Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 6, Issue, 05, pp.6466-6473, May, 2014

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

# DIVERSITY AND ABUNDANCE OF FISHES IN AVEYA RIVER, BLUE NILE BASIN, ETHIOPIA

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## ARTICLE INFO

*Article History:*
Received 26th February, 2014
Received in revised form
14th March, 2014
Accepted 15th April, 2014
Published online 20th May, 2014

*Key words:*

Cyprinids,
River,
Species Composition

## ABSTRACT

In the present study we evaluate the diversity and abundance of fishes in Aveya River during the wet season (September-October 2011) and dry season (March-April 2012). Fishes were collected from seven sampling sites by using multi-mesh gillnets of stretched mesh sizes 6, 8, 10, 12 and 14 cm. Eight hundred six fish specimens, all belonging to the Cyprinidae, were collected. All the studied rivers were dominated by cyprinids. The sites harbors large flock of *Varicorhinus beso* population which is IUCN red list category. Gumara site had the highest diversity (average H' = 3.47) in both seasons. All the fish species showed significant differences in abundance between seasons with overall catch composition of 55.5%, 17.2%, 16.0% and 11.3% for *V. beso*, *Labeobarbus nedgia*, *L. intermedius* and *L. forskalii*, respectively. *Varicorhinus beso*, *L. nedgia* and *L. intermedius* were the most important species in both seasons and in most of the sampling sites. Our results showed that the studied habitats are in danger of being destroyed and therefore catchment rehabilitation should be considered and the massive seasonal fishing by the local communities should be reduced.



## INTRODUCTION

Ethiopia is the water-tower of East Africa and has a number of inland water bodies. The Lakes and rivers cover a total area and length of about 7400 $km^2$ and 7700 km, respectively (Wood and Talling, 1988). In Ethiopia, there are nine major river basins. The Blue Nile basin is the largest basin in Ethiopia. Rivers of this basin drain the great central and north-west plateau. It accounts for almost 20% of Ethiopia's land area and 50% of its total average annual run-off (BCEOM, 1999; Getahun, 2005 a, b). Some of the families of fishes identified within the Blue Nile and its tributary rivers are Mormyridae, Characidae, Cyprinidae, Bagridae, Schlibeidae, Mockokidea and Cichlidae (MoWR, 1998).

Studies on species diversity and abundance are important to obtain information on the quality and quantity of the available habitats. Since the 20th century, many fish species have suffered continuing declines in abundance and distribution, some at alarming rate. In many parts of the world human population growth, agricultural development and industrialization contribute to the loss of species diversity of inland water fishes (Getahun and Stiassny, 1998). Widespread deforestation and degradation of the pristine environment and other human induced factors might have left many Ethiopian streams, especially the northern ones, devoid of fish but the apparently resilient cyprinids (Getahun and Stiassny, 1998). In Ethiopia, the fish diversity and species distributions is still poorly known (JERBE, 1995; Getahun, 2005b). A large number of small, medium and even some large rivers have not been well studied including the ones explored in this study, the Aveya River. The absence of information about fish diversity and distribution in this river triggered the necessity to conduct this study. We addressed the following research questions: 1) What is the species composition and relative abundance of fishes in the 'Aveya River?' 2) Does the fish species composition in these rivers differ from the Blue Nile River?

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## MATERIALS AND METHODS

### Description of the study area

The source of Blue Nile River is Lake Tana and flows at the Eastern outskirts of Bahir Dar town, forming the famous Blue Nile Fall (Tiss Isat Fall) after 30 km travel from its source which drops down into a gorge with a depth of about 45 m (Dile, 2009). Blue Nile River basin lies in the west of Ethiopia between latitude 7°45' and 12°45' N, and longitude 34°05' and 39°45' E (MoWR, 2010). The present study was conducted in lower catchment areas of Aveya River which is arising from the central Gojjam highlands (Figure 1). The studied river flow to the Eastern side of Gojjam highlands and joins the main Blue Nile River. This river is found near the border of East (Hulet Iju Enesie and Bibugn Woredas) and West Gojjam (Dega Damot Woreda).

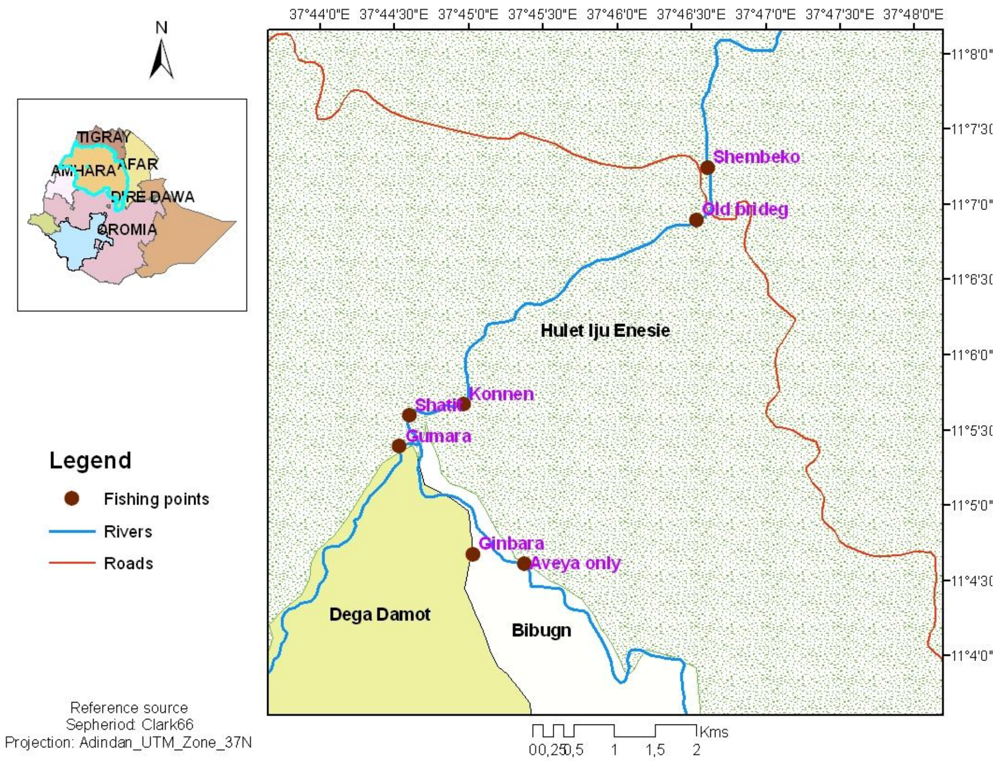


**Figure 1. Map of study area and sampling sites**

## Field sampling

Seven sampling sites were selected by considering nature and velocity of the flowing river, accessibility, interference by human beings and other farm animals and substrate type of the sediments and suitability for setting gillnets, the coordinates of the sampling sites were determined using GPS (Figure 1 and Table 1). Data was collected both in dry season (April 2012) and wet season (October 2011). Fish was sampled by an overnight setting of multifilament and monofilament gillnets. Multifilament gillnets had mesh sizes 6, 8, 10, 12 and 14 cm stretched bar mesh and a length of 25 m and a depth of 1.5 m. Whereas monofilament gillnets had mesh sizes of 5 mm - 55 mm and a length of 25 m and a depth of 1.5 m. Fish were identified to the species level using the keys developed by Nagelkerke (1997). After taking the entire necessary information, individual specimen were preserved with 4% formalin and put in plastic jar and was transported to the laboratory of Bahir Dar Fisheries and other Aquatic Life Research Center for further identification and to serve as a reference specimen.

## Species diversity and relative abundance

Estimation of relative abundance of fish was made by the contribution of the catch in each sampling effort. An Index of Relative Importance (IRI) and Shannon Diversity Index (H') were used to evaluate relative abundance and diversity of fish, respectively. An IRI is a measure of 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). IRI gives a better replacement of the ecologically important species rather than the weight, number or frequency alone (Sanyanga, 1996).

$$\%\mathbf{IRI} = \frac{(\%\mathbf{W_i} + \%\mathbf{N_i}) \times \%\mathbf{F_i}}{\sum_{j-1}^{s-1}(\%\mathbf{W_j} + \%\mathbf{N_j}) \times \%\mathbf{F_j}} \times \mathbf{100}$$

Where, %Wi and %Ni are percentages weight and number of each species of total catch, respectively. %Fi is a percentage frequency occurrence of each species in total number of settings. %Wj and Nj are percentage weight and number of total species in total catch. Fj is percentage frequency of occurrence of total species in total number of settings. The Shannon index of diversity (H'): H' is a measure of species weighted by the relative abundance (Begon *et al*., 1990).
H' is calculated as follows:

$$H' = \sum pi \ln pi$$

Where, pi - the proportion of individuals in the $i^{th}$ species. Shannon index is used to indicate diversity of fishes at different sampling sites or rivers.

## Data Analysis

Descriptive statistics was used to analyze the mean value of the biomass weight during wet and dry seasons and also the mean, range and standard error of the species length frequency. The significant difference of species relative abundance during wet and dry season was analyzed using t-test. One way ANOVA was used to determine the significant difference of species diversity between sites. SPSS version 16 and Microsoft Excel sheet 2007 was used to analyze and manage the data.

## RESULTS

### Species composition

In our study, a total of four species were identified, namely: *V. beso*, *L. intermedius*, *L. nedgia* and *L. forskalii* (Table 2). The local seasonal fishers also confirmed that there are four species only in the rivers studied. They are represented by a single class Actinopeterygii (ray-finned fishes), a single order cyprinformes and a single family cyprinidae (Table 2). In all the rivers studied, the family cyprinidae was the only dominant family. The freshwater fish fauna of all the rivers studied contained a mixture of Nilo-Sudanic (*L. forskalii*) and highland East African (e.g., *V. beso*, *L. intermedius* and *L. nedgia*). Whereas *V. beso*, *L. intermedius*, *L. nedgia* and *L. forskalii* were found in most of the sampling sites, *L. nedgia* and *L. forskalii* were not found at the upper most site (named Aveya) in the Aveya River system (Table 2). The number of fish species was low at Aveya and Ginbara (Table 2). Thus, *V. beso* and *L. intermedius* were common in all the sampling sites in both seasons (Table 2). Aveya River was dominated by the only family Cyprinidae and mainly by the genus *Labeobarbus*.

**Table 1. Sampling sites and their characteristics: Elevation, habitat and width**

| Sites | Elevation (m) | Habitat | Width (m) |
|---|---|---|---|
| Aveya | 1548 | Clear water, sandy substrate, forest cover at the right bank | 250 |
| Ginbara | 1739 | Turbid water , rocky substrate, forest cover on both sides | 200 |
| Gumara | 1730 | Clear water, rocky substrate, and forest covered | 150 |
| Shatit | 1709 | Clear water, sandy substrate and forest cover | 150 |
| Konnen | 1718 | Clear water, rocky substrate, trees and small shrubs | 70 |
| Old Bridge | 1669 | Clear water, sandy substrate | 160 |
| Shembeko | 1640 | Clear water, rocky substrate | 110 |

**Table 2. Fish distribution in wet and dry seasons**

| Sites | Season | Species | | | |
|---|---|---|---|---|---|
| | | *V. beso* | *L. intermedius* | *L. nedgia* | *L. forskalii* |
| Aveya | Wet | + | + | - | - |
| | Dry | + | + | - | - |
| Ginbara | Wet | + | + | - | + |
| | Dry | + | + | - | + |
| Gumara | Wet | + | + | + | + |
| | Dry | + | + | + | + |
| Shatit | Wet | + | + | + | + |
| | Dry | + | + | + | + |
| Konnen | Wet | + | + | + | + |
| | Dry | + | + | + | + |
| Old Bridge | Wet | + | + | + | - |
| | Dry | + | + | | + |
| Shembeko | Wet | + | + | + | - |
| | Dry | + | + | + | + |

### Species diversity and abundance

Shannon diversity index (H') was used to evaluate species diversity in all sampling sites. Shannon diversity index explains both variety and the relative abundance of fish species (Naesje *et al*., 2004). Gumara showed the highest species diversity as compared to other sites in both seasons (Table 3). The H' was highest at Gumara with the values of (H' = 3.34) followed by Ginbara (H' = 2.83), Old Bridge (H' = 2.81), Shembeko (H' = 2.75), Konnen (H' = 2.64), Shatit (H' = 2.29) and Aveya (H' = 1.33) during wet season (Table 3). The H' was highest at Gumara with the values of (H' = 3.6) followed by Shembeko (H' = 3.45) and Old Bridge (H' = 3.15) during the dry season sampling period (Table 3). In both seasons, Aveya was the least in species diversity. There was no significant variation ($P > 0.05$) in H' and N among all the sampling sites in both seasons. The number of fish species was similar in both seasons. However, Shannon diversity index (H') value was generally higher in dry season than wet season in all the sampling sites except sampling sites Aveya and Ginbara (Table 3). Generally, the Shannon diversity index indicates that there was no species segregation among the sampling sites and months, indicating all the four cyprinid fishes are adapted to live in all tributaries of this catchment.

During the study period, 44455.7 kg and 92750.8 kg total biomass of specimens were collected during wet and dry seasons, respectively (data not shown). Dry season showed higher values than wet season in terms of weight (kg) and number of specimens of fishes. In all sampling sites except at Ginbara, the number of fishes was high during the dry season than wet (Table 4). The reason for such variations could be probably due to the high turbidity of the river water, velocity of the water and low temperature during wet season may have attributed to the less number of fish caught in that season. During wet season, there was also higher water discharge; fishes could have highly dispersed in the large volume of water in this season as compared to the dry season and it became difficult to catch them. In addition, the variation in catches between wet and dry seasons might be due to the variation gillnet efficiency and time of setting of gillnet. Wood logs, leaves, roots and grasses which were brought by flooding, could have decreased the efficiency of gillnets during the wet season.

### Relative abundance of fish during wet and dry seasons

All fish specimens showed very highly significant variation in number of catches between dry and wet seasons ($P < 0.001$) (Table 4). There was a highly significant difference in fish specimen abundance between dry and wet seasons for all specimens collected (Table 4). In this study, *V. beso* was the most abundant specie, constituting of 55.46% in the total number of catch. *Labeobarbus nedgia*, *L. intermedius* and *L. forskalii* were found in relative abundance of 17.25%, 16% and 11.29%, respectively (Table 4). The species composition of all catches both in dry and wet seasons ranked based on the IRI value for different sampling site (Tables 5 and 6). *Varicorhinus beso* was the most important fish species in wet season at Aveya, Ginbara, Shatit and Konnen with IRI values of 98%, 76%, 64% and 45%, respectively but *L. nedgia* was the most

**Table 3. Shannon diversity index (H') and number of fish species (N) in wet and dry season**

| Season | H′/N | Sampling sites | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Aveya | Ginbara | Gumara | Shatit | Konnen | Old Bridge | Shembeko |
| Wet | H′ | 1.33 | 2.83 | 3.34 | 2.29 | 2.64 | 2.81 | 2.75 |
| | N | 2 | 3 | 4 | 4 | 4 | 3 | 3 |
| Season | H′/N | Sampling Sites | | | | | | |
| | | Aveya | Ginbara | Gumara | Shatit | Konnen | Old Bridge | Shembeko |
| Dry | H′ | 1.15 | 1.93 | 3.6 | 2.87 | 3.13 | 3.15 | 3.45 |
| | N | 2 | 3 | 4 | 4 | 4 | 4 | 4 |

**Table 4. Total catches of fishes in dry and wet seasons (t-test)**

| | Seasons | | | | |
|---|---|---|---|---|---|
| Fish species | Wet | Dry | Total | Percentage Composition | P-value |
| *V. beso* | 105 | 342 | 447 | 55.46 | 0.000*** |
| *L. intermedius* | 38 | 92 | 129 | 16.00 | 0.000*** |
| *L. nedgia* | 41 | 98 | 139 | 17.25 | 0.000*** |
| *L. forskalii* | 9 | 82 | 91 | 11.29 | 0.000*** |

*** (P<0.001) (highly significant)

**Table 5. Percentage of Index of Relative Importance (IRI) of fishes in all sampling sites during wet season. (NB: %Wi and %Ni = percentages in weight and number of each species of total catch. %Fi = percentage frequency occurrence of each species in total number of settings. %Wj and Nj = percentages in weight and number of total species in total catch. Fj = percentage frequency of occurrence of total species in total number of settings.)**

| Sites | Fish | Ni | %Ni | Wi | %Wi | Fi | %FI | IRI | %IRI |
|---|---|---|---|---|---|---|---|---|---|
| Aveya | *L. intermedius* | 1 | 8 | 81.1 | 5 | 1 | 17 | 230 | 2 |
| | *V. Beso* | 11 | 92 | 1404.4 | 95 | 3 | 50 | 9310 | 98 |
| | Total | 12 | 100 | 1485.5 | 100 | 6 | 100 | 9540 | |
| | *L. intermedius* | 4 | 50 | 7.4 | 2 | 1 | 17 | 859 | 16 |
| Ginbara | *V. beso* | 2 | 25 | 466.4 | 98 | 2 | 33 | 4095 | 76 |
| | *L. forskalii* | 2 | 25 | 2.8 | 1 | 1 | 17 | 426 | 8 |
| | Total | 8 | 100 | 476.6 | 100 | 6 | 100 | 5381 | |
| | *L. intermedius* | 4 | 31 | 370.8 | 27 | 1 | 17 | 968 | 29 |
| Gumara | *V. beso* | 1 | 8 | 97.2 | 7 | 1 | 17 | 247 | 7 |
| | *L. forskalii* | 2 | 15 | 368.6 | 27 | 1 | 17 | 708 | 21 |
| | *L. nedgia* | 6 | 46 | 522.5 | 38 | 1 | 17 | 1410 | 42 |
| | Total | 13 | 100 | 1359.1 | 100 | 6 | 100 | 3333 | |
| | *L. intermedius* | 2 | 4 | 262.9 | 3 | 1 | 17 | 111 | 1 |
| Shatit | *V. beso* | 39 | 74 | 4582.2 | 50 | 3 | 50 | 6169 | 64 |
| | *L. forskalii* | 4 | 8 | 296.8 | 3 | 2 | 33 | 359 | 4 |
| | *L. nedgia* | 8 | 15 | 4059.7 | 44 | 3 | 50 | 2961 | 31 |
| | Total | 53 | 100 | 9201.6 | 100 | 6 | 100 | 9599 | |
| | *L. intermedius* | 10 | 16 | 4795.2 | 30 | 3 | 50 | 2268 | 21 |
| Konnen | *V. beso* | 40 | 63 | 5704.5 | 35 | 3 | 50 | 4894 | 45 |
| | *L. forskalii* | 1 | 2 | 179.5 | 1 | 1 | 17 | 45 | 0 |
| | *L. nedgia* | 13 | 20 | 5448 | 34 | 4 | 67 | 3606 | 33 |
| | Total | 64 | 100 | 16127.2 | 100 | 6 | 100 | 10812 | |
| Old Bridge | *L. intermedius* | 15 | 48 | 6247.9 | 66 | 1 | 17 | 1900 | 33 |
| | *V. Beso* | 6 | 19 | 862.8 | 9 | 2 | 33 | 947 | 17 |
| | *L. nedgia* | 10 | 32 | 2415.8 | 25 | 3 | 50 | 2881 | 50 |
| | Total | 31 | 100 | 9526.5 | 100 | 6 | 100 | 5727 | |
| | *L. intermedius* | 2 | 17 | 511.1 | 8 | 2 | 33 | 827 | 9 |
| Shembeko | *V. Beso* | 6 | 50 | 1457.1 | 23 | 3 | 50 | 3660 | 38 |
| | *L. nedgia* | 4 | 33 | 4311 | 69 | 3 | 50 | 5099 | 53 |
| | Total | 12 | 100 | 6279.2 | 100 | 6 | 100 | 9587 | |

important fish species at Gumara, Old Bridge and Shembeko with IRI values of 42%, 50% and 53%, respectively (Table 5). *Varicorhinus beso* was the most important fish species in dry season at Aveya, Gumara, Shatit, Konnen and Old Bridge with IRI values of 98%, 36%, 82%, 48% and 44%, respectively whereas *L. intermedius* and *L. nedgia* were the most important fish species for sites Ginbara (59% IRI) and Shembeko (47% IRI), respectively (Table 6). The percentage IRI value for *V. beso* was equal and higher during dry season than wet season at Aveya, and at Gumara, Shatit, Konnen and Old Bridge, respectively (Tables 5 and 6). However, it was less at Ginbara and Shembeko. The %IRI value of *L. nedgia* was higher in wet season than dry season at all sampling sites. The IRI percentage of *L. intermedius* was higher in dry season than wet season at Aveya, Ginbara, Shatit and Shembeko. However, it was low at Gumara, Konnen and Old Bridge. *Labeo forskalii* seemed less important fish species in both seasons for most of the sampling sites. Percentage IRI value from the pooled catch in sampling sites for *V. beso* (49.21%), L. *nedgia* (24.93%), *L. intermedius* (18.43%) and *L. forskalii* (7.21%) were in order of their decreasing importance. However, IRI values were not statistically significant between seasons.

There might be several reasons for variation in abundance between wet and dry seasons. Variation in available nutrients and habitats, temperature, fishing effort, fish behavior, size and life history stages of fishes and others might have contributed to the variation in abundance of the catches. Moreover, water level (Karenge and Kolding, 1995) and turbidity of water may also affect abundance.

**Table 6. Percentage of Index of Relative Importance (IRI) of fishes in all sampling sites during dry season. (NB: %Wi and %Ni = percentages in weight and number of each species of total catch. %Fi = percentage frequency occurrence of each species in total number of settings. %Wj and Nj = percentages in weight and number of total species in total catch. Fj = percentage frequency of occurrence of total species in total number of settings.)**

| Sites | Fish | Ni | %Ni | Wi | %Wi | Fi | %FI | IRI | %IRI |
|---|---|---|---|---|---|---|---|---|---|
| Aveya | *L. intermedius* | 1 | 3.03 | 111.9 | 3.19 | 1 | 16.67 | 104 | 2 |
| | *V. beso* | 32 | 96.97 | 3401.3 | 96.81 | 2 | 33.33 | 6459 | 98 |
| | Total | 33 | | 3513.2 | | 3 | 50 | 6563 | |
| | *L. intermedius* | 2 | 14.29 | 326.1 | 69.66 | 2 | 33.33 | 2798 | 59 |
| Ginbara | *V. beso* | 1 | 7.14 | 91.5 | 19.55 | 1 | 16.67 | 445 | 9 |
| | *L. forskalii* | 11 | 78.57 | 50.5 | 10.79 | 1 | 16.67 | 1489 | 31 |
| | Total | 14 | | 468.1 | | 4 | 66.67 | 4733 | |
| | *L. intermedius* | 6 | 25 | 564.1 | 20.23 | 1 | 16.67 | 754 | 23 |
| Gumara | *V. beso* | 9 | 37.5 | 985.1 | 35.34 | 1 | 16.67 | 1214 | 36 |
| | *L. forskalii* | 2 | 8.33 | 470.2 | 16.87 | 1 | 16.67 | 420 | 13 |
| | *L. nedgia* | 7 | 29.17 | 768.4 | 27.56 | 1 | 16.67 | 945 | 28 |
| | Total | 24 | | 2787.8 | | 4 | 66.67 | 3333 | |
| | *L. intermedius* | 19 | 12.03 | 1587.1 | 7.49 | 3 | 50 | 976 | 6 |
| Shatit | *V. beso* | 105 | 66.46 | 15442 | 72.87 | 6 | 100 | 13932 | 82 |
| | *L. forskalii* | 22 | 13.92 | 88.2 | 0.42 | 1 | 16.67 | 239 | 1 |
| | *L. nedgia* | 12 | 7.60 | 4074.9 | 19.23 | 4 | 66.67 | 1788 | 11 |
| | Total | 158 | | 21192.2 | | 14 | 233.33 | 16935 | |
| | *L. intermedius* | 41 | 17.60 | 8452.5 | 22.08 | 4 | 66.67 | 2645 | 18 |
| Konnen | *V. beso* | 125 | 53.65 | 19116 | 49.94 | 4 | 66.67 | 6906 | 48 |
| | *L. forskalii* | 13 | 5.58 | 2364.9 | 6.18 | 2 | 33.33 | 392 | 3 |
| | *L. nedgia* | 54 | 23.18 | 8347.6 | 21.81 | 6 | 100 | 4498 | 31 |
| | Total | 233 | | 38281 | | 16 | 266.67 | 14441 | |
| | *L. intermedius* | 10 | 10.75 | 2493.9 | 19.97 | 5 | 83.33 | 2560 | 17 |
| Old Bridge | *V. beso* | 46 | 49.46 | 6465.2 | 51.77 | 4 | 66.67 | 6749 | 44 |
| | *L. forskalii* | 30 | 32.26 | 2048.8 | 16.41 | 3 | 50 | 2433 | 16 |
| | *L. nedgia* | 7 | 58.33 | 1480.6 | 11.86 | 3 | 50 | 3509 | 23 |
| | Total | 93 | | 12488.5 | | 15 | 250 | 15252 | |
| | *L. intermedius* | 12 | 20.69 | 2939.2 | 20.97 | 3 | 50 | 2083 | 22 |
| Shembeko | *V. beso* | 24 | 41.38 | 5028.6 | 35.87 | 2 | 33.33 | 2575 | 27 |
| | *L. forskalii* | 4 | 6.90 | 761 | 5.43 | 2 | 33.33 | 411 | 4 |
| | *L. nedgia* | 18 | 31.03 | 5291.2 | 37.74 | 4 | 66.67 | 4585 | 47 |
| | Total | 58 | | 14020 | | 11 | 183.33 | 9653 | |

**Table 7. Comparison of fishes species composition at Lake Tana source of Blue Nile River (BNR) , BNR before the Fall, BNR after the Fall and Aveya River (+ = present and - = absent)**

| Species | Lake Tana (Nagelkerke, 1997) | BNR before the Fall (Oumer *et al.*, 2011) | BNR after the Fall (Awoke, 2011) | Aveya River (This study, 2012) |
|---|---|---|---|---|
| *L. intermedius* | + | + | + | + |
| *L. nedgia* | + | + | + | + |
| *L. crassibarbis* | + | + | + | - |
| *L. surkis* | + | + | - | - |
| *L. longissimus* | + | + | - | - |
| *L. platydorsus* | + | + | - | - |
| *L. gorgorensis* | + | + | - | - |
| *L. brevicephales* | + | + | - | - |
| *L .tsanansis* | + | + | - | - |
| *L. acutirostris* | + | + | - | - |
| *L. megastoma* | + | + | - | - |
| *L. gorguri* | + | + | - | - |
| *L. daineillii* | + | + | - | - |
| *L. macroptalmus* | + | - | - | - |
| *L. triuttiforms* | + | - | - | - |
| *G. dembecha* | + | + | - | - |
| *V. beso* | + | + | - | + |
| *C. gariepinus* | + | + | + | - |
| *O. niloticus* | + | + | + | - |
| *Small Barbus* | + | - | - | - |
| *B. docmak* | - | - | + | - |
| *L. forskalii* | - | - | + | + |
| *M. kannume* | - | - | + | - |

Generally in this study, fish species composition (4 species) of the Aveya River (which is also a tributary of the Blue Nile River) was low (Table 7) as compared to results reported by other workers in the upper Blue Nile, Lake Tana and Tekeze drainage basins. Oumer (2010) reported 17 species from head of Blue Nile River (Lake Tana to Tiss Isat Fall), Awoke (2011) also reported 8 species after the Fall of Blue Nile River. Tesfaye (2006) identified 10 species from Sanja and Angereb Rivers, Beletew (2007) reported 17 species from Beshilo, Dura and Ardi Rivers, Berie (2007) 23 species from Beles and Gelegel Beles, Tewabe (2008) 27 species in Guang, Ayima, Gendwuha and Shinfa Rivers, Melak (2009) 59 species from Baro and Tekeze Basins. The low species diversity may be related to the size and productivity of the river.

The presence of few fish species and dominance of one family only in this study seemed that these cyprinid fishes, being riverine origin, are specifically segregated or adapted in the tributaries of Blue Nile River. The presence of bed rocks might favor for the large population of *V. beso* found in this study. Flow variability might also have an effect on fish assemblages, for example, high flows could destroy fish habitat and wash away the already laid fish eggs. The absence of *L. forsakalli* at Old Bridge and Shembeko during the wet season may be due to the big volume of water which is accompanied by the fast river course. This condition might have forced the fish to hide themselves in rock beds. In addition, during the wet season sampling, it rained in the upstream areas and the river was muddy, making the fishes to hide in the caves.

The species composition of the present study was very much less and different from Lake Tana, above the Tissisat fall of Blue Nile River but more or less similar to the fish species below the Tiss Isat Fall of Blue Nile River as seen from Table 7. This might be due to the isolation the lake's ichthyofauna from the lower Nile basin (de Graaf, 2003) and special adaption of the riverine cyprinids. In this study, *L. forskalii* was identified which was not recorded from de Graaf (2003) in Lake Tana and Oumer *et al*. (2011) in head of Blue Nile River but it was reported below the Fall by Awoke (2011) (Table 7). As it was in the other parts of the Ethiopian rivers and lakes, *V. beso* was found in our study sites but not it was not found in Blue Nile River below the Fall (Awoke, 2011). So, some kind of ecological niching might have occurred in these species even with same river system. The superdominance of cyprinids especially *V. beso* in this study indicates the ecological importance of this rivers. Whereas *L. intermedius* was common in most of the Ethiopian inland water bodies, *L. nedgia* was previously reported only in Lake Tana (de Graaf, 2003) but latter reports by Tewabe *et al*. (2009), Anteneh (2005), Oumer *et al*. (2011), Gebremedhin *et al*. (2012), Mequaninnet (2012) and recently Awoke (2011) in the same river system below the Fall indicated the presence of this specie. So like *L. intermedius*, *L. nedgia* is found in most of the river systems in Ethiopia. The preliminary survey done by Golubstov and Mina (2003), about 4-5 km downstream from Tissisat falls recorded the four typical Nilotic species: *Morymurs hasslequistii*, *L. forskalii*, *Raiamas senegalensis* and *Bagrus zdocmak*. Except *L. forskalii*, none of them was found

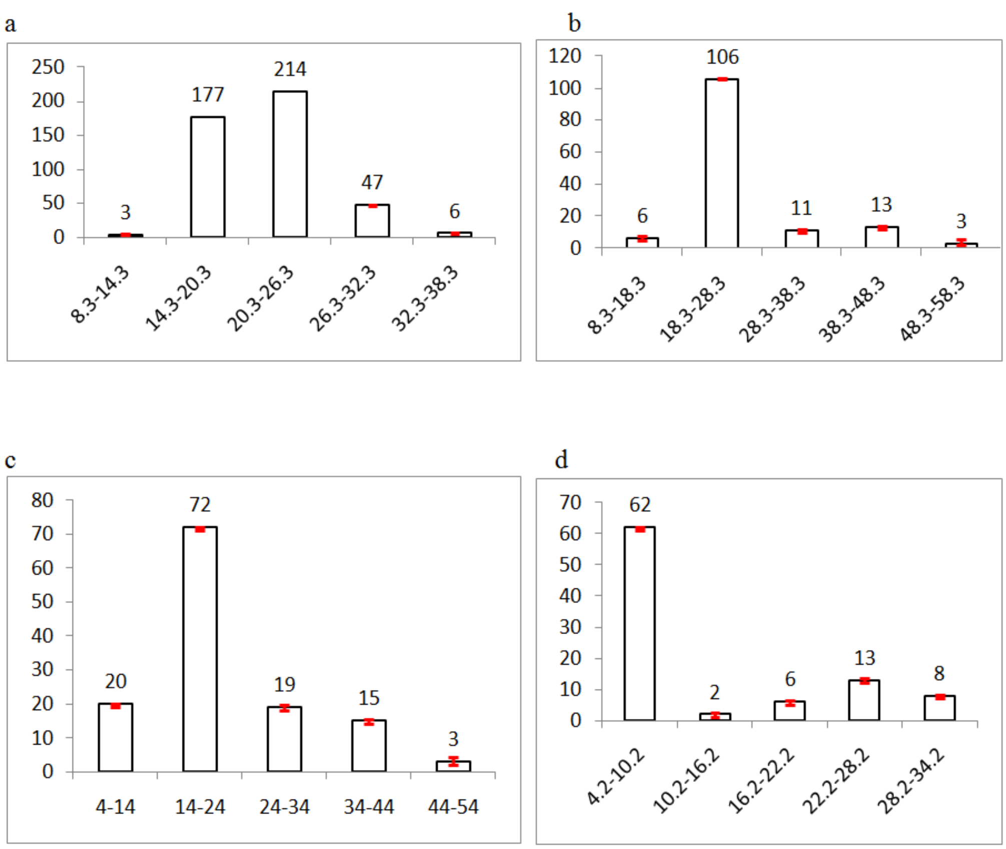


**Figure 2. Length-frequency distribution of *V. beso* (a, N = 447), *L. nedgia* (b, N = 139), *L. intermedius* (c, N = 129) and *L. forskalii* (d, N = 91).**

in the present study. As mentioned above, this may be due to some kind of ecological niching of the existing fishes in the same river system. Differences in sampling habitats (river width, substrate type, source distance and depth), fishing effort, type of gear and gillnet efficiency, sampling seasons and altitude might have contributed to the variation in the catch rates and species diversity.

**Length-frequency distribution**

The length frequency distribution of *V. beso*, *L. nedgia*, *L. intermedius* and *L. forskalii* is shown below (Figure 2). *Varicorhinus beso* the most dominant specie had fork length ranging from 8.3 to 38.3 cm, with the mean and standard error of 21.53±0.17 (Figure 2a). *Labeobarbus nedgia* was the second most abundant specie with fork length ranging from 8.3 to 58.3 cm with mean and standard error of 25.12±0.66 (Figure 2b). *Labeobarbus intermedius* was the third most abundant species with fork length ranging from 4.14 to 54 cm with mean and standard error of 22.61±0.87 (Figure 2c). *Labeobarbus forskalii* was the least abundant specie, having a fork length ranging from 4.2 to 34.2 cm with mean and standard error of 12.60±0.88 (Figure 2d). The majority of *V. beso* (88%), *L. nedgia* (76%), *L. intermedius* (56%) and *L. forskalii* (68%) had length ranges 14.3 to 26.3, 18.3-28.3, 14-24, 4.2-10.2 cm, respectively. From length-frequency data, it seemed that most of the sampled fish specimens were near to table sizes for *V. beso* and *L. nedgia* but it was below the table sizes for *L. intermedius* and *L. forskalii*, respectively.

From the informal discussion made with local residents, we have learnt that the communities living around the studied rivers have a long tradition of fishing in the late wet season and dry season. In these periods, a lot of people went out for massive fishing in the rivers (personal communication with Abebaw Misganaw, local resident and fisher). It seemed that these massive fishing could have a high impact on the aquatic resources. Thus, it is necessary to study the ecological impacts and socio-economic aspects of the riverine fishery.

**Acknowledgement**

The authors would like to thank Bahir Dar University for providing the budget and logistic support. Our special appreciation goes to Mr. Derejie Tewabe for providing fishing gears and Mr. Lewoye Tsegaye for producing the map of the study area. We would like to thank Mr. Abebaw Misganaw and Mr. Alem Anteneh for their great help during sampling.

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