997).

As in many parts of the world, population growth, agricultural development and industrialization contribute to the loss of species diversity of freshwater fishes in Ethiopia (Abebe Getahun and Stiassny, 1998). Wide spread deforestation, degradation of the pristine environment, and other human induced factors might have left many Ethiopian streams, specially the northern ones, devoid of fish but the apparently resilient cyprinids (Abebe Getahun and Stiassny, 1998). As in many parts of the Ethiopia, human activities degrade fish habitat in numerous ways in study area. Wild fire, logging, impoundment, canalisation and agricultural activities are some of

the major activities that degrade fish habitat. At present, we have no evidence of species extinction from Ethiopian freshwaters (Harrison and Stiassny, undated cited in Abebe Getahun and Stiassny, 1998) resulting from degradation of environment. One of the main reasons is a lack of definitive information on diversity of freshwater fishes and inconclusive data on the freshwater fish species.

Beles and Gilgel Beles Rivers are flowing to the lower course of Abay in which adequate attention has not been given in the study of the diversity, abundance and economical potential of the fish fauna due to the presence of some inaccessible mountains and rugged geographical features. The absence of fishery data on these rivers triggers the researcher to conduct this study. Therefore, the study attempted to provide answers to the following leading research questions:

- What is the species composition and relative abundance of fishes in Beles and Gilgel Beles Rivers?
- Do fishes of Beles and Gilgel Beles Rivers vary in species composition?
- Do fishes of Beles and Gilgel Beles Rivers vary in their relative abundance?
- What does the biology (Reproduction, Condition Factor and Length-weight relationship) look like in the dominant species of these rivers?

2. Objectives of the study

2.1 General objectives

The major objective of the study was to generate base line scientific information/ data about fish diversity, relative abundance and biology of commonly found species for management and sustainable utilization of the resources, and recommend ways and means of conserving the diversity of the ichthyofauna of the Beles and Gilgel Beles Rivers.

2.2 Specific objectives

- To identify species composition of fishes in Beles and Gilgel Beles Rivers.
- To evaluate the relative abundance of fish species in Beles and Gilgel Beles Rivers.
- To assess length - weight relationship of the dominant species.
- To compare the well - being of dominant species with respect to sex and season.
- To asses sex ratio and estimate fecundity of the dominant species.

3. Description of the study area

Beles and Gilgel Beles Rivers are located in Benishangul Gumuz region, Metekel Administrative zone. Beles River is situated around Gilgel Beles town and Mankush (formerly Guba) woreda in Babizenda Kebele at 541 km and 696 km away from Addis Ababa, respectively while Gilgel Beles River around Gilgel Beles town at 538 km (Fig.1).

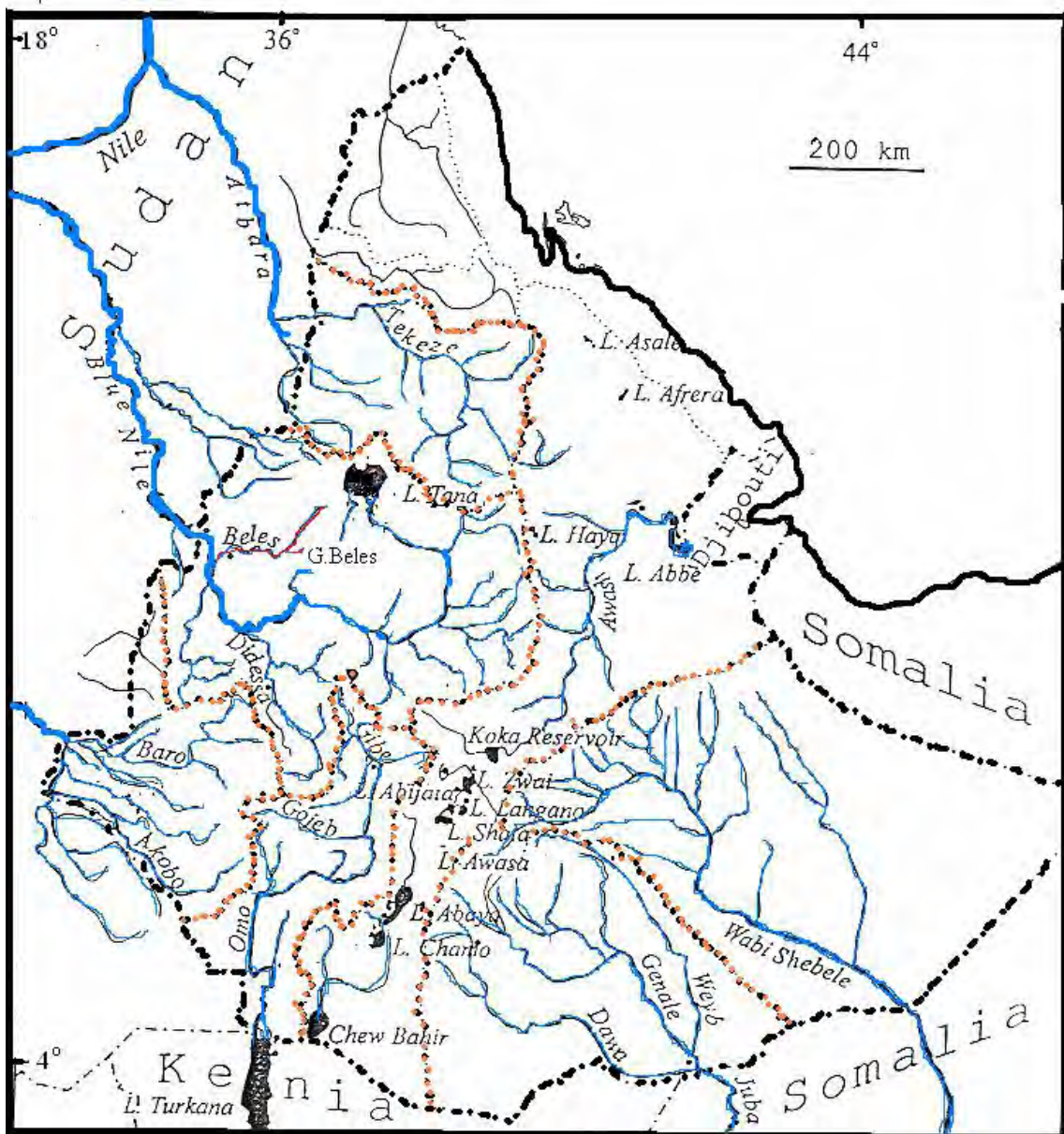


Fig.1. A map showing major drainage basins of Ethiopia (Golubtsov and Mina, 2003).

Metekel zone is a vast territory in North West Ethiopia bordering the Republic of the Sudan to the north of the Abay River (Blue Nile). It can be described as a hot, humid, flat and desolate region. It is broken here and there by many rivers. The most important rivers are Beles, Gilgel Beles, Durra, Ardi, Dinder, Alaltu, Dondor, Qarsa and Shar Rivers.

The headwater of Beles River starts from the area close to the western periphery of Lake Tana where as Gilgel Beles starts from Agew Awi zone, Dangilla Woreda Jebana Geweregese Kebele. The central part of Beles River catchments encloses the wide gently undulating to flat plain of Pawi area. Beles River has large watershed area. It has an area of 3,474 km² (FDROE, MOWR, 2000). Unlike Beles River, Gilgel Beles River has smaller watershed areas. The shape of the catchments of Beles River is elongated along the main course of the river, broadening towards south west as more tributary streams join the main river. Gilgel Beles River is one of the largest tributaries of Beles River in its middle course.

Beles and Gilgel Beles Rivers are situated at altitudes ranging from about 600 m to 2,731 m above sea level (Abdussamad Ahmed, 1995). Much of the area is lowland (54 %) while the highland is only 3 % (Abdussamad Ahmed, 1995). Beles and Gilgel Beles Rivers are found in hot lowland with undulating plains and a thick tropical forest which receives heavy rainfall. The lowest and the highest mean monthly average temperatures are between 18.53 and 39.43°C at Mankush station; and 12.06 and 38.6°C at Pawi station (Fig.2.). The main rainy season occurs between May and mid November. Mean monthly average rainfall ranges between 0 and 281.56 mm at Mankush station; 0 and 393.86 mm at Pawi station (Fig.3).

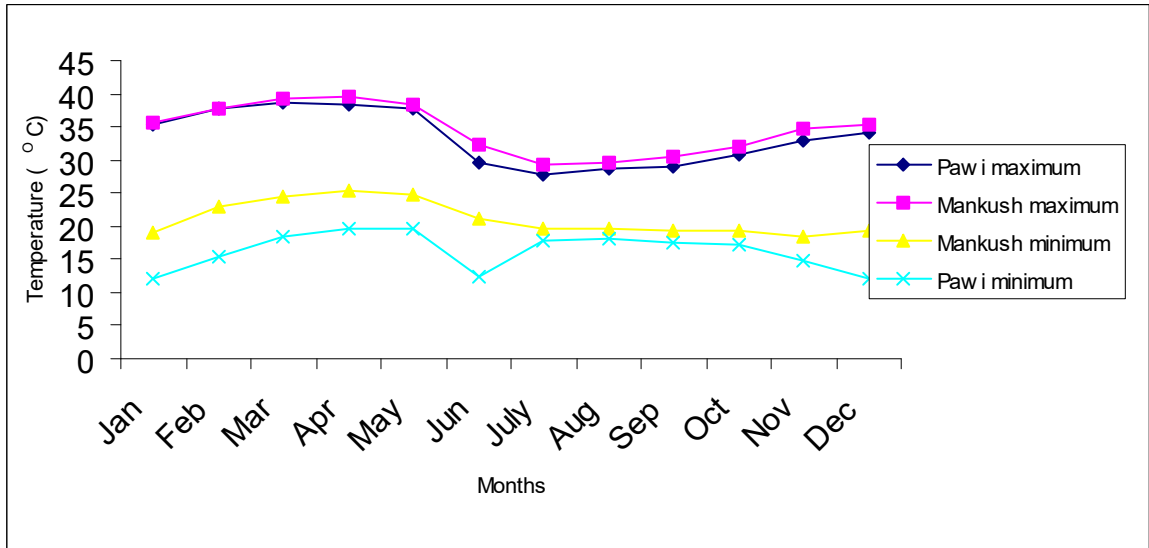


Fig. 2. Monthly mean maximum and minimum temperature at Mankush and Pawi stations from 2003-2005 (Ethiopian Meteorological Agency, 2005).

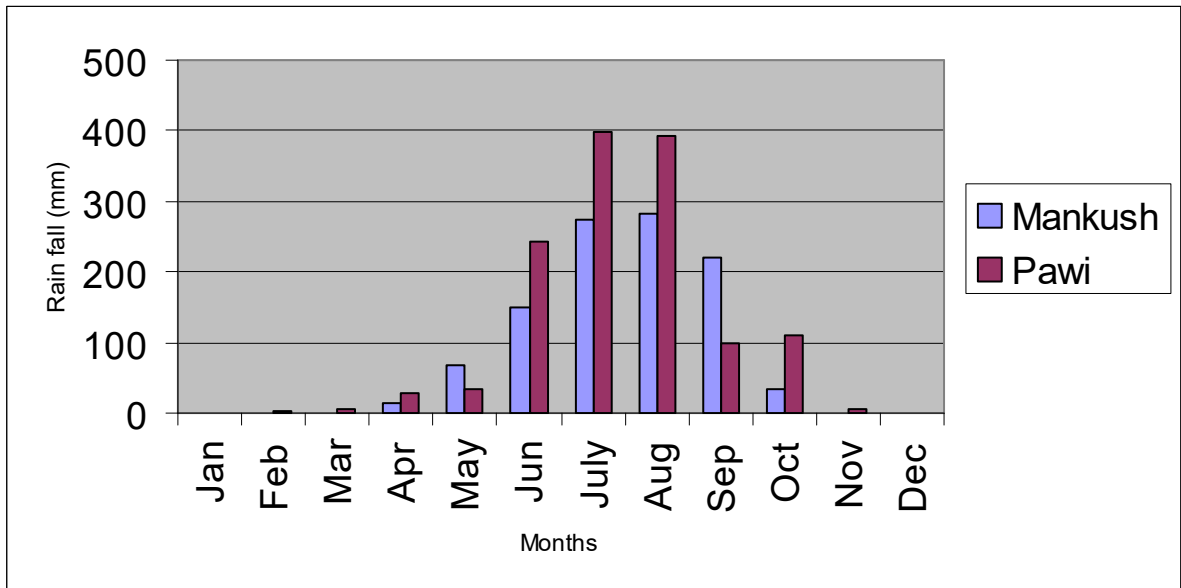


Fig.3. Mean monthly rainfall at Mankush and Pawi stations 2003-2005 (Ethiopian Meteorological Agency, 2005).

The geology of the middle and central part of the Beles catchment is with topography of flat to gently undulating ground ranging from 1000 m to 1500 m a.s.l (FDROE, MOWR, 2000). This catchment is made of metamorphic rocks of the lower complex, undifferentiated, covered by thin alluvial deposits occupying 54 % of the total catchment area (FDROE, MOWR, 2000). Ashangi basalt exists as a continuous outcrop over the catchment extending from the south west to north east, along the northern catchment water shed boundaries, as well as at the middle of the northern half of the catchment area towards the south eastern watershed boundaries (FDROE, MOWR, 2000).

Flora: - The north east and the south western highland areas of Beles Rivers are covered by a thick tropical forest, while the lower and central parts have some scattered tree coverage (FDROE, MOWR, 2000). The tropical forest characterize the vegetations of the study area. Vegetations of the study areas are dominated by *Acacia abyssinica*, *Cordia africana*, *Syzigium guineense*, *Borassia aethiopicum*, *Phoenix reclinata* and *Ceiba Pentandra* (Metekel zone Agriculture Department, 2006). Vegetations on either side of the riverbank are mainly trees and dominated by *Acacia abyssinica* and *Cordia africana*. These trees grow hanging their branches down to the water.

Fauna: - Nile crocodile, tortoise, phyton, snakes and monitor lizards were commonly animals in the study area. Nile crocodile, tortoise and phyton were trapped by fishing gears during sampling in Beles River. The weight and length of a phyton caught during sampling period was 18 kg and 3.5 m, respectively.

JERBE (1999) conducted a pilot study at Gilgel Beles River, upstream the bridge along the road Injibara – Mambuk c. 30 km NW of the town of Chagnie at latitude 11° 10' N; longitude 36° 22' E. They reported that *Barbus large sp.*, *Garra sp.*, *Varicorhinus beso* and *Oreochromis niloticus* from Gilgel Beles River. JERBE (2000) also assessed fish diversity in Beles River at 25 km SE of Mankush (formerly Guba) at latitude 11° 7' N; longitude 35° 24' 30'' E, and found a total of 25 species of fishes. These are categorized in six orders, i.e., Cypriniformes, Tetraodontiformes,

Characiformes, Osteoglossiformes, Perciformes and Siluriformes, and represented by nine families i.e. Cyprinidae, Mormyridae, Tetraodontidae, Distichodontidae, Mochokidae, Bagridae, Schilbeidae, Cichlidae and Characidae. Some of the species were *Mormyrus kannume* Forsskal 1775, *Brycinus macrolepidotus* Valenciennes 1849, *Labeo coubie* Rüppell 1832, *L. cylindricus* Peters 1852, *L. forskalii*, *L. horie* Heckel 1846, *L. niloticus* Forsskal 1775, *Bagrus bajad* Forsskal 1775, *B. docmak*, *Synodontis schall* Bloch & Schneider 1801, *S. serratus* Rüppell 1829, *O. niloticus*, *Tetraodon lineatus* Linnaeus 1758, *Distichodus engycephalus* Gunther 1864, *Chelaethiops bibie* de Joannis 1835, *Garra* sp and *Schilbe mystus* Linnaeus 1758 (JERBE, 2000).

Fishing is generally artisanal in the study area and its purpose is limited to meet subsistence needs of fishing communities in the form of food by local people, and an additional source of household income by a few settlers. Fishing is carried out for limited months of the year, from December to April, when the water level become stable and farmers are off – farm activities. Subsistence fishing is done using traditional gears i.e hook and line, trap, cast net and spears, and poisonous plants (e.g. Berbera seeds).

4. Materials and methods

A. Site selection: - A reconnaissance survey was conducted together with the research advisor to fix sampling sites. The survey was conducted in four sub areas along the Beles and Gilgel Beles Rivers. Two sampling sites were selected from each river taking into consideration the velocity of water, habitat type, altitude, depth of water, vicinity to road and substrate type (Table 2 & Fig.4). These sub areas are namely; sub area I (Gilgel Beles at Mender hullet), sub area II (Gilgel Beles at College), sub area III (Beles at bridge) and sub area IV (Beles at Babizenda). Babizenda sampling site is located below the confluence of the rivers.in Guba woreda. Some information about the stations is given in Table 2.

Table 2. Estimated distances from Gilgel Beles at Mender hullet, altitude and coordinates of sampling sites.

Site	Code	Distance from Mh	Elevation (a.s.l)	Coordinate (GPS)
Gilgel Beles at Mender hullet	Mh	-	1011 m	11 ^o 09' 53.5'' N; 36 ^o 20' 39.3'' E
Gilgel Beles at College	Coll	2 km	1007 m	11 ^o 09' 35.1'' N ; 36 ^o 20' 008'' E
Beles at bridge	BB	6 km	994 m	11 ^o 11' 56.7'' N ; 36 ^o 19' 31.7'' E
Beles at Babizenda	BAB	156 km	596 m	11 ^o 07' 54.8'' N ; 35 ^o 28' 13.6'' E

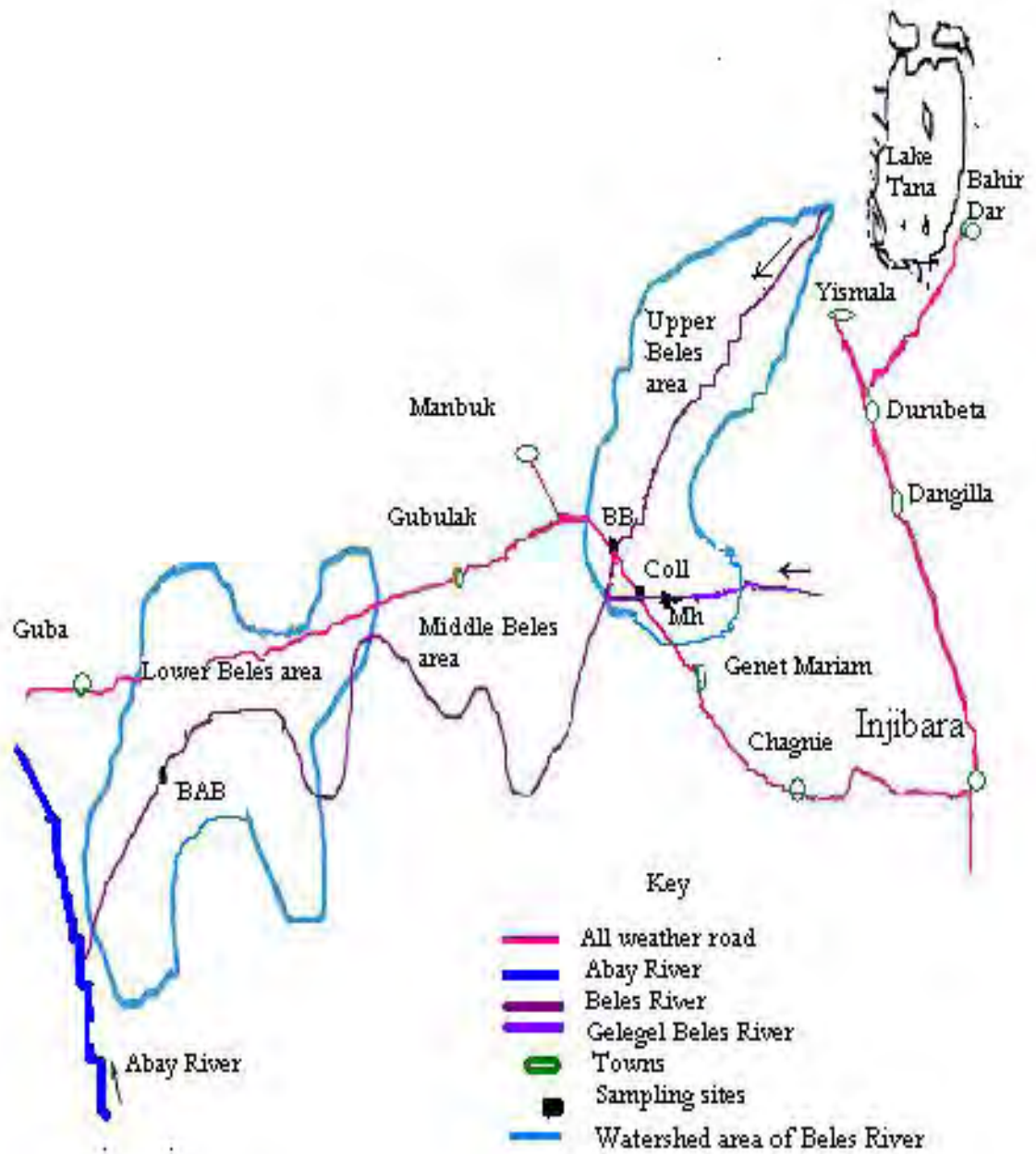


Fig.4. Map of Beles and Gilgel Beles Rivers (un scaled) (FDROE, MOWR, 2000).

B. Fieldwork: - Three surveys were conducted to collect specimens from the sampling sites. The samples were taken in November 2005, March 2006 and May 2006. November and May were wet months while March was dry month. Gill nets with 6 cm, 8 cm, 10 cm, 12 cm and 14 cm mesh sizes were used to collect fishes. Monofilament gill nets were also used to collect juvenile and smaller sized fishes. Multiple hooks and lines were used in areas where gill nets were not suitable. The gill nets and multiple hooks and lines were set using swimmers across the river diagonally late in the afternoon (5:00 PM) and left in the rivers for about 15 hrs, and retrieved in the next morning (8:00 AM). However, monofilament gill nets were set for an hour during daytime.

Immediately after retrieval, fishes were removed and total length and total weight of each specimen were measured. Total length was measured to the nearest 0.1 cm and total weight was measured to the nearest 0.1 g. After length and weight measurement, each specimen was dissected and its sex determined by inspecting the gonads. Then, specimens and gonads of dominant species were preserved in 10 % and 5 % formalin, respectively.

During fieldwork the physical and chemical features of the rivers were recorded. In every sampling time and site, the oxygen content (mg l^{-1}) and water temperature ($^{\circ}\text{C}$) (using oxygen-guard oxygen meter, water transparency (Secchi-depth) (cm) (using Secchi disc), pH (using pH meter) and conductivity ($\mu\text{ S.cm}^{-1}$) (using a conductivity meter) were measured. Beam balance, measuring board, buckets, plastic bowls, collection bottles, strings, camera, syringe, GPS and other materials were used when required.

C. Laboratory studies: - The specimens were soaked in tap water for a week to wash the formalin from the specimens. Then, they were transferred to 75 % ethanol. Identification was made to species level by comparing the sample characters with taxonomic keys found in the literature and specimens deposited at the Fisheries Laboratory, Department of Biology, AAU, and also at Bahir Dar fisheries and other aquatic life Research Center, and at National Fisheries and Other Living Aquatic

Resources Research Centre, Sebeta. Keys found in Shibru Tedla (1973), Boulenger (1909-1916), Lévêque *et al.* (1990,1992), Eschemeyer (2006), Nagelkerke (1997), Bishai and Khalil (1997) and Golubtsov *et al.*, (1995) were used for identification. Meristic and morphometric characters were assessed for comparison purpose.

D. Species description: - External morphological, morphometric and meristic data were used in species diagnosis. Measurements were made using a digital caliper to the nearest 0.1 mm. Undamaged specimens representing different size groups were selected and measured for description of species. The principal dimensions used for describing a fish were as follows: Total length was measured from the end of the snout to end of the longest rays of the caudal fin; Fork length was measured from the tip of the snout to the end of the middle ray of the caudal fin; Standard length was measured from the tip of the snout to the origin of the central caudal rays, excluding the fin itself; Head length was measured from snout tip to posterior edge of gill cover; Depth of body was measured where depth is greatest. Caudal peduncle depth was measured where dorsoventral dimension of the caudal peduncle is minimum. Caudal peduncle length was measured as the distance from the base of the last ray of the anal fin to the origin of the central caudal rays (Fig.5).

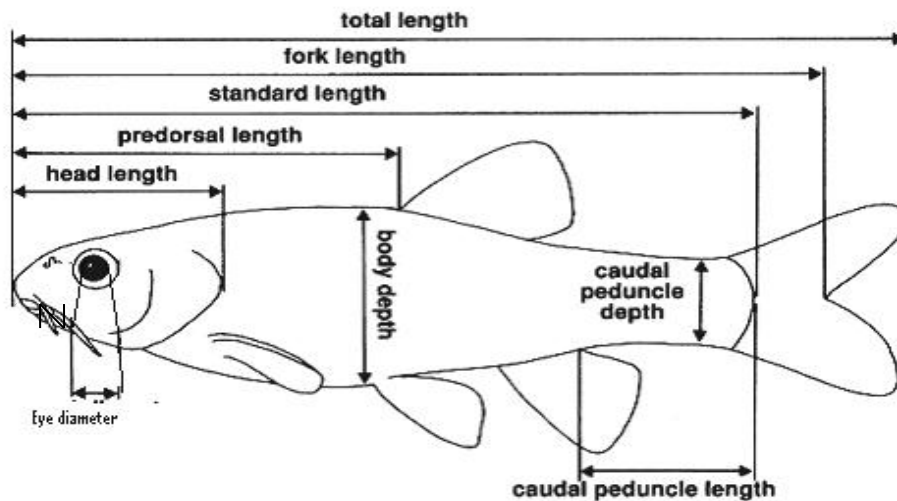


Fig.5. Principal measurements of fish (Skelton, 1993).

Scales are characteristic features of most fishes although catfish has no scale (Crass, 1964). The most useful scales counted for identification of fishes were lateral line scales, round the caudal peduncle scales, scales between lateral line and center of belly, scales between lateral line and the origin of the dorsal, and scales between lateral line and origin of ventral fins. The lateral line scales were counted from base of the caudal fin, excluding scales which cover the base of the caudal rays, forward to the upper edge of the gill opening. Caudal Peduncle scales were counted as the number of rows round the narrowest part of the peduncle. Scales between lateral line and the origin of the dorsal, origin of ventral fins, and the center of the belly were counted in a transverse line. Scale counts were written in modern description formula (JUBB, 1967). For example, scale formula for *L. forskalii* was $40 - 43 \frac{6^{1/2} - 7^{1/2}}{8^{1/2}}$, and this would mean that there are 40 - 43 lateral line scales, $6^{1/2} - 7^{1/2}$ scales between lateral line and origin of dorsal fin and $8^{1/2}$ between lateral line and center of belly. The size and position of eyes were used for identification. For example, they were on the side (lateral), partly on the top (supero-lateral) or partly below (infero-lateral). The number and morphology of gill rakers on the lower gill arch, barbells and teeth, and the number and morphology of fin rays were also used for identification. In fin ray formula, soft ray and spine were indicated by Roman numerals (e.g. III, IV) while branched rays were indicated by Arabic numerals (e.g. 5, 8, 9). Color is one of the most striking features of live fish, but few pigments persist after death (Crass, 1964). There fore, alive fish color was used in describition of species.

E. Data analysis

Generally, SPSS for Windows (version 10) and MINITAB (version 14) were used to perform the calculations and statistical analysis.

I. Species description

The morphometric data have been converted into percentages with respect to Standard length and head length. Standard univariate statistical methods (mean, median, range, average and standard deviation) were used to summarize the morphometric and meristic data.

II. Species diversity and relative abundance

An index of relative importance (IRI) and Shannon diversity index (H') were used to evaluate relative abundance and species diversity of fishes, respectively.

An index of relative importance (IRI) is a measure of the relative abundance or commonness based on number and weight of individuals, as well as their frequency of occurrence (Kolding, 1989; 1999). An "index of relative importance" IRI (Pinkas *et al.* 1971; Caddy and Sharp, 1986; Kolding, 1989, 1999) was used to find the most important species in terms of number, weight and frequency of occurrence in catches from the different sampling localities. IRI gives a better representation of the ecological importance of species rather than the weight, numbers or frequency of occurrence alone (Sanyanga, 1996). Index of relative importance (% IRI) was calculated as:

$$\% \text{ IRI}_i = \frac{(\%W_i + \%N_i) \cdot \%F_i}{\sum_{j=1}^S (\%W_j + \%N_j) \cdot \%F_j} \cdot 100$$

Where $j = 1-S$, % W_i and % N_i is percentage weight and number, respectively, of each species (i) in the total catch; % F_i is percentage frequency of occurrence of each species in total number of settings; and S is total number of species. A high value indicates the most abundant species.

The Shannon index of diversity (H') is a measure of the number of species weighted by their relative abundances (Begon *et al.* 1990). The Shannon's diversity index

explains both the variety and the relative abundance of species (Næsje et al., 2004). H' was calculated as:

$$H' = -\sum p_i \ln p_i$$

Where, p_i is the proportion of individuals found in the i th species. Shannon's diversity index (H') was used to indicate diversity at different sampling sites and/or rivers. A high value indicates high species diversity. Significance of differences in species diversity and relative abundance between sampling sites and/or rivers was tested using T-test.

III. Length- weight relationship

The relationship between total length and total weight was calculated using least squares regression analysis (LeCren, 1951; Bagenal and Tesch, 1978) as follows:

$$TW = a * TL^b$$

Where, TW = Total weight in grams

TL = Total length in centimeters

a and b = intercept and slope of the equation, respectively.

Significance of the relationship was statistically tested using ANOVA.

IV. Condition factor

The well-being or plumpness was studied by calculating Fulton condition factor (LeCren, 1951; Bagenal and Tesch, 1978). Fulton condition factor (%) was calculated as:

$$FCF = \frac{TW}{TL^3} \times 100$$

Where, FCF= Fulton condition factor,

TW= Total weight in grams, and

TL= Total length in cms.

V. Estimation of Sex ratio

Sex ratio (female: male) was calculated for total sample. Chi-square test was employed to test if sex ratio varied from 1:1 in the total sample.

VI. Fecundity

Fecundity is the measure of reproductive potential in fishes. Absolute fecundity was estimated by the Gravimetric method (Cailliet, *et al.* 1986). Three sub-samples of 1g eggs were taken from different part of the ovary and counted, and an average of these was calculated. Then, the total number of eggs per ovary was calculated by extrapolation from the mean calculated. The total number of eggs was estimated by the following formula:

$$\frac{X}{N} = \frac{W}{w}$$

Where X = Total number of eggs to be calculated

N = Number of eggs counted in a sample of known weight

W = Total weight of all eggs

w = weight of the sample

Relation between fecundity and total length, total weight and gonad weight were analysed using regression analysis.

5. Results and discussion

5.1 Physical and chemical (abiotic) parameters

The following physical and chemical parameters measured during this study are presented in Table 3. For most parameters the difference among sites were related to longitudinal position. Mean temperature, river width and secchi depth showed apparent longitudinal trends. Mean temperature, river width and secchi depths were highest at BAB and lowest at Mh sites. Mean conductivity was highest at BB and lowest at Mh sites. Mean Dissolved oxygen was highest at Mh and lowest at BB sites (Table 3). Mean river depth was highest in Beles River at Bridge and lowest in Gilgel Beles River at Mh sites.

Table 3. Physical and chemical parameters of sampling sites (Mean \pm SD) (O = Oxygen, T = Temperature, S = Secchi depth, Con = Conductivity, RW = River Width and RD = River Depth).

Sites	pH	T (°C)	Con. (μ S.cm ⁻¹)	O (mg l ⁻¹)	S (cm)	RW (m)	RD (m)
Mh	7.86 \pm 0.73	24.4 \pm 3.4	146.3 \pm 75.7	7.07 \pm 0.18	41.2 \pm 38.3	31 \pm 2	2.42 \pm 0.28
Coll	7.85 \pm 0.72	25.43 \pm 4.1	153.8 \pm 67.2	6.62 \pm 0.59	47.8 \pm 59.2	32.67 \pm 2.08	2.7 \pm 0.5
BB	8.02 \pm 0.52	27 \pm 3.47	241.8 \pm 140	6.53 \pm 0.15	86.7 \pm 53.5	38.67 \pm 1.53	6.3 \pm 0.5
BAB	7.96 \pm 0.17	28.7 \pm 1.7	202 \pm 188	6.79 \pm 1.11	90 \pm 14.1	56.5 \pm 2.12	4.25 \pm 0.5

There were no significant variations in pH, conductivity, temperature and secchi depth among sampling sites ($P > 0.05$) (Appendix 2). However, there were significant differences ($P < 0.05$) in river width and depth among sampling sites except between Mh and Coll sites (Appendix 2) also, there was no significant variation ($P > 0.05$) in dissolved oxygen content among sampling sites except between Mh and BB sites (Appendix 2).

5.2 Fish species composition of Beles and Gilgel Beles Rivers

A total of 23 fish species were recorded during the present study from Beles and Gilgel Beles Rivers (Table 4). These fishes were represented by a single class Actinopterygii (ray-finned fishes), seven families and five orders (Table 4). The Cyprinidae, Bagridae and Characidae were the best-represented families with respect to numbers of species; with 11, 3 and 3 species, respectively (Table 4). *Labeo* and *Labeobarbus* were the best-represented genera with numbers of species; with five and four species, respectively (Table 4). The freshwater fish fauna of Beles and Gilgel Beles Rivers contain a mixture of Nilo Sudanic (e.g. *B. docmak*, *B. bajad*, *H. forskhalii*, *L. forskalii*, *M. kannume*, *S. serratus* and *S. schall*), highland East African (e.g. *L. intermedius*, *L. nedgia*, *C. gariepinus* and *O. niloticus*) and Endemic forms (e.g. *V. beso*).

Table 4. Fish species composition of Beles and Gilgel Beles Rivers

Species name	Common name (Gumuz)	Family	Order
<i>R. loati</i> Boulenger 1901	Abella	Cyprinidae	Cypriniformes
<i>V. beso</i>	-		
<i>L. niloticus</i>	Tsemebebella		
<i>L. horie</i>	-		
<i>L. coubie</i>	-		
<i>L. forskalii</i>	Tseyya		
<i>L. cylindricus</i>	-		
<i>L. bynni</i> Boulenger 1911	Goshe		
<i>L. intermedius</i>	-		
<i>L. nedgia</i> Rüppell 1836	-		
<i>L. degeni</i> Boulenger 1902			
<i>C. gariepinus</i>	-	Clariidae	Siluriformes
<i>H. longifilis</i> Valenciennes 1840			
<i>B. bajad</i>	-	Bagridae	
<i>B. docmak</i>	-		
<i>A. occidentalis</i>	Jajuma		
<i>S. serratus</i>	-	Mochokidae	
<i>S. schall</i>	Buwa		
<i>H. forskhalii</i>	-	Characidae	Characiformes
<i>B. macrolepidotus</i>	Yechacheya		
<i>B. nurse</i> Rüppell 1832	Lekewar		
<i>M. kannume</i>	Bebela	Mormyridae	Osteoglossiformes
<i>O. niloticus</i>	Begebella	Cichlidae	Perciformes

5.2.1 Key to Beles and Gilgel Beles River fishes

1. No teeth on jaws..... 2

-Teeth on jaws..... 12

2(1). Ten to sixteen distinct bluish - black vertical bars on each side of the body; no barbells; 50 - 58 scales in lateral line:

R. loati

- No bluish - black vertical bars on each side of the body..... 3

3(2). It's lower lip absent, replaced by a sharp horny scraping rim; 30 - 31 scales in lateral line:

V. beso

- Lower lip present 4

4(3). Dorsal fin originating well in advance of ventrals; no less than 38 scales in lateral line and no less than 10 branched rays in dorsal fin; if there are fewer scales (36) in lateral line and less branched rays (9) in dorsal fin5

- Dorsal fin originating a little in advance of ventrals; no more than 38 scales in lateral line and less than 10 branched rays in dorsal fin 9

5(4). Dorsal fin with 14 - 16 branched rays, its upper edge concave or straight6

- No more than 10 branched rays in dorsal fin, its upper edge concave.....8

6(5). Dorsal fin with 14 - 16 branched rays, its upper edge concave; 38 - 44 scales in lateral line; ill-defined dark longitudinal lines run between series of scales:

L. niloticus

- Dorsal fin with 14 branched rays.....7

7(6). Labial folds rather poor - developed in comparison with other *Labeo*; dorsal fin with 14 branched rays, its longest dorsal ray much longer than head length; light colors prevalent in alive fish coloration; 43 - 44 scales in lateral line:

L. horie

- Labial folds-well developed; snout fleshy; dark colors prevalent in alive fish coloration; no dark longitudinal lines running between the series of scales; dorsal fin with 14 branched rays; 38 scales line lateral line:

L. coubie

8(5). Dorsal fin with 10 branched rays; rostral flap large and horny tubercles on the snout: 40 - 43 scales in lateral line:

L. forskalii

- Dorsal fin with 9 branched rays; slender in shape; 36 - 39 scales in lateral line:

L. cylindricus

9(4). Depth of the body much greater than length of head; dorsal spine as long as head length or longer; dorsal with 9 branched rays; 30 - 33 scales in lateral line:

L. bynni

- Depth of the body a little greater than the length of head; spine of dorsal shorter than head length; dorsal with 9 branched rays..... 10

10(9). Lips poorly developed; no extreme characters; 28 - 33 scales in lateral line:

L. intermedius

- Lips well developed compared to other large *Barbus*..... 11

11(10). Upper lip lobe curls back over the snout; 30 - 33 scales in lateral line:

L. nedgia

- Snout produced into a triangular dermal flap over hanging the lip; 30 - 33 scales in lateral line:

L. degeni

- 12(1). Long barbells present; no scales.....13
 - No barbells; scales present...19
- 13(12). Dorsal fin with out spine; dorsal and anal fins with elongated base length.....14
 - Dorsal fin with spine; dorsal and anal fins with short base length.....15
- 14 (13). No adipose fin; dorsal fin with 66 - 71 rays; anal fin with 52 - 53 rays:

C. gariepinus

- Adipose dorsal fin present; dorsal fin with 30 - 34 rays; anal fin with 44 - 50 rays; adipose fin as long as rayed dorsal:

H. longifilis

- 15(13). Four pairs of barbells (nasal barbell present).....16
 - Three pairs of barbells (nasal barbell absent).....17
- 16(15). Dorsal I 9 rays, last ray behind vertical of inner ray of ventral; maxillary barbell reaching extremities of ventral fin:

B. bajad

- Dorsal I 9 rays, last ray in advance of vertical of inner ray of ventral; maxillary barbells do not reach extremities of ventral fin:

B. docmak

17(15). None of the barbells branched; two pair of nostrils widely separated from each other, the anterior pair located on the upper lip and posterior on the surface of head; Greenish with large dark brown or blackish spots color prevalent in alive coloration:

A. occidentalis

- Mandibular barbells branched.....18

18(17). Dorsal spine distinctly serrated in front, feebly serrated behind; maxillary barbell broadly margined; movable mandibular teeth, 39 - 41 in number:

S. serratus

- Dorsal spine not serrated in front; maxillary barbell is not broadly margined; moveable mandibular teeth, 29 - 34 in number:

S. schall

19(12). Dorsal fin with small adipose fin.....20

- Dorsal fin with out adipose fin.....22

20(19). Teeth unicuspid, caniniform, in one row on both jaws; distinct longitudinal stripes deep black run along the series of scales above lateral line:

H. forskhalii

- Teeth pluricuspid, in two rows on the upper jaw.....21

21(20). Dorsal fin originating well behind vertical base of ventrals; head much flattened above; anal fin with 13 branched rays; 22 - 23 scales in lateral line:

B. macrolepidotus

- Dorsal fin originating above base of ventrals; a blackish spot above lateral line, behind gill opening and another on caudal peduncle; anal fin with 14 branched rays; 24 - 32 scales in lateral line:

B. nurse

- 22(19). Snout at least nearly as long as post orbital part of head; dorsal in advance of base of ventral; dorsal fin with 58 - 66 rays; anal 8 - 9 rays; 101 - 108 scales in lateral line:

M. kannume

- Regular Vertical stripes through out the depth of caudal; dorsal XVII 12 and anal III 8-9 rays:

O. niloticus

5.2.2 Diagnostic and descriptive characteristics of Beles and Gilgel

Beles River fishes.

1. *Raiamas loati* (Fig. 6)

Diagnosis: - The most distinguishing characteristic of the species is the presence of ten to sixteen distinct bluish – black vertical bars on each side of the body. Mouth extending to below center or posterior third of eye. No barbells; 50 - 58 scales in lateral line.

Description: - Depth of the body is less than length of head (its depth 21.2 - 26.2 % in SL). Snout pointed and projected beyond mouth, its length 26.67 - 33.33 % in HL. It has big eye, its diameter 12.5 - 26.7 % in HL. Dorsal III 8 rays, second half of its base above anal. Anal III 14 rays, notched and produced into a convex anterior lobe. Pectoral fin pointed, its length 17.6 - 21.8 % in SL. Caudal deeply forked. Caudal peduncle length is longer than depth. Scales with radiating striae, 50 - 58 $\frac{4}{3}^{1/2}$, 2

between lateral line and ventral, 12 - 16 round caudal peduncle. No teeth on jaws. Total length upto 20.2 cm.

Coloration: - Silvery white or steel-blue on the back.

Distribution: - Tekeze, Gendewuha, Guang and Omo Rivers (JERBE, 2004, 2005).



Fig. 6. Lateral view of *R. loati*

2. *Varicorhinus beso* (Fig. 7)

Diagnosis: - It has non-protractile, inferior mouth. Lower lip absent, replaced by a sharp horny scraping rim.

Description: - Body moderately deep, its depth 30 - 32.9 % in SL. Snout broad and swollen, its length 30.8 - 37.5 % in HL. Eye supero-lateral, its diameter 18.2 - 21.9 % in HL. Interorbital region is convex, its width 45.2 - 47.7 % in HL. It has wide mouth, its width 48.39 - 56.82 % in HL. A minute barbell at angle of mouth; horny conical or subconical tubercles round snout and below eye. Dorsal IV 10 - 11 rays, originating a little in advance of ventral. Anal III 5 rays. Pectoral and anal fins are shorter than head length. Caudal deeply forked. Caudal peduncle length is longer than its depth.

Lateral line scales 30 - 31 $\frac{4^{1/2} - 5^{1/2}}{3^{1/2} - 4^{1/2}}$, 2 between lateral line and ventral, 12 round caudal peduncle. No teeth on jaws. Total length upto 26.5 cm.

Coloration: - Grey above, base of scales blue or yellowish below; fins bluish or pinkish.

Distribution: - Blue Nile, Angereb, Sanja, Dirma, Megech, Awash, Siblu, Arjo, Dimttu and Genfel Rivers (Abebe Getahun, 2005b; JERBE, 2004, 2005).



Fig. 7. A: Lateral view of *V. beso*; B: Ventral view of mouth region (JERBE, 2004, 2005).

3. *Labeo niloticus* (Fig. 8)

Diagnosis: - Dorsal fin with 14 - 16 branched rays; 38 - 44 lateral line scales. Ill-defined dark longitudinal lines run between series of scales.

Description: - Body strongly compressed, its depth 29.4 - 36 % in SL. Snout broadly rounded, its length 33.33 - 50 % in HL. Eye perfectly lateral, its diameter 15.7 - 20 % in HL. Both lips with several rows of rounded or subconical papillae. A minute barbell concealed under the folds of skin at the angle of mouth. Tubercles on the snout are numerous but very small in size. Dorsal III 14 - 16 rays, upper edge concave. Last simple ray of dorsal as long as head length. Anal III 5 rays, not reaching root of caudal. Pectoral fin nearly as long as head length. Caudal deeply emarginate. Caudal peduncle depth is longer than length. Scales 38 - 44 $\frac{7^{1/2} - 8^{1/2}}{8 - 9^{1/2}}$, 4 - 6 between lateral line and root of ventral and 18 - 20 round caudal peduncle scales. No teeth on jaws. Total length upto 33.2 cm.

Coloration: - Grayish, brownish, olive or steel-blue above; silvery white beneath.

Distribution: - Blue Nile, Alvero, Tekeze, Omo, Angereb, Sanja and Gibe Rivers; Chamo and Abaya Lakes (Abebe Getahun, 2005b; Genanew Tesfaye, 2006; JERBE, 2004, 2005).



A.



B.

Figs.8. A: Lateral view of *L. niloticus*; B: Ventral view of head region.

4. *Labeo horie* (Fig. 9)

Diagnosis: - 14 branched rays in dorsal, its longest ray much longer than head length. Light colors prevalent in alive fish coloration. Labial folds rather poorly-developed in comparison with other *Labeo*.

Description: - Body strongly compressed, its depth 29.41 - 30 % in SL. Snout broadly rounded, its length 37.8 - 38.82 % in HL; tubercles on snout. Eye nearly lateral, its diameter about 18 % in HL. Both lips with several rows of papillae. A minute barbell hidden under folds of skin. Dorsal III 14 rays, upper edge straight. Anal III 5 rays. Pectoral nearly as long as head, not reaching ventral. Caudal deeply emarginate. Caudal peduncle depth is longer than length. Scales 43 - 44 $\frac{8}{8}$, 4 - 5 between lateral line and root of ventral, 18 round caudal peduncle scales. No teeth on jaws. Total length upto 48.8 cm.

Coloration: - Greyish, olive, greenish brown or steel-blue above, pale golden or silvery beneath.

Distribution: - Omo and Ayima (Dinder) Rivers; Chamo and Abaya Lakes (Abebe Getahun, 2005b; JERBE, 2004, 2005).



A.

B.

Figs. 9. A: Lateral view of *L. horie*; B: Ventral view of head region.

5. *Labeo coubie* (Fig. 10)

Diagnosis: - Labial folds well developed; snout fleshy; dark colors prevalent in alive fish coloration; no longitudinal lines running between the series of scales; 38 lateral line scales.

Description: - Body moderately deep, its depth 36 - 38.46 % in SL. Snout rounded and swollen, its length 50 - 56.25 % in HL; tubercles on the snout. Eye nearly lateral, its diameter about 15 % in HL. It has large rostral flap. Dorsal III 14 rays, upper edge straight. Anal III 5 rays. Caudal peduncle depth is longer than caudal peduncle length.

Scales 38 $\frac{8-8}{9}^{1/2}$, 6 between lateral line and root of ventral, 20 round caudal peduncle scales. Total length upto 35.8 cm.

Coloration: - Dark body, bluish gray to violet black back and sides; light belly.

Distribution: - Tekeze, Ayima, Omo and Gibe Rivers (JERBE, 2004, 2005).



A.

B.

Figs. 10. A: Lateral view of *L. coubie*; B: Ventral view of head region.

6. *Labeo forskalii* (Fig. 11)

Diagnosis: - This species is distinguished from other species of the genus by the following combination of characters: Labial folds well-developed forming sucker around the mouth, rostral flap large and horny tubercles on the snout.

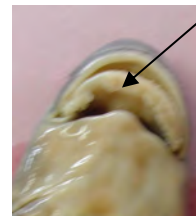
Description: - Body more or less compressed, its depth 26.4 - 30.8 % in SL. Snout is swollen with a distinct curved transverse groove above. Lips strongly developed. Lower lip expanded and bordered in front by a fringe of papillae. Inner surface of lips with small papillae forming numerous transverse plicae. Rostral flap large completely detached at the sides. A minute barbell concealed under folds of skin in the corner of mouth. Horny tubercles on the snout much developed in adult, more so in males than in females. Dorsal III 10 rays, upper edge concave. Longest rays of dorsal considerably exceeding length of head. Anal III 5 rays, its length shorter than head length. Pectoral and pelvic fins nearly as long as head length. Caudal peduncle length as long as depth. Scales 40 - 43 $\frac{6^{1/2} - 7^{1/2}}{8^{1/2}}$, 3 - 5.5 between lateral line and root of ventral, 16 - 20 rounds caudal peduncle. No teeth on jaws. Total length upto 44.7 cm.

Coloration: - Dark olive above and on the sides, white beneath.

Distribution: - Blue Nile, Dabus, Angereb, Sanja, Tekeze, Omo, Gendewuha, Guang (Atbara), Ayima (Dinder) and Gibe Rivers (JERBE, 2004, 2005). Labial folds



A.



B.

Figs. 11. A: Lateral view of *L. forskalii*; B: Ventral view of head region.

7. *Labeo cylindricus* (Fig. 12)

Diagnosis: - Dorsal III 9 and anal III 5 rays. 36 - 39 scales in lateral line; slender in shape.

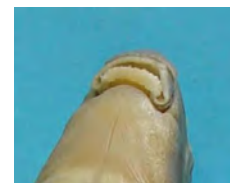
Description: - Body feebly compressed, its depth as long as head length. It has wide interorbital width (40 - 43.48 % in HL). Mouth is ventral and inner surface of the lip lined transversely with papillae. Width of mouth is large (35.71 - 47.83 % in HL). It is very closely allied to *L. forskalii* but eye larger (14.29 - 17.39 % in HL). Dorsal III 9 rays, upper edge concave. Longest dorsal rays as long as the length of head. Anal III 5 rays, its length shorter than head. Pectoral a little less than head length, not reaching ventral. Caudal peduncle length is longer than depth. A pair of barbells, their length 14.29 - 17.39 % in HL. Scales 36 - 39 $\frac{6}{7^{1/2}}$, 5 between lateral line and root of ventral, 16 rounds caudal peduncle. No teeth on jaws. Total length upto 16.4 cm.

Coloration: - Dark brownish above and on the sides; white beneath.

Distribution: - Blue Nile, Genale, Dawa, Tekeze, Omo and Angereb Rivers (JERBE, 2004, 2005).



A.



B.

Figs. 12. A: Lateral view of *L. cylindricus*; B: Ventral view of head region.

8. *Labeobarbus bynni* (Fig. 13)

Diagnosis: - Depth of the body much greater than length of head. Dorsal spine length as long as head length or longer. It's caudal yellowish in colour.

Description: - Depth of the body much greater than length of head, its depth 28 - 40.35 % in SL. Snout rounded, its length 23.1 - 52.9 % in HL. Eye relatively large (14.3 - 26.3 % in HL). Mouth inferior, its width 25 - 32.9 % in HL. Lips well developed, lower continuous across the chin and produced in to a median rounded lobe. Two barbells on each side of the head; anterior barbell length 16.7 - 27.1 % in HL and posterior barbell 23.8 - 31.6 % in HL. Dorsal IV 9 rays, outer edge concave. Last simple ray of dorsal very strong and not serrated, its length 20 - 29.31 % in HL. Anal III 5 rays, nearly reaching root of caudal. Caudal peduncle length is longer than depth. Scales longitudinally striated, $30 - 33 \frac{6 - 6^{1/2}}{4^{1/2} - 5^{1/2}}$, 3 between lateral line and ventral, 10 - 14 round caudal peduncle. No teeth on jaws. Total length upto 54.3 cm.

Coloration: - Yellowish or silvery, grey or olive on the back; fins yellow or orange, ends of dorsal and caudal rays sometimes blackish.

Distribution: - Omo, Bonga, Baro and Tekeze Rivers; Chamo and Abaya Lakes (Abebe Getahun, 2005b; JERBE, 2004, 2005).



Figs. 13. A: Lateral view of *L. bynni*; B: Ventral view of mouth region.

9. *Labeobarbus intermedius* (Fig. 14)

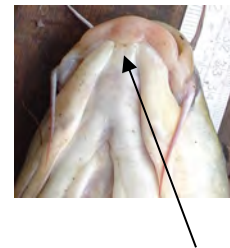
Description: - Depth of the body a little greater than length of head (its depth 29.8 - 34.4 % in SL). It has small eyes (12.3 - 17.14 in HL). Mouth inferior, its width 24.3 - 36.7 % in HL. Lip development variable, lower interrupted and some times continuous on chin. Two barbells on each side of the head; anterior barbell length 23.1 - 31.4 % in HL and posterior barbell 25.3 - 37.1 %. Dorsal IV 9 rays, border concave. Last simple ray of dorsal is very strong and not serrated, its length 13.42 - 20.31 % in HL. Anal III 5 rays, often reaching caudal. Caudal peduncle length is longer than depth. Scales longitudinally striated, $28 - 33 \frac{5^{1/2} - 6}{4^{1/2} - 6}$, 2 - 3 between lateral line and ventral, 12 - 14 round caudal peduncle. Body variable in shape. Three different dorsal head profiles have been observed: concave, straight and convex. No teeth on jaws. Total length upto 69.5 cm.

Coloration: - Olive above, yellow or pinkish beneath; fins brown or olive.

Distribution: - The species is widely distributed in Ethiopian fresh waters. For example, in Gibe, Megech, Omo, Baro, Sanja and Angereb Rivers (Genanew Tesfaye, 2006; JERBE, 2004).



A.



B. Interrupted lip

Figs. 14. A: Lateral view of *L. intermedius*; B: Ventral view of mouth region.

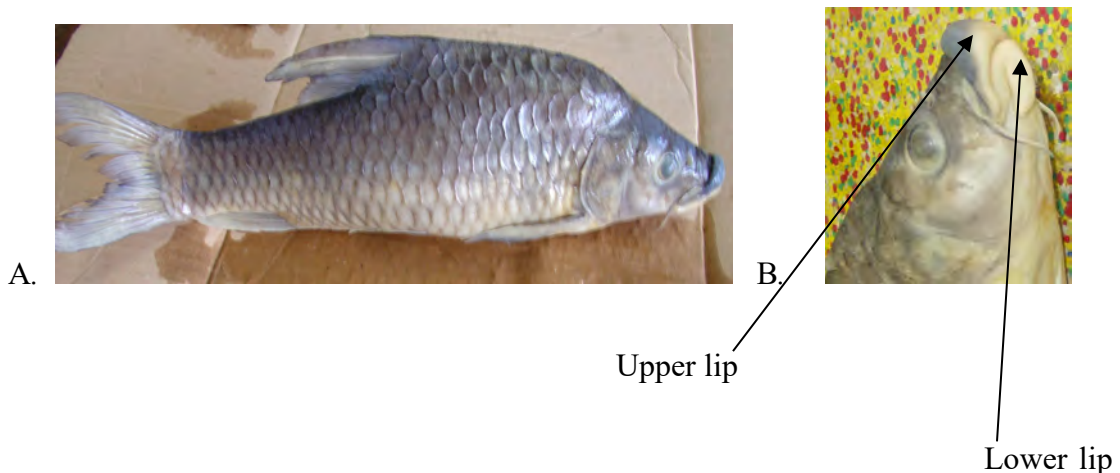
10. *Labeobarbus nedgia* (Fig. 15)

Diagnosis: - Lips strongly developed both upper and lower, produced into a rounded or subtriangular lobes. It has fleshy rounded lobe on upper lip that curls back over the snout.

Description: - Depth of the body a little greater than length of head (its depth 28.57 - 42.42 % in SL). Eye small, its diameter 11.82 - 17.65 % in HL. Mouth inferior, its width 25.7 - 33.3 % in HL. Lips are strongly developed, both upper and lower, produced into a rounded or pointed lobe. Two barbells on each side of head; anterior barbell length 17.4 - 27.1 % and posterior barbell 18.6 - 36.4 % in HL. Dorsal IV 9 rays, upper edge concave. Last simple ray is very strong and not serrated, its length 17.11 - 27.08 % in HL. Anal III 5 rays, often reaching caudal. Caudal peduncle length is longer than depth. Scales longitudinally striated, $30 - 33 \frac{5^{1/2} - 6^{1/2}}{4^{1/2} - 5^{1/2}}$, 3 between lateral line and ventral, and 14 round caudal peduncle. No teeth on jaws. Total length upto 54.6 cm.

Coloration: - Olive or greenish grey above, yellowish beneath; fins olive or grey.

Distribution: - Angereb, Sanja, Omo, Muger and Didessa Rivers; Lake Tana (Shibru Tedla, 1973; Genanew Tesfaye, 2006).



Figs. 15. A: Lateral view of *L. nedgia*; B: Ventral view of mouth region.

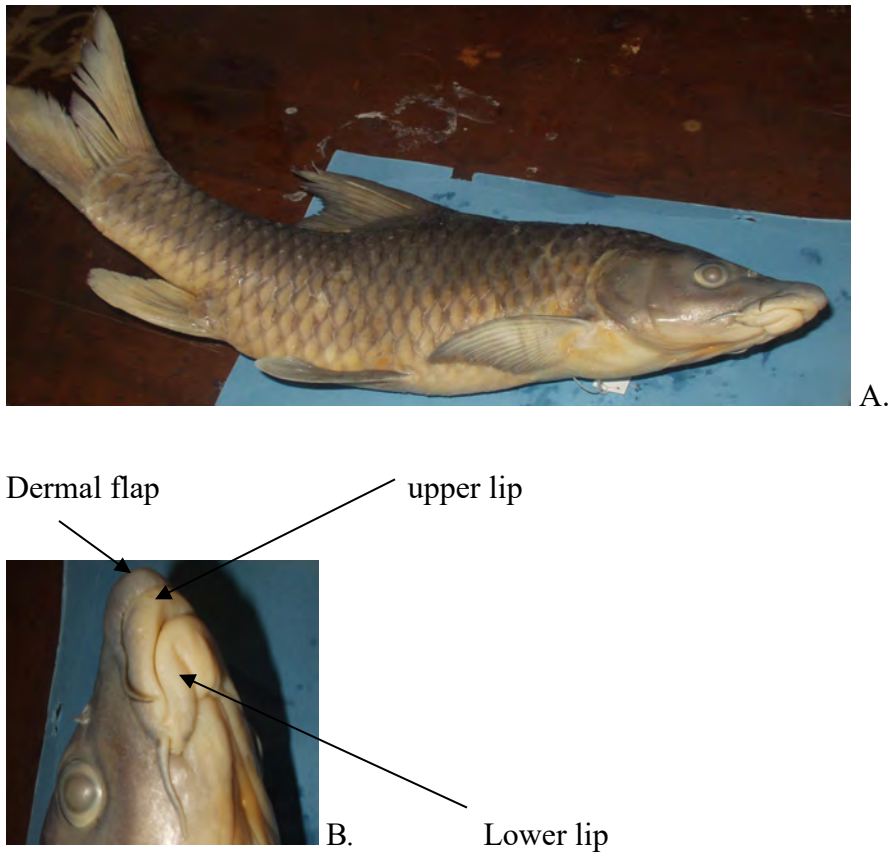
11. *Labeobarbus degeni* (Fig. 16)

Diagnosis: - Lips strongly developed, lower produced into rounded median lobes. Snout produced into a triangular dermal flap overhanging the lip.

Description: - Depth of the body a little greater than length of head (its depth 32 - 37.2 % in SL). Snout produced into a triangular dermal flap overhanging the lip, its length about 37 % in HL. Mouth inferior, its width 27.3 - 33.3 % in HL. Lips very strongly developed, lower produced into a truncated or mild forked median lobe. Two barbells on each side of head; anterior barbell length 17.7 - 27.3 % in HL and posterior barbell 19.6 - 31.8 %. Dorsal IV 9 rays, border concave. Last simple ray is very strong and not serrated, its length about 21 % in HL. Anal III 5 rays, nearly reaching caudal. Caudal peduncle length is longer than depth. It has relatively elongated predorsal length compared to other mentioned large *Barbus*. Scales longitudinally striated, $30 - 33 \frac{5^{1/2} - 6^{1/2}}{4^{1/2} - 5^{1/2}}$, 3 between lateral line and ventral, 12 - 14 round caudal peduncle. No teeth on jaws. Total length upto 51.6 cm.

Coloration: - Dark yellowish green; fins steel – grey.

Distribution: - Lake Tana, Ethiopia – Zegie and Bahirdar (Shibru Tedla, 1973).



Figs. 16. A: Lateral view of *L. degeni*; B: Ventral view of mouth region.

Comparison *L. nedgia* and *L. degeni*

L. nedgia has strongly developed upper and lower lips; produced into rounded or subtriangular lobes. It has fleshy rounded lobe on upper lip that curls back over the snout. This kind of fish was called *L. nedgia* by Rüppell 1836, *B. nedgia* by Boulenger 1902 and Bini 1940 in Lake Tana; and *B. nedgia* by Boulenger 1911 and Shibu Tedla (1973) in other lakes and several rivers in Ethiopia (Appendix 3). Recently, Genanew Tesfaye (2006) described *L. nedgia* from Sanja and Angereb Rivers whose upper lip curls back over the snout. *L. degeni* is distinguished from *L. nedgia* by the following combination of characters. It has strongly developed lower lip. Its lower lip produced into rounded median lobes and their snout produced into a triangular dermal flap overhanging the lip. This kind of fish was called *B. degeni* in

Lake Tana by Boulenger 1902, Bini 1940 and Shibru Tedla (1973) (Appendix 3). Recently, Eschmeyer (1998a, 1998b), listed *L. degeni* & *L. nedgia* as different valid species. Nagelkerke and Sibbing (1996) considered *L. nedgia* and *L. degeni* as belonging to a single lip morphotype (*Labeobarbus nedgia*) endemic to Lake Tana (Appendix 3). However, the two morphotypes of *Labeobarbus* which were considered as endemic to Lake Tana are found in Beles River.

12. *Clarias gariepinus* (Fig. 17)

Diagnosis: - Dorsal 66 - 71 and anal 52 - 53 rays. No adipose fin.

Description: - Depth of the body is less than length of head (its depth 14 – 18.75 in SL). The upper surface of head more or less distinctly granulate; occipital process angular. Eye very small, its diameter 4 - 6. 32 % in HL. It has wide interorbital width (44 – 52.63 % in HL). Mouth is terminal and large. Width of mouth nearly equal to interorbital width. Length of premaxillary teeth band is about 7 times as long as broad. Vomerine teeth forming a crescentic band which slightly interrupted in the middle. Vomerine teeth band is wider than premaxillary teeth band. Maxillary barbell is much longer than head, reaching base of pectoral spine. Outer mandibular barbell is longer than inner (76 – 107.14 % in HL). Gill-rakers are close-set, 100 to 113 in number. Pectoral spine serrated on the outer border; its length 13.4 - 15.38 % in SL. Dorsal and anal fins are extended to the base of the caudal fin. Ventrals are nearer caudal than end of snout. Total length upto 60.8 cm.

Coloration: - Dark, grayish - black above and creamy-white below.

Distribution: - Dabus, Tekeze, Guang, Angereb, Sanja, Ayima, Omo, Baro and Jejebie Rivers; Awasa, Tana and Zeway Lakes (Abebe Getahun, 2005; Demeke Admasu, 1994; JERBE, 2004, 2005; Tesfaye Wudneh, 1998).



Fig. 17. Dorsal view of *C. gariepinus*

13. *Heterobranchus longifilis* (Fig. 18)

Diagnosis: - Dorsal 30 – 34 and anal 44 - 50 rays. Anal fin and adipose dorsal are extended to the base of the caudal fin. Adipose fin as long as rayed dorsal.

Description: - Depth of the body is less than length of head (its depth 13.08 -16 % in SL). Head less strongly depressed and its upper surface coarsely granulated. It has wide head breadth (80 - 100 % in HL). Occipital process acutely pointed. It has small eyes (6 – 6.67 % in HL) with wide interorbital width (40 - 72.41 % in HL). Width of mouth a little less than interorbital width. Vomerine teeth forming a crescentic band which is nearly as broad premaxillary band. Maxillary barbell is much longer than length of head, extending to end of pectoral. Outer mandibular barbell is also much longer than head length. Pectoral spine feebly serrated on the outer border; its length 14.2 – 16 % in SL. Total length upto 77.3 cm.

Coloration: - Olive above, white beneath; adipose dorsal fin often blackish at the end.

Distribution: - Angereb, Guang, Sanja and Ayima Rivers (Genanew Tesfaye, 2006; JERBE, 2005).



Fig. 18. Dorsal view of *H. longifilis*

14. *Bagrus bajad* (Fig. 19)

Diagnosis: - Dorsal I 9 rays, last ray behind vertical of inner rays of ventral. Maxillary barbell reaching extremities of ventral fin.

Description: - Body depth 22.6 - 64.6 % in standard length. Head much depressed and smooth above; occipital process long and narrow. Snout broadly rounded projecting beyond the lower lip, its length 34.72 - 36.84 % in HL. It has small eyes, their diameter about 8 % in HL. It has wide mouth, its width about 53 % times in HL. Premaxillary teeth band is broader than vomerine teeth. Maxillary barbell is much longer than head length. Mandibular barbell length is less than head length. Gill-rakers are long and widely set, 10 on lower part of anterior arch. Dorsal I 9 rays, its spine moderately strong compared to *B. docmak*. Last ray of dorsal found behind vertical of inner ray of ventral; anterior soft rays produced into filaments. Anal II 8 rays. Pectoral spine relatively strong compared to *B. docmak* and feebly serrated on inner side; its length about 19 % in SL. Caudal deeply forked. Adipose dorsal length is longer than depth. Caudal peduncle length is longer than depth. Total length upto 38.2 cm.

Coloration: - Pale grey to dark brown above, white beneath.

Distribution: - Guang, Omo and Angereb Rivers (JERBE, 2004, 2005)



Fig. 19. Lateral view of *B. bajad*.

15. *Bagrus docmak* (Fig. 20)

Diagnosis: - Body slightly elongated. Dorsal I 9 rays, last ray in advance of vertical of inner rays of ventral. Maxillary barbells do not reach extremities of ventral fin.

Description: - Depth of the body is less than length of head (its depth about 22 % in SL). Like *B. bajad* its head much depressed and smooth above; occipital process long and narrow. Snout broadly rounded and projected beyond the lower jaw, its length 28.6 - 33.57 % in HL. It has relatively small eyes (6.43 - 7.14 % in HL). It has wide mouth, its width 53.6 - 60.7 % in HL. Premaxillary teeth band as broad as vomerine teeth. Maxillary barbell length is much longer than head length. Mandibular barbell length is less than head length. Gill-rakers are long and widely set, 10 to 11 on lower part of anterior arch. Dorsal I 9 rays; its spine relatively smooth. Anal II 8 rays. Pectoral spine relatively smooth and feebly serrated on inner side; its length about 18 % in SL. Caudal deeply forked. Adipose dorsal length is longer than depth. Caudal peduncle length is longer than deep. Total length upto 59.3 cm.

Coloration: - Greyish blue to dark olive above, white beneath.

Distribution: - Guang, Omo, Sanja, Angereb and Ayima Rivers; Lake Abaya (Abebe Getahun, 2005b; JERBE, 2004, 2005).



Fig. 20. Lateral view of *B. docmak*

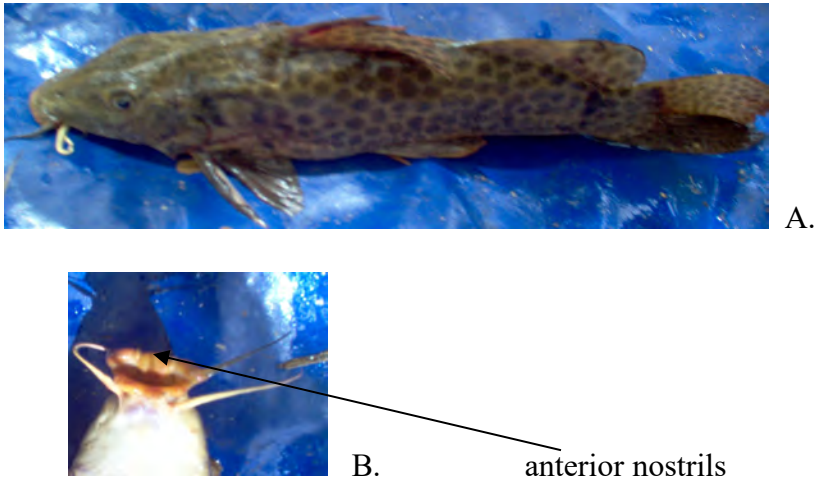
16. *Auchenoglanis occidentalis* (Fig. 21)

Diagnosis: - Eye with free border. Two pair of nostrils widely separated from each other, the anterior pair located on the upper lip and posterior on upper surface of head. Snout usually more than half length of head. Maxillary barbell is shorter than outer mandibular barbell. Greenish with large dark brown or blackish spots color prevalent in alive coloration.

Description: - Body feebly compressed, its depth 22 - 27 % in HL. It has relatively long head length (35.71 - 41 % in SL). Eye supero lateral, its diameter 9.82 - 13 % in HL. Maxillary barbell length is shorter than outer mandibular, not extending beyond posterior border of eye. It has longer snout length (56.3 - 61% in HL). Dorsal and pectoral spines are strong. Dorsal I 7, pectoral I 8 and anal III 8 rays. Adipose dorsal length is much longer than depth. Total length upto 39.7 cm.

Coloration: - Olive or brown, spotted with dark brown or blackish; these spots often very large on the dorsal and caudal fins.

Distribution: - Tekeze, Omo, Angereb and Ayima Rivers (JERBE, 2004, 2005).



Figs. 21. A: Lateral view of *A. occidentalis*; B: Ventral view of mouth region.

17. *Synodontis serratus* (Fig. 22)

Diagnosis: - Dorsal spine distinctly serrated in front, feebly serrated behind. Maxillary barbell broadly margined; skin smooth. Movable mandibular teeth, 39 - 41 in number.

Description: - Depth of body as long as head length. Head is more or less rugose, its width 71.93 - 88.33 % in HL. Snout rounded or obtusely pointed, its length longer than post-ocular part of head. Eye supero-lateral, its diameter 12.28 - 15.33 % in HL. Lips moderately developed. Band of premaxillary teeth not extending along the whole width of the mouth. Premaxillary teeth forming a short and broad teeth band. Gill-openings are not extending down wards beyond root of pectoral spine. Maxillary barbell with a broad marginal membrane (96.49 - 146.67 % in HL). Maxillary barbells are not branched. Outer mandibular barbell with long slender branches. Humeral process length is longer than broad. Humeral process is acutely pointed, flat or keeled extending as far as occipito-nuchal process. Dorsal I 7 and anal III 9 - 10 rays. Adipose dorsal length is longer than depth. Pectoral spine is longer than dorsal, its outer border finely and inner side strongly serrated. Caudal deeply forked. Caudal peduncle length is longer than depth. Total length upto 57.5 cm.

Coloration: - Uniform grey or brownish above, white beneath.

Distribution: - Blue Nile, Gendewuha, Guang, Omo, Angereb, Ayima and Gibe Rivers (JERBE, 2004, 2005).

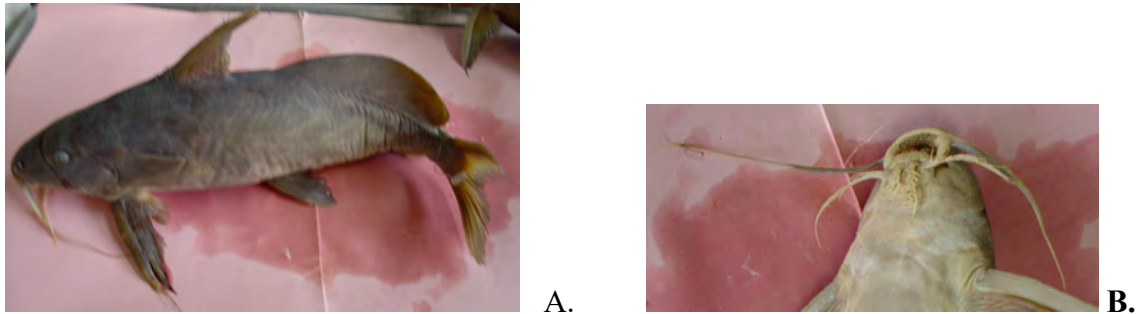


Fig. 22. A: Lateral view of *S. serratus*; B: Ventral view of mouth region.

18. *Synodontis schall* (Fig. 23)

Diagnosis: - Dorsal spine not serrated in front. Skin more or less distinctly villose on sides. Maxillary barbell is not broadly margined. Humeral process pointed, with out spine. Movable mandibular teeth, 29 - 34 in number.

Description: - Depth of body as long as head length. Head length a little longer than breadth. Snout is rounded and longer than post ocular part of head. Eye supero-lateral, its diameter 14.67 - 16.25 % in HL. Lips moderately developed. Band of premaxillary teeth not extending along the whole width of the mouth. Premaxillary teeth forming a short and broad teeth band. Outer mandibular barbell about twice as long as inner, former with long slender branches. Like *S. serratus*, maxillary barbells are not branched; gill-openings not extending down wards beyond root of pectoral spine. Occipito-nuchal shield rough like the occiput, with posterior processes pointed or truncate. Humeral process is longer than broad, very obtusely keeled, extending as far back as occipito-nuchal process. Dorsal I 7 and anal III 9 rays. Dorsal spine sharp-edged and feebly serrated behind. Adipose dorsal length is longer than depth. Pectoral spine is longer than dorsal spine; its outer border very finely and inner border strongly

serrated. Caudal deeply forked. Caudal peduncle depth is longer than length. Total length upto 43.3 cm.

Coloration: - Grey, brown, or olive above; white beneath.

Distribution: - Alvero, Guang, Tekeze, Angereb, Ayima, Blue Nile and Gibe Rivers; Abaya and Chamo Lakes (Abebe Getahun, 2005b; JERBE, 2004, 2005; Shibru Tedla, 1973).

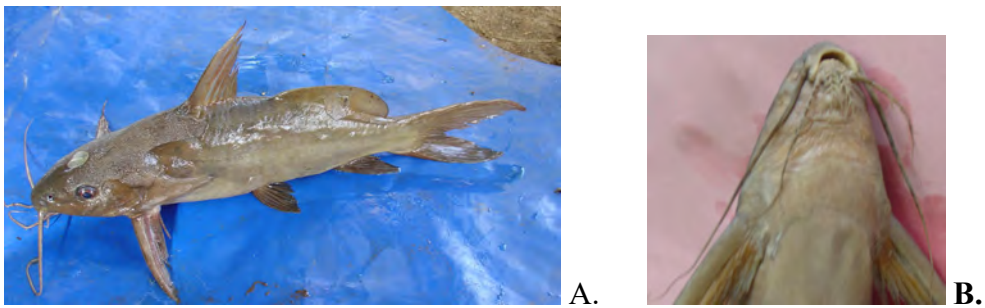


Fig. 23. A: Lateral view of *S. schall*; B: Ventral view of mouth region.

19. *Hydrocynus forskhalli* (Fig. 24)

Diagnosis: - Mouth large, uniceral sharp-edge teeth. Lateral line nearer the ventral than the dorsal out line; a small adipose fin. Long and few gill rakers (9); distinct longitudinal stripes deep black run along the series of scales above the lateral line.

Description: - Body elongated and compressed; belly rounded. Depth of the body is greater than length of head (its depth 25.64 - 27.66 % in SL). It has wide head and interorbital width. Mouth extending to below nostrils. It has 8 large teeth in the upper and lower jaw. Dorsal II 9 rays, originating in front of ventral. Anal II 13 rays. Pectoral is shorter than head length. Caudal deeply forked, with long and pointed lobes. Caudal length is longer than depth. Two series of scales between lateral line

and scaly process at the base of ventral. Scales 47 - 49 $\frac{7^{1/2}}{8^{1/2}}$, 2 between lateral line and ventral, 12 caudal scales. Total length upto 35.9 cm.

Coloration: - Back grey, brown or olive-green; sides and belly silvery white. Dorsal fin and upper lobe of caudal yellowish or grey; adipose fin grey or whitish; ventral and anal tinged with pink or pale orange; lower lobe of caudal bright red.

Distribution: - Gendewuha, Tekeze, Omo, Ayima and Gibe River; Lake Abaya (Abebe Getahun, 2005b; JERBE, 2004, 2005; Shibru Tedla, 19973).



Fig. 24. Lateral view of *H. forskhalii*

20. *Brycinus macrolepidotus* (Fig. 25)

Diagnosis: - Dorsal fin originating well behind vertical of base of ventrals; head much flattened above; a small adipose fin.

Description: - Depth of the body as long as head length. Head much flattened above, its length 24.32 - 26.92 % in SL. Snout rounded and projected beyond lower lip. Eye infero-lateral, its diameter 20 - 27.59 % in HL. Adipose eyelid scarcely developed. It has wide interorbital width (27.59 - 55.56 % in HL). Dorsal II 8 rays, considerably nearer to caudal than occiput. Anal III 13 rays. Caudal deeply forked. Caudal

peduncle length as long as depth. Scales 22 - 23 $\frac{4 - 4^{1/2}}{2^{1/2} - 3^{1/2}}$, 2 between lateral line and root of ventral, and 12 caudal scales. Total length upto 46.2 cm.

Coloration: - Brown or olive above, the scales with a darker edge silvery white or pinkish beneath and on the cheeks; fins pink or orange, the caudal often edged with grey and blackish.

Distribution: - Alvero, Omo, Gendewuha, Angereb, Ayima, Blue Nile, Guang and Gibe Rivers (JERBE, 2004, 2005).



Fig. 25. Lateral view of *B. macrolepidotus*

21. *Brycinus nurse* (Fig. 26)

Diagnosis: - A blackish spot above lateral line, behind gill opening and another on caudal peduncle. Anal fin with III 14 rays; 24 - 32 lateral line scales. $5^{1/2}$ scales above lateral line; a small adipose fin.

Description: - Depth of the body is greater than length of head (its depth 29.03 - 33.33 % in SL). Snout is rounded and its length not longer than eye diameter. It has large lateral eye (22.5 - 30.77 % in HL). Interorbital region moderately convex, its width 37.5 - 45.46 % in HL. Dorsal II 8 rays, originating above base of ventrals. Longest dorsal ray a little shorter than head length. Pectoral is shorter than head

length. Caudal deeply forked and its lobes pointed. Caudal peduncle length as long as depth. Scales with radiating striae, $24 - 32 \frac{5^{1/2}}{2^{1/2} - 3^{1/2}}$, 2 between lateral line and root of ventral and 10 caudal scales. Total length upto 19.8 cm.

Coloration: - Silvery or pale golden, dark grey or brown on the back; dorsal greyish, with a little pink or red; ventrals and anal white or yellow. Caudal orange or yellow, its base and edge is blackish.

Distribution: - Alvero, Tekeze and Ayima Rivers (JERBE, 2004, 2005).



Fig. 26. Lateral view of *B. nurse*

22. *Mormyrus kannume* (Fig. 27)

Diagnosis: Snout at least nearly as long as post orbital part of head; dorsal in advance of base of ventral fins with 58 - 66 rays; anal 8 - 9 rays; 101 - 108 scales in lateral line.

Description: - Depth of the body is greater than length of head (its depth 29.4 -33.52 % in SL). Upper profile of head descending in a straight line. Mouth very small, with thick lips. Teeth are notched, 7 or 8 on upper and lower jaw. It has small eyes (7.77 - 12.96 % in HL). Dorsal 58 - 66 rays, originating in advance of base of ventral. Anal 8 - 9 rays, originating at equal distance from bases of pectoral and from base of caudal. Pectoral obtusely pointed, its length 16.33 - 18.53 % in SL. Ventral about 11.4 - 12.68 % in SL. Caudal with obtusely pointed lobes. Caudal peduncle length is much

longer than depth. 101 - 108 scales in lateral line $\frac{24-26}{29-30}$, 27 to 29 round caudal peduncle. Total length upto 48.2 cm.

Coloration: - Brownish or olive above; white beneath.

Distribution: - Blue Nile, Gendewuha, Guang, Omo, Angereb, Ayima and Gibe Rivers (Abebe Getahun, 2005b; JERBE, 2004, 2005).



Fig. 27. Lateral view of *M. kannume*

23. *Oreochromis niloticus* (Fig. 28)

Diagnosis: - The most distinguishing characteristic of the species is the presence of regular vertical stripes throughout the depth of caudal fin. Dorsal XVII 12 and anal III 8 – 9 rays; gill-rakers short, 24 - 25 in numbers.

Description: - Depth of the body is greater than length of head (its depth 41.74 - 44 % in SL). Snout rounded, with straight or slightly convex upper profile. It has relatively large eye, its diameter 21.05 - 29 % in HL. Mouth moderately large, its width 27.27 - 39 % in HL. Gill-rakers short, 24 to 25 on upper part of anterior arch. Pectoral 35 - 41 % in standard length. Ventral reaching vent or anal. It has truncated caudal fin edge. Caudal peduncle depth is longer than length. It has interrupted lateral line. Scales cycloid $37 \frac{4-5}{14}$, 5 between lateral line and root of ventral and 18 around

caudal peduncle. 8 or 9 more or less distinct dark bars on the body and a dark spot just below the upper border of the caudal peduncle and on operculum. Total length upto 21.4 cm.

Coloration: - Brown or grey to dark olive colour.

Distribution: - Blue Nile, Angereb, Sanja, Dabus, Alvero, Wabishebele ,Gendewuha, Omo, Ayima, Baro, Awash, Bulbula, Tekeze and Jejebie Rivers; Abaya, Awasa, Ziway, Chamo, Hayq and Tana Lakes (Abebe Getahun, 2005b; Demeke Admasu,1994; JERBE, 2004, 2005; Shibru Tedla,1973; Tesfaye Wudneh,1998).



Fig. 28. Lateral view of *O. niloticus*

5.2. 3 Species diversity and relative abundance

5.2. 3.1 Species diversity

A higher number of species were recorded in the Beles River (22 species) than in the Gilgel Beles River (5 species) in the present study (Table 5). From a total of five species recorded in the Gilgel Beles River, four were common to Mh and Coll sites, and one species, *O. niloticus*, was found only in the Gilgel Beles at College site (Table 5). A total of twelve fish species were recorded in the Beles River at bridge site, all of which except *L. intermedius* occurred also in the Beles at Babizenda site (Table 5). The number of fish species was highest at BAB and lowest at Mh sites (Table 5). Cyprinidae was the best-represented family with the highest number of fish species both in the Gilgel Beles and Beles Rivers. Although there was a pronounced disparity in species composition between Beles and Gilgel Beles Rivers, there was an overlap in *L. forskalii*, *L. nedgia*, *L. intermedius* and *O. niloticus* in the present study. However, *V. beso*, which is found in Gilgel Beles River, was not found in Beles River. Thus, large incidence of Gilgel Beles fishes in Beles River is due to drainage connection between the two rivers. Although several fish collections have been made from the Blue Nile system, few reports of collections are available from Gilgel Beles and Beles Rivers. Fish surveys which were carried out in the Gilgel Beles and Beles Rivers by JERBE (1999) and 2000 respectively were comparable to the present study. Compared to Sanja, WabiShebele and Angereb Rivers, Beles River harbors more diverse fish fauna. Sanja, WabiShebele and Angereb Rivers harbor 8, 13 and 19 fishes, respectively (Genanew Tesfaye, 2006; JERBE, 2004, 2005). However, fish species diversity of Beles River comparable to Alvero River (31), a tributary of Baro, in the lowland Gambela region (JERBE, 2001).

Table 5. Species composition of Beles and Gilgel Beles Rivers (+ = present; - absent).

Species	<u>Sampling sites</u>				<u>Rivers</u>	
	Mh	Coll	BB	BAB	G.Beles	Beles
<i>R. loati</i>	-	-	+	+	-	+
<i>V. beso</i>	+	+	-	-	+	-
<i>L. niloticus</i>	-	-	-	+	-	+
<i>L. horie</i>	-	-	-	+	-	+
<i>L. coubie</i>	-	-	-	+	-	+
<i>L. forskalii</i>	+	+	+	+	+	+
<i>L. cylindricus</i>	-	-	+	+	-	+
<i>L. bynni</i>	-	-	+	+	-	+
<i>L. intermedius</i>	+	+	+	-	+	+
<i>L. nedgia</i>	+	+	+	+	+	+
<i>L. degeni</i>	-	-	+	+	-	+
<i>C. gariepinus</i>	-	-	-	+	-	+
<i>H. longifilis</i>	-	-	-	+	-	+
<i>B. bajad</i>	-	-	-	+	-	+
<i>B. docmak</i>	-	-	+	+	-	+
<i>A. occidentalis</i>	-	-	-	+	-	+
<i>S. serratus</i>	-	-	-	+	-	+
<i>S. schall</i>	-	-	+	+	-	+
<i>H. forskhali</i>	-	-	-	+	-	+
<i>B. macrolepidotus</i>	-	-	+	+	-	+
<i>B. nurse</i>	-	-	-	+	-	+
<i>M. kannume</i>	-	-	+	+	-	+
<i>O. niloticus</i>	-	+	-	+	+	+

The species list obtained in the present study reveal a difference in number of species between Beles and Gilgel Beles Rivers, as it was also shown by the species list of JERBE (1999; 2000). However, there was some difference in species composition between the present study and that of JERBE (1999; 2000). Most of the species recorded during the present study in the Gilgel Beles and Beles Rivers were also recorded by JERBE surveys (Table 6). Although JERBE (2000) listed 25 fish species from Beles River, the following seven species were recorded during the present study but were not listed by JERBE (2000): *H. forskhali*, *C. gariepinus*, *H. longifilis*, *B. nurse*, *A. occidentalis*, *R. loati* and *L. bynni* (Table 6). Some species that were found

by JERBE (2000) from Beles River were not found by the present study. These were *Mormyrops anguilloides* Linnaeus 1758, *Mormyrus caschive* Linnaeus 1758, *M. hasselquistii*, *Micralestes acutidens* Daget 1957, *Distichodus engycephalus*, *Chelaethiops bibie*, *Garra sp.*, *Leptocypris niloticus*, *Schilbe mystus*, *Chiloglanis sp.*, and *Tetraodon lineatus*. JERBE (1999) listed four fish species from Gilgel Beles River. *L. forskalii* is recorded in the present study from Gilgel Beles River but not JERBE (1999). However, *Garra sp.* was recorded by JERBE (1999) from Gilgel Beles River but not in the present study.

Differences seen in the species composition between the present study and that of JERBE (1999; 2000) might be due to differences in the sampling efficiency, habitats and seasons. The higher number of species recorded by JERBE might be attributed to the flexibility of their gears. In addition, many of their gears can be classified as active gears, in contrast to the gill nets and multiple hooks and lines of present study. Compared to JERBE surveys, a wider range of habitats and months were sampled in the present study. This might be a reason for some species that caught in the Present study that were not reported by JERBE.

Table 6. Comparison of JERBE and present study (+ = present; - = absent).

<u>Species</u>	<u>JERBE</u>		<u>Present study</u>	
	Beles	G. Beles	Beles	G. Beles
<i>A. occidentalis</i>	-	-	+	-
<i>B. macrolepidotus</i>	+	-	+	-
<i>B. bajad</i>	+	-	+	-
<i>B. docmak</i>	+	-	+	-
<i>B. nurse</i>	-	-	+	-
<i>C. gariëpinus</i>	-	-	+	-
<i>Chelaethiops bibie</i>	+	-	-	-
<i>Chiloglanis sp.</i>	+	-	-	-
<i>Distichodus engycephalus</i>	+	-	-	-
<i>Garra sp.</i>	+	+	-	-
<i>H. longifilis</i>	-	-	+	-
<i>H. forskhalii</i>	-	-	+	-
<i>L. bynni</i>	-	-	+	-
<i>L. coubie</i>	+	-	+	-
<i>L. cylindricus</i>	+	-	+	-
<i>L. degeni</i>	-	-	+	-
<i>L. forskalii</i>	+	-	+	+
<i>L. horie</i>	+	-	+	-
<i>L. nedgia</i>	-	-	+	+
<i>L. niloticus</i>	+	-	+	-
<i>L. intermedius</i>	-	-	+	+
<i>Large Barbus sp.</i>	+	+	-	-
<i>Leptocypris niloticus</i>	+	-	-	-
<i>M. caschive</i>	+	-	-	-
<i>M. hasselquistii</i>	+	-	-	-
<i>M. kannume</i>	+	-	+	-
<i>Micralestes acutidens</i>	+	-	-	-
<i>Mormyrops anguilloides</i>	+	-	-	-
<i>O. niloticus</i>	+	+	+	+
<i>R. loati</i>	-	-	+	-
<i>S. schall</i>	+	-	+	-
<i>S. serratus</i>	+	-	+	-
<i>Schibe mystus</i>	+	-	-	-
<i>Small Barbus sp.</i>	+	-	-	-
<i>Tetraodon lineatus</i>	+	-	-	-
<i>V. beso</i>	-	+	-	+

Species diversity, according to H' , was higher in the Beles River ($H' = 2.42$) than in the Gilgel Beles River ($H' = 0.88$) for the total catch (Table 7). Among sampling sites, species diversity was highest at Babizenda ($H' = 2.3$) and lowest at College ($H' = 0.77$) (Table 7).

Table 7. Number of species (N) and diversity index (H') for total catch at sampling sites and rivers.

	<u>Sampling sites</u>				<u>Rivers</u>	
	Mh	Coll	BB	BAB	Gilgel Beles	Beles
H'	1.08	0.77	1.82	2.3	0.88	2.42
N	4	5	12	21	5	22

The number of fish species ranged from 6 to 19 with a mean \pm SD of 11.2 ± 5.26 in Beles River and it ranged 3 to 4 with a mean \pm SD of 3.67 ± 0.82 in Gilgel Beles River. Shannon diversity index ranged 1.67 to 2.6 with a mean \pm SD of 1.81 ± 0.52 in Beles River and it ranged 0.46 to 1.04 with a mean \pm SD of 0.73 ± 0.2 in Gilgel Beles River. There was significant variation in both mean number of fish species and diversity index between Beles and Gilgel Beles Rivers ($P < 0.05$) (Table 8).

Table 8. Mean number of species (N) and diversity indices (H') for fish caught in Beles and Gilgel Beles Rivers.

H'/N	River	Mean \pm SD	t	df	Sig.
H'	Gilgel Beles	0.73 ± 0.2	4.71	9	0
	Beles	1.81 ± 0.52			
N	Gilgel Beles	3.67 ± 0.82	3.49	9	0.01
	Beles	11.2 ± 5.26			

iodiversity patterns are directly and indirectly influenced by the geomorphology of riverine landscapes, which may be perceived as a nested hierarchy (Ward, 1998). The number of fish species in Beles and Gilgel Beles Rivers appear to be negatively correlated with altitude. The increase in number of fish species from Mh to BAB sampling sites coincide with decline in elevation. The main pattern documented in this study, is the occurrence of a distinct headwater fauna, and a sequential down stream shift in species composition. The decrease in number of fish species from lower to upper reaches were consistent with the studies carried out in other areas by Nikolsky (1963), Sydenham (1977) and Golubtsov and Mina (2003). The increase in species number from up stream sites to down stream sites was associated with change in catchment area, canopy closure, substrate type, distance from source, depth and width of rivers (Toham and Teugels, 1998). These variables reflect longitudinal gradient in the study area. Width of river was the most important variable that coincided with increase in species number from Mh sites to BAB sites. A total of 21 fish species found in Beles River at BAB sampling site with its mean river width of 56.5 ± 2.12 m while the lowest number of species (4) in Gilgel Beles River at Mh sampling site with its mean river width of 31 ± 2 m. This result is consistent with the studies carried out in other areas. In tropical area as Angermerier and Karr (1983) in Panama, EDDS (1993) in India and Toham and Teugels (1998) in Cameroon found respectively a significant relation ship between species number and width of the river, and species number and increasing gradient of depth. A total of 12 fish species found in Beles River at BB sampling site with its mean river depth of 6.3 ± 0.5 m while the lowest number of species (4) in Gilgel Beles River at Mh sampling site with its mean river width of rive 2.42 ± 0.28 m. A similar result using depth gradient (Sheldon, 1968), stream order or river position in the gradient (Beecher *et al.* 1988, Oberdorff and Porcher, 1992; Oberdorff *et al.* 1993; Schlosser, 1982) have also been reported for temperate rivers. In addition, canopy closure and diversity of substrate type (sand, gravel and large rocks) were also most probable environmental gradient explaining the spatial distribution of species in the sampling sites. Thus, the presence of year round dense vegetation and higher catchment area, diversity of substrate, river depth

and width might contribute to high species diversity in Beles River than in Gilgel Beles.

5.2.3.1.1 Species diversity during wet and dry seasons.

A higher number of species was recorded in the dry than in the wet season in total catch (22 versus 18 species) (Table 9). *R. loati*, *V.beso*, *L. niloticus*, *L. forskalii*, *L. horie*, *L. bynni*, *L. intermedius*, *L. nedgia*, *L. degeni*, *B. docmak*, *B. macrolepidotus*, *B. nurse*, *A. occidentalis*, *S. serratus*, *S. schall*, *M. kannume* and *O. niloticus* were found both during wet and dry seasons in total catch (Appendix 7). *L. coubie*, *C. gariepinus*, *B. bajad*, *H. longifilis* and *H. forskhalii* were collected during dry season where as *Labeo cylindricus* was collected during wet season (Appendix 7). There was no pronounced disparity in the species composition between wet and dry seasons in Gilgel Beles River (Table 9). However, there was marked difference in species composition during wet and dry seasons in Beles River (Table 9).

The value of Shannon's diversity index was 0.81 and 0.66 in dry and wet seasons in Gilgel Beles River, respectively (Table 9). The index was also higher in the dry ($H' = 2.48$) than wet season ($H' = 2.21$) in Beles River (Table 9). Shannon's diversity index (H') indicated that species diversity was higher in dry than wet season in each river. The species diversity was also higher in the dry ($H' = 2.29$) than wet season ($H' = 1.99$) for the total catch (Table 9). The highest species diversity was obtained in Beles River during dry season ($H' = 2.48$) while the lowest in Gilgel Beles River during wet season ($H' = 0.66$) (Table 9).

Table 9. Number of species (N) and diversity index (H') for fish caught during wet and dry seasons.

River	<u>Gilgel Beles</u>		<u>Beles</u>		<u>Beles and Gilgel Beles</u>	
	Dry	Wet	Dry	Wet	Dry	Wet
H'	0.81	0.66	2.48	2.21	2.29	1.99
N	4	5	19	17	22	18

The number of fish species ranged from 3 to 14 with a mean \pm SD of 6.57 ± 4.04 in wet seasons in Beles and Gilgel Beles Rivers and it ranged 3 to 19 with a mean \pm SD of 8 ± 7.44 in dry season. Shannon diversity index ranged from 0.46 to 1.99 with a mean \pm SD of 1.16 ± 0.59 in wet season in Beles and Gilgel Beles Rivers and it ranged 0.75 to 2.6 with a mean \pm SD of 1.33 ± 0.88 in dry season. There was significant difference in the mean number of fish species and diversity index between Beles and Gilgel Beles Rivers both in wet and dry seasons ($P < 0.05$) (Table 10). However, there was no significant difference in the mean number of fish species and diversity indices between wet and dry seasons in the total catch ($P > 0.05$) (Table 10).

Table 10. Mean number of fish species (N) and diversity index (H') during wet and dry seasons.

H'/N	Season	River	Mean \pm SD.	t	df	Sig.
H'	Wet	Beles & G. Beles	1.16 ± 0.59	0.39	9	0.7
	Dry	Beles & G. Beles	1.33 ± 0.88			
N	Wet	Beles & G. Beles	6.57 ± 4.04	0.42	9	0.68
	Dry	Beles & G. Beles	8 ± 7.44			
H'	Wet	Gilgel Beles	0.72 ± 0.24	5.82	5	0
	Wet	Beles	1.75 ± 0.21			
N	Wet	Gilgel Beles	3.75 ± 0.96	3.98	5	0.01
	Wet	Beles	10.33 ± 3.21			
H'	Dry	Gilgel Beles	0.76 ± 0.14	3.98	5	0.01
	Dry	Beles	1.91 ± 0.98			
N	Dry	Gilgel Beles	3.5 ± 0.71	5.82	5	0
	Dry	Beles	12.5 ± 9.19			

There might be several reasons for changes in catches between wet and dry seasons. For example, variation in available habitats and gill net efficiency might contribute to variations in the catches. The higher number of species recorded during dry season than wet season attributed to a wider range of habitats sampled. This was mainly due to habitats suitable for gill net sampling during dry season. However, during wet season trees that grow hanging their branches down to the water on either side of the riverbank hinder reaching residency of fish in their habitats. Habitats targeted to gill nets were seldom deep water areas where some fish often reside dislocated by current of rivers during wet seasons. In addition, during wet season the efficiency of gill nets

were decreased by logs, leaves, roots etc that were brought by flooding into rivers. Thus, differences seen in the data between wet and dry season may be due to differences in available habitats and gill net efficiency.

5. 2. 3.2 Relative abundance of fishes

A total number of 1124 fishes with a total weight of 319.44 kg were caught from Beles and Gilgel Beles Rivers (Table 11 & Appendix 5). The number of individual caught and weight of fishes was higher in Beles River than Gilgel Beles (Table 11 & Appendix 5). The number of individuals, caught, and weight of fishes was highest at BAB and BB sites, respectively while the lowest at Mh site (Table 11 & Appendix 6).

Table 11. Total number and weight (kg) of fish specimen caught from Beles and Gilgel Beles Rivers.

River	<u>Gilgel Beles</u>		Total	<u>Beles</u>		<i>Total</i>
Sampling sites	Mh	Coll		BB	BAB	
Number	118	341	459	247	418	665
Weight	27.85	87.38	115.23	106.85	97.36	204.21

Total N = 1124

Total W = 319.44

The species caught during all the surveys from November 2005 to May 2006 were ranked based on the index of relative importance (IRI) (Table 12). *L. intermedius* was the most abundant species in Gilgel Beles River. This species comprised 75.57 % and 83 % IRI of the catch at Mh and Coll sites, respectively (Table 12). *L. bynni* was the most dominant species in Beles River. This species comprised 42.69 % and 29.18 % IRI of the catch at BB and BAB sites, respectively. The Cyprinidae was the most dominant family in Beles and Gilgel Beles Rivers. This family comprised 99.99 and 74.83 % IRI of the catches in the Gilgel Beles and Beles Rivers, respectively (Table 12). The dominance of this family in both rivers was due to large catches of *L.*

intermedius, *L. bynni* and *L. forskalii*. *L. intermedius* was the most abundant species according to IRI (38.86 %), while *L. forskalii* was second (24.68 %) and *L. bynni* third (18.36%) in the total catch (Table 12). The second most dominant family in the total catch was the Mochokidae; comprising 5.53 % IRI. Cichlidae was the least abundant family in Beles and Gilgel Beles Rivers. This family comprised only 0.04 % IRI of the catches in Gilgel Beles and Beles Rivers (Table 12).

Table 12. Index of relative importance (% IRI) for fish species caught from Beles and Gilgel Beles Rivers.

Family	Species	Sampling sites				Rivers		
		Mh	Coll	BB	BAB	G.Beles	Beles	Beles & G.Beles
Cyprinidae	<i>R. loati</i>	0	0	0.07	4.46	0	2.42	0.96
	<i>V. beso</i>	3.86	0.18	0	0	0.82	0	0.28
	<i>L. niloticus</i>	0	0	0	1.19	0	0.27	0.11
	<i>L. horie</i>	0	0	0	1.25	0	0.27	0.11
	<i>L. coubie</i>	0	0	0	0.36	0	0.08	0.03
	<i>L. forskalii</i>	17.5	9.58	35.06	4.79	11.26	21.28	24.68
	<i>L. cylindricus</i>	0	0	0.04	0.98	0	0.42	0.17
	<i>L. bynni</i>	0	0	42.69	29.18	0	44.67	18.36
	<i>L. intermedius</i>	75.57	83	6.29	0	82.5	2.16	38.86
	<i>L. nedgia</i>	3.08	7.22	4.74	0.15	5.4	2.27	5.39
	<i>L. degeni</i>	0	0	1.17	0.3	0	0.93	0.39
Clariidae	<i>C. gariiepinus</i>	0	0	0	0.66	0	0.14	0.06
	<i>H. longifilis</i>	0	0	0	1.71	0	0.36	0.15
Bagridae	<i>B. docmak</i>	0	0	0.64	0.04	0	0.37	0.15
	<i>B. bajad</i>	0	0	0	0.26	0	0.12	0.03
	<i>A. occidentalis</i>	0	0	0	3.98	0	0.89	0.37
Mochokidae	<i>S. serratus</i>	0	0	0.98	19.18	0	6.6	3
	<i>S. schall</i>	0	0	0.39	19.22	0	6.15	2.53
Characidae	<i>H. forskhalii</i>	0	0	0	0.36	0	0.08	0.03
	<i>B. macrolepidotus</i>	0	0	0.02	0.42	0	0.16	0.07
	<i>B. nurse</i>	0	0	0	1.81	0	0.47	0.19
Mormyridae	<i>M. kannume</i>	0	0	7.92	9.46	0	9.82	4.05
Cichlidae	<i>O. niloticus</i>	0	0.02	0	0.23	0.01	0.06	0.04

L. nedgia, *L. forskalii*, *L. intermedius* and *O. niloticus* were found both in Gilgel Beles and Beles Rivers. *L. intermedius*, the most abundant species had an Index of relative importance (% IRI) range of 45.2 to 94.67 with a mean \pm SD of 63.84 ± 34.70 in Gilgel Beles River and it ranged 0 to 27.93 with a mean \pm SD of $9.04 \pm 20.219.04$ in Beles River. *L. forskalii*, the second most abundant species had an Index of relative importance (% IRI) range of 1.44 to 20.76 with a mean \pm SD of 16.98 ± 33.54 in Gilgel Beles River and it ranged 2.47 to 85.38 with a mean \pm SD of 51.20 ± 42.08 in Beles River. Index of relative importance (IRI) indicated that relative abundance of *L. intermedius* was higher in Gilgel Beles River than Beles River ($P < 0.05$). Moreover, the number, weight and frequency of occurrence of *L. intermedius* were highest in Gilgel Beles River than Beles River (Appendix 5). However, there were no significant differences in IRI % between the two rivers for *L. nedgia*, *L. forskalii* and *O. niloticus* ($P > 0.05$) (Table 13).

Table 13. Mean % IRI of the common species in the two rivers.

Species	River	Mean \pm SD.	t	df	Sig.
<i>L. intermedius</i>	Beles	9.04 ± 20.21	3.10	9	0.01
	Gilgel Beles	63.84 ± 34.70			
<i>L. nedgia</i>	Beles	4.75 ± 5.56	0.48	9	0.64
	Gilgel Beles	7.134 ± 9.83			
<i>L. forskalii</i>	Beles	51.20 ± 42.08	1.50	9	0.17
	Gilgel Beles	16.98 ± 33.54			
<i>O. niloticus</i>	Beles	1.36 ± 2.07	1.60	9	0.14
	Gilgel Beles	0.02 ± 0.046			

5. 2.3. 2.1 Relative abundance of fishes during wet and dry seasons.

The number of fishes caught was higher in wet (N = 846) than dry seasons (N = 278) for the total catch (Table 14). The total biomass of fishes caught was higher in wet (w = 219.11 kg) than in dry season (w = 100.33 kg) for the total catch (Table 14). The number and weight of fishes caught was higher in wet than dry seasons both for Beles and Gilgel Beles Rivers (Table 14).

Table 14. Number and weight (kg) of fishes in the two rivers during wet and dry seasons.

River	<u>Gilgel Beles</u>		<u>Beles</u>		<u>Beles & Gilgel Beles</u>	
	Dry	Wet	Dry	Wet	Dry	Wet
Number	96	363	182	483	278	846
Weight	19.63	95.60	80.70	123.51	100.33	219.11

There were no significant differences in both mean number and weight of fishes between dry and wet seasons for total catch ($P > 0.05$) (Table 15).

Table 15. Mean number and weight (gm) of fishes in the two rivers during wet and dry seasons.

	Season	Mean \pm SD	t	df	Sig.
Number	Wet	211.5 \pm 127.77	0.7295442	4	0.506
	Dry	139 \pm 60.81			
Weight	Wet	54778 \pm 12168.50	0.2216518	4	0.84
	Dry	50165.4 \pm 43190.65			

The species caught during wet and dry seasons were ranked based on the index of relative importance (IRI) (Table 16). According to the index of relative importance

(IRI), *L. intermedius* was the most abundant species during the wet season, while *L. forskalii* was the most abundant species during the dry season in Beles and Gilgel Beles Rivers (Table 16). Among the most dominant species, *L. intermedius*, *L. bynni* and *L. nedgia* experienced a marked increase in the % IRI value during wet seasons while *L. forskalii*, *M. kannume*, *S. schall* and *S. serratus* during dry seasons (Table 16). Moreover, the percentage frequency, weight and number were higher for the catches during wet seasons for these three species (Appendix 7). The catches of the other species showed a higher or approximately equal % IRI in dry than in wet seasons except for *L. forskalii* (Table 16).

Table 16. Index of relative importance (% IRI) of fish species in the two rivers during wet and dry seasons.

River	Beles		Gilgel Beles		Beles & Gilgel Beles	
	DRY	WET	DRY	WET	DRY	WET
<i>R. loati</i>	0.73	2.2	0	0	0.34	0.72
<i>V. beso</i>	0	0	0.09	0.48	0.39	0.2
<i>L. niloticus</i>	0.95	0.06	0	0	0.49	0.02
<i>L. horie</i>	0.7	0.19	0	0	0.38	0.06
<i>L. coubie</i>	0.61	0	0	0	0.31	0
<i>L. forskalii</i>	32.43	15.02	90.88	2.57	61.27	10.55
<i>L. cylindricus</i>	0	0.89	0	0	0	0.29
<i>L. bynni</i>	23.85	53.5	0	0	12.23	17.34
<i>L. intermedius</i>	0	4.87	9	90.09	3.2	56.51
<i>L. nedgia</i>	0.51	3.56	0.03	6.85	0.5	7.9
<i>L. degeni</i>	1.12	0.65	0	0	0.59	0.21
<i>C. garipepinus</i>	0.96	0	0	0	0.52	0
<i>H. longifilis</i>	2.42	0	0	0	1.33	0
<i>B. bajad</i>	0.48	0	0	0	0.24	0
<i>B. docmak</i>	0.55	0.25	0	0	0.29	0.08
<i>A. occidentalis</i>	1.54	0.55	0	0	0.8	0.18
<i>S. serratus</i>	9.75	5.59	0	0	5.07	1.81
<i>S. schall</i>	9.84	4.23	0	0	5.02	1.37
<i>H. forskhalii</i>	0.66	0	0	0	0.33	0
<i>B. macrolepidotus</i>	0.18	0.12	0	0	0.1	0.04
<i>B. nurse</i>	0.37	0.49	0	0	0.17	0.16
<i>M. kannume</i>	12.29	7.77	0	0	6.4	2.52
<i>O. niloticus</i>	0.05	0.05	0	0.01	0.03	0.04

has larger mean % IRI in dry than wet season in the total catch. The two samples T-test showed that there was significant difference in the mean % IRI between dry and wet season for *L. forskalii* in the total catch ($P < 0.05$). There were no significant differences in % IRI between dry and wet seasons for *L. nedgia*, *L. intermedius* and *O. niloticus* in the total catch ($P > 0.05$) (Table 17).

Table 17. Mean % IRI of the common species in the two rivers during wet and dry seasons.

Species	Season	Mean \pm SD.	t	df	Sig.
<i>L. intermedius</i>	wet	55.23 \pm 41.22	2.07	9.00	0.07
	dry	10.40 \pm 13.35			
<i>L. nedgia</i>	wet	8.00 \pm 9.14	1.58	9.00	0.15
	dry	0.61 \pm 0.73			
<i>L. forskalii</i>	wet	7.24 \pm 7.22	3.56	9.00	0.01
	dry	56.51 \pm 36.87			
<i>O. niloticus</i>	wet	0.05 \pm 0.09	0.21	9.00	0.84
	dry	0.04 \pm 0.08			

There might be several reasons for changes in abundance between wet and dry seasons. Variation in available nutrients and habitats, fishing effort, fish behavior, size and life history stages of fishes might all contribute to variations in the catches. There are other reasons that could influence abundance in the catches; for example, water level (Karenga and Kolding, 1995) and turbidity of the water. In addition to the above, in the rainy season, the lateral flow of water seeping over the plain is enriched by nutrients mainly from decomposing materials. They also flush terrestrial nutrients into the channel. As a result, the high-water level season becomes the main feeding and growing time for fishes, and fat deposits are then accumulated which keep fishes going through the dry season, when they eat little (Lowe-McConnell, 1977). This is also likely for higher weight of fishes in wet season than in the dry season at the study sites. The highest % IRI of *L. intermedius* and *L. forskalii* occurred in wet and dry

seasons respectively and coincides with matured gonads. The increased abundance of *L. intermedius* and *L. forskalii* in wet and dry seasons, respectively, might be due to increased spawning activity during these seasons. Spawning activities of *L. intermedius* and *L. forskalii* in the respective seasons enlarged their catchability by passive gears. Since our gill nets were passive i.e. restricted to certain habitats, catchments of fishes mainly depend on the movement of fishes. Therefore, spawning activity of *L. intermedius* and *L. forskalii* was the most probable reason for abundance of these species. Thus, differences seen in the data between wet and dry seasons might be due to differences in the fishing effort, fish behavior and enrichment of rivers by nutrients.

5.2.3.3 Length frequency distribution of the most dominant species

L. intermedius, the most abundant species had a total length range of 10.6 cm to 69.5 cm with a mean \pm SD of 26.419 ± 7.563 cm. *L. forskalii*, the second most abundant species had total length range of 10.2 cm to 44.7 cm with a mean \pm SD of 26.951 ± 7.477 cm length (Fig. 29).

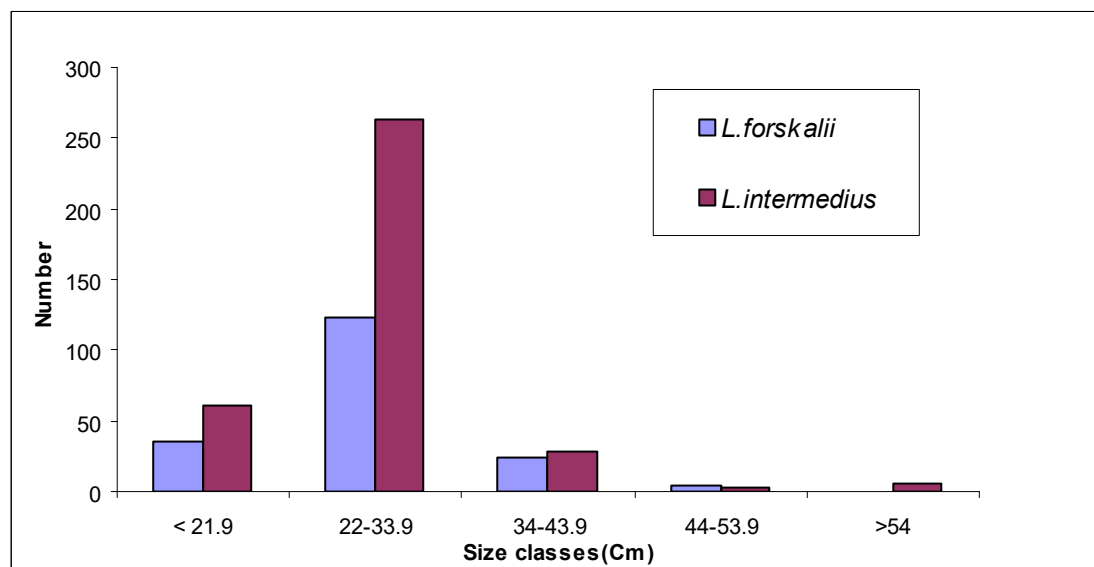


Fig. 29. Length frequency distribution of *L. intermedius* (N=362) and *L. forskalii* (N=186) from Beles and Gilgel Beles Rivers

5.3 Some biological aspects of the dominant fish species

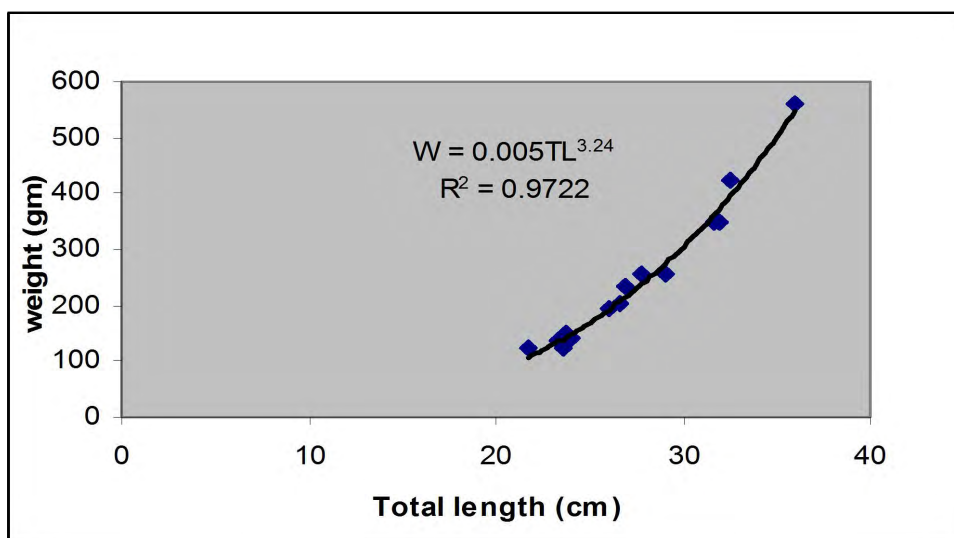
5.3.1 Length-weight relationship

The relationship between total weight and total length, for *L. intermedius* and *L. forskalii*, was curvilinear and statistically significant (ANOVA, $P < 0.05$) (Table 18). The line fitted to the data was best described by the regression equations shown in Table 18, and Figs. 30 and 31. In fishes, the regression coefficient $b = 3$ describes isometric growth. The value is exactly 3 if the fishes retain the same shape and their specific gravity remains unchanged during lifetime (Ricker, 1975). However, some fishes have value greater or less than 3, a condition described as allometric growth (Bagenal and Tesch, 1978). From Table 18, Fig. 30 and Fig. 31, it can be seen that *L. forskalii* in Beles and Gilgel Beles Rivers show isometric growth, i.e. the weight of these fishes increases as the cube of length because the b value is nearly 3. The b -value obtained in this study for *L. forskalii* in Beles and Gilgel Beles Rivers are close to the value reported for *L. forskalii* in Sanja River (Genanew Tesfaye, 2006) and *L. horie* from Lake Chamo (Elias Dadebo, 2000). From Table 18, Fig. 30 and Fig. 31, it can be seen that *L. intermedius* in Beles and Gilgel Beles Rivers show allometric growth. The result obtained in this study for *L. intermedius* in Beles and Gilgel Beles Rivers were not in agreement with Demeke Admassu and Elias Dadebo (1997) for the species in Lake Awassa, Wassie Anteneh (2005) and Nagelkerke *et al.* (1994) for Lake Tana and Genanew Tesfaye (2006) for Angereb River and Sanja Rivers. Observed differences in parameters b calculated in the present study when compared with those obtained by other authors are likely due to differences in the number of specimens examined, differences in the utilized length ranges or differing study seasons, food availability, feeding rate, gonad development and spawning period (Bagenal and Tesch, 1978).

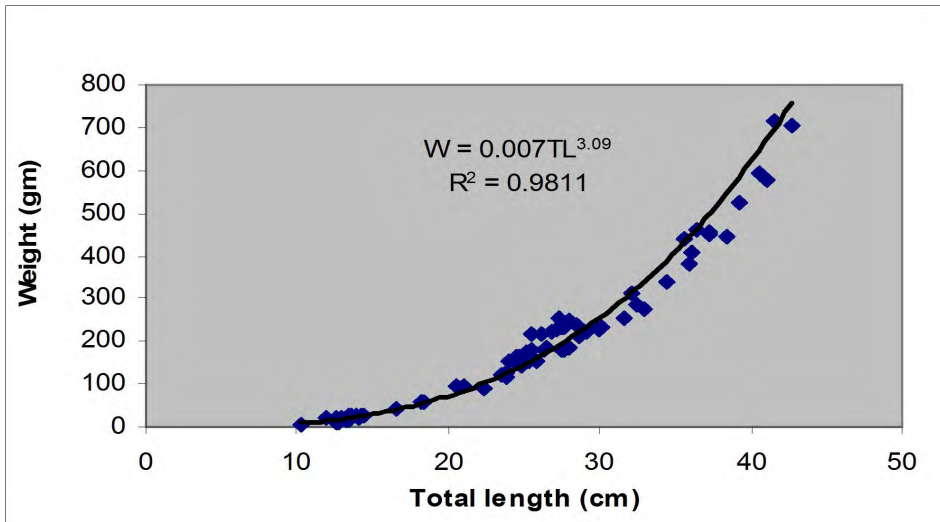
Table 18. Length - weight relationship of the most dominant species in Beles and Gilgel Beles Rivers.

Fish species	Rivers	Regression equation	r	P	TW Mean \pm SD	TL Mean \pm SD	N
<i>L.intermedius</i>	Beles	$W = 0.005TL^{3.24}$	0.97	0.00 ^s	226.0 \pm 114.1	26.77 \pm 3.71	40
	G. Beles	$W = 0.003TL^{3.36}$	0.97	0.00 ^s	252.1 \pm 391.7	26.38 \pm 7.91	322
<i>L. forskalii</i>	Beles	$W = 0.007TL^{3.09}$	0.98	0.00 ^s	217.6 \pm 177.7	26.03 \pm 8.68	96
	G. Beles	$W = 0.0157TL^{2.86}$	0.97	0.00 ^s	240.5 \pm 151.9	27.93 \pm 5.82	90

S- Significant

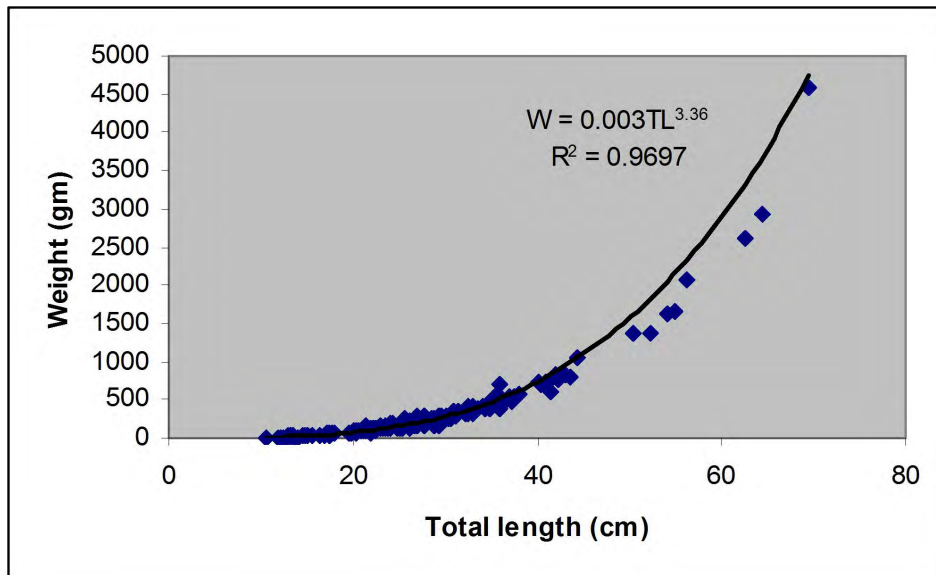


A.

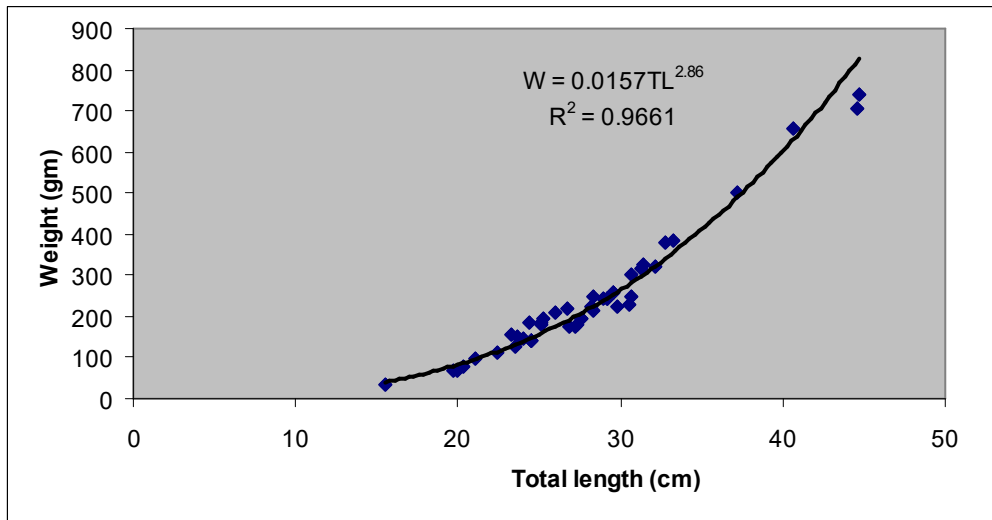


B.

Figs. 30. Length – weight relationship for A= *L. intermedius* and B = *L. forskalii* in Beles River.



C.



D.

Figs. 31. Length – weight relationship for C = *L. intermedius* and D = *L. forskalii* in Gilgel Beles River.

5.3.2 Fulton Condition Factor (FCF)

L. forskalii and *L. intermedius* were found in better condition in Gilgel Beles and Beles Rivers, respectively. Fulton condition factor values of *L. intermedius* ranged from 0.93 to 1.23 in Beles River and 0.43 to 1.73 in Gilgel Beles River. Fulton condition factor values of *L. forskalii* ranged from 0.79 to 1.26 in Gilgel Beles River and 0.49 to 1.29 in Beles River. There were significant differences in the mean Fulton condition factor for both *L. forskalii* and *L. intermedius* between Beles and Gilgel Beles Rivers (ANOVA, $P < 0.05$) (Table 19). Females were found in better condition than males in both Beles and Gilgel Beles Rivers (Table 20). The difference in mean Fulton condition factor for *L. forskalii* and *L. intermedius* was insignificant both in Beles and Gilgel Beles Rivers except *L. intermedius* in Beles River (ANOVA, $P > 0.05$) (Table 20). Fulton condition factor calculated for *L. intermedius* in Beles and Gilgel Beles Rivers were comparable to those reported of *L. intermedius* in Lake Awassa (Demeke Admassu and Elias Dadebo, 1997) and in Sanja River (Genanew

Tesfaye, 2006). Fulton condition factor calculated for *L. forskalii* in Beles and Gilgel Beles Rivers were close to the value reported for *L. forskalii* in Angereb and Sanja Rivers (Genanew Tesfaye, 2006).

Table 19. Mean \pm SD Fulton Condition Factor (FCF) for *L. forskalii* and *L. intermedius* in Beles and Gilgel Beles Rivers.

Species	Beles		Gilgel Beles		F	P
	FCF	N	FCF	N		
<i>L. forskalii</i>	0.9379 \pm 0.14	96	0.9987 \pm 0.11	90	10.32	0.002
<i>L. intermedius</i>	1.0970 \pm 0.08	40	0.9971 \pm 0.17	322	12.89	0.00

Table 20. Mean \pm SD Fulton condition factor (FCF) by sex for *L. intermedius* and *L. forskalii*.

Fish species	River	Females(FCF)	N	Males(FCF)	N	F	P
<i>L. forskalii</i>	G. Beles	1.026 \pm 0.106	42	1.012 \pm 0.09	38	0.19	0.666
	Beles	0.9699 \pm 0.13	39	0.930 \pm 0.15	46	1.56	0.215
<i>L. intermedius</i>	G. Beles	0.990 \pm 0.148	180	0.98 \pm 0.20	115	0.15	0.699
	Beles	1.145 \pm 0.055	16	1.05 \pm 0.108	16	7.92	0.009

Mean Fulton condition factor of *L. forskalii* was greater in dry season than wet season (ANOVA, $P < 0.05$) (Table 21). However, mean Fulton condition factor of *L. intermedius* was greater in wet season than dry season (ANOVA > 0.05) (Table 21). Demeke Admassu and Elias Dadebo (1997) also found insignificant variation (ANOVA > 0.05) in Fulton condition factor for *L. intermedius* between dry and wet seasons in Lake Awassa. However, Genanew Tesfaye (2006) reported significant

variation (ANOVA < 0.05) for *L. intermedius* and *L. forskalii* between dry and wet seasons in Sanja and Angereb Rivers.

Table 21. Mean \pm SD Fulton condition factor (FCF) for *L. intermedius* and *L. forskalii* in Beles and Gilgel Beles Rivers during the two seasons (combined data).

Species	Season	N	FCF		
			Mean \pm SD	F	P
<i>L. forskalii</i>	Wet	81	0.8993 \pm 0.1265	47.51	0
	Dry	105	1.0198 \pm 0.1114		
<i>L. intermedius</i>	Wet	338	1.0107 \pm 0.1712	1.15	0.285
	Dry	24	0.9726 \pm 0.1243		

The measure of fish condition can be linked to the general fish health, fat and lipid content, prey or food availability, reproductive potential, environmental conditions and water level fluctuations. In general, high condition is associated with higher energy (fat) content; increased food base, reproductive potential, or more favorable environmental conditions (Paukert & Rogers, 2004). For instance, better FCF of *L. forskalii* and *L. intermedius* in dry and wet seasons respectively was associated with large ovarian development. The low FCF of fishes of the rivers is probably because of fluctuations in factors such as food quantity and quality, water level, flow rate and temperature.

5.3.3 Reproductive Biology

5.3.3.1 Sex ratio

In general, females were more numerous than males in the total sexed specimens (Table 22). The sex proportions of each species were not significantly different (Chi-square, $P > 0.05$) from the theoretical 1:1 ratio except *L. intermedius* (Table 22). The

imbalance was most probably related to vulnerability of fish to gears. Increased vulnerability of females by some gears due to increased ovarian development, as suggested by Tayler and Villosio (1994), can be the cause for the deviation from 1: 1 sex ratio.

Table 22. Number of males, females and the corresponding sex ratios of fish species of Beles and Gilgel Beles Rivers (data from all sites pooled).

Species	Female	Male	Sex ratio (F: M)	X ²	P
<i>R. loati</i>	46	45	1: 0.99	0.01	0.92
<i>V. beso</i>	6	5	-	-	-
<i>L. niloticus</i>	0	0	-	-	-
<i>L. horie</i>	1	0	-	-	-
<i>L. coubie</i>	1	1	-	-	-
<i>L. forskalii</i>	84	81	1:0.96	0.02	0.88
<i>L. cylindricus</i>	14	3	-	-	-
<i>L. bynni</i>	84	69	1: 0.82	1.47	0.23
<i>L. intermedius</i>	196	131	1:0.67	12.92	0
<i>L. nedgia</i>	20	16	1:0.8	0.44	0.51
<i>L. degeni</i>	0	1	-	-	-
<i>C. gariepinus</i>	1	1	-	-	-
<i>H. longifilis</i>	0	0	-	-	-
<i>B. bajad</i>	0	0	-	-	-
<i>B. docmak</i>	3	0	-	-	-
<i>A. occidentalis</i>	3	1	-	-	-
<i>S. serratus</i>	13	7	1: 0.54	1.8	0.18
<i>S. schall</i>	20	16	1:0.8	0.44	0.51
<i>H. forskhalii</i>	1	1	-	-	-
<i>B. macrolepidotus</i>	3	2	-	-	-
<i>B. nurse</i>	9	6	1:0.67	0.6	0.44
<i>M. kannume</i>	20	13	1 :0.65	1.49	0.22
<i>O. niloticus</i>	1	1	-	-	-

5.3.3.2 Fecundity

Fecundity was determined in fish fork lengths of 18.4 to 46.7 cm, total body weights of 113 to 1215 gm and with gonad weights of 3 to 68.3 gm. In 55 female *L. intermedius*, fecundity varied from 1535 to 13864 with mean 3173 eggs (Table 23). Fecundity of *L. intermedius* increased with an increase in fish size (Table 23). Fecundity of *L. intermedius* was linearly related to total weight and gonad weight, and curvilinearly to fork length (Fig. 32). The lines of best fit to the relationships were described by the following regression equation:

$$\text{Log eggs} = 2.06 \text{ Log FL} + 0.6114 \text{ (R}^2 = 0.8492 \text{)}$$

$$\text{F} = 9.8138\text{W} + 497.35 \text{ (R}^2 = 0.8491\text{)}$$

$$\text{F} = 189.13\text{Gw} + 1095.8 \text{ (R}^2 = 0.8807\text{)}$$

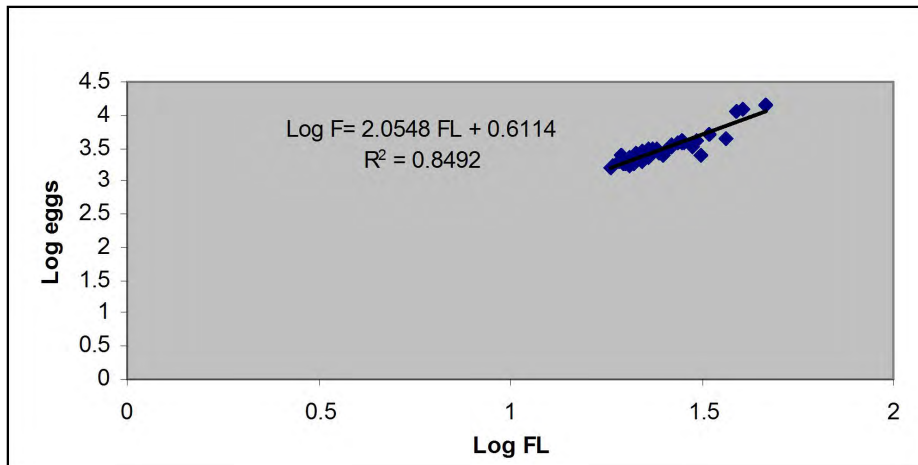
Where Gw, W, FL and AF are gonad weight, body weight, fork length and fecundity, respectively.

The information about fecundity of large *Barbus* fish species in Africa is scarce (Marshall, 1995). There are few data on the fecundity of Ethiopian large *Barbus*. The most recent studies and publications were done these of Alekseyev *et al.* (1996) and Wassie Anteneh (2005) from Lake Tana and its tributaries. Compared to Lake Tana *Labeobarbus spp.*, a similar size of female *L. intermedius* in Beles and Gilgel Beles Rivers laid more eggs. The fecundity of *L. brevicephalus* and *L. truttiformis* ranged from 1284 to 4563 and 1732 to 8134 eggs, respectively in Lake Tana (Wassie Anteneh, 2005). The average fecundity of the small (precocious) and big (normal), ‘intermedius’ was 4.6 thousand and 11.7 thousand eggs, respectively in tributaries of Lake Tana (Gelda and Gumara Rivers)(Alekseyev *et al.*, 1996). Fecundity of *Labeobarbus* in other African lakes is moderately high (Skelton *et al.*, 1991). A 30 cm female *L. aeneus* in Orange River drainage system carries about 30,000 eggs on average (Gaigher, 1976) but a similar size female *L. intermedius* in Beles and Gilgel Beles Rivers lays about 4690 eggs. According to Oliva-Paterna *et al.* (2002) fast growth, early maturity and high fecundity are characteristics of unstable environment.

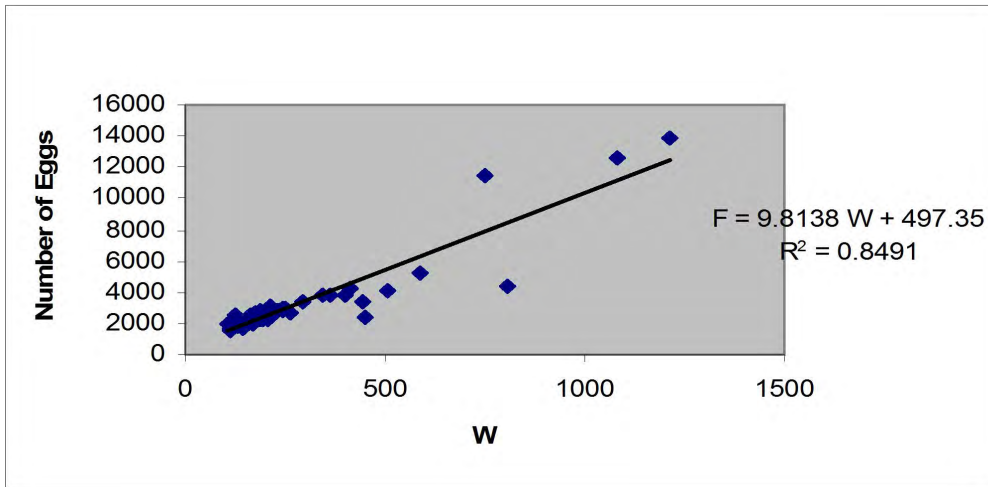
Therefore, the main cause for the above variations might be due to genetic or habitat differences. Generally, the fecundity of *L. intermedius* in Beles and Gilgel Beles Rivers was strongly correlated with their gonad weight, body weight and length. Similar result was obtained by Alekseyev *et al.* (1996) in tributaries of Lake Tana.

Table 23. Mean absolute and relative fecundity of *L. intermedius* in relation to fork length.

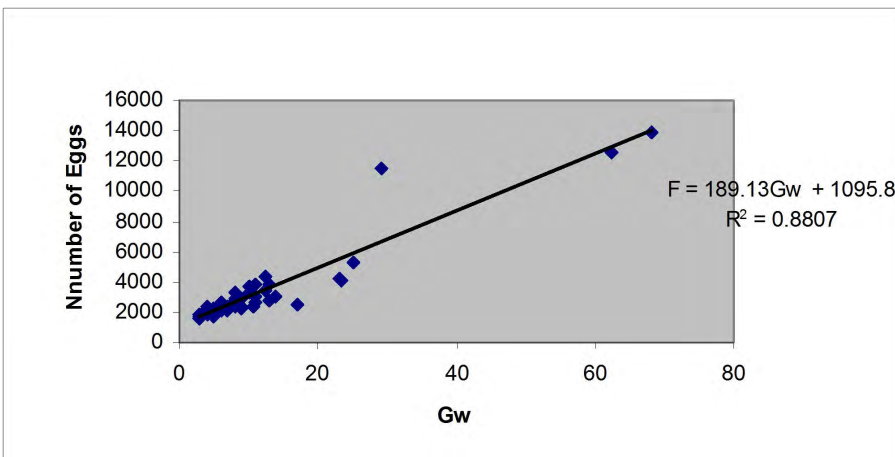
Size class	N	Mean FL	Mean body weight (g)	Mean gonad weight (g)	Mean absolute fecundity	Mean relative fecundity
18.4-21.4	8	19.275	120.63	6.5	1918	16
21.5-24.4	19	21.226	161	6.789	2220	14
24.5-27.4	17	24.141	233.2	8.2	2809	12
27.5-30.4	3	28.167	390	14.67	3941	10
30.5-33.4	4	31.275	497.3	16.88	3786	8
>>33.5	4	40.6	963	43.1	10576	11



A.



B.



C.

Figs. 32. The relationship between (A) fecundity and fork length, (B) fecundity and body weight, and (C) fecundity and gonad weight in *L. intermedius*

6. Conclusions and Recommendations

Conclusions: -

- Beles River is richer than Gilgel Beles River, in terms of both total numbers of fish caught and numbers of species recorded. A higher number of species were recorded in the Beles River (22 species) than in the Gilgel Beles River (5 species) in the present study. The increase in number of fish species from lower to upper reaches of study area coincide with decline in elevation.
- The Cyprinidae, Bagridae and Characidae were the best-represented families with respect to numbers of species; with 11, 3 and 3 species, respectively. The *Labeo* and *Labeobarbus* were the best-represented genera with numbers of species. *L. nedgia* and *L. degeni* considered belonging to a single lip morphotype (*Labeobarbus nedgia*) endemic to Lake Tana by Nagelkerke and Sibbing (1996) are found in Beles River.
- Cyprinidae was the most dominant family in Beles and Gilgel Beles Rivers. This family comprised 99.99 and 74.83 % IRI of the catches in the Gilgel Beles and Beles Rivers, respectively. *L. intermedius* was the most abundant species according to IRI (38.86%), while *L. forskalii* was second (24.68%) and *L. bynni* third (18.36%) in the total catch. *L. intermedius* had bigger mean % IRI in Gilgel Beles River than Beles River ($P < 0.05$). However, there were no significant differences in % IRI between the two rivers for *L. nedgia*, *L. forskalii* and *O. niloticus* ($P > 0.05$). *L. intermedius* was the most abundant species during the wet season, while *L. forskalii* during the dry season in the total catch.
- The species diversity was also higher in the Beles River ($H' = 2.42$) than in the Gilgel Beles River ($H' = 0.88$) for total catch. A higher number of species was recorded in dry than wet season in total catch (22 versus 18 species). The species diversity was also higher in the dry ($H' = 2.29$) than wet season ($H' = 1.99$) for the total catch.
- The length-weight relationships were curvilinear for *L. forskalii* and *L. intermedius* in both rivers. From length-weight relationship, *L. forskalii* showed

isometric growth while *L. intermedius* exhibited positive allometric growth in both Beles and Gilgel Beles Rivers.

- *L. forskalii* was found in better condition in Gilgel Beles River than Beles River (ANOVA, $P < 0.05$). However, Mean Fulton condition factor for *L. intermedius* was greater in Beles River than Gilgel Beles River (ANOVA, $P < 0.05$)
- Females *L. intermedius* and *L. forskalii* were found in better condition than males both in Beles and Gilgel Beles Rivers. Mean Fulton condition factor of *L. forskalii* was greater in dry season than wet season. However, Mean FCF of *L. intermedius* was greater in wet than dry season. There was significant difference in the mean FCF for *L. forskalii* between dry and wet seasons in total catch (ANOVA, $P < 0.05$). However, there was no significant variation in FCF of *L. intermedius* seasons (ANOVA > 0.05).
- Fecundity of *L. intermedius* was linearly related to total weight and gonad weight, and curvilinearly to fork length in the two rivers.
- Mean temperature, river width and secchi depth showed longitudinal trends.

Recommendation: -

In order to have a better knowledge of the fish populations detailed studies and investigations are required on diversity and abundance of fish species in Abay basin in general and in Beles and Gilgel Beles Rivers in particular, especially at the lower reaches of Beles River. In addition, detailed knowledge on the biology and behaviour of most of the species are still lacking. Therefore, further studies are required on the biology and behaviour of fishes in the study area. Although fishing is carried out for limited months of the year in study area, intensive fishing is done in Gilgel Beles River using traditional gears and poisonous plants (e.g. Berbera seeds), especially during the low water period between Februarys and April. However, these months are the onset of the breeding season of *L. forskalii*. Therefore the brood stock is more vulnerable to disturbances and exploitation. Unless fisheries management established, there is no sustainable fish resource in the river. Any changes to the flood regime caused by factors such as logging, wild firing, water abstraction, impoundment and canalisation on the floodplains can have serious negative effects on the functioning of

the river system. Therefore, sustainable utilization and conservation measures should be taken in the two rivers.

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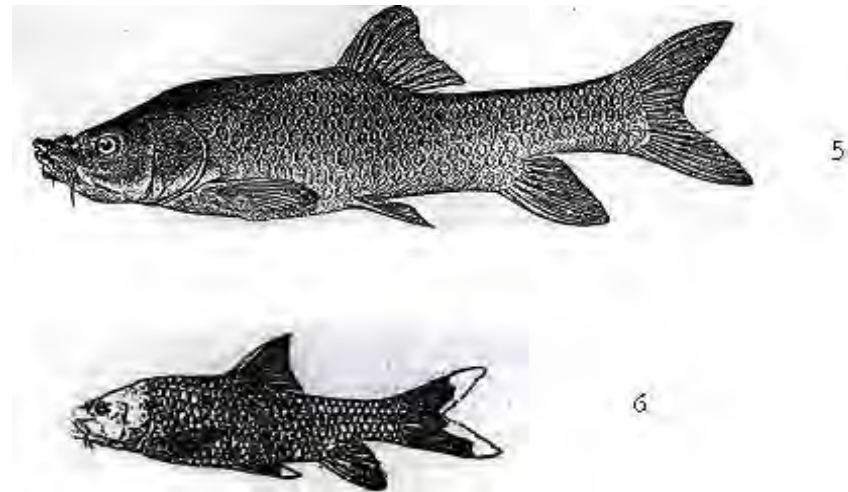
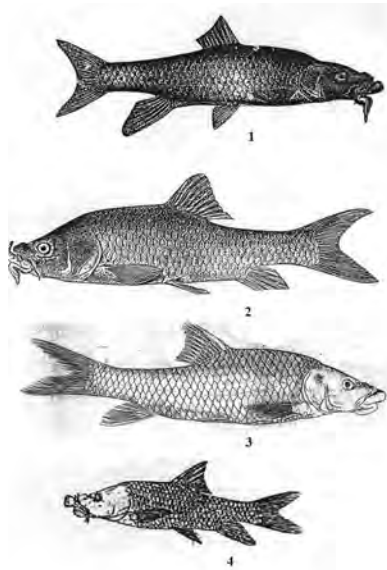
Appendix 2. Comparison of abiotic parameters between sampling sites using independent T- test at 0.05 degree of significant.

X	MH	Coll	BB	BAB
MH	X	X	X	X
Coll	<p>$P^H = 0.99$ $T = 0.75$ $Con = 0.90$ $O = 0.27$ $S = 0.88$ $RW = 0.37$ $RD = 0.52$</p>			
BB	<p>$P^H = 0.76$ $T = 0.41$ $Con = 0.36$ $O = 0.02$ (*) $S = 0.30$ $RW = 0.01$ (*) $RD = .00$ (*)</p>	<p>$P^H = 0.75$ $T = 0.64$ $Con = 0.38$ $O = 0.82$ $S = 0.45$ $RW = 0.02$ (*) $RD = .00$ (*)</p>	X	
BAB	<p>$P^H = 0.86$ $T = 0.21$ $Con = 0.66$ $O = 0.61$ $S = 0.20$ $RW = 0.00$ (*) $RD = 0.02$ (*)</p>	<p>$P^H = 0.85$ $T = 0.38$ $Con = 0.69$ $O = 0.87$ $S = 0.42$ $RW = .00$ (*) $RD = 0.03$ (*)</p>	<p>$P^H = 0.88$ $T = 0.58$ $Con = 0.80$ $O = 0.73$ $S = 0.94$ $RW = .00$ (*) $RD = 0.02$ (*)</p>	X

(*) Significant difference ($P < 0.05$)

Appendix 3. Compilation of illustration, published by Rüppell (1936), Boulenger (1911), Bini (1940), and Nagelkerke and Sibbing (1996).

1. *L. nedgia* Rüppell (1936)
2. *B. nedgia* Boulenger (1911)
3. *L. nedgia* Nagelkerke and Sibbing (1996).
4. *B. nedgia* Bini (1940)
5. *B. degeni* Boulenger (1911)
6. *B. degeni* Bini (1940)



Appendix 4. Morphometric and meristic measurements of the fish species from the two rivers.

	<i>V. beso</i>								<i>R. loati</i>							
	Variable	N	Mean	SD	Min	Max	Med.	Av.	N	Mean	SD	Min	Max	Med.	Av.	
%SL	HL	4	23.71	1.52	22	25.16	23.83	23.58	8	27.51	3.89	20.55	30.77	29.52	25.66	
	BD	4	31.4	1.3	30	32.9	31.36	31.45	8	22.47	1.62	21.18	26.15	22.04	23.67	
	PrDL	4	46.6	2.34	43.87	49.6	46.46	46.74	8	61.85	1.64	58.82	64.1	61.97	61.46	
	DBL	4	22.11	1.42	20	23	22.72	21.5	8	10.91	1.2	8.97	12	11.36	10.49	
	DBH	4	22.24	3.4	19	26.4	21.79	22.7	8	18.29	0.87	17.65	20	17.86	18.82	
	ABL	4	9.22	1.36	7.2	10	9.84	8.6	8	15.93	3.51	9.23	19.2	17.65	14.22	
	ABH	4	19.51	1.08	18.4	21	19.32	19.7	8	18.2	1.52	15.56	20.89	18.1	18.22	
	PcFL	4	20.69	0.67	20	21.6	20.57	20.8	8	19.6	1.48	17.65	21.8	19.63	19.72	
	PIFL	4	19.8	0.4	19.2	20	20	19.6	8	12.88	0.81	11.85	14.12	12.88	12.99	
	CL	4	18.47	2.72	16.13	22.4	17.68	19.27	8	12.4	1.4	9.6	13.92	12.56	11.76	
CD	4	13.33	2.52	11.43	17	12.45	14.22	8	9.42	0.65	8.24	10.26	9.5	9.25		
%HL	ED	4	19.98	1.58	18.18	21.88	19.93	20.03	8	18.95	5.33	12.5	26.67	17.09	19.59	
	HW	4	66.39	2.42	64.1	68.75	66.35	66.43	8	42.26	9.17	27.27	53.33	42.3	40.3	
	MW	4	51.62	3.66	48.39	56.82	50.64	52.61	8	31.77	7.08	22.73	45.83	32.46	34.28	
	SnL	4	34.22	3.22	30.77	37.5	34.31	34.14	8	30.73	2.07	26.67	33.33	31.41	30	
	IOW	4	46.48	1.09	45.16	47.73	46.51	46.44	8	30.79	3.08	26.67	36.36	30.63	31.52	
	ABL_1	4	12.37	2.52	9.68	15.63	12.09	12.66	-	-	-	-	-	-	-	
Meristic	LLS	4	30.75	0.5	30	31	31	30.5	7	53.75	3.3	50	58	53.5	54	
	SALL	4	4.88	0.48	4.5	5.5	4.75	5	5	4	0	4	4	4	4	
	SBLL	4	2	0	2	2	2	2	5	2	0	2	2	2	2	
	SAb	4	4.25	0.5	3.5	4.5	4.5	4	5	3.5	0	3.5	3.5	3.5	3.5	
	CS	4	12	0	12	12	12	12	8	12.88	1.46	12	16	12	14	
	DSp	4	4	0	4	4	4	4	8	3	0	3	3	3	3	
	DBR	4	10.75	0.5	10	11	11	10.5	8	8	0	8	8	8	8	
	ASR	4	3	0	3	3	3	3	8	3	0	3	3	3	3	
	ABR	4	5	0	5	5	5	5	8	14	0	14	14	14	14	

		<i>L. niloticus</i>							<i>L. horie</i>						
	Variable	N	Mean	SD	Min	Max	Med.	Av.	N	Mean	SD	Min	Max	Med.	Av.
%SL	HL	5	25.52	1.61	23.53	28	25.53	25.76	3	23.62	1.2	22.86	25	23	23.93
	BD	5	30.96	2.82	29.41	36	29.79	32.71	3	29.67	0.3	29.41	30	29.6	29.71
	PDL	5	44.27	1.14	43.14	46	44.12	44.57	3	43.33	0.69	42.86	44.12	43	43.49
	DBL	5	27.41	1.88	24.31	29.41	27.66	26.86	3	28.86	0.48	28.57	29.41	28.6	28.99
	DBH	5	31.68	4.91	25.49	37.35	29.79	31.42	3	31.57	5	28.57	37.35	28.8	32.96
	ABL	5	11.45	7.04	7.66	24	8.82	15.83	3	8.44	0.41	8	8.82	8.5	8.41
	ABH	5	17.98	5.73	8	22.55	19.61	15.28	3	20.72	0.14	20.59	20.86	20.7	20.72
	PcFL	5	22.6	2.67	19.61	26	22.55	22.81	3	23.23	1.08	22.29	24.41	23	23.35
	PIFL	5	21.09	2.69	18.72	25.2	20.59	21.96	3	20.91	0.46	20.59	21.43	20.7	21.01
	CL	5	13.61	0.57	12.65	14.04	13.73	13.35	3	12.73	0.11	12.64	12.86	12.7	12.75
%HL	CD	5	15.33	1.77	13.73	18	14.71	15.86	3	36.7	22.1	14.6	58.8	36.7	36.7
	ED	5	18.01	1.55	15.71	20	18.33	17.86	3	17.58	0.08	17.5	17.65	17.6	17.57
	HW	5	66.74	4.91	60	71.43	68.33	65.72	3	72.2	2.44	70.59	75	71	72.79
	MW	5	37.06	7.66	30	50	35.29	40	3	36.26	1.13	35.29	37.5	36	36.4
	SnL	5	39.1	6.4	33.33	50	36.67	41.67	3	38.46	0.57	37.8	38.82	38.75	38.79
Meristic	IOW	5	49.64	4.66	45	57.14	49.41	51.07	3	51.25	2.38	49	53.75	51	51.58
	LLS	5	42.4	2.51	38	44	43	41	3	43.33	0.58	43	44	43	43.5
	SALL	5	8	0.35	7.5	8.5	8	8	3	8	0	8	8	8	8
	SBLL	5	5	0.71	4	6	5	5	3	4.33	0.58	4	5	4	4.5
	SAb	5	8.6	0.55	8	9.5	8.5	8.75	3	8	0	8	8	8	8
	CS	5	19	1.16	18	20	19	19	3	18	0	18	18	18	18
	DSR	5	3	0	3	3	3	3	3	3	0	3	3	3	3
	DBR	5	15.25	0.96	14	16	15.5	15	3	14	0	14	14	14	14
	ASR	5	3	0	3	3	3	3	3	3	0	3	3	3	3
ABR	5	5	0	5	5	5	5	3	5	0	5	5	5	5	

		<i>L. cylindricus</i>							<i>L. coubie</i>							
		Variable	N	Mean	SD	Min	Max	Med.	Av.	N	Mean	SD	Min	Max	Med.	Av.
%SL	HL	6	24.66	1.79	22.86	27.78	24.67	25.32	2	29.4	1.96	28	30.77	29.38	29	
	BD	6	25.27	1.58	23.00	27.78	25.00	25.39	2	37.2	1.74	36	38.46	37.23	37	
	PrDL	6	44.82	2.55	41.00	48.89	45.00	44.95	2	47	1.47	46	48.08	47.04	47	
	DBL	6	17.23	1.75	15.00	20.00	17.07	17.50	2	29.4	1.96	28	30.77	29.38	29	
	DBH	6	25.40	2.01	23.00	27.83	25.00	25.41	2	37.2	1.74	36	38.46	37.23	37	
	ABL	6	11.65	3.65	8.00	17.00	11.11	12.50	2	25.5	2.07	24	26.92	25.46	25	
	ABH	6	17.34	2.86	12.00	20.00	18.02	16.00	2	9.77	2.5	8	11.54	9.77	9.8	
	PcFL	6	21.28	1.35	20.00	23.48	21.00	21.74	2	27.4	2.01	26	28.85	27.42	27	
	PIFL	6	17.87	1.28	16.19	19.13	17.94	17.66	2	26.6	2.03	25	28.08	26.64	27	
	CL	6	13.83	1.62	12.00	15.56	14.00	13.78	2	15.7	2.34	14	17.31	15.65	16	
CD	6	12.30	.73	11.43	13.33	12.00	12.38	2	19.6	2.23	18	21.15	19.58	20		
%HL	ED	6	16.06	1.03	14.29	17.39	16.00	15.84	2	15.4	0.505	15	15.714	15.36	15	
	HW	6	63.19	4.54	60.00	71.43	61.25	65.72	2	71.3	0.126	71	71.429	71.34	71	
	MW	6	40.84	4.42	35.71	47.83	40.00	41.77	2	50	0	50	50	50	50	
	SnL	6	38.01	2.38	36.00	41.67	37.57	38.83	2	53.1	4.42	50	56.25	53.13	53	
	ABL_1	6	16.06	1.03	14.29	17.39	16.00	15.84	-	-	-	-	-	-	-	
Meristic	IOW	6	41.33	1.57	40.00	43.48	40.83	41.74	2	56.7	0.631	56	57.143	56.7	57	
	LLS	6	38.17	1.17	36.00	39.00	38.50	37.50	2	38	0	38	38	38	38	
	SALL	6	6	0	6	6	6	6	2	8.25	0.354	8	8.5	8.25	8.3	
	SBLL	6	5	0	5	5	5	5	2	6	0	6	6	6	6	
	SAb	6	7.5	0	7.5	7.5	7.5	7.5	2	9.5	0	9.5	9.5	9.5	9.5	
	CS	6	16	0	16	16	16	16	2	20	0	20	20	20	20	
	DSR	6	3	0	3	3	3	3	2	3	0	3	3	3	3	
	DBR	6	9	0	9	9	9	9	2	14	0	14	14	14	14	
	ASR	6	3	0	3	3	3	3	2	3	0	3	3	3	3	
ABR	6	5	0	5	5	5	5	2	5	0	5	5	5	5		

		<i>L. forskalii</i>						
Variable		N	Mean	SD	Min	Max	Med.	Av.
%SL	HL	6	23.75	1.87	20.36	25.71	24.11	24.91
	BD	6	27.83	1.65	26.36	30.77	27.39	28.57
	PrDL	6	46.45	2.41	43.33	50.80	46.13	47.07
	DBL	5	19.64	.86	18.18	20.39	20.00	19.28
	DBH	6	34.84	2.80	30.00	38.46	35.23	34.23
	ABL	6	7.55	.61	6.67	8.16	7.64	7.41
	ABH	6	19.41	2.15	16.67	21.92	19.52	19.30
	PcFL	6	23.04	.30	22.73	23.33	23.05	23.03
	PIFL	6	22.59	1.60	20.00	24.00	23.20	22.00
	CL	6	12.96	1.11	11.67	14.55	12.80	13.11
	CD	6	13.31	.90	11.67	14.40	13.47	13.03
%HL	ED	6	12.55	.98	11.11	13.85	12.57	12.48
	HW	6	74.23	2.81	69.44	77.14	74.16	73.29
	MW	6	51.04	2.27	47.37	53.85	51.11	50.61
	SnL	6	52.09	2.74	49.12	56.92	51.85	53.02
	IOW	6	39.98	7.8	29.17	45.71	44.32	37.44
Meristic	LLS	6	41.33	1.21	40	43	41.5	41.5
	SALL	6	6.67	0.41	6.5	7.5	6.5	7
	SBLL	6	4.17	1.13	3	5.5	4	4.25
	SAb	6	8.5	0	8.5	8.5	8.5	8.5
	CS	6	18.33	1.51	16	20	18	18
	DSR	6	3	0	3	3	3	3
	DBR	6	10	0	10	10	10	10
	ASR	6	3	0	3	3	3	3
ABR	6	5	0	5	5	5	5	

	<i>L. intermedius</i>								<i>L. bynni</i>						
	Variable	N	Mean	SD	Min	Max	Med.	Av.	N	Mean	SD	Min	Max	Med.	Av.
%SL	HL	10	29.32	1.85	26.56	32	28.99	29.28	11	25.72	1.9	21.66	28.57	26.13	25.11
	BD	10	32.12	1.56	29.79	34.38	32.26	32.08	11	32.59	4.8	28	40.35	30	34.17
	PrDL	10	49.68	10.54	28.19	57.45	54.25	42.82	11	54.44	9.2	33.75	68	54.2	50.88
	DBL	10	14.36	1.51	12.5	16.32	14.29	14.41	11	15.71	1.6	12.17	17.5	16	14.83
	DBH	10	19.7	3.08	14.29	24	18.75	19.15	11	27.4	3.9	20	32.6	28.46	26.3
	ABL	10	7.97	1.16	6	9.38	7.81	7.69	11	7.53	1.1	5.97	10	7.14	7.99
	ABH	10	21.28	1.78	17.19	23.08	21.88	20.13	11	20.41	2.1	18.25	23.75	19.7	21
	PcFL	10	21.95	0.84	20.31	23.08	21.91	21.7	11	21.56	2	18.98	24.5	21.41	21.74
	PIFL	10	18.31	1.11	17.02	20.64	18.28	18.83	11	18.91	1.6	17.03	21.61	18.89	19.32
	CL	10	17.06	1.27	14.89	18.75	17.19	16.82	11	17.64	3.1	14.29	24	17.37	19.14
	CD	10	12.1	1.25	8.82	13.42	12.5	11.12	11	13.9	1.1	12.86	15.85	13.43	14.35
LLDSP	10	17.66	2.12	13.42	20.31	17.32	16.86	11	24.66	2.8	20	29.31	24.39	24.66	
%HL	ED	10	15.23	1.33	12.31	17.14	15.43	14.73	11	20.23	4.1	14.29	26.32	19.05	20.31
	HW	10	63.3	16.02	38.89	93.75	64.98	66.32	11	62.91	14	43.24	88.24	59.5	65.74
	MW	10	29.83	4.27	24.29	36.67	28.57	30.48	11	28.08	2.5	25	32.88	27.93	28.94
	SnL	10	32.36	2.79	28.57	37.5	31.58	33.03	11	32.34	8.6	23.08	52.94	30	38.01
	ABL_1	10	25.9	2.99	23.08	31.43	24.72	27.25	11	23.91	3.1	16.67	27.06	24.86	21.86
	PBL	10	30.28	3.47	25.26	37.14	30.63	31.2	11	28.28	2.3	23.81	31.58	27.74	27.69
	IOW	10	32.6	2.32	30	35.29	33.33	32.65	11	37.88	7.3	30	52.94	37.29	41.47
Meristic	LLS	10	30.6	1.51	28	33	30	30.5	11	31	1.3	30	33	30	31.5
	SALL	10	5.8	0.26	5.5	6	6	5.75	8	6.44	0.2	6	6.5	6.5	6.25
	SBLL	10	2.9	0.32	2	3	3	2.5	10	3	0	3	3	3	3
	SAb	10	5.2	0.48	4.5	6	5.25	5.25	8	5.25	.5	4.5	5.5	5.5	5
	CS	10	12.89	1.05	12	14	12	13	5	11.6	1.7	10	14	12	12
	DSP	10	4	0	4	4	4	4	11	4	0	4	4	4	4
	DBR	10	9	0	9	9	9	9	11	9	0	9	9	9	9
	ASR	10	3	0	3	3	3	3	11	3	0	3	3	3	3
	ABR	10	5	0	5	5	5	5	11	5	0	5	5	5	5

		<i>L. degeni</i>							<i>L. nedgia</i>							
		variable	N	Mean	SD	Min	Max	Med	Av.	N	Mean	SD	Min	Max	Med.	Av.
%SL	HL	4	30	1.202	28.9	31.39	30	30.17	6	28.4	1.4	25.758	29.49	28.76	27.62	
	BD	4	35	2.37	32	37.18	36	34.59	6	33.1	4.8	28.57	42.42	31.97	35.49	
	PrDL	4	60	2.34	57.1	61.54	60	59.34	6	56.8	1.9	54.167	59.09	56.78	56.63	
	DBL	4	16	1.778	14.3	18.42	15	16.35	6	14.6	2.1	11.25	17.95	14.38	14.59	
	DBH	4	24	2.76	20.5	27.08	25	23.79	6	23.3	2.5	19.74	25.71	24.37	22.73	
	ABL	4	7.7	1.377	6.15	8.97	7.8	7.56	6	7.65	1.2	6.349	9.09	7.42	7.72	
	ABH	4	23	1.672	21.4	25	22	23.22	6	22.1	1.6	20.513	24.24	21.53	22.38	
	PcFL	4	24	2.97	21.5	28.16	23	24.85	6	22.9	1.7	20.833	25.76	22.74	23.29	
	PIFL	4	21	2.74	18.5	25	21	21.73	6	19.9	1.5	18.367	22.73	19.48	20.55	
	CL	4	17	2.1	15.4	19.74	17	17.56	6	17.3	1.2	16.327	19.70	16.89	18.01	
	CD	4	15	0.987	13.5	15.79	15	14.66	6	14	1.5	12.5	16.67	13.67	14.58	
	LLDSP	4	21	0.463	20.5	21.54	21	21.03	6	22.4	3.7	17.11	27.08	22.38	22.09	
%HL	ED	4	14	1.053	12.5	14.71	14	13.60	6	14.9	2.2	11.818	17.65	15	14.73	
	HW	4	69	6.52	63.7	77.27	67	70.5	6	69.5	8	60	82.35	68.72	71.18	
	MW	4	30	2.53	27.3	33.33	29	30.3	6	30.6	4.3	25.71	33.33	32.86	29.52	
	SnL	4	37	0.804	36.4	37.5	37	36.93	6	38.9	4.1	31.82	42.86	39.01	37.34	
	ABL_1	4	21	4.54	17.7	27.27	19	22.46	6	22.8	3.3	17.39	27.06	23.25	22.23	
	PBL	4	24	5.59	19.6	31.82	22	25.72	6	27.5	6.4	18.57	36.36	28.89	27.47	
	IOW	4	38	2.68	36.3	41.67	36	38.97	6	37.6	3.1	32.86	41.18	37.9	37.02	
Meristic	LLS	4	32	1.258	30	33	32	31.5	6	31.2	1.2	30	33	31	31.5	
	SALL	4	6	0.408	5.5	6.5	6	6	6	6.08	0.5	5.5	6.5	6.25	6	
	SBLL	4	3	0	3	3	3	3	6	3	0	3	3	3	3	
	SAb	4	5	0.577	4.5	5.5	5	5	6	5.17	0.5	4.5	5.5	5.5	5	
	CS	4	14	1	12	14	14	13	6	14	0	14	14	14	14	
	DSP	4	4	0	4	4	4	4	6	4	0	4	4	4	4	
	DBR	4	9	0	9	9	9	9	6	9	0	9	9	9	9	
	ASR	4	3	0	3	3	3	3	6	3	0	3	3	3	3	
	ABR	4	5	0	5	5	5	5	6	5	0	5	5	5	5	

<i>C. gariepinus</i>								
	Variable	N	Mean	SD	Min	Max	Med.	av.
%SL	HL	3	27.87	3.45	24.36	31.25	28	27.81
	BD	3	16.47	2.38	14	18.75	16.67	16.38
	PrDL	3	38.227	1.544	37.18	40	37.5	38.59
	DBL	3	63.51	1.78	61.54	65	64	63.27
	DBH	3	5.983	1.703	5	7.95	5	6.48
	ABL	3	45.29	0.618	44.87	46	45	45.44
	ABH	3	10.67	4.96	5	14.2	12.82	9.6
	PcFL	3	14.593	1.051	13.4	15.38	15	14.39
	PIFL	3	11.17	0.873	10.26	12	11.25	11.13
	CL	3	3.183	0.675	2.5	3.85	3.2	3.175
	CD	3	7.9	2.01	6	10	7.69	8
	Sn-VL	3	59.29	13.73	47.5	74.36	56	60.93
	E-VL	3	41.26	2.63	38.75	44	41.03	41.38
	V-CL	3	47.27	13.23	32.05	56	53.75	44.03
	C-DL	3	47.2	1.6	36.7	66.3	38.6	51.5
%HL	ED	3	5.343	1.203	4	6.32	5.71	5.16
	SnL	3	28.68	6.2	24	35.71	26.32	29.86
	HW	3	72.29	11.87	63.16	85.71	68	74.44
	MW	3	50.77	6.21	46.43	57.89	48	52.16
	IOW	3	49.11	4.53	44	52.63	50.71	48.32
	NBL	3	52.01	14.03	36	62.14	57.89	49.07
	MxBL	3	115.42	12.38	104	128.57	113.68	116.3
	OMnBL	3	90.87	15.62	76	107.14	89.47	91.57
	ImnBL	3	59.77	8.8	50.4	67.86	61.05	59.13
	MTL	3	29.72	4.41	26.43	34.74	28	30.59
	MTB	3	4.543	0.874	3.57	5.26	4.8	4.42
	VTL	3	35.76	11.25	24	46.43	36.84	35.22
	VTB	3	6.057	1.015	5.26	7.2	5.71	6.23
Meristic	DBR	3	68	2.65	66	71	67	69
	ABR	3	52.333	0.577	52	53	52	52.5
	GRN	3	107.67	6.81	100	113	110	106.5

		<i>B. docmak</i>							<i>B. bajad</i>						
	Variable	N	Mean	SD	Min	Max	Med.	av.	N	Mean	SD	Min	Max	Med.	av.
%SL	HL	3	32.58	0.76	31.82	33.33	32.58	32.58	2	30.32	.46	30.00	30.65	30.32	30.32
	BD	3	21.86	0.75	21.43	22.73	21.43	22.08	2	43.60	29.70	22.60	64.60	43.60	43.60
	PrDL	3	48.09	0.62	47.73	48.81	47.73	48.27	2	33.20	14.60	22.90	43.50	33.20	33.20
	DBL	3	16.8	0.22	16.67	17.05	16.67	16.86	2	16.40	.38	16.13	16.67	16.40	16.40
	DBH	3	20.28	2.12	19.05	22.73	19.05	20.89	2	29.10	.10	29.03	29.17	29.10	29.10
	ABL	3	10.93	0.38	10.71	11.36	10.71	11.04	2	11.90	.86	11.29	12.50	11.90	11.90
	ABH	3	17.02	0.61	16.67	17.73	16.67	17.20	2	19.05	.43	18.75	19.36	19.05	19.05
	PcFL	3	18.23	0.09	18.18	18.33	18.18	18.26	2	19.26	.13	19.17	19.36	19.26	19.26
	PLFL	3	16.16	0.03	16.14	16.19	16.14	16.16	2	17.14	.51	16.77	17.50	17.14	17.14
	CL	3	16.8	0.22	16.67	17.05	16.67	16.86	2	15.59	1.52	14.52	16.67	15.59	15.60
	CD	3	10.39	0.28	10.23	10.71	10.23	10.47	2	8.62	.78	8.07	9.17	8.62	8.62
	E_VL	3	46.17	1.25	45.45	47.62	45.45	46.54	2	42.84	1.28	41.94	43.75	42.84	42.84
	V_CL	3	42.97	0.19	42.86	43.18	42.86	43.02	2	47.11	1.81	45.83	48.39	47.11	47.11
%HL	ED	3	6.67	0.41	6.43	7.14	6.43	6.79	2	8.38	.06	8.33	8.42	8.38	8.38
	HB	3	73.81	4.12	71.43	78.57	71.43	75.00	2	73.46	4.15	70.53	76.39	73.46	73.46
	MW	3	55.95	4.12	53.57	60.71	53.57	57.14	2	52.71	.10	52.63	52.78	52.71	52.71
	SnL	3	30.24	2.89	28.57	33.57	28.57	31.07	2	35.78	1.50	34.72	36.84	35.78	35.78
	MxBL	3	207.14	0	207.14	207.14	207.14	207.10	2	231.76	.26	231.58	231.94	231.76	231.80
	NBL	3	29.76	2.06	28.57	32.14	28.57	30.36	2	35.26	.76	34.72	35.79	35.26	35.26
	OMnBL	3	80.71	1.24	80.00	82.14	80	81.07	2	76.00	19.10	62.50	89.50	76.00	76.00
	IMnBL	3	42.62	3.3	40.71	46.43	40.71	43.57	2	44.66	3.62	42.11	47.22	44.66	44.67
	IOW	3	35.24	0.41	35.00	35.71	35	35.36	2	32.29	.49	31.94	32.63	32.29	32.29
	MTB	3	7.38	0.42	7.14	7.86	7.14	7.50	2	9.43	1.55	8.33	10.53	9.43	9.43
VTB	3	7.86	1.24	7.14	9.29	7.14	8.22	2	5.94	0.54	5.56	6.32	5.94	5.94	
Meristic	DSp	3	1	0	1	1	1	1	2	1	0	1	1	1	1
	DBR	3	9	0	9	9	9	9	2	9	0	9	9	9	9
	ASR	3	2	0	2	2	2	2	2	2	0	2	2	2	2
	ABR	3	8	0	8	8	8	8	2	8	0	8	8	8	8
	GRN	3	10.33	0.58	10	11	10	10.5	2	10	0	10	10	10	10

		<i>A. occidentalis</i>							<i>H. longifilis</i>								
		Variable	N	Mean	SD	Min	Max	Med.	Av.	Variable	N	Mean	SD	Min	Max	Med.	Av.
%SL	HL	5	37.27	2.34	35.71	41	36	38.5	HL	3	24.86	4.46	22.14	30	22.43	26.07	
	BD	5	24.53	2.33	22	27	25.81	24.34	BD	3	14.27	1.531	13.08	16	13.74	14.54	
	PrDL	5	47.28	2.16	44.4	50	47.619	47.2	PrDL	3	38.21	1.78	36.45	40	38.17	38.23	
	DBL	5	14.87	0.96	14	16	14.667	15.1	DBL	3	29.64	0.547	29.01	30	29.91	29.51	
	DBH	5	27.87	2.15	24.33	30	28	27.17	DBH	3	6.217	0.285	6	6.54	6.11	6.27	
	ABL	5	9.711	0.43	9.03	10	10	9.516	ABL	3	39.25	2.33	36.64	41.12	40	38.88	
	ABH	5	21	1.24	19.36	22	21.667	20.68	ABH	3	3.803	1.048	3.05	5	3.36	4.03	
	PcFL	5	20.9	1.25	20	23	20	21.29	PcFL	3	15.05	0.904	14.2	16	14.95	15.1	
	PIFL	5	20.2	1.06	19.05	22	20	20.49	PIFL	3	11.32	1.46	10.28	13	10.69	11.64	
	CL	5	8.768	1.75	7.143	12	8	9.41	CL	3	5.08	0.79	4.58	6	4.67	5.29	
	CD	5	12.04	0.39	11.61	13	12	12.14	CD	3	9.17	0.175	9	9.35	9.16	9.18	
	AdFL	5	29.01	1.56	26.45	30	30	28.23	AdL	3	27.35	2.09	25	29.01	28.04	27.01	
AdFH	5	8.902	1.37	6.45	9.6	9.524	8.03	AdH	3	5.5	0.563	4.89	6	5.61	5.45		
%HL	ED	5	10.6	1.11	9.82	13	10	11.16	ED	3	6.293	0.343	6	6.67	6.21	6.34	
	HW	5	58.55	2.91	54.69	63	57.78	58.6	HW	3	92.18	10.69	80	100	96.55	90	
	MW	5	35.04	5.15	28	39	36.63	33.45	MW	3	56.01	13.94	40	65.52	62.5	52.76	
	SnL	5	57.79	2.09	56.25	61	56.667	58.79	SnL	3	31.49	4.22	26.67	34.48	33.33	30.58	
	IOW	5	36.15	3.13	31.25	39	36	35.07	IOW	3	64.14	9.79	53.33	72.41	66.67	62.87	
	MxBL	5	41.15	3.38	37.33	46	40.85	41.45	NBL	3	74.77	4.66	70	79.31	75	74.66	
	OMnBL	5	56.51	3.3	53.33	61	55.8	57.22	MxBL	3	174.9	18.2	163.3	195.8	165.5	179.6	
IMnBL	5	30.88	15.2	20.31	53	24.94	36.82	OMnBL	3	120.3	9.4	113.3	131.03	116.67	122.2		
Meristic	DSp	5	1	0	1	1	1	1	DBR	3	31.67	2.08	30	34	31	32	
	DBR	5	7	0	7	7	7	7	ABR	3	47.67	3.21	44	50	49	47	
	ASR	5	3	0	3	3	3	3	-	-	-	-	-	-	-	-	
	ABR	5	8	0	8	8	8	8	-	-	-	-	-	-	-	-	
	PcSp	5	1	0	1	1	1	1	-	-	-	-	-	-	-	-	
	PCBR	5	8	0	8	8	8	8	-	-	-	-	-	-	-	-	

		<i>S. schall</i>						<i>S. serratus</i>							
Variable		N	Mean	SD	Min	Max	Med.	Av.	N	Mean	SD	Min	Max	Med.	Av.
%SL	HL	4	28.95	2.25	27.12	32.14	28.27	29.63	5	26.92	2.83	22.64	30	26.67	26.32
	BD	4	29.8	1.65	28.48	32.14	29.3	30.31	5	26.78	3.92	21.51	30.19	28.89	25.85
	PrDL	4	44.81	2.4	42.05	47.86	44.66	44.96	5	41.91	3.22	36.6	45.28	42.59	40.94
	DBL	4	14.81	1.876	12.821	17.143	14.64	14.98	5	13.46	1.74	10.57	14.82	13.97	12.69
	DBH	4	29.97	3.89	27.12	35.71	28.53	31.42	5	28.78	2.64	24.91	31.48	30	28.2
	ABL	4	10.95	0.39	10.71	11.53	10.77	11.12	5	9.86	1.99	6.42	11.32	10.37	8.87
	ABH	4	21.41	1.41	20	23.08	21.27	21.54	5	20.94	2.41	17.36	23.16	21.9	20.26
	PcFL	4	30.91	1.5	28.85	32.14	31.32	30.49	5	33.4	3.51	29.43	38.89	32.38	34.16
	PIFL	4	17.04	1.13	15.39	17.86	17.47	16.62	5	17.68	3.05	12.83	21.05	18.52	16.94
	CL	4	8.48	0.47	7.8	8.85	8.65	8.32	5	13.96	1.57	11.7	15.79	14.29	13.74
	CD	4	10.83	0.92	9.62	11.8	10.95	10.71	5	9.74	0.4	9.21	10.19	9.81	9.7
	AdFL	4	33.39	2.79	30.77	35.9	33.45	33.34	5	39.24	2.22	35.85	41.51	39.68	38.68
	AdFH	4	8.68	1.61	7.31	10.71	8.34	9.01	5	10.28	2.31	7.92	14.07	9.47	11
DBAD	4	6.43	5.53	1.69	12.82	5.6	7.26	5	7.27	1.44	5.79	9.52	7.17	7.66	
%HL	ED	4	15.24	0.88	14.67	16.25	14.82	15.46	5	13.56	1.23	12.28	15.33	13.1	13.81
	HW	4	88.72	5.59	83.33	93.75	88.89	88.54	5	82.77	6.33	71.93	88.33	84.52	80.13
	MW	4	28.19	2.65	26.67	31.25	26.67	28.96	5	97.5	145.9	23.8	358.3	35.1	191.05
	SnL	4	47.04	2.8	44.44	50	46.67	47.22	5	55.24	3.93	50	60	56.41	55
	IOW	4	44.07	1.68	42.22	46.3	43.88	44.26	5	36.71	6.3	26.67	42.86	38.46	34.77
	POL	4	35.93	6.33	26.67	40	38.52	33.34	5	2.63	0.26	2.4	3	2.55	2.7
	HPL	4	51.94	1.73	50	53.33	52.5	51.67	5	3.7	0.36	3.3	4	3.75	3.65
	HPD	4	28.56	2.39	26.67	31.25	27.78	28.96	5	1.93	0.19	1.8	2.2	1.85	2
	MxBL	4	149.8	11.4	137.33	165	148.5	151.2	5	115.9	20.48	96.49	146.67	111.54	121.58
Meristic	DSp	4	1	0	1	1	1	1	5	1	0	1	1	1	1
	DBR	4	7	0	7	7	7	7	5	7	0	7	7	7	7
	ASR	4	3	0	3	3	3	3	5	3	0	3	3	3	3
	ABR	4	9	0	9	9	9	9	5	9.2	0.45	9	10	10	9.5
	T	4	31.67	2.52	29	34	32	31.5	5	40	1	39	41	40	40

<i>H. forskhalii</i>							
	N	Mean	SD	Min	Max	Med.	Av.
HL	2	23.88	1.134	23.08	24.68	23.88	24
BD	2	26.65	1.43	25.64	27.66	26.65	27
PrDL	2	47.972	1.36	47.01	48.94	47.97	48
DBL	2	8.10	0.58	7.69	8.511	8.101	8.1
DBH	2	22.39	1.44	21.37	23.4	22.39	22
ABL	2	12.37	0.57	11.97	12.77	12.37	12
ABH	2	16.42	0.86	15.81	17.02	16.42	16
PcFL	2	16.20	1.16	15.39	17.02	16.2	16
PIFL	2	14.29	0.86	13.68	14.89	14.28	14
CL	2	12.15	0.87	11.54	12.77	12.15	12
CD	2	8.95	0.58	8.55	9.362	8.954	9
ED	2	16.95	0.41	16.67	17.24	16.95	17
HW	2	41	2.98	38.89	43.1	41	41
MW	2	51.79	0.09	51.72	51.85	51.79	52
SnL	2	24.97	1.26	24.08	25.86	24.97	25
IOW	2	33.91	0.81	33.33	34.48	33.91	34
LLS	2	48	1.41	47	49	48	48
SALL	2	7.5	0	7.5	7.5	7.5	7.5
SBLL	2	2	0	2	2	2	2
SAb	2	8.5	0	8.5	8.5	8.5	8.5
CS	2	12	0	12	12	12	12
DSR	2	2	0	2	2	2	2
DBR	2	9	0	9	9	9	9
ASR	2	2	0	2	2	2	2
ABR	2	13	0	13	13	13	13
UJT	2	8	0	8	8	8	8
LJT	2	8	0	8	8	8	8
GRN	2	9	0	9	9	9	9

		<i>B. nurse</i>						<i>B. macrolepidotus</i>							
		N	Mean	SD	Min	Max	Med.	Av.	N	Mean	SD	Min	Max	Med.	Av.
%SL	HL	8	24.4	1.6	22.22	26.67	24.44	26	6	26.17	0.99	24.32	26.92	26.52	26.72
	BD	8	31.72	1.63	29.03	33.33	31.72	33	6	24.99	0.72	24.32	26.36	24.81	25.59
	PDL	8	51.52	1.43	50	54.07	51.49	53	6	59.91	1.59	58.11	61.54	59.96	60.75
	DBL	8	10.81	0.52	10	11.67	10.84	11	6	11.13	0.87	9.46	11.67	11.54	11.6
	DBH	8	22.35	1.31	20.87	25	22.16	24	6	22.49	0.74	21.08	23.08	22.61	22.85
	ABL	8	15.39	0.97	14	16.67	15.56	16	6	14.29	0.87	13.33	15.83	14.09	14.96
	ABH	8	13.14	1.9	10.44	16.67	13.3	15	6	18.38	1.41	16.22	20	18.78	19.39
	PcFL	8	19.54	1.31	17.42	20.87	19.64	20	6	21.66	0.9	20.27	22.5	21.99	22.24
	PIFL	8	17.58	1.51	16.13	20.87	17.21	19	6	18.92	0.85	17.57	20	19.2	19.6
	CL	8	11.01	1.09	9.68	13.04	10.91	12	6	10.28	1.27	8.33	11.54	10.42	10.98
CD	8	10.22	0.35	9.57	10.71	10.35	11	6	10.42	1.34	9.09	12.7	10.39	11.54	
%HL	ED	8	26.47	2.94	22.5	30.77	26.67	29	6	23.05	3.47	20	27.59	21.88	24.74
	HW	8	48.72	6.05	37.5	56.67	47.66	52	6	12.19	1.2	10.83	13.51	12.45	12.98
	MW	8	26.01	4.77	20	33.33	23.93	29	6	33.84	0.88	32.26	34.48	34.29	34.38
	SnL	8	18.51	2.38	15	21.62	18.44	20	6	36.25	1.78	34.38	38.89	36.31	37.6
	IOW	8	40.44	2.71	37.5	45.46	40	43	6	42.96	8.95	27.59	55.56	43.3	49.43
meristic	LLS	8	29	2.39	24	32	29	31	5	22.4	0.55	22	23	22	22.5
	SALL	8	5.5	0	5.5	5.5	5.5	5.5	6	4.17	0.26	4	4.5	4	4.25
	SBLL	8	2	0	2	2	2	2	6	2	0	2	2	2	2
	SAb	8	3.38	0.35	2.5	3.5	3.5	3.5	6	2.83	0.58	2.5	3.5	2.5	3
	CS	8	10	0	10	10	10	10	6	12	0	12	12	12	12
	DSp	8	2	0	2	2	2	2	6	2	0	2	2	2	2
	DSR	8	8	0	8	8	8	8	6	3	0	8	8	8	8
	ASp	8	3	0	3	3	3	3	6	3	0	3	3	3	3
ASR	8	14	0	14	14	14	14	6	13	0	13	13	13	13	

		<i>M. kanume</i>							<i>O. niloticus</i>								
		Variable	N	Mean	SD	Min	Max	Med.	Av.	Variable	N	Mean	SD	Min	Max	Med.	Av.
%SL	HL	5	27.8	1.86	25.31	30.11	27.42	27.71	HL	5	35.05	2.22	32.94	38	35	35.6	
	BD	5	32.6	1.79	29.39	33.52	33.26	31.45	BD	5	43.35	0.93	41.74	44	43.529	42.87	
	DBL	5	53.5	4.11	48.98	58.95	52.5	53.97	PDL	5	36.22	2.41	33	39	35.65	36.07	
	DBH	5	10.2	0.77	9.47	11.43	10.14	10.45	DBL	5	57.88	2.81	55.29	63	57	58.95	
	ABL	5	12.9	1.05	11.27	14	13.06	12.63	DBH	5	19.7	1.49	17.65	22	20	19.69	
	ABH	5	13	1.59	11.29	15	12.63	13.15	ABL	5	17.52	0.75	17	19	17.391	17.91	
	PcFL	5	17.6	0.8	16.33	18.53	17.74	17.43	ABH	5	22.31	4.66	19.13	30	20	24.78	
	PIFL	5	12	0.55	11.43	12.68	11.94	12.05	PcFL	5	37.84	2.24	35	41	38	37.94	
	CL	5	25	2.51	21	27.42	25.26	24.21	PIFL	5	28.95	1.81	26.09	30	30	28.26	
	CD	5	6.58	0.37	6.2	7	6.45	6.6	CL	5	11.18	1.4	9.412	13	11	11.23	
%HL	ED	5	10.2	2.13	7.77	12.96	10.59	10.37	CD	5	14.42	1.13	13.04	16	14.118	14.52	
	HW	5	47	5.66	41.18	56.45	45.63	48.82	ED	5	23.49	2.93	21.05	29	22.73	24.81	
	MW	5	11.7	1.32	9.79	12.94	11.65	11.37	HW	5	53.19	5.64	47.22	61	52.63	53.97	
	SnL	5	40.9	4.48	35.48	45.45	41.75	40.47	MW	5	33.71	4.56	27.27	39	34.29	33.28	
	IOW	5	45.5	11.43	32.84	57.77	46.82	45.31	SnL	5	32.85	2.41	29.55	36	33.33	32.63	
	POL	5	51.8	3.01	48.54	55.56	52.94	52.05	IOW	5	40.07	2.47	36.36	43	40	39.61	
Meristic	LLS	5	104	2.94	101	108	103.5	104.5	LLS	5	37	0	37	37	37	37	
	SALL	5	25	1	24	26	25	25	SALL	5	4.7	0.45	4	5	5	4.5	
	SBLL	5	29.5	0.58	29	30	29.5	29.5	SBLL	5	5	0	5	5	5	5	
	CS	5	28	0.71	27	29	28	28	SAb	5	14	0	14	14	14	14	
	DBR	5	61.4	3.21	58	66	61	62	CS	5	18	0	18	18	18	18	
	ABR	5	8.4	0.55	8	9	8	8.5	DSp	5	17	0	17	17	17	17	
	UJT	5	7.5	0.71	7	8	7.5	7.5	DSR	5	12	0	12	12	12	12	
	LJT	5	7.5	0.71	7	8	7.5	7.5	ASp	5	3	0	3	3	3	3	
	-	-	-	-	-	-	-	-	ASR	5	8.8	0.447	8	9	9	8.5	
	-	-	-	-	-	-	-	-	GRN	5	24.6	0.55	24	25	25	24.5	

Appendix 5. Number and weight fishes caught from Beles and Gilgel Beles Rivers.

Species	Gilgel Beles			Beles			Beles & Gilgel Beles		
	N	W (gm)	F	N	W(gm)	F	N	W(gm)	F
<i>R. loati</i>	0	0	0	111	1624.9	4	111	1624.86	4
<i>V. beso</i>	15	666	8	0	0	0	15	666	8
<i>L. niloticus</i>	0	0	0	7	3152	3	7	3152	3
<i>L. horie</i>	0	0	0	4	4094	3	4	4094	3
<i>L. coubie</i>	0	0	0	3	1476	2	3	1476	2
<i>L. forskalii</i>	90	21642	11	96	20888	25	186	42530	36
<i>L. cylindricus</i>	0	0	0	25	617.3	3	25	617.3	3
<i>L. bynni</i>	0	0	0	169	63042.9	23	169	63042.9	23
<i>L. intermedius</i>	322	81171.5	22	40	9040	6	362	90211.5	28
<i>L. nedgia</i>	31	11674	12	18	5648.2	12	49	17322.2	24
<i>L. degeni</i>	0	0	0	8	8573	5	8	8573	5
<i>C. gariepinus</i>	0	0	0	4	7071	1	4	7071	1
<i>H. longifilis</i>	0	0	0	4	9417	2	4	9417	2
<i>B. bajad</i>	0	0	0	3	894	2	3	894	2
<i>B. docmak</i>	0	0	0	5	3897	4	5	3897	4
<i>A. occidentalis</i>	0	0	0	9	4785	7	9	4785	7
<i>S. serratus</i>	0	0	0	31	17280	16	31	17280	16
<i>S. schall</i>	0	0	0	43	19835	11	43	19835	11
<i>H. forskhalii</i>	0	0	0	4	1257	2	4	1257	2
<i>B. macrolepidotus</i>	0	0	0	6	1376	3	6	1376	3
<i>B. nurse</i>	0	0	0	26	1230.9	3	26	1230.86	3
<i>M. kannume</i>	0	0	0	44	18785.5	18	44	18785.5	18
<i>O. niloticus</i>	1	76.7	1	5	227.8	2	6	304.45	3
Total	459	115230	54	665	204213	157	1124	319442.6	211

Appendix 6. Number and weight fishes caught from the sampling sites.

Species	BAB			BB			Mh			Coll		
	N	W(gm)	F	N	W(gm)	F	N	W(gm)	F	N	W(gm)	F
<i>R. loati</i>	109	1565.9	2	2	59	2	0	0	0	0	0	0
<i>V. beso</i>	0	0	0	0	0	0	9	509	6	6	157	2
<i>L. niloticus</i>	7	3152	3	0	0	0	0	0	0	0	0	0
<i>L. horie</i>	4	4094	3	0	0	0	0	0	0	0	0	0
<i>L. coubie</i>	3	1476	2	0	0	0	0	0	0	0	0	0
<i>L. forskalii</i>	32	2203	6	64	18685	19	38	8946	4	52	12696	7
<i>L. cylindricus</i>	23	554.3	2	2	63	1	0	0	0	0	0	0
<i>L. bynni</i>	92	13834.9	10	77	49208	13	0	0	0	0	0	0
<i>L. intermedius</i>	0	0	0	40	9040	6	63	16082	10	259	65089.5	12
<i>L. nedgia</i>	3	236.2	2	15	5412	10	8	2314	3	23	9360	9
<i>L. degeni</i>	2	1357	2	6	7216	3	0	0	0	0	0	0
<i>C. gariepinus</i>	4	7071	1	0	0	0	0	0	0	0	0	0
<i>H. longifilis</i>	4	9417	2	0	0	0	0	0	0	0	0	0
<i>B. bajad</i>	3	894	2	0	0	0	0	0	0	0	0	0
<i>B. docmak</i>	1	287	1	4	3610	3	0	0	0	0	0	0
<i>A. occidentalis</i>	9	4785	7	0	0	0	0	0	0	0	0	0
<i>H. forskhalii</i>	4	1257	2	0	0	0	0	0	0	0	0	0
<i>S. serratus</i>	26	13265	12	5	4015	4	0	0	0	0	0	0
<i>S. schall</i>	39	16726	9	4	3109	2	0	0	0	0	0	0
<i>B. macrolepidotus</i>	5	1351	2	1	25	1	0	0	0	0	0	0
<i>B. nurse</i>	26	1230.9	3	0	0	0	0	0	0	0	0	0
<i>M. kannume</i>	17	12378	7	27	6407.5	11	0	0	0	0	0	0
<i>O. niloticus</i>	5	227.8	2	0	0	0	0	0	0	1	76.7	1
Total	418	97363	82	247	106850	75	118	27851	23	341	87379.2	31

Appendix 7. Number and weight fishes caught from Beles and Gilgel Beles Rivers in the two seasons.

Species	Beles and Gilgel Beles						Beles						Gilgel Beles					
	Dry			wet			Dry			wet			Dry			wet		
	N	W (gm)	F	N	W (gm)	F	N	W (gm)	F	N	W (gm)	F	N	W(gm)	F	N	W (gm)	F
<i>R. loati</i>	15	73.8	1	96	1551.06	2	15	73.8	1	96	1551.06	2	0	0	0	0	0	0
<i>V. beso</i>	5	310	3	10	356	5	0	0	0	0	0	0	5	310	3	10	356	5
<i>L. niloticus</i>	5	2176	2	2	976	1	5	2176	2	2	976	1	0	0	0	0	0	0
<i>L. horie</i>	2	2355	2	2	1739	2	2	2355	2	2	1739	2	0	0	0	0	0	0
<i>L. coubie</i>	3	1476	2	0	0	0	3	1476	2	0	0	0	0	0	0	0	0	0
<i>L. forskalii</i>	105	24652	16	81	17878	20	39	9992	11	57	10896	14	66	14660	5	24	6982	6
<i>L. cylindricus</i>	0	0	0	25	617.3	3	0	0	0	25	617.3	3	0	0	0	0	0	0
<i>L. bynni</i>	32	13402	8	137	49640.9	15	32	13402	8	137	49640.9	15	0	0	0	0	0	0
<i>L. intermedius</i>	24	4396	4	338	85815.5	24	0	0	0	40	9040	6	24	4396	4	298	76775.5	18
<i>L. nedgia</i>	4	1287	3	45	16035.2	21	3	1028	2	15	4620.2	10	1	259	1	30	11415	11
<i>L. degeni</i>	3	2131	3	5	6442	2	3	2131	3	5	6442	2	0	0	0	0	0	0
<i>B. docmak</i>	2	1676	2	3	2221	2	2	1676	2	3	2221	2	0	0	0	0	0	0
<i>B. bajad</i>	3	894	2	0	0	0	3	894	2	0	0	0	0	0	0	0	0	0
<i>C. gariepinus</i>	4	7071	1	0	0	0	4	7071	1	0	0	0	0	0	0	0	0	0
<i>H. longifilis</i>	4	9417	2	0	0	0	4	9417	2	0	0	0	0	0	0	0	0	0
<i>A. occidentalis</i>	5	2540	3	4	2245	4	5	2540	3	4	2245	4	0	0	0	0	0	0
<i>S. serratus</i>	13	7137	7	18	10143	9	13	7137	7	18	10143	9	0	0	0	0	0	0
<i>S. schall</i>	22	8470	5	21	11365	6	22	8470	5	21	11365	6	0	0	0	0	0	0
<i>H. forskhalii</i>	4	1257	2	0	0	0	4	1257	2	0	0	0	0	0	0	0	0	0
<i>B. macrolepidotus</i>	1	1221	1	5	155.1	2	1	1221	1	5	155.1	2	0	0	0	0	0	0
<i>B. nurse</i>	7	314	1	19	916.86	2	7	314	1	19	916.86	2	0	0	0	0	0	0
<i>M. kannume</i>	14	8013	8	30	10772.5	10	14	8013	8	30	10772.5	10	0	0	0	0	0	0
<i>O. niloticus</i>	1	62	1	5	242.46	2	1	62	1	4	165.8	1	0	0	0	1	76.66	1
Total	278	100331	79	846	219111.9	132	182	80705.8	66	483	123507	91	96	19625	13	363	95605.2	41

