Introduction

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 [1], modified patterns of stream flow [2], interrupted migratory pathways [3], reduced water quality and pollution [4], introduction of alien fish and diseases [5], illegal fishing and commercial overfishing [6] and altered biotic interactions [7].

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 [8]. 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 [8]. 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 researchers to conduct this study. Therefore, the study attempted to identify species composition of fishes in Beles and Gilgel Beles Rivers and evaluate the species diversity of Beles and Gilgel Beles Rivers fishes.

**Materials and methods**

**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 1, Figure 1.

**Fieldwork:** Three surveys were conducted to collect specimens from the sampling sites. The samples were taken in November, March and May. November and May were wet months while March was dry month. Gill nets with different mesh sizes were used to collect specimens from the sampling sites. The samples were taken

| Site               | Code  | Distance from Mh | Elevation (a.s.l.) | Coordinate (GPS) |
|--------------------|-------|------------------|--------------------|-------------------|
| Gilgel Beles at Mh | Mh    | -                | 1011 m             | 11°09'53.5"N; 36°20'20.008"E |
| Gilgel Beles at College | Coll | 2 km             | 1007 m            | 11°09'35.1"N; 36°20'008"E |
| Beles at bridge | BB    | 6 km             | 994 m             | 11°11'56.7"N; 36°19'31.7"E |
| Beles at Babizenda | BAB   | 156 km           | 956 m             | 11°07'54.8"N; 35°28'13.6"E |

**Results and discussion**

**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 2). These fishes were represented by a single class Actinopterygii (ray-finned fishes), seven families and five orders (Table 2). The Cyprinidae, Bagridae and Characidae were the best–represented families with respect to numbers of species; with 11, 3 and 3 species, respectively (Table 2). Labeo and Labeobarbus were the best–represented genera with numbers of species; with 11, 3 and 3 species, respectively (Table 2). 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).

**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 3). The number of fish species was highest at BAB and lowest at Mh sites (Table 3). Ceypriniidae 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. forskalli, 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 and 2000 [20,21], 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 [22–24]. How ever, fish species diversity of Beles River comparable to Alvero River (31), a tributary of Baro, in the lowland Gambela region [25].

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 [20,21]. However, there was some difference in species composition between the present study and that of JERBE [20,21]. Most of the species recorded during the present study in the Gilgel Beles and Beles Rivers were also recorded by JERBE surveys. Although JERBE [21] listed 25 fish species from Beles River, the following seven species were recorded during the present study but were not listed by JERBE [21]: H. forskhali, C. gariepinus, H. longifilis, B. nurse, A. occidentalis, R. loati and L. bynni. Some species that were found by JERBE [20], 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, Chelaethobios bibie, Garra sp., Leptocypris niloticus, Schilbe mystus, Chiloglanis sp., and Tetraodon lineatus. JERBE [20] listed four fish species from Gilgel Beles River. L. forskalli is recorded in the present study from Gilgel Beles River but not JERBE [20]. However, Garra sp. was recorded by JERBE [20], from Gilgel Beles River but not in the present study.

Differences seen in the species composition between the present study and that of JERBE [20,21], 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.

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 4). Among sampling sites, species diversity was highest at Babizenda (H’ = 2.3) and lowest at College (H’ = 0.77) (Table 4).

The number of fish species ranged from 6 to 19 with a mean ± SD of 11.2 ± 5.26 in Beles River and it ranged 3 to 4 with a mean ± SD of 3.67 ± 0.82 in Gilgel Beles River. Shannon diversity index ranged 1.67 to 2.6 with a mean ± SD of 1.81 ± 0.52 in Beles River and it ranged 0.46 to 1.04 with a mean ± SD of 0.73±0.2 in Gilgel Beles River.

Table 2: Fish species composition of Beles and Gilgel Beles Rivers.

| Species name | Common name (Gunmu) | Family | Order |
|-------------|---------------------|--------|-------|
| R. loati | Boulenger 1901 | Abella | Cyprinidae | Cypriniformes |
| V. beso | - | - | - |
| L. niloticus | Tsemebebella | - | - |
| L. horie | - | - | - |
| L. cobbie | - | - | - |
| L. forskalli | Tseya | - | - |
| L. cylindicus | - | - | - |
| L. bynni | Boulenger 1910 | Gosh | - | - |
| L. intermedius | - | - | - |
| L. nedgia | Rüppell 1836 | - | - |
| L. degeni | 1902 | - | - |
| C. gariepinus | - | - | - |
| H. longifilis | Valenciennes1840 | - | - |
| B. bajad | - | - | - |
| B. docmak | - | - | - |
| A. occidentalis | Jajurna | - | - |
| S. serratus | - | - | - |
| S. scholl | Buva | - | - |
| H. forskhali | - | - | - |
| B. macrolegididotus | Yechachya | - | - |
| B. nurse Rüppell 1832 | Lekewar | - | - |
| M. kannume | Bebelela | - | - |
| O. niloticus | Bebegelia | - | - |

Table 3: Species composition of Beles and Gilgel Beles Rivers (+ = present; - absent).

| Species | Sampling sites | Rivers |
|---------|---------------|--------|
|        | Mh | Coll | BB | BAB | G.Bele | Beles |
| R. loati | - | - | + | + | + | - |
| V. beso | + | + | + | - | - | + |
| L. niloticus | - | - | - | + | - | + |
| L. horie | - | - | - | - | - | + |
| L. cobbie | - | - | - | + | - | + |
| L. forskalli | + | + | + | - | + | + |
| L. cylindicus | - | - | - | + | - | + |
| L. bynni | - | - | - | + | - | + |
| L. intermedius | + | + | + | - | + | + |
| L. nedgia | + | + | + | + | + | + |
| L. degeni | - | - | - | + | - | + |
| C. gariepinus | - | - | - | - | - | + |
| H. longifilis | - | - | + | - | + | + |
| B. bajad | - | - | - | + | - | + |
| B. docmak | - | - | + | - | + | + |
| A. occidentalis | - | - | + | - | + | + |
| S. serratus | - | - | - | + | - | + |
| S. scholl | - | - | + | - | + | + |
| H. forskhali | - | - | + | - | + | + |
| B. macrolegididotus | - | - | + | - | + | + |
| B. nurse | - | - | - | + | - | + |
| M. kannume | - | - | + | - | + | + |
| O. niloticus | - | + | + | - | + | + |

Citation: Getahun A, Bereie Z, Dejen E (2020) Diversity of fishes in Beles and Gilgel beles Rivers, abay basin, Ethiopia. Int J Aquac Fish Sci 6(3): 068-073. DOI: https://dx.doi.org/10.17352/2455-8400.000059
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 5).

### Table 4: Number of species (N) and diversity index (H') for total catch at sampling sites and rivers.

| Sampling sites | Rivers    | Mean± SD | t  | df | Sig. |
|----------------|-----------|----------|----|----|------|
| Mh             | Beles     | 0.73±0.21|    |    |      |
| Coll           | Beles     | 1.82     |    |    |      |
| BB             | Beles     | 2.3      |    |    |      |
| BAB            | Beles     | 0.88     |    |    |      |
| Gilgel Beles   | Beles     | 2.42     |    |    |      |
| N              |           |          |  5 |    |      |

### Table 5: Mean number of species (N) and diversity indices (H') for fish caught in Beles and Gilgel Beles Rivers.

| Species | Sampling sites | Mean± SD | t  | df | Sig. |
|---------|----------------|----------|----|----|------|
| Beles   | Mh             | 0.73±0.21|    |    |      |
|        | Gilgel Beles   | 1.81±0.27|    |    |      |
|        | Beles          | 3.67±0.82|    |    |      |
|        | Gilgel Beles   | 11.2±5.26|    |    |      |

Biodiversity patterns are directly and indirectly influenced by the geomorphology of riverine landscapes, which may be perceived as a nested hierarchy. 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 downstream 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 [26], Sydeman [27] and Golubtsov and Mina [28]. The increase in number of fish species 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 [29]. 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 [30] in India with the studies carried out in other areas. In tropical area as Angermerier and Karr (1983) in Panama, EDDS [30] in India

### Table 6: Number of species (N) and diversity index (H') for fish caught during wet and dry seasons.

| River       | Sampling sites | Mean± SD | t  | df | Sig. |
|-------------|----------------|----------|----|----|------|
| Beles       | Dry            | 2.48     |    |    |      |
| Gilgel Beles| Wet            | 2.29     |    |    |      |
| Beles       | Dry            | 2.21     |    |    |      |
| Gilgel Beles| Wet            | 0.66     |    |    |      |

The number of fish species ranged from 3 to 14 with a mean ± SD of 6.57 ± 4.04 in wet seasons in Beles and Gilgel Beles Rivers and it ranged 3 to 19 with a mean ± SD of 8 ± 7.44 in dry season. Shannon diversity index ranged from 0.66 to 1.99 with a mean ± 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 ± 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 7). 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 7).

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
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 (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.

**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.
19. Golubstov AS, Dorkov AA, Dgebuadze Yu, Mina MV (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. Link: https://bit.ly/2Zv0m6A

20. JERBE (1999) Report on the studies carried out by the freshwater biology group of the joint Ethio-Russian biological expedition.

21. JERBE (2000) Report on the studies carried out by the freshwater biology group of the joint Ethio-Russian biological expedition.

22. Genanew Tesfaye (2006) Diversity, relative abundance and biology of fishes in Angereb and Sanja Rivers, Tekeze basin, Ethiopia. M. Sc. Thesis, Addis Ababa University, Ethiopia 89. Link: https://bit.ly/3Ta8P8

23. JERBE (2004) Report on the studies carried out by the freshwater biology group of the joint ethio-russian biological expedition.

24. JERBE (2005) Report on the studies carried out by the freshwater biology group of the joint ethio-russian biological expedition.

25. JERBE (2001) Report on the studies carried out by the freshwater biology group of the joint ethio-russian biological expedition.

26. Nikolovsky GV (1963) The Ecology of fishes. Academic Press, London and New York. 352. Link: https://bit.ly/3s785G

27. Sydenham DHJ (1977) The qualitative composition and longitudinal zonation of the fish fauna of the River Ogun, Western Nigeria. Revue de Zoologie Africaines 91: 974-996.

28. Golubtsov AS, Mina MV (2003) Fish species diversity in the main drainage systems of Ethiopia: current state of knowledge and research perspectives. Ethiop J Natu Reso 5: 281-318. Link: https://bit.ly/3imYdT0

29. Andre Kandem T, Teugels G (1998) Diversity pattern of fish assemblages in the lower Ntem River basin (Cameroon), with notes on potential effects of deforestation. Arch Hydrobiology 141: 421-446. Link: https://bit.ly/2ZybO0V

30. EDDS DR (1993) Fish assemblage structure and environmental correlates in Nepal’s Gandaki River. Corea 1: 48 - 60. Link: https://bit.ly/3goK1Qp

31. Sheldon AL (1968) Species diversity and longitudinal succession in stream fishes. Ecology 49:193-198. Link: https://bit.ly/31hB6X

32. Beecher HA, Dott ER, Fernow RF (1988) Fish species richness and stream order in Washington streams. Environ Biol Fish 22: 193 - 209. Link: https://bit.ly/3iwS4DN

33. Oberdorff T, Porcher JF (1992) Fish assemblage structure in Brittany streams (France). Aqua Living Resour 5: 215-223.

34. Oberdorff T, Guilbert E, Luccetta JU (1993) Patterns of fish species richness in the seine river basin, France. Hydrobiologia 259: 157-169. Link: https://bit.ly/3eZn0KL

35. Wudneh T (1998) Biology and management of fish stock in Bahir Dar gulf, Lake Tana, Ethiopia. PhD Thesis, Wageningen Agricultural University, Wageningen143. Link: https://bit.ly/31PRY4w

36. Wood RB, Talling JF (1988) Chemical and algal relationships and salinity series of Ethiopian inland waters. Hydrobiologia 158: 29-67. Link: https://bit.ly/38sYa3E