International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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Fish diversity from dissimilar habitats in Savitri River

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International Journal of Science and Research Archive, 2023, 09(01), 047–055

Publication history: Received on 17 March 2023; revised on 27 April 2023; accepted on 30 April 2023

Article DOI: https://doi.org/10.30574/ijsra.2023.9.1.0335

Abstract

Fish population in any aquatic habitat depends upon physico-chemical and biological parameters. Lotic water body having influx of waste gets divided into different habitats viz. upstream and downstream with varying degree of parameters in their waters. Savitri River in Mahad is receiving effluents released from Maharashtra Industrial Development Corporation (MIDC) Mahad, thus getting divided into two distinct upstream and downstream zones. With this central idea the present study was under taken between October 2014 and September 2016. The fish species were collected from the upstream water from Savitri river near village Isane kamble (Spot S1) and downstream of Savitri River near Dadali bridge belonging to Dadali village (Spot S2). During study period 34 species of fish belonging to 18 families were recorded fromspot S1 and 17 species belonging to14 families were recorded from spot S2. Analysis of result indicated that Cyprinidae was dominant among all the families at both the spots. 23 species were exclusively found at spot S1 and 06 at spot S2. 11 species fish were common at both the spots. Species *Garra mullya* was more abundant followed by *Puntius amphibius* at both the spots. The study signals that the long-term contamination due to industrial effluents of Savitri River may pose a risk to fish species at spot S2.

Keywords: Fish diversity; Industrial effluents; Riverine fauna; Savitri river; Dissimilar habitat

1. Introduction

The earth's hydrosphere encompasses oceans, estuaries, rivers, streams, lakes, ponds, and other aquatic bodies. The primary feature of the Earth is its abundance of water that covers 71% of its surface. Of the total water on the earth only 1% is fresh water, 2.15% is locked up in the frozen form and 92.2% water is in the Oceans, Seas and estuaries. Faunal variations in freshwater estuaries and marine habitats synchronize with the volumes of waters they hold. India has vast water spread area in the form of river, streams, lakes, reservoirs etc. but 70% of this water has gone polluted (Basu, 1986). Chacko and Krishnamurthy (1945), Ganpati (1956, 1968); Vijayaraghvan (1971); Goel *et. al.,* (1985), Mule and Gaikwad (1999) and Pailwan (2005) have done some hydro-biological work in historic shallow water bodies like moats, temple tank, reservoirs and ponds.

India has a rich freshwater fish and marine fish diversity. Fish known from India's fresh and marine waters comprise 3231 valid species, accounting for 9.7%. Of the total number of approximately 33,059 species known from the world, with marine fish diversity accounting for 7.4 %. Marine fishes account for 75.6% of the total fish diversity known from India, with 2443 species belonging to this group. Species from 927 genera are classified into 230 families and 40 orders. Among the fish diversity-rich areas in India's marine waters, the Andaman and Nicobar archipelago has the most species, 1431, followed by the east coast with 1121 and the west coast with 1071. There are 91 endemic marine fish species known to exist in India's coastal waters. India is well-known for providing freshwater habitat to a diverse range of flora and fauna. Maharashtra is important for freshwater biodiversity, particularly ichthyofaunal diversity (Ubarhande and *et al*., 2016)

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In the northern Western Ghats, the Raigad District makes up the centre of the Konkan region where scanty research has been carried out. While there are very few research on the fish in the Konkan region. (Annandale 1919; Kulkarni 1947; Bal & Mohmed, 1957; Singh & Yazdani 1988: Singh & Yazdani 1993; Arunachalam 2000, 2002).

In the Raigad area of Maharashtra, a study was conducted to look at the contamination of heavy metals in muscle and intestine tissue in seven fish species and one prawn species, taken from upstream and downstream points along the Savitri River (Yardi *et. al*., 2012), least information is available on fish fauna in Savitri river of Mahad hence, to know the status of fish diversity in non-polluted and polluted habitats in Savitri river the present study was undertaken.

2. Material and methods

Mahad is a town that can be found at 18.05' North latitude and 73.025' East longitude. It is about 175 Km south of Mumbai. The Savitri river rises in Mahabaleshwar at Tiger Point and flows east to west through Raigad and Ratnagiri districts before reaching the Arabian Sea at Harihareshwar (Bankot estuary). The MIDC, in the year 1987, has established an industrial belt on 426.39 hectares of land. There are approximately 73 operational industries producing pesticides, pharmaceuticals, paints, petrochemicals, papers, plastics, heavy metals, food materials, etc. and discharging gases, liquids, and solid wastes into the air, water, and soil, polluting local and adjacent environments.

Water samples along with desirable fish species were monthly collected from the upstream water in Savitri river at village Isane Kamble (Spot S1) and downstream of Savitri River near Dadali bridge of Dadali village (Spot S2) with reference to the Mahad MIDC. Distance between Spot S1 and Spot S2 is around 10 km.Spot S1is located on 18.05’11 North latitude and 73.028’19 E longitude; and Spot S2 is located on 18.04’28 North latitude and 73.025’14 E longitude. During the study period fish samples were monthly collected with the help of skilled local fishermen using various fishing crafts and gears with having varying mesh sizes. Sampling points were placed throughout the site to cover the entire area, and the location for collecting fish fauna was changed depending on the season.

Fish markets and landing areas closer to the study spots were frequently visited to avoid skipping off of any fish species that were not there in the study areas during actual fishing.

Fish identification was done up to the species level at the fish landing center to obtain its natural colour, scale pattern, fin pattern, mouth pattern, identification marks like black spot, blotch on operculum, paired and unpaired fins and body parts using standard literature (Jayaram 1991; 1999; 2010; Talwar & Jhingran 1991 and Francis Day, 1986).

Fish that could not be identified on the field (landing center) were preserved in 10% formalin in glass jar and carried to ICAR-CIFE Versova, Mumbai and ZSI, Pune for further identification.

The physicochemical parameters viz. Temperature, pH, Turbidity, Transparency, Total Dissolved Solids, Total Solids, Gross Primary Productivity, Net Primary Productivity, Dissoved Oxygen (DO), Biological Oxygen Demand (BOD), Free CO2, Chemical Oxygen Demand (COD), Total Acidity, total Alkalinity, total Hardness, Chlorides, Phosphate Phosphorus and Nitrates were estimated using standard methods (APHA, 2005).

3. Results

In the present investigation, conducted during study period, it was noted that, spot S1 was having more fish diversity as compared to spot S2 (Table 1A). The average number of fish collected from spot S1 during study period was 1173. These fish belonged to 18 families and 34 species. The dominant family among all the families was Cyprinidae which included 14 species of fish. Among 34 species of fish reported from spot S1, the species *Garra mullya*(20.11%) was dominant followed by species *Puntius amphibius*(11.42%), followed by *Glassogobius giuris* (08.01%) (Table 1A). *Garra mullya* was amply available at spot S1 during pre-monsoon and monsoon, while *Puntius amphibius* was ample in number during post-monsoon among three dominant species arranged in orderly manner. After the family Cyprinidae family Gobiidae Bagridae and Poecillidae stood second since each of them contained two species of fish. Rest 14 families contained single species of fish (Table 1A).

The Average numbers of fish collected from spot S2 during the study period were 885. This fish belong to 14 families and 17 species. Among all the families, the dominant family reported was Cyprinidae which included 3 species of fish. Among the 17 species of fish reported from spot S2 the species *Garra mullya* was dominant (23.16%) followed by *Puntius amphibius* (22.59%) followed by *Glassogobius giuris* (18.87%) (Table 1B). *Glassogobius giuris* was amply

available at spot S2 during pre-monsoon; *Garra mullya* during monsoon and post-monsoon. After the family Cyprinidae (3 species), family Siluridae (2 species) stood second. Rest 12 families included single species of fish (Table 1B).

The analysis of physico-chemical parameters of water samples collected monthly from spot S1 and S2 during study period is depicted in Table 2. The maximum temperature (31.9^0C) was recorded at spot S2. Similarly more acidic pH was also recorded at the same spot. Among the 18 parameters studied temperature, pH, turbidity, Transparency, Total Dissolved Solids (TDS), Total Solids (TS), Gross Primary Productivity (GPP), Net Primary Productivity (NPP), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Acidity, Hardness, Chlorides and Nitrates-N contents were toward adverse levels at spot S2, however free CO2, Total Alkalinity and PO4-P content at spot S1 were towards adverse level. This indicated that well use of various parameters at spot S2 deviated from those at S1.

4. Discussion

At most of the places, industrial effluents are released in to rivers which create adverse effects on aquatic body and also on human health (Tanner, 2001). Every industry generates specific type of effluents that may contain hazardous compounds, organic materials, inorganic materials, and heavy metals. On releasing such contaminants in aquatic medium, they alter physicochemical properties of water. Various physicochemical parameters like DO, BOD, COD, Alkalinity, total hardness, salinity, pH, temperature, PO4-P, NO3-N in riverine waters give information regarding intensity of pollution therein. Various national and international agencies have set certain standard ranges for these parameters (WHO, 1992). According to Khan *et. al*., (2021) if water parameters exceed the standard limits, water sample is said to be polluted. In the present investigation though temperature, pH, turbidity, DO, Total acidity remained well within the permissible limits but the parameters like TDS, TS, BOD, COD, free CO2, Total hardness, Chlorides, PO4-P, NO3-N exceeded standard values prescribed by WHO (1990) and BIS (1991). This indicated that the water is polluted at both the study sites spot S1 and S2. In between these study spots effluents from Mahad MIDC are released in Savitri river showing more pollution at the spot S2.

Wepener (2008) had reported endocrine dysfunction in aquatic organisms exposed to industrial effluents. Endocrine destructing chemicals like xenoestrogen may interfere with reproductive system in fish by causing seminization of male fish thus affecting the breeding in fish population in aquatic reservoir (Arvindakshan *et. al.,* 2004; Johnson, 2008). Siphilie *et. al*., (2016) reported that male zebra fish exposed to different concentrations of industrial effluents showed abnormal induction of vitellogenine due to presence of histogenic chemicals in effluents. Similar results were obtained by Orrego *et. al*., (2009) and Ajani *et. al*., (2012) who reported paper mill and textile industrial effluent, respectively.

Present investigation reported that the fish diversity is comparatively more at spot S1 than S2. The fish diversity at spot S1 encompasses 34 species of fish belonging to 18 families. The dominant family was reported to be Cyprinidae which included 14 species of fish. Among 34 species of fish, *Garra mullya* (20.11%) was dominant followed by *Puntius amphibius* (11.42%) followed by *Glassogobius giuris* (8.01%). The dominant family Cyprinidae was followed by family Gobiidae, Bagridae, Poecillidae, each contained two species of fish. At spot S2, 17 species of fish belonging to 14 families were reported. Though Cyprinidae was dominant family at spot S2 but, only three species of fish were reported which were less by 11 species of fish as compared to spot S1. The trend of dominancy of fish species at spot S2 was similar to that of S1. While working on riverine fish fauna of Raigad district in India, Katwate *et. al*., (2012) reported 66 species of fish belonging to 31 families where Cyprinids were the most dominant group represented by 22 species followed by the loaches, croakers and gobiids of the family Balitoridae, Sciaenidae, Gobiidae, respectively. They represented 64 species of fish from Savitri river. As compared to fish diversity data of Katwate *et. al*., (2012) our finding indicated 14 fish species at spot S1 and 03 species at spot S2 from dominant family Cyprinidae. After family Cyprinidae dominancy was followed by Bagridae, Gobiidae, Poecillidae at spot S1 and by Siluridae at spot S2 in our findings.

While working on the fish diversity in Raigad district Singh and Yazdani (1993) recorded occurrence of *Mystus singhala*, *M. vitatus* and *M. keletius* but Katwate *et. al*., (2012) could not report these species but could report 2 new Bagrids, *M. bleekeri* and *M. malabaricus*.

In the present study we could not record all the fish species reported by earlier workers but could record new Bagrids *M. cavasius* from spot S1 but no *Mystus* was found at spot S2. On comparing results of the present study with the earlier studies, it indicated sharp decline in the species diversity in Savitri river. This may be due to heavy load of industrial effluents from Mahad MIDC and municipal waste emptied in Savitri river posing pollution threat to fish species living therein.

In the light of above discussion, it is suggested to initiate exhaustive monitoring studies to assess impact of anthropogenic activities in general and industrial activities in particular on the fish diversity in Savitri river of Raigad district.

Table 1A Average seasonal diversity of fish species at spot S1 in Savitri River during October 2014 to September 2016

Family	Fish Species	Pre Monsoon	Monsoon	Post Monsoon	Total
Clariidae	*Clarias gariepinus*	03	01	02	06
Megalopidae	*Megalops cyprinoides*	03	02	05	10
Therapontidae	*Theraponjarbua*	00	01	03	04
Gobiidae	*Glassogobiusgiuris*	33	32	29	94
	Boleophthalmusdissumieri	28	06	08	42
Cyprinidae	*Puntius amphibius*	21	48	65	134
	Garra mullya	139	48	49	236
	Dawkinsia filamentosa	11	07	16	34
	Puntius ticto	03	03	08	14
	Puntius sarana	11	03	06	20
	Hypselobarbus kolus	18	18	19	55
	Devario aequipinnatus	17	19	18	54
	Systomus sarana subnasutus	05	04	13	22
	Rasbora daniconius.	05	12	25	42
	Catla catla.	14	04	10	28
	Cirrhinusmrigala	12	05	12	29
	Crossoscheilus latius	16	02	07	25
	Cyprinus carpio	04	03	06	13
	Labeo rohita	05	05	07	17
Siluridae	*Wallago attu*	01	02	02	05
Ambassidae	*Ambassis commersoni*	01	02	02	05
Cynoglossidae	*Cynoglossus punticeps*	18	09	14	41
Centropomidae	*Lates calcalifer*	12	01	09	22
Cinchlidae	*Tilapia mossambica*	04	03	02	09
Anguillidae	*Anguilla bengalensis*	02	01	02	05
Bagridae	*Mystus cavasius*	04	02	07	13
	Mystus malabaricus	01	01	03	05
Mugilidae	*Mugil cephalus*	08	07	16	31
Clupeidae	*Tenualosa ilisha*	10	04	11	25
Ariidae	*Arius sona*	10	03	04	17
Poecillidae	*Gambusia affinis*	09	01	05	15
	Poecilia reticulate	11	02	03	16
Lutjanidae.	*Lutjanus johni*	24	04	10	38
Channidae.	*Channa punctata*	22	08	17	47
	Total	485	273	415	1173

Table 1B Average seasonal diversity of fish species at spot S2 in Savitri River duringOctober 2014 to September 2016

Family	Fish Species	Pre Monsoon	Monsoon	Post Monsoon	Total
Clariidae	*Clarias gariepinus*	01	01	02	04
Megalopidae	*Megalops cyprinoides*	00	07	17	24
Therapontidae	*Theraponjarbua*	03	03	12	18
Gobiidae	*Glassogobiusgiuris*	98	30	39	167 (18.87%)
Cyprinidae	*Puntius amphibius*	67	41	92	200 (22.59%)
	Garra mullya	45	56	104	205 (23.16%)
	Dawkinsia filamentosa	02	07	17	26
Siluridae	*Wallago attu*	02	02	03	07
	Ompok bimaculatus	06	07	06	19
Ambassidae	*Ambassis commersoni*	08	08	06	22
Cynoglossidae	*Cynoglossus punticeps*	23	11	16	50
Centropomidae	*Lates calcalifer*	02	03	09	14
Cichlidae	*Etroplus suratensis*	20	10	18	48
Sciaenidae	*Johnius dissumeri*	01	07	04	12
Leognathidae	*Leiognathusequulus*	04	07	07	18
Scatophagidae	*Scatophagus argus*	10	07	06	23
Sparidae	*Acanthopagarus berda*	11	08	09	28
	Total	303	215	367	885

Table 2 Minimum and Maximum range of physicochemical parameters of water samples collected from spot S1 and S2 in Savitri River during June 2014 toDecember 2016

Sr No.	Parameter	S1	S1	S2	S2
		Min.	Max.	Min.	Max.
1	Temperature (°C)	27	31.5	27	31.9
2	pH	7.31	8.25	6.14	7.73
3	Turbidity (NTU)	0.008	0.04	0.014	0.08
4	Transparency (cm)	159.6	291.5	125.5	184
5	TDS (ppm)	43	158	54	8700
6	TS (ppm)	80	255	320	18170
7	GPP (mg/l)	0.718	2.81	0.229	2.13
8	NPP (mg/l)	0.269	1.9	0.007	1.9
9	DO (mg/l)	4.82	20.01	3.9	14.07
10	BOD (2 days) (mg/l)	0.41	15	1.18	16
11	Free CO_2 (mg/l)	2	46	4.4	44
12	COD (mg/l)	8	49	60	600

13	Total acidity (mg/l)	10	80	10	105
14	Total alkalinity (mg/l)	55.3	203	46	200
15	Hardness (mg/l)	24	151	44	4800
16	Chlorides (mg/l)	7.1	446.3	11.3	8011.7
17	PO_4-P(mg/l)	0.02	13.2	NIL	12.5
18	NO_3-N mg/lit	0.01	138.78	0.4	148.98

Mystus malabaricus

Systomus subnasutus

Hypselobarbus kolus

Devario aequipnnatus

Mugil cephalus

Mystus cavasius

Puntius ticto

Tilapia mossambica

Puntius sarana

Figure 1 Species of fishes observed at Spot S1 in Savitri River

Etroplus suratensis

Rasbora daniconius

Leiognathus equulus

Scatophagus argus

Johnius dissumeri

Ompok bimaculatus

Figure **2** Species of fishes observed at Spot S2 in Savitri River

5. Conclusion

This study concludes that the fish diversity at two dissimilar spots in the Savitri river has significantly different due to release of industrial effluents in the riverine water between selected study spots S1 and S2. Spot S1 did not receive industrial effluents indicating more fish diversity whereas spot S2 continuously receiving effluent inflow indicated less fish diversity. Such anthropogenic intervention in aquatic bodies may lead to lifeless habitat in due course of time. Hence, strict enforcement of water pollution prevention and control act be done. The present study is helpful to the academicians, environmentalists, MIDC authorities and policy makers to adopt measures to prevent riverine pollution and implement programs supportive to aquatic life that may enrich fish diversity. Frequent monitoring of riverine water as well as fish diversity therein may be undertaken by researchers in future.

Compliance with ethical standards

Acknowledgments

Authors are thankful to The Principal of D.B.J. College, Chiplun and Principal of Dr. Babasaheb Ambedkar College, Mahad for providing laboratory facilities to conduct research work. We extend our sincere thanks to Dr. Jaiswal, Principal Scientist, ICAR_CIFE, Mumbai and Dr. Nilima Prabhu, Patkar-Varde College, Mumbai for helping us in identification of fish species.

Disclosure of conflict of interest

Authors do not have any conflict of interest to declare.

Statement of ethical approval

A letter of permission (Letter No. Zoo/01/2014-15, 13th June 2014) was taken from The Dissection Monitoring Committee of Research Centre to use minimum required number of fish species from Savitri river during research period.

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