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ASSESSMENT OF FLOOD IMPACTS ON FISH BIODIVERSITY IN THE SWAT RIVER, PAKISTAN

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ABSTRACT

The Swat River originates from Mahodand Lake as the Peshmal stream of Ushu before merging with the Utror stream. The river experienced severe flooding during two major periods, July 29–31, 2010, and August 26–29, 2022, which greatly disturbed its biodiversity and caused substantial damage to fish fauna. To assess the impacts of these floods, fish samples were collected from different sites and preserved in formalin for identification. Population density and species abundance were evaluated before and after the flood events. A total of 17 fish species belonging to different orders and families were recorded from various months and locations after the floods. Interestingly, four native fish species of the Swat River, namely *Glyptothorax cavia*, *Xenentodon cancila*, *Channa punctatus*, and *Puntius sophore*, were absent in the present study. Questionnaire data obtained from fishermen revealed that *Schizothorax esocinus*, *Tor putitora*, and *Labeo dero* are threatened and rarely encountered. The study concluded that fish populations declined by 42–51% after the severe floods of 2010 and 2022, mainly due to habitat destruction and ecological losses caused by flooding.

1. INTRODUCTION

The River Swat lies in Swat valley between 34° 30′ 00″ 34° 30′ 00″’ North and 72° 05′ 00″’ and 72° 50′ 00″’ East, (Atta-ur-Rahman and Khan, 2011) River swat originate from Kalam by the joining of Peshmal stream of Ushu and stream of Utror. The pleasant climate of the valley and its rich productivity is mainly due to the river which plays a vital role in agriculture and also as a source of ground water for domestic use. The river is famous for 3 species known as Swati fish belonging to genus *Schizothorax* and other fish species. Beyond the fish fauna, the river is rich in phytoplanktons. Ali (2010) reported 38 genera of algae from the river and Zooplanktons which are an important food for aquatic fauna and floods greatly affect and decrease this feed source of wild fish (Rao, 1993).

The fish biodiversity of the river is studied by many ichthyologists. Hussain and Shah (1960) reported six species from this river i.e. *Schizothorax curvifrons, S esocinus, S longipinnus, S planifrons, S progastus* and *S nasus*. Ahmad and Mirza (1963) and Ahmad (1969) reported twelve other species from the area i.e. *Schizothorax plagiostomus, Schizothorax labiatus, Glyptosternum reticulatum, Noemacheilus choprai, Noemacheilus naseeri, Noemacheilus alepidota, Noemacheilus griffithi naziri, Barilius vagra, Puntius ticto, Crossocheilus latiu diplochielus, Channa gachua* and *Oncorhynchus mykiss*. The detailed report about the fish fauna of Swat was presented by Mirza (1973) and reported 13 species from River Swat, Yousaf (2004) reported 20 species and Ahmad (2009) reported 18 species from the river, Hasan et al., (2013) reported 50 species from River swat and River Panjkora, Naveed *et al.,* (2014) described 18 species i.e. *Barilius pakistanicus, Barilius vagra, Cirrhinus*

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mrigala, Crossocheilus diplocheilus, Cyprinus carpio, Garra gotyla, Glyptothorax cavia, Glyptothorax punjabensis, Glyptothorax sufii, Labeo rohita, Mastacembelus armatus, Puntius sophore, Rasbora daniconius, Salmophasia bacaila, Salmophasia punjabensis, Schizothorax plagiostomus, and *Tor putitora*.

2. MATERIALS AND METHODS

During the survey fish specimens were collected with the help of cast net, gills net and hand nets etc. in different months of the year and preserved in 5% formalin. The fish samples were collected from eight points i.e. Madyan, Khwaza khela, Matta, Ningolai, Kanju, Panjigram, Landaki, and Chakdara in the months of February and March 2018 and November, December 2022. The fish specimens were identified with the help of different keys, books and papers. For the data of relative abundance of fish species, the fishing activity of local fishermen were recorded at eight collection point. A questionnaire was also arranged to obtain pre and post flood data of species abundance.

1. A contribution to the fishes of Lahore (Mirza 1983).
2. Inland fishes of India and adjoining areas (Talwar and Jhingran, 1991).
3. Aquatic Fauna of Swat Valley, Pakistan, Part 1; Fishes of Swat and Adjoining Areas. (Mirza, 1973).
4. Checklist of freshwater fishes of Pakistan. (Mirza, 2002).
5. Pakistan ke taza Pani Ke machlian, (Mirza, 2003).
6. Pakistan ke machlian awr mahe parwari (Mirza and Bhatti, 1993).
7. Taxonomy of hill stream fishes of Kaghan and Swat (Mirza, 2006).
8. A note on the fishes of Alai khwar (Mirza, 2006).

3. RESULTS

The species recorded are *Schizothorax plagiostomus, Schizothorax labiatus, Schizothorax esocinus, Tor putitora, Labeo dero, Gara gotyla, Crosochielus latius diplochilus, Barilius pakistanicus, Cyprinus carpio, Carasius auratus Tryplophysa choprai, tryplophysa naziri, Schistora alipidotus, Oncorhynchus mykiss, Glyptosternum reticulatum, Channa gachua* and *Mastacembilus armatus.* These species belong to five order and six families. The orders were *Cypriniformes, Salmoniformes, Siluriformes, Channiformes* and *Synbranchiformes*, in which Cypriniformes was the richest order. The families were Cyprinideae, Nemacheilideae, Salmonideae, Sisorideae, Channideae and Mastacembelideae in which ciprinideae was the richest family of River Swat. Their relative abundance and statistical data are given below. The species have their own local name in each locality. The local names were confirmed from the fishermen.

1. Fish biodiversity shown in bar graph

The results for fish biodiversity are shown by the bar graph. Relative abundance of different fish species was recorded from collection points that is explained below.

1.1 *Schizothorax plagiostomus*

The fish abundance increased downstream. The population of the species was greater at Chakdara and decreased towards Madyan. Population of the species at various locations is shown in figure 1.

1.2 *Schizothorax labiatus*

The fish was abundant at Panjigram and poor population was observed at Madyan in the river. The population of the species was low in the river as compared to *Schizothorax Plagiostomus*. At this point a comparatively warm water stream joins the river which increases algal bloom in the river which is food of this species. The population of the species at various locations is shown in figure 2.

1.3 *Schizothorax esocinus*

The fish was abundant at Chakdara in the river as going down the river. The population of the species was greater at Chakdara and decreased upstream as we move towards Kanju and no specimen was reported above this point. The population of the species at various locations is shown in figure 3.

1.4 *Tor putitora*

The fish was reported from localities of Kanju and downstream with maximum abundance at Landaki which then decreased in Chakdara. The population of the species at various locations is shown in figure 4.

1.5 *Labeo dero*
The fish was abundant at Chakdara and Panjigram. The species abundance was recorded from Kanju and downstream till Chakdara. The population of the species was greater at Chakdara and decrease towards Kanju. The population of the species at various locations is shown in figure 1.5.

1.6 *Gara gotyla*
The fish abundance increased downstream. The population of the species was greater at Chakdara and decrease towards Madyan. The population of the species at various locations is

1.7 *Cyprinus carpio*
The fish showed irregular distribution in the river. The population of the species ws greater at Ningolai and decrease towards Madyan. Similarly, a decreasing trend in population density was also observed downstream from Ningolai. The population of the species at various locations is shown in figure 7.

1.8 *Carasius auratus*
The fish was abundant everywhere at the river. The population of the species is greater at Panjigram and Kanju and decrease towards Madyan. The fish mostly found in warm water therefore abundant in the river at Kanju and Panjigram where warm water bodies join the river. The population of the species at various locations is shown in figure 8.

1.9 *Barilius pakistanicus*
The fish was abundant in the river downstream from khwaza khela to Chakdara. The population of the species was greater at Chakdara and decreased towards Madyan. The population of the species at various locations is shown in figure 9.

1.10 *Crosochielus latius diplochielus*
The fish was also abundant downstream from Madyan to Chakdara. The population of the species was greater at Chakdara and decreased towards Madyan. The population of the species at various locations is shown in figure 10.

1.11 *Triplophysa choprai*
This stream loach is abundant at the river. The population of the species is greater at Matta. The population of the species at various locations is shown in figure 11.

1.12 *Triplophysa naziri*
This stream fish is too much abundant in the river as compared to other two loaches of River Swat. The population of the species is greater at Matta and abundant everywhere in River Swat. The population of the species at various locations is shown in figure 12.

1.13 *Schistora alipidotus*
The fish is abundant at the river everywhere. The population of the species is greater at Matta and decrease towards Madyan. The population of the species at various locations is shown in figure 13.

1.14 *Oncorhynchus mykiss*
The fish is exotic and found at Madyan in the river as going up the river. The population of the species is only confined to Madyan and not reported downward to Chakdara. The population of the species at various locations is shown in figure 14.

1.15 *Channa gachua*
The fish is abundant at the river and increase as going down the river. The population of the species is greater at Landaki and decrease towards Matta while not recorded from Khwaza Khela and Madyan the population of the species at various locations is shown in figure 15.

1.16 *Glyptosternum raticulatum*
This hill stream fish is abundant in the upper parts of the river. The population of the species is greater at Matta and decrease towards Ningolai and Chakdara. The population of the species at various locations is shown in figure 16.

1.17 *Mastacembilus armatus*
The fish is abundant at the river as going down the river. The population of the species is greater at Landaki and decrease towards Madyan. The population of the species at various locations is shown in figure 17.

2. Population of fish species before and after flood
In this graph the fish population of 2018 was compared with the present population of fishes in River Swat. After the flood the fish population showed a striking

decrease for some species while some species were found in satisfying numbers. The major food fishes *Schizothorax plagiostomus* and *Schizothorax labiatus* were observed to decrease in number but although in comparatively stable position. The populations of *Curassius auratus* and *Tryplophysa naziri* declined significantly. The details of comparative abundance of fish biodiversity of River Swat are given in graphic form in figure 18. The fish populations were found to be decreased up to 51 % as shown in figure 19.

4. DISCUSSION

The biodiversity of the river has lost up to a remarkable limit during the severe flood of July 2010 and August 2022 mainly due to habitat lost and damages happened to them. Ahmad and Mirza (1963a), Ahmad (1969) and Mirza (1973) reported the species from the area are *Schizothorax plagiostomus, Schizothorax labiatus, Glyptosternum reticulatum, Noemacheilus choprai, Noemacheilus naseeri, Noemacheilus alepidota, Noemacheilus griffithi naziri, Barilius vagra, Puntius ticto, Crossocheilus latius, Channa gachua* and *Oncorhynchus mykiss*. But the present survey only represents eight species from Ahmad and Mirza (1963a), Ahmad (1969) and Mirza (1973) which are *Schizothorax plagiostomus*, *Schizothorax labiatus, Glyptosternum reticulatum, Noemacheilus choprai Noemacheilus alepidota, Crossocheilus latius, Channa gachua* and *Oncorhynchus mykiss*. The species of family *nemachielideae Noemacheilus naseeri, Noemacheilus griffithi naziri, Noemacheilus alepidotus alepidotus*, and *Noemacheilus stenurus choprai* were said the endemic species of Swat (Mirza, 1973). But *Nemacheilus naseeri* was not recorded in the present study. Ahmad (2009) presented a survey of fish fauna River Swat and reported 18 species from the river. Ahmad (2009) reported four new species *Puntius conchonius*, *Puntius chola, Glyptothorax punjabiensis* and *Glyptothorax stocki* which were not recorded by any of the above authors and also not represented in the present study.

In the present study 17 species have been collected which were *Schizothorax plagiostomus, Schizothorax labiatus, Schizothorax esocinus, Tor putitora, Labeo dero, Gara gotyla, Crosochielus latius diplochilus,, Barilius pakistanicus, Cyprinus carpio, Carasius auratus, Tryplophysa choprai, Tryplophysa naziri, Schistora alipidotus, Oncorhynchus mykiss, Glyptosternum reticulatum, Channa gachua,*and *Mastacembilus armatus.* The present study was unable to record four species of River Swat i.e. *Glyptothorax cavia, Xinontodon cancila, Channa punctatus* and *Puntius sophor* from River Swat. These species are considered to be escaped or otherwise said to be endangered in the fish fauna of River Swat. The fishermen denied the capture of such species. *Barilius pakistanicus* and *Crosochielus latius diplochilus*are warm water fish and therefore as temperature of water increases the population of these species increases.

The data of abundance of fish species indicate that the population of *Schizothorax labiatus* and *Schizothorax esocinus* is greatly reduced and *Schizothorax plagiostomus* is found to survive best in all the snow carp in the present limnological condition of River Swat. But according to fisher men *Schizothorax labiatus* is rarely reduced than *Schizothorax plagiostomus* due to their protruding mouth. Loaches i.e. *Tryplophysa choprai*, *Tryplophysa naziri, Schistora alipidotus* and a cyprinid *Gara gotyla* reduced a little in River Swat. This statement was proved by the fishermens. The *Mastacembilus armatus* or Eel and *Channa gachua* are also reduced due the destruction of water bodies on the bank of River Swat, which were consist of warm water as compared to the main river. The fishermen stated that the small water bodies present on the bank of river were loaded by the flood through builders' stone and gravel. New water bodies containing warm water were also created by the flood but will take duration to be developed as spawning ground for these species.

Comparing the present abundance of fish population with the population before flood shows a striking decline in the fisheries of the river. The species mean of River Swat was 27.235 in 2018 while in 2022 it is 13.47, which shows a striking decline of 50.54 % in population of River Swat. A questionnaire was arranged and data were obtained, which prove the study result. Before flood the mean capture of fish per day by a fisherman was 5.167 kg, while after flood it decreased to 3 kg per day by a fisherman from the River Swat and shows 42 % decrease after the flood.

5. CONCLUSION

The study concludes that fish population shows about 42 to 51 % decrease after the severe flood of 2010 and 2022. The decline in the diversity and abundance of fish fauna of the river is concluded due to the loss of natural habitat and ecology. The fishery of the river needs attention to conserve the biodiversity.

6. CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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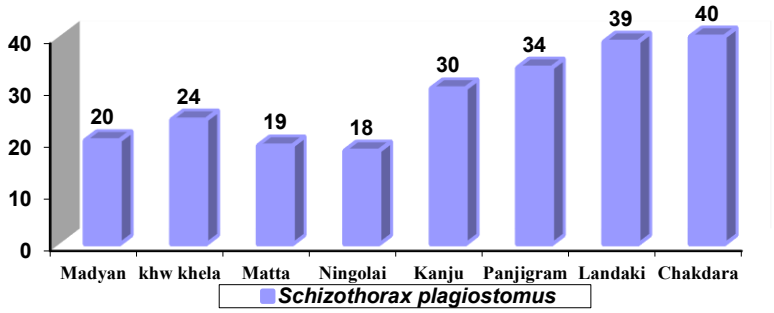

Figure 1. ***Schizothorax plagiostomus*** **at various locations**

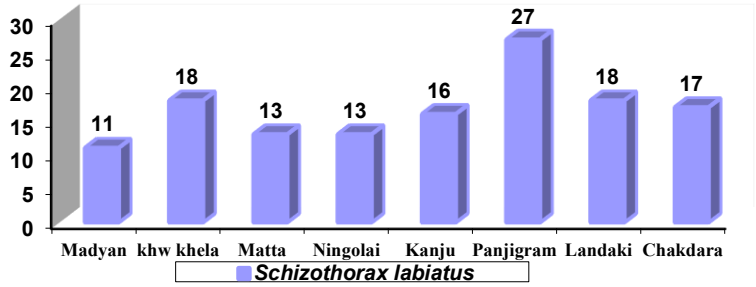

Figure 2. ***Schizothorax labiatus*** **at various locations**

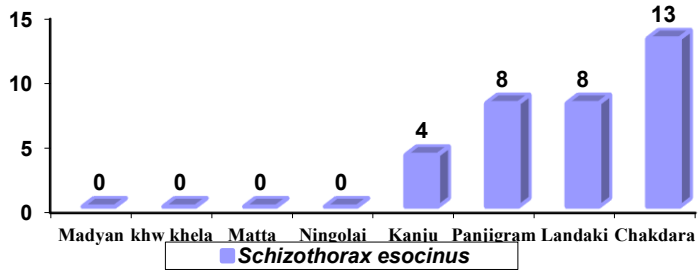

Figure 3. ***Schizothorax esocinus*** **at various locations**

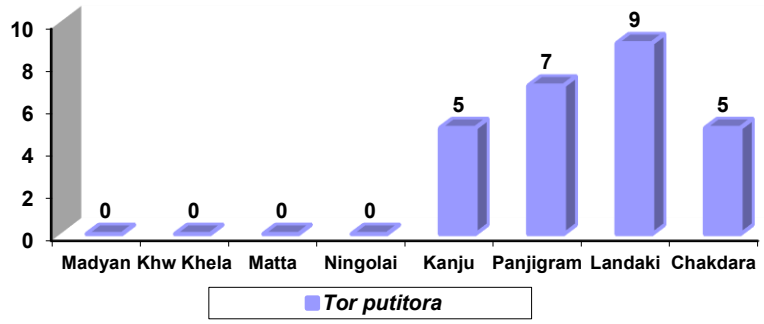

Figure 4. ***Tor putitora*** **at various locations**

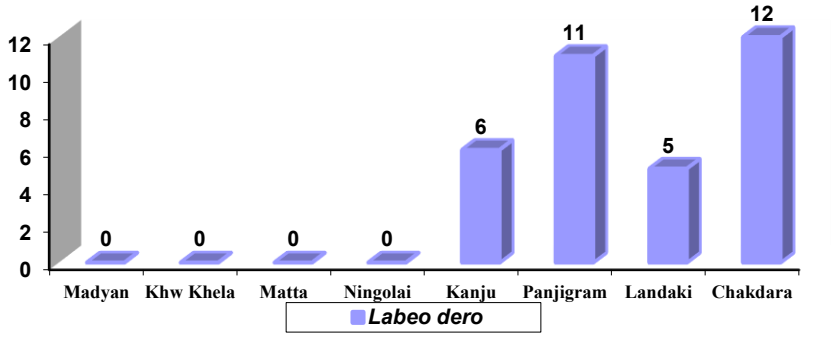

Figure 5. ***Labeo dero*** **at various locations**

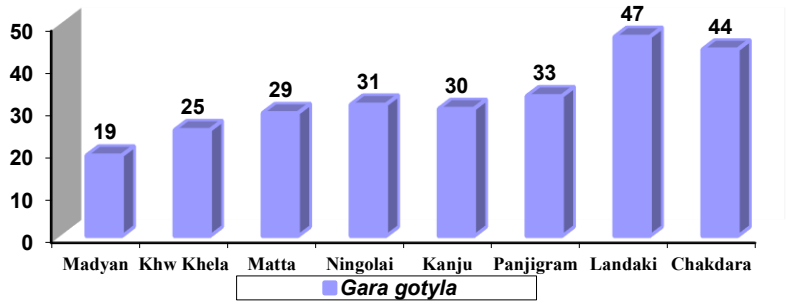

Figure 6. ***Gara gotyla*** **at various locations**

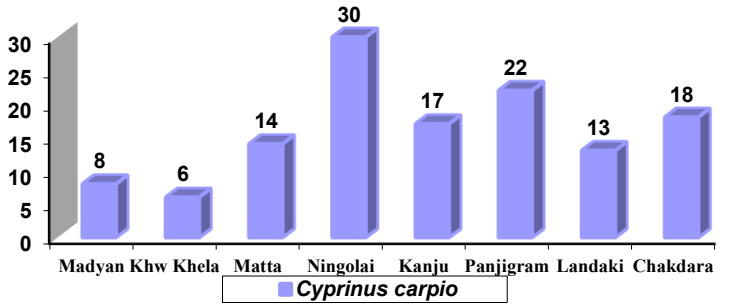

Figure 7. ***Cyprinus carpio*** **at various locations**

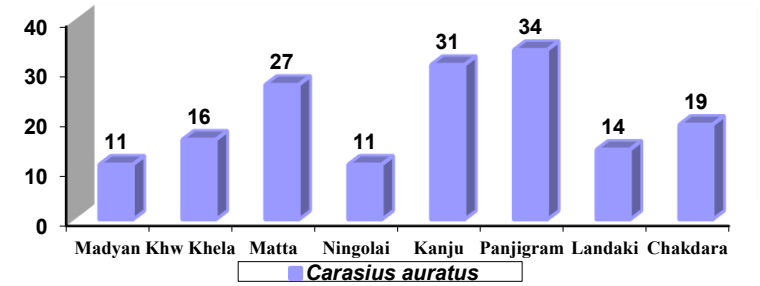

Figure 8. ***Carasius auratus*** **at various locations**

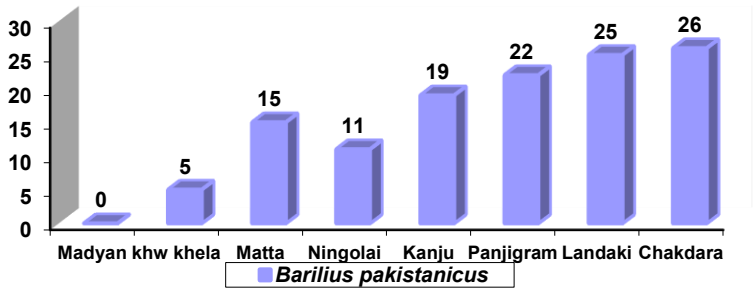

Figure 9. ***Barilius pakistanicus*** **at various locations**

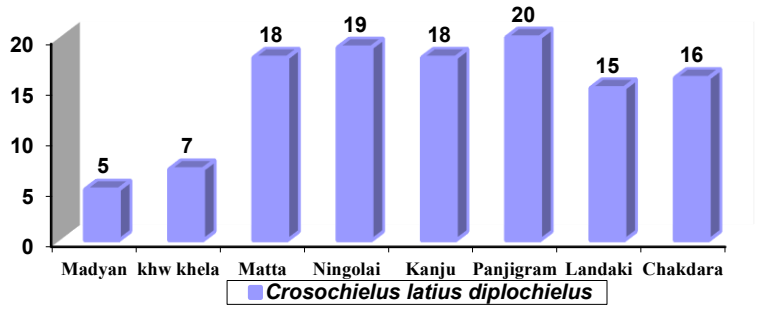

Figure10. ***Crosochielus latius diplochielus*** **at various locations**

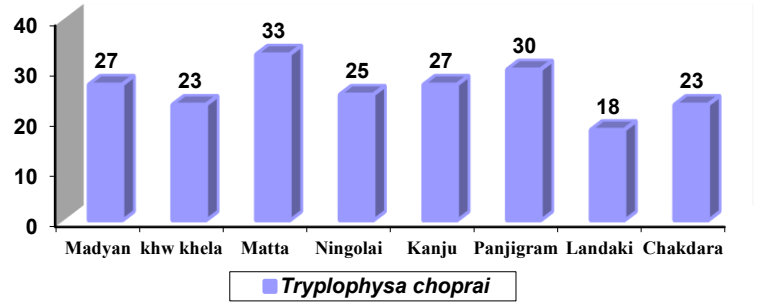

Figure11. ***Tryplophysa choprai*** **at various locations**

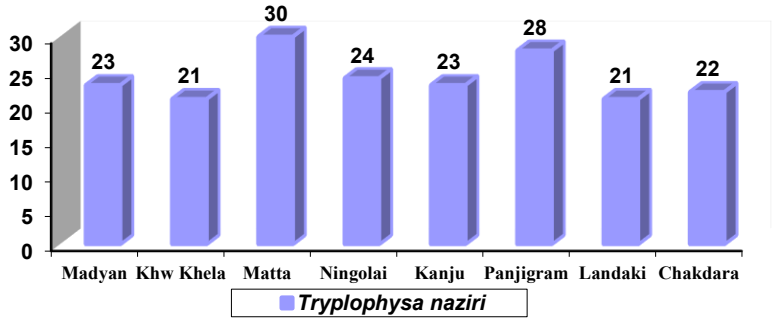

Figure 12. ***Tryplophysa naziri*** **at various locations**

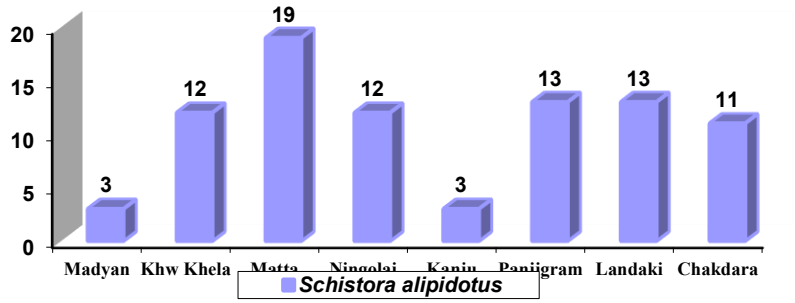

Figure 13. ***Schistora alipidotus*** **at various locations**

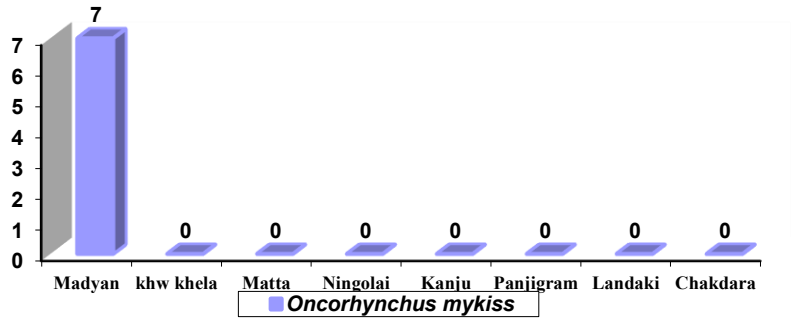

Figure 14. ***Oncorhynchus mykiss*** **at various locations**

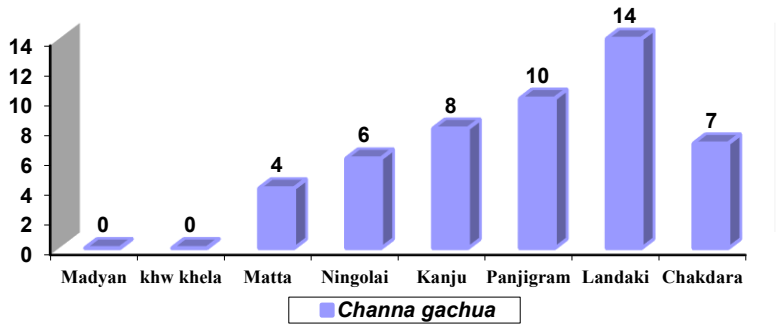

Figure 15. ***Channa gachua*** **at various locations**

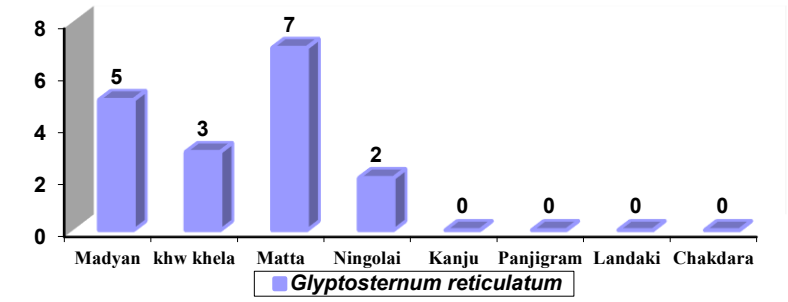

Figure 16. *Glyptosternum raticulatum* at various locations

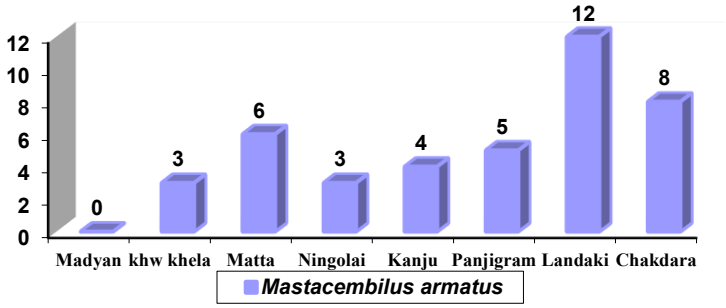

Figure 17. *Mastacembilus armatus* at various locations

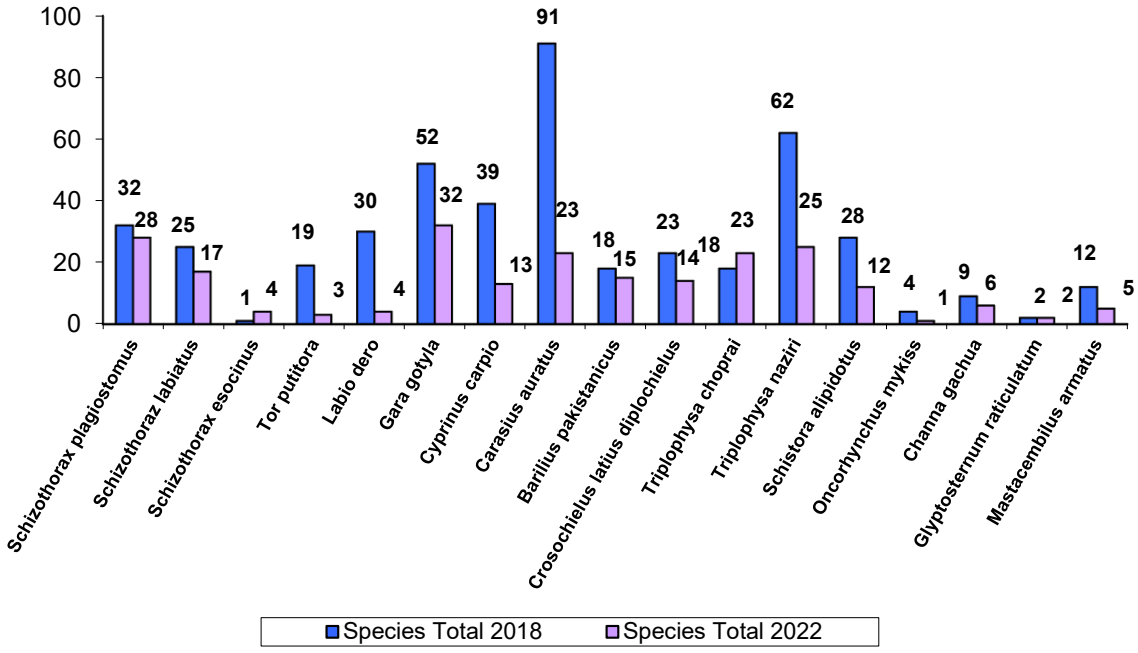

Figure 18. Mean species abundance in River Swat in 2018 and 2022

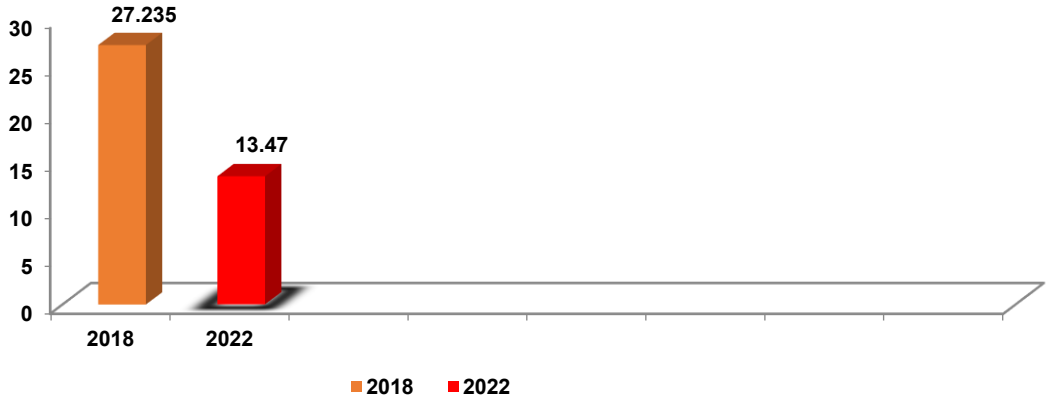

Figure 19. The mean of fish population in 2004 and 2011