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DIVERSITY AND RELATIVE ABUNDANCE OF FISHES IN SOME RIVERS OF THE TEKEZE AND BLUE NILE (ABAY) BASINS, ETHIOPIA

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ABSTRACT: Diversity and relative abundance of fish species of Gendwuha, Guang, Shinfa, and Ayima Rivers from Tekeze and Blue Nile (Abay) basins were studied. One thousand sixty three (1063) fish samples were collected using gillnets of 6, 8, 10, 12 and 14 cm stretched mesh sizes, monofilaments with stretched mesh sizes of 5, 10, 15, 19, 25 35, 45 and 55 mm as well as hooks and lines. Fish sampling was also done by fyke and cast nets. The fishes were collected in dry and wet seasons in October-November 2007 and January 2008. Twenty seven species were identified that belong to 18 genera and 13 families. Cyprinidae, Alestidae, Bagridae and Mormyridae were the dominant families, with respect to numbers of species. Cyprinidae was the most dominant family in all the four rivers, and it comprised 51.5 % (Index of Relative Importance-IRI) of the catches from the four rivers. *Labeobarbus* and *Mormyrus* were the most represented genera with 4 and 3 species each, respectively. A higher number of species was recorded from Rivers Shinfa and Ayima with 20 species each, whereas 18 and 16 species were identified from Guang and Gendwuha Rivers, respectively. Fish contributes to food security of the surrounding communities and understanding the resource potential and recommending appropriate management options for sustainable utilization of this fishery need further research.

Key words/phrases: Blue Nile basin, Conservation, Fish abundance, Fish diversity, Tekeze basin.

INTRODUCTION

The inland water bodies of Ethiopia cover about 7,400 km^2 of lake area and about 7,000 km total length of rivers (Wood and Talling, 1988). These water bodies contain large population of fish species. However, the territory of Ethiopia seems to be one of the regions of the African continent which are least explored for their icthyofauna (Golubtsov *et al*., 1995).

The main drainage basins of Ethiopia flow away from the rift system either towards the Nile system in the west or to the Indian Ocean in the southeast. Ethiopia has seven drainage basins that include Abay, Awash, Wabeshebelle-Ghenale, Omo-Gibe, Baro-Akobo, Tekeze and Rift valley

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basins (Mesfin Wolde Mariam, 1970); which can be categorized under three main drainage systems.

The first main drainage system is the western drainage system which includes the sub-drainage systems of Baro-Akobo, Abay (Blue Nile) and Atbara-Tekeze. Rivers Didessa, Dabus, Abat Beles, Gelgel Beles, Beshilo, Dura and Ardi are tributaries of the Abay (Blue-Nile) that drain the southwestern parts of the western highlands of Ethiopia (Abebe Getahun and Stiassny, 1998). In the Tekeze basin, Angereb, Sanja and Guang drain the northwestern parts of the western highlands, north of Lake Tana (MoWR, 1998 cited in Genanaw Tesfaye, 2006). All the rivers drain to Sudan to join the White Nile.

The second drainage system is the rift valley system, which is composed of Awash sub-drainage system that drains into Lake Abbe, at the Ethio-Djibouti border and it is a closed system. Omo-Gibe sub-drainage system flows to the south to Lake Turkana (Rudolf) at the border with Kenya. The Rift Valley lakes are again categorized into three sub-systems on the bases of the similarities of their fish fauna, and these are southern Rift Valley lakes (Chamo, Abaya and Chew Bahir); central Rift Valley lakes such as Hawassa, Shalla, Abijata, Langeno and Ziway (LFDP, 1996) and the extreme north saline lakes such as Afambo, Gamari, Afdera, Asale and parts of Abbe.

The third main drainage basin is the Wabeshebelle-Juba drainage system. It is composed of sub-drainage systems of Ghenale, Dawa and Weyb Rivers that join Shebelle River and then drain to southwestern parts of the eastern highlands. The Wabeshebelle River is called Juba in Somalia. The major rivers in this drainage system arise from the eastern highlands in the Bale Mountains of Ethiopia and flow into the Indian Ocean (Roberts, 1975).

The fresh water fish fauna of Ethiopia contains a mixture of Nilo Sudanic, East African and Endemic forms (Banaerscu, 1995; Nichols and Griscom, 1975; Roberts, 1975 cited in Abebe Getahun and Stiassny, 1998). The Nilosudanic forms are related to West African fishes and this, too, is believed to be due to past connections of the Nile to central and West African river systems (Boulenger, 1905; Nichols and Griscom, 1917; Nichols, 1928 cited in Abebe Getahun, 2002). 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 basin (e.g. the genera *Alestes* Müller and Troschel, *Bagrus* Bosc *, Citharinus* Cuvier*, Hydrocynus* Cuvier*, Hyperopisus* Gill*, Labeo* Cuvier*, Mormyrus*

Linnaeus etc.) (Abebe Getahun and Stiassny, 1998; Abebe Getahun, 2005, 2007).

Although Ethiopia has high production potential and diversity of fish fauna, notable fishery investigations have been carried out only in a few of the freshwater bodies. Gendwuha, Guang, Shinfa and Ayima Rivers are some of the rivers flowing to the lower course of Tekeze and Abay in which adequate attention has not been given to the study of the diversity, abundance and economic potential of the fish fauna. This was due to inaccessibility, security problems and harsh geographical features of the area.

The objectives of the study were, therefore, to:

- identify the fish diversity of some major rivers in the Tekeze and Abay Basins and
- quantify the relative abundance of the fish species found in these rivers.

MATERIALS AND METHODS

Description of the study area

Gendwuha, Shinfa and Guang Rivers are found in Metema district of North Gondar Administrative Zone while Ayima River is found in Quara district of the same zone (Fig. 1). The rivers are perennial and Ayima River is the largest while Guang is the smallest in volume of water both during the dry and wet seasons. All the four rivers flow through gentle slopes, without waterfalls, in all areas of the sampling sites.

The general climate of the region is hot with high temperature, consistent with the altitude of the region. The altitude, temperature and coordinates of the sampling sites are given in Table 1.

All studied rivers are found at altitudes ranging from 500 m to below 800 m above sea level. Shinfa and Ayima Rivers are found relatively in lower altitudes and the forest coverage of their catchment areas are relatively denser than the other two rivers. Monthly mean maximum temperature and monthly mean minimum temperature at Metema station ranges from 30.0^0C in August to 42.8^0C in April and 15.4^0C in December to 24.1^0C in April, respectively (Fig. 2a) (Ethiopian Meteorological Agency, 2008). Mean monthly rainfall at the same station ranges from 0.00 mm during December, January and February to 252.78 mm in August (Fig. 2b) (Ethiopian Meteorological Agency, 2008).

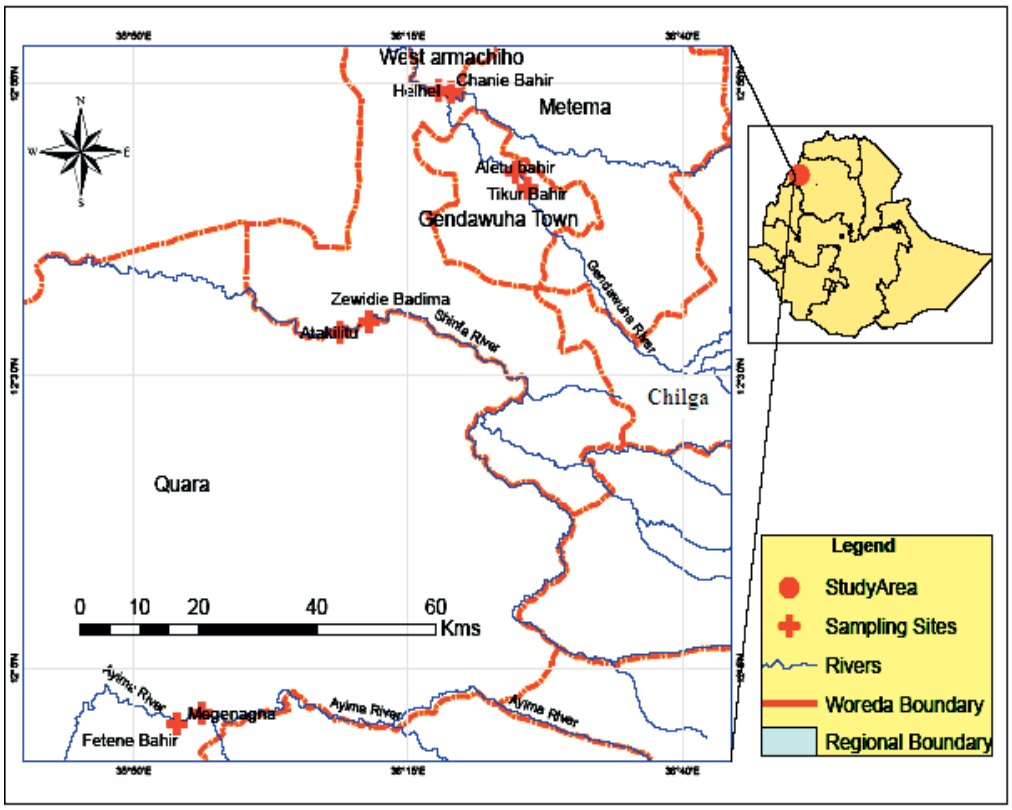

Fig.1. Map of the sampling sites at Gendwuha, Guang, Shinfa and Ayima Rivers.

Table 1. Estimated distances of sampling sites from nearby reference towns, and their elevations, coordinates and temperatures.

River	Sampling site	Reference town	Distance (km)	Elevation (a.s.l)	Coordinate (GPS)	Lowest and highest temp.
Gendwuha	Aletu Bahir	Shehedi	1.5	737	N 12° 47' 24.7" E 036° 24' 46.3"	24.5-29.6
	Tikur Bahir	Shehedi	6	741	N 12° 46' 12.3" E 036° 25' 50.7"	
Guang	Helhel	Kokit	7.5	692	N 12° 54' 27.9" E 036° 18' 08.6"	26.9-28.5
	Chanie Bahir	Kokit	8.5	694	N 12° 54' 18.3" E 036° 18' 19.8"	
Shinfa	Atakiltu (Mohammedie) Bahir	Shinfa	1	586	N 12° 33' 45.5" E 036° 08' 44.0"	27.25-30.7
	Zewdie badima Bahir	Shinfa	6	592	N: 12° 34' 41.2" E:036° 11' 25.6"	
Ayima	Megenagna	Gelegu	24	638	N 12° 00' 58.9" E 035° 56' 08.8"	24.5-29.9
	Fetene Bahir	Gelegu	32.5	645	N 12° 00' 26.9" E 035° 54' 00.7"	

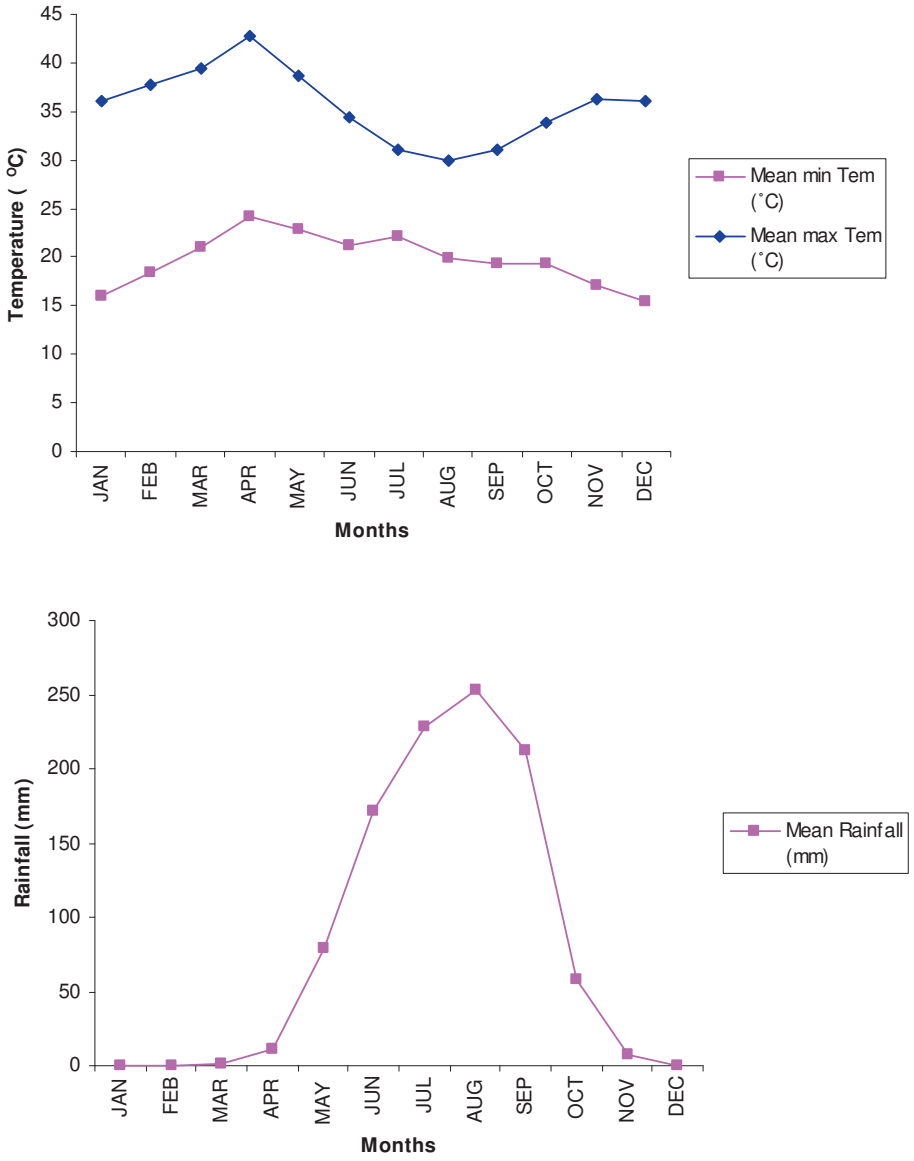

Fig. 2. Monthly Mean maximum and minimum temperature (a) and mean monthly rainfall (b) at Metema station from 2004-2007 (Ethiopian Meteorological Agency, 2008).

Fishing in all the rivers was carried out using gillnets, hook and lines, fykenets, castnets, spears and poisons prepared from seeds and barks of "Lalo" (*Balanites aegyptica*) and "Birbira" (*Milletia ferruginea*) as well as an industrial product of Malathion chemical.

Gendwuha River

Gendwuha River is located near Gendwuha town at about 151 km from Gondar town. Sinkua and Gint Rivers are major tributaries to Gendwuha. Fishes were collected from two sites. The sites were identified based on differences in habitat, vegetation cover, human and animal impact and types of bottom substrates.

Site 1 was located at Aletu Bahir, by the side of Metema Preparatory and Senior Secondary school, north east direction from Gendwuha town. The bottom of the water was mainly sandy, and there are big trees at the river banks. Site 2 was at Tikur Bahir, which is located 6 km upstream of the first site, and which is relatively free from human and animal impacts. The water has mainly rocky bottom substrates and the banks are scarcely covered with big trees.

Guang River

Guang River is located at around 18 km from Gendwuha town on the way to the border with Sudan. Two sampling sites were selected. Site 1 (Helhel), has bottom basalt rock and hard black rocks at each side of the river bank. Site 2 (Chanie Bahir), which is 0.5 km upstream of the first site, is with muddy substrates and is narrow and deep. The two sites are not impacted by agricultural activities (relatively free of human and animal impacts). Fishing activity in Guang River was mainly carried out by four permanent fishermen, and their market for the catch is Gelabat town at the Sudanese border which is located at 34 km from Gendwuha town.

Shinfa River

Shinfa River is located at 46 km from Gendwuha town in the west direction. Shinfa River, before leaving the territory of Ethiopia, serves as a boundary for two districts of North Gondar zone; namely Metema and Quara. Last destination of Shinfa River is a lake known as Alfa Jedida in the semi desert area of Sudan. This lake is used for irrigation purposes and farmers produce "Besel", vernacular name of onion. Shinfa River originates around Shawera town in Alefa Takusa district. Main tributary of Shinfa River is Jira River that joins with the main channel at Bambasefer of Shashgie village in Metema district.

Two sampling sites were selected and Site 1, known locally as Atakiltu (Mohamedie) Bahir, is a site where horticultural activities are taking place and human and animal interferences are relatively high. The riparian vegetation is relatively intact at this site and it is about 1 km east of Shinfa town. Site 2. Zewdie Badima Bahir-It is about 1-1.5 km far from Shinfa town particularly from the main Metema-Quara road; and it is about 6 km north east of the "Gumuz village". The two sites are 7 km far apart from each other (Zewdie Badima Bahir is upstream). Catchment area of this site is covered by a dense canopy of trees. There are two fishermen cooperatives with 10 members in each. This was due to recent increase of fish demand in the surrounding areas and high cost in the nearby Sudan towns. This has also attracted illegal fishers that poison fishes by using plant and chemical products.

Ayima River

Ayima River arises from Jawi district, which is found in Awi zone of the Amhara Region and the river goes out of the country into the Sudan by dissecting the Amhara and Benishangul Gumuz Regions. Major tributaries of Ayima River are Adebluk, Sid, Awjemis, Demo and Tsira Rivers. There are two fishermen cooperatives (although at their early stage) that were recently organized around Ayima River. The cooperatives export dried fish to Sudan and present to local markets. Fishermen use locally made gillnets and hook and lines that come from Bahir Dar and Sudan. Selferege, Dubaba and Gelegu Rivers are rivers, which are potentially rich in fish that are found across the main road from Shinfa to Gelegu town (Quara district). There is obviously a need of further investigation of fish stocks in these rivers.

The river is accessible at around Gelegu village near Bemur, in Quara district. The sampling site, Fetene Bahir is located at about 14 km from Bemur. The second site, Megenagna is about 6 km upstream of the first site. The two sites are found at the boundary of Benishangul Gumuz Region and Quara district (Amhara Region) where Agew and Gumuz ethnic groups inhabit the area. The Gumuz people are found along the river sides, and they are highly engaged in fishing from Ayima River.

Field sampling

Two sampling sites were selected along each river making up a total of eight sampling sites. Fish samples were collected in both wet season (October-November 2007) and dry season (January 2008). Each site was sampled four

times (two times in the wet season and two times in the dry season). Samples were collected using gillnets of various mesh sizes (6, 8, 10, 12 and 14 cm stretched mesh) and monofilament nets with various stretched mesh sizes (5 mm-55 mm). In all studied rivers monofilaments were set during the day time for only two hours. The gillnets, monofilaments and hooks and lines (long lines) were set, using swimmers, across the width of the river. Gillnets and hooks and lines were set late in the afternoon starting from 4:30 to 5:00 pm and left in the water for about 14 hours and collected in the following morning from 6:30 to 7:30 am. Cast and Fyke nets were also used by selecting an appropriate site. Immediately after capture, total length, fork length, standard length and body weight of all specimens were measured to the nearest 0.1 cm and 0.1 g precision for length and weight, respectively. Specimens were preserved in formalin for further investigation in the laboratory.

Laboratory studies

Specimens were soaked in tap water for one day to wash the formalin from the specimens, and then specimens were identified to species level using taxonomic keys found in Boulenger (1909-1916), Shibru Tedla (1973), and Golubtsov *et al*. (1995). The specimens were also compared with previously identified specimens, especially *Labeobarbus* species, available at Bahir Dar Fisheries and Other Aquatic Life Research Center.

Data analysis

PASGEAR, SPSS for windows version 13 and Mintab for windows version 14 were used for analysis.

Species description

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

Species diversity and relative abundance

Estimation of relative abundance of fishes was made by taking the contribution in number and weight of each species in the total catch in each sampling effort. 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 of the species based on

number and weight of individuals in catches, as well as their frequency of occurrence (Kolding, 1989, 1999; Pinkas *et al*., 1971; Caddy and Sharp, 1986). 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:

$$\%IRIi = \frac{(\%Wi + \%Ni)X\%FiX100}{\sum_{j=1}^{s=1}(\%Wj + \%Nj)X\%Fj}$$

Where %Wi and %Ni are percentage weight and number of each species of total catch, respectively; %Fi is percentage frequency of occurrence of each species in total number of settings. %Wj and %Nj are percentage weight and number of total species of total catch. %Fj is percentage frequency of occurrence of total species in total number of settings. S is total number of 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 index of diversity (H') was calculated as: $H' = \Sigma$ pi ln pi; Where, pi is the proportion of individuals found in the i^{th} species. The Shannon index of diversity (H') was used to indicate diversity at different sampling sites and/or rivers. A high value indicates high species diversity.

RESULTS

Species diversity

A total of twenty seven species of fishes were identified from Rivers Gendwuha, Guang, Shinfa and Ayima at the study sites (Table 2 and 3). A higher number of species were recorded from Ayima and Shinfa Rivers (twenty species each). Eighteen and sixteen species were identified from Guang and Gendwuha Rivers, respectively (Table 3).

Table 2. Fish species composition of Gendwuha, Guang, Shinfa and Ayima Rivers with their common names in Amharic and Gumuz languages.

Species	Fetene bahir	Megenagna	Zewdie badima	Atakiltu bahir	Aletu bahir	Tikur bahir	Helhel	Chanie bahir
L. niloticus	x	x	-	-	-	-	-	-
O. niloticus	-	x	x	x	x	x	x	x
A. biscutatus	x	x	-	-	-	-	-	-
B. docmak	x	-	x	x	x	x	x	x
B. bajad	-	-	x	x	-	x	-	-
S. intermedius	-	-	x	x	-	-	-	-
C. gariepinus	x	x	x	x	x	x	-	-
H. longifilis	x	-	-	x	-	-	-	x
M. electricus	-	-	-	-	-	-	x	-
S. serrata	x	x	x	x	x	x	x	x
S. schall	x	x	x	x	x	x	x	x
H. niloticus	x	x	-	-	-	-	-	-
M. kannume	-	-	x	x	x	x	x	x
M. hasselquistii	x	x	-	-	x	x	-	-
M. caschive	-	-	x	-	-	-	-	-
H. forskahlii	x	x	x	-	x	x	x	x
A. baremoze	x	x	x	x	-	-	-	-
B. macrolepidotus	-	x	-	-	x	x	x	x
B. nurse	x	x	-	x	-	-	-	-
C. latus	-	x	-	-	-	-	-	-
L. crassibarbis	-	-	x	-	x	x	x	-
Labeo niloticus	x	x	x	x				x
L. degeni	x	x	x	x	-	x	x	x
L. intermedius	x	x	x	x	x	x	x	x
L. forskalii	x	-	x	x	x	x	x	x
L. nedgia	x	x	x	x	x	x	x	x
B. bynni	x	-	x	x	x	x	x	x

Table 3. Fish distribution among the sampling sites during both wet and dry season (x: present; -: absent) .

Species	Fetene bahir	Megenagna	Zewdie badima	Atakiltu bahir	Aletu bahir	Tikur bahir	Helhel	Chanie bahir
L. niloticus	x	x	-	-	-	-	-	-
O. niloticus	-	x	x	x	x	x	x	x
A. biscutatus	x	x	-	-	-	-	-	-
B. docmak	x	-	x	x	x	x	x	x
B. bajad	-	-	x	x	-	x	-	-
S. intermedius	-	-	x	x	-	-	-	-
C. gariepinus	x	x	x	x	x	x	-	-
H. longifilis	x	-	-	x	-	-	-	x
M. electricus	-	-	-	-	-	-	x	-
S. serrata	x	x	x	x	x	x	x	x
S. schall	x	x	x	x	x	x	x	x
H. niloticus	x	x	-	-	-	-	-	-
M. kannume	-	-	x	x	x	x	x	x
M. hasselquistii	x	x	-	-	x	x	-	-
M. caschive	-	-	x	-	-	-	-	-
H. forskahlii	x	x	x	-	x	x	x	x
A. baremoze	x	x	x	x	-	-	-	-
B. macrolepidotus	-	x	-	-	x	x	x	x
B. nurse	x	x	-	x	-	-	-	-
C. latus	-	x	-	-	-	-	-	-
L. crassibarbis	-	-	x	-	x	x	x	-
Labeo niloticus	x	x	x	x				x
L. degeni	x	x	x	x	-	x	x	x
L. intermedius	x	x	x	x	x	x	x	x
L. forskalii	x	-	x	x	x	x	x	x
L. nedgia	x	x	x	x	x	x	x	x
B. bynni	x	-	x	x	x	x	x	x

Out of the twenty species recorded from Shinfa River, nineteen species were found at Zewdie Badima, sixteen of which also occurred in the second site (Table 3). Out of the eighteen species from Guang River, fifteen species were recorded from Helhel site, eleven of which also occurred at the Chanie Bahir site. Those species that were absent at Chanie Bahir site include *Labeo forskalii* Rüppell, 1836, *Labeobarbus degeni* Boulenger, 1902, *Labeobarbus crassibarbis* (Nagelkerke and Sibbing, 1997), *Hydrocynus* forskahlii (Cuvier, 1819), *Synodontis serrata* Rüppell, 1829, *Synodontis schall* (Bloch and Schneider, 1801) and *Malapterurus electricus* (Gmelin, 1789) (Table 3). From a total of sixteen species recorded from Gendwuha River, eleven species were common to Aletu Bahir and Tikur Bahir sites. *Clarias gariepinus* (Burchell, 1822) was found only at Aletu Bahir site. Barbus bynni (Forsskål, 1775), *L. degeni*, *Bagrus bajad* (Forsskål, 1775) and *S. schall* were found in Gendwuha at Tikur Bahir site only.

Although there was some disparity in the species composition of Gendwuha, Guang, Shinfa and Ayima Rivers, most species occur in all the rivers. The common species included *L. forskalii*, *L. nedgia*, *L. bynni*, *L. intermedius*, *L. degeni*, *H. forskahlii*, *S. serrata*, *S. schall*, *Bagrus docmak* (Forsskål, 1775), and *O. niloticus*. However, *C. latus*, *H. niloticus*, *Lates niloticus* (Linnaeus, 1758) and *A. biscutatus* that were collected from Ayima River were not found in the other three rivers. *M. electricus* was only found in Guang River and *S. intermedius* and *Mormyrus caschive* Linneaus, 1758 were collected only from Shinfa River (Table 3).

Species distribution pattern

Specimens of *L. intermedius*, *S. schall*, *L. degeni*, and *S. serrata* were collected from all studied rivers at both times of the sampling periods. Representatives of *L. forskalii*, *H. forskahlii*, *B. docmak*, *O. niloticus* and *C. gariepinus* were found in all of the rivers at one or the other of the sampling periods. However, *L. forskalii* and *B. docmak* were not found in Ayima River during the wet season, and *H. forskahlii* was not collected from Shinfa River during the wet season. *O. niloticus* was found in Gendwuha only during wet season and *C. gariepinus* was not found in Ayima during wet season and it was not found in Guang and Shinfa Rivers during dry season. *Labeobarbus nedgia* (Ruppel, 1836) and *L. bynni* were not collected during the dry season from Shinfa and Ayima Rivers, respectively.

Mormyrus kannume (Forskål, 1775) and *L. crassibarbis* were found in Gendwuha, Guang and Shinfa Rivers, but not in Ayima River. *L. niloticus* was found in Guang, Shinfa and Ayima Rivers, but not found in Gendwuha.

B. macrolepidotus was found in Gendwuha, Guang and Ayima, but not in Shinfa. During wet season it was not possible to collect it from Ayima River. *Heterobranchus longifilis* (Valenciennes, 1840) was found in Guang, Shinfa and Ayima Rivers. However it was only found in Shinfa and Ayima Rivers during wet season and Ayima River during dry season (Table 3).

B. bajad was found in Rivers Gendwuha and Shinfa, but it was only found in Shinfa River during dry season. Alestes baremoze (Joannis, 1835) and *Brycinus nurse* (Rüppell, 1832) were found in Shinfa and Ayima Rivers. *A. baremoze* was found in both sampling seasons, but B. nurse was found during dry season. *Mormyrus hasselquistii* Valenciennes, 1847 was found in Ayima River during wet season, while it was found in Gendwuha River during both seasons. *A. biscutatus*, *L. niloticus*, and *H. niloticus* were found only in River Ayima in both sampling periods of the year, even though C. latus was found in Ayima River, it occurred only during the dry season as a single specimen. *Schilbe intermedius* (Rüppell, 1832), and *M. caschive* were found only in Shinfa River and *M. electricus* was found only in Guang River as a single specimen (Table 3).

Species diversity during wet and dry seasons

Species composition was much higher in the dry sampling season than in the wet season. Total number of species in the catch in wet season was twenty-four while it was twenty-seven in dry season (Table 3). *C. latus, M. caschive* and *M. electricus* were caught only during the dry season.

The Shannon diversity index (H') was higher in Shinfa River (H' = 2.562) followed by Ayima (H' = 2.51), Guang (H' = 2.43) and Gendwuha (H' = 2.383) Rivers (Table 4). According to Shannon's diversity index (H'), *L. intermedius* was the first (H' = 0.272), while *L. forskalii* the second (H' = 0.237) and *H. forskahlii* the third most diverse species in the total catch (H' = 0.203) (Table 5).

Table 4. Catch composition and Index of Relative Importance (IRI) in the four rivers.

Fish species	Ayima River			Shinfa River			Guang River			Gendwuha River		
	IRI	%IRI	H'	IRI	%IRI	H'	IRI	%IRI	H'	IRI	%IRI	H'
C. gariepinus	1417	23.9	0.22	39	0.6	0.05	-	-	-	45	0.6	0.07
H. forskahlii	1236	20.8	0.3	2	0	0.02	243	3.6	0.16	905	12.1	0.22
Labeo niloticus	1112	18.7	0.29	765	12.1	0.26	6	0.1	0.02	-	-	-
S. schall	712	12	0.26	820	13	0.25	220	3.2	0.14	14	0.2	0.04
S. serrata	302	5.1	0.2	163	2.5	0.1	228	3.4	0.12	219	2.9	0.1
Lates niloticus	290	4.9	0.13	-	-	-	-	-	-	-	-	-
A. baremoze	257	4.3	0.18	19	0.3	0.06	-	-	-	-	-	-
L. degeni	106	1.8	0.08	465	7.4	0.18	270	4	0.13	15	0.2	0.03
H. niloticus	85	1.4	0.05	-	-	-	-	-	-	-	-	-
H. longifilis	84	1.4	0.04	3	0	0.02	4	0.1	0.02	-	-	-
L. nedgia	81	1.4	0.09	425	6.7	0.17	756	11.2	0.23	905	12.1	0.22
L. intermedius	74	1.2	0.09	171	2.7	0.13	2573	37.9	0.33	2322	31.1	0.33
L. forskalii	70	1.2	0.16	362	5.7	0.2	807	11.9	0.27	828	11.1	0.26
B. nurse	44	0.7	0.13	2	0	0.01	-	-	-	-	-	-
A. biscutatus	29	0.5	0.05	-	-	-	-	-	-	-	-	-
B. docmak	20	0.3	0.04	1198	18.9	0.2	520	7.7	0.16	407	5.4	0.14
B. macrolepidotus	5	0.1	0.04	-	-	-	11	0.2	0.05	239	3.2	0.19
O. niloticus	3	0	0.02	16	0.3	0.05	58	0.9	0.13	581	7.8	0.22
B. bynni	2	0	0.02	25	0.4	0.06	69	1	0.13	321	4.3	0.2
C. latus	2	0	0.02	-	-	-	-	-	-	-	-	-
M. kannume	-	-	-	640	10.1	0.23	846	12.5	0.23	621	8.3	0.18
B. bajad	-	-	-	636	10	0.19	4	0.1	0.02	5	0.1	0.01
S. intermedius	-	-	-	569	9	0.26	-	-	-	-	-	-
M. caschive	-	-	-	8	0.1	0.05	-	-	-	-	-	-
L. crassibarbis	-	-	-	3	0.1	0.02	65	1	0.05	29	0.4	0.04
M. hasselquistii	-	-	-	-	-	-	99	1.5	0.16	14	0.2	0.04
M. electricus	-	-	-	-	-	-	3	0	0.02	-	-	-

Relative abundance of fishes

A total of 1063 (448.172 kg) fish specimens were collected from the four rivers. The specimens collected during wet and dry sampling periods were, in decreasing order, from Gendwuha, Shinfa, Guang and Ayima Rivers (Table 5). The biomass of fishes was highest in Shinfa and lowest in Guang Rivers (Table 5).

Table 5. Combined catch composition and Index of Relative Importance (IRI) for the four rivers.

Species	NO	% NO	W(kg)	% W	FRQ	% FRQ	IRI	% IRI	H`	J`
L. intermedius	145	13.6	52.4	11.7	46	38.3	971	20.5	0.27	0.08
L. nedgia	81	7.6	33.61	7.5	40	33.3	504	10.6	0.19	0.06
L. forskalii	112	10.5	27.88	6.2	34	28.3	475	10	0.23	0.07
B. docmak	54	5.1	42.73	9.5	37	30.8	451	9.5	0.15	0.05
M. kannume	77	7.2	33.59	7.5	35	29.2	430	9.1	0.19	0.06
H. forskahlii	86	8.1	30.07	6.7	33	27.5	407	8.6	0.2	0.06
S. schall	76	7.1	20.21	4.5	34	28.3	330	7	0.18	0.06
Labeo niloticus	73	6.9	21.43	4.8	24	20	233	4.9	0.18	0.06
S. serrata	47	4.4	19.93	4.4	30	25	222	4.7	0.13	0.04
L. degeni	37	3.5	22.68	5.1	24	20	171	3.6	0.11	0.04
C. gariepinus	30	2.8	39.92	8.9	16	13.3	156	3.3	0.1	0.03
O. niloticus	44	4.1	9.22	2.1	19	15.8	98	2.1	0.13	0.04
B. bynni	41	3.9	8.68	1.9	16	13.3	77	1.6	0.12	0.04
B. bajad	21	2	23.32	5.2	9	7.5	54	1.1	0.07	0.02
S. intermedius	34	3.2	6.43	1.4	10	8.3	39	0.8	0.11	0.03
A. baremoze	21	2	6.96	1.6	11	9.2	32	0.7	0.07	0.02
B. macrolepidotus	24	2.3	5.91	1.3	10	8.3	30	0.6	0.08	0.03
L. crassibarbis	7	0.7	8.61	1.9	7	5.8	15	0.3	0.03	0.01
Lates niloticus	10	0.9	7.3	1.6	7	5.8	15	0.3	0.04	0.01
M. hasselquistii	18	1.7	2.38	0.5	7	5.8	13	0.3	0.06	0.02
H. longifilis	4	0.4	12.86	2.9	4	3.3	11	0.2	0.02	0.01
H. niloticus	3	0.3	6.98	1.6	3	2.5	5	0.1	0.01	0.01
B. nurse	10	0.9	1.43	0.3	2	1.7	2	0	0.04	0.01
A. biscutatus	3	0.3	1.35	0.3	3	2.5	1	0	0.01	0.01
M. caschive	3	0.3	1.75	0.4	1	0.8	1	0	0.01	0.01
M. electricus	1	0.1	0.48	0.1	1	0.8	0	0	0	0
C. latus	1	0.1			1	0.8	0	0	0	0
Total	1063	100	448.17	100	-	-	4742	100	2.86	0.87

The species collected were analyzed based on the Index of Relative Importance (IRI). Accordingly, *C. gariepinus* (23.9%), *H. forskahlii* (20.8%) and *L. niloticus* (18.7%) were, in order of their decreasing

importance, the most abundant species in Ayima River (Table 4). *B. docmak*, *S. schall* and *L. niloticus* were the most dominant species in Shinfa River, with IRI of 18.9%, 13.0% and 12.1%, respectively (Table 4).

L. intermedius, M. kannume and *L. forskalii* were the most dominant species in Guang River, with 37.9%, 12.5% and 11.9%, respectively (Table 4). *L. intermedius, L. nedgia*, *H. forskahlii* and *L. forskalii* were the most dominant species in Gendwuha River; having IRI values of 31.1%, 12.1%, 12.1% and 11.1%, respectively (Table 4).

Cyprinidae was the most dominant family in Gendwuha, Guang, Shinfa and Ayima Rivers. This family comprised 51.5% IRI of the catches in the four rivers. *L. intermedius* was the most abundant species in the total catch (IRI of 20.5%), while *L. nedgia* was second (10.6%) and *L. forskalii* third (10.0%) (Table 5). The second, third and fourth most dominant families in the total catch were Bagridae (10.6%), Mormyridae (9.4%), and Characidae (9.2%), respectively (Table 5).

Relative abundance of fishes during wet and dry seasons

The number of fishes collected was higher in dry (N=631) than wet season (N=432) for the total catch (Table 6). The total biomass of fishes was also higher in dry (W=249.051 kg) than in wet season (W=199.121 kg) for the total catch (Table 6). The number and weight of fishes caught was higher in dry season than wet season in Ayima and Guang Rivers (Table 6). On the other hand number was a little higher in dry than in wet season but weight was higher in wet than in dry season in Shinfa River.

Table 6. Number and weight (kg) of fishes in the four rivers during wet and dry seasons.

	Rivers									
	Gendwuha		Guang		Shinfa		Ayima		Four rivers	
	wet	dry	wet	dry	wet	dry	wet	dry	wet	dry
Number	174	128	63	204	135	136	60	163	432	631
Weight	67.50	35.56	23.28	79.10	73.82	52.79	34.50	81.59	199.12	249.05

DISCUSSION

Genanaw Tesfaye (2006) has recorded *Varicorhinus beso* Rüppell from the Tekeze basin which could not be collected in the present study. However fourteen species that were identified in this study were not recorded in Genanaw Tesfaye (2006). Similarly six species that were identified by Zeleke Berie (2007) from Abay basin; namely *Raiamas senegalensis* (Steindachner, 1870), *V. beso*, *Labeo horie* Heckel, 1846-49, *Labeo coubie*

Rüppell, 1832, *Labeo cylindricus* Peters, 1868 and *Auchenoglanis occidentalis* (Valenciennes, in Cuvier and Valenciennes, 1840) could not be traced in the present study. On the other hand, ten species identified in the present study were not recorded in Zeleke Berie (2007). These include *L. niloticus*, *H. niloticus*, *A. baremoze*, *A. biscutatus*, *M. hasselquistii*, *M. caschive*, *L. crassibarbis*, *S. intermedius*, *C. latus* and *M. electricus*. According to Moges Beletew (2007), *Garra dembeensis* (Rüppell, 1836) and *G. dembecha* Getahun and Stiassny, 2007 as well as *Barbus humilis* Boulenger, 1902 and *Barbus paludinosus* Peters, 1852 were reported from Dura and Ardi Rivers of Abay drainage basin. However, *Garra* spp. and small *Barbus* species were not collected from all the four rivers during the present study.

Differences seen in the species composition between present study, Zeleke Berie (2007), Moges Beletew (2007) and Genanaw Tesfaye (2006) might be due to differences in sampling efficiency and gears, habitat, and sampling season.

The species list obtained in the present study revealed a difference in number of species between the four studied rivers, similar to the disparity seen in the species lists of the field report of Teferi Mekonnen and Seid Mohammed (2000) between Gendwuha and Shinfa. *V. beso* was the single species that was listed by the above report from Gendwuha and Shinfa that was not identified during the present study.

The difference in fish diversity of the four rivers may be associated with the difference in habitat, volume of water discharge through tributaries, vegetation cover of catchment area and temperature differences. It has been stated that the geomorphology of the riverine scenery in one way or another affects biodiversity pattern (Wardle, 1998). The discharge of water was also mentioned to be influential in Ethiopian river fish diversity (Golubtsov *et al*., 2002). The reason why fish diversity was lower during the wet season than the dry season would probably be due to the high turbidity of rivers, speedy run-off, and low temperature during wet season. It is also reasonable to think that the fishes could be highly dispersed in the large volume of water during the wet season and become difficult to catch.

Fishing in all the rivers was observed to be carried out using gillnets, hook and lines, fyke nets, cast nets, spears and poisons prepared from seeds and barks of a soap berry tree, *Balanites aegyptica* (Linnaeus, 1812) (locally known as “Lalo”) and *Millettia ferruginea* (Hochst, 1846) (locally known as “Birbira”) as well as an industrial product of Malathion chemical. Fish

contributes to food security of the surrounding communities around these rivers. Therefore, understanding the resource potential and recommending appropriate management options for sustainable utilization of these fisheries need further research.

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REFERENCES

Abebe Getahun (2007). An overview of the diversity and conservation status of the Ethiopian freshwater fish fauna. *Journal of Afrotropical Zoology*, Special issue: 87-96.

Abebe Getahun (2005). Freshwater Eco-regions of Ethiopia. In: **Freshwater Eco-regions of Africa,** pp. 253-255 (Theime, M.L., Abell, R., Stiassny, M.L.J., Skelton, P., Lehner, B, Teugels, G.G., Dinerstein, E., Tohan, A.K., Burgess, N. and Olson, D., eds.). A conservation assessment/Island Press, Washington, D.C., U.S.A.

Abebe Getahun (2002). The Nile Basin: Riverine Fish and Fisheries. Department of Biology, Addis Ababa University, Ethiopia. 19 pp.

Abebe Getahun and Stiassny, M.L.J. (1998). The fresh water biodiversity crisis: the case of the Ethiopian fish fauna. *SINET. Eth. J. Sci.* **21**(2):207-230.

Begon, M., Harper, J.L. and Townsend, C.R. (1990). **Ecology: individuals, populations and communities.** 2nd ed. Blackwell Scientific Publications, 945 pp.

Boulenger, G.A. (1909-1916). Catalogue of the fresh water fishes of Africa. Vol. I-IV. British Museum (Natural History), London,

Caddy, J.F. and Sharp, G.D. (1986). An ecological framework of marine fishery investigations. FAO Fish. Tech. Pap. No. 283, 151 pp.

Ethiopian Meteorological Agency (2008). Meteorological data compiled for Metema station at Bahir Dar, Amhara Regional State, Ethiopia.

Genanaw Tesfaye (2006). **Diversity, relative abundance and biology of fishes in Angereb and Sanja Rivers, Tekeze basin, Ethiopia.** MSc.Thesis, Addis Ababa University, Ethiopia. 89 pp.

Golubtsov, A.S., Darkov, A.A., Dgebuadze, Yu.Yu. and Mina, M.V. (1995). An artificial key to fish species of the Gambela region (The White Nile basin in the limits of Ethiopia). Joint Ethio-Russian Biological expedition. Addis Ababa, Ethiopia. 84 Pp.

Golubtsov, A.S., Dgebadze, Yu. Yu. And Mina, M.V. (2002). Fishes of the Ethiopian Rift Valley. In: **Ethiopian Rift Valley Lakes**, pp.167-258 (Tudorancea and Taylor, W.D., eds.). Backhuys Publishers, Leiden, Holland.

Kolding, J. (1989). **The fish resource of Lake Turkana and their environment.** Unpublished thesis, University of Bergen, Norway, 262 pp.

Kolding, J. (1999). **PASGEAR. A data base package for experimental or artisanal fishery data from passive gears.** An introductory manual. University of Bergen,

Department of Fisheries and Marine Biology.

Lake Fisheries Development Project (LFDP) (1996). Lake management plan working paper No 23, Commission of the European communities, Fisheries resources development division in the Ministry of Agriculture, 52 pp.

Mesfin Wolde Mariam (1970). An Atlas of Ethiopia. Polgrafico, Priv. Ltd. co Asmara, Ethiopia. 101 pp.

Moges Beletew (2007). **Diversity, relative abundance and biology of fishes in some rivers, and cestode parasites of African catfish (*C. gariepinus*) in some lakes of Ethiopia.** Unpublished MSc.Thesis, Department of Biology, Addis Ababa University.

Pinkas, L., Oliphant, M.S. and Iverson, I.L.K. (1971). Food habits of albacore, blue fin tuna and bonito in Californian waters. *Calif. Fish Game* **152**:1-105.

Roberts, T.R. (1975). Geographical distribution of African freshwater fishes. *Zool. J. Linn. Soc.* **57**:249-319.

Sanyanga, R.A. (1996). Variation in abundance of *Synodontis zambezensis* (Pisces: Mockokidae) Peters 1852, in the shore fishery of Lake Kariba. *Fish. Res.* **26**:171-186.

Shibru Tedla (1973). Freshwater fishes of Ethiopia. Compiled at the Department of Biology, Addis Ababa University, Addis Ababa, Ethiopia.

Teferi Mekonnen and Seid Mohammed (2000). Riverine fishery survey on Shinfa and Gendwuha rivers in Metema Woreda, North Gondar Zone. Field report. Gorgora fisheries research sub-center, Bahir Dar, Ethiopia.

Wardle, J.V. (1998). Riverine landscapes: Biodiversity patterns, disturbance regimes and aquatic conservation. *Biol. Conserv.* **83**:269-278.

Wood, R. and Talling, J. (1988). Chemical and algal relationships in a salinity series of Ethiopian waters. *Hydrobiologia* **158**: 29-67.

Zeleke Berie (2007). **Diversity, relative abundance and biology of fishes in Beles and Gelgel Beles Rivers, Abay basin, Ethiopia.** Unpublished MSc.Thesis, Department of Biology, Addis Ababa University, Ethiopia. 108 pp.