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Ichthyofaunal diversity of Hiran-ii reservoir, Gujarat with special reference to Physico-chemical parameters

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Abstract
The present investigation was carried out to study the ichthyofauna diversity of Hiran-II reservoir. Monthly samples were collected from the selected sites during July 2018 to March 2019. The study revealed that physico-chemical parameters of Hiran-II Reservoir, commercial importance 28 fish species were collected which are belonging to 19 genera, 10 families and 6 orders. Investigated the occurrence of Cypriniformes were dominant (13 species) followed by Siluriformes (6 species), Perciformes (3 species), Channiformes (3 species), Osteoglossiformes (2 species) and Synbranchiformes (1 species). Highest diversity of fish were recorded in the month of December (post monsoon). The range of physico-chemical parameters were observed such as water temperature 21.77°C – 28.43°C, pH 7.57 – 8.43, electrical conductivity 284.3–367.7µmhos/cm, transparency 19.67 – 30.26/cm, dissolved oxygen 6.77–9.33mg/l, BOD 6.27- 8.47mg/l, total alkalinity 212.33–254.67mg/l; total hardness 145– 194mg/l, TDS 212.3 – 271.7mg/l, TSS 25.87 – 38.90mg/l, nitrate 0.92 – 2.04, and phosphate 0.59 – 0.90mg/l.

Keywords: Icthyofauna, physico-chemical parameters, Hiran-II reservoir

1. Introduction
Fish biodiversity are act as good bio-indicator of aquatic ecosystem and very important from the biodiversity point of observation [1]. Fish constitutes half the entire number of vertebrates within the world. They live in almost all possible aquatic habitats. According to [2] there are 21,723 commercially importance living fish species have been recorded out of these 11,650 are marine and 8,411 are freshwater species. Ichthyofaunal biodiversity refers to mixture of fish species depending on the environment and scale, it could refer to genotypes or alleles inside of life forms within a fish population and to variety or life forms across aqua regimes [3] India ranking 9th position in the world in provisions of larger freshwater biodiversity. There are about 450 families of freshwater fishes globally, approximately, 40 freshwater fish families are represented in India, out of these 25 families have commercially important species [4]. According to [5], Indian fish diversity are classified into two groups, *viz*., Osteichthyes (bony fishes) and Chondrichthys (cartilage fishes). The 2.21% of total bony fish families' are endemic in Indian region. In addition to 223 endemic fish, species are found in India, representing 8.75% of the total fish species recognized from the Indian region. The western Ghats of India region having richest endemic freshwater fish species. Northeastern India, which has a very high diversity among freshwater fish, does not have many endemic species within India because of its serrated political boundary.
Rich variety of fish fauna preserve in Indian reservoir. According to the study on large reservoirs commonly, 60 specie fish contributed out of which 40 fish species contribute to the commercial fisheries. Indian major carps inhabit a major in reservoir place along with the commercially important fishes both the indigenous as well as exotic carps like rohu, catla, mrigal, grass carp, silver carp, and common carp, account for a enormous volume of the production [6]. The physico-chemical condition of an aquatic ecosystem depends on the biotic and abiotic properties of water and the biological diversity of the aquatic ecosystem [7]. The quality of aquatic water system is measured by its physico-chemical characteristics. The changes in the physico-chemical characteristics of water body tend to change the living biota, particular in the diversities, distributions and numbers, in the aquatic ecosystem [8]. The icthyofauna diversity is the major constituent of an aquatic ecosystem having high economic value, as they provide the healthy and delicious food for mankind [9].

2. Materials and Methods

2.1 Study area: Reservoir is located about 34 km away from Veraval city. The Reservoir lies on Umrethi, Gujarat (Lat-21° 01' 56" N, Lon-70° 28' 49" E), India (Fig. 1). Hiran-II reservoir is a man-made reservoir meant for irrigation and flood control. The reservoir was also supposed to serve the purposes of fisheries and water supply to the host communities. It was constructed across the River of Hiran. The Gross storage capacity of the reservoir is over 35.8 mm^3. It provides a natural habitat for various aquatic lives including fish. The reservoir is flooded during the rainy season and the climate is characterized by distinct dry and rainy seasons. The human communities around the reservoir are involved in fishing activities and rainy season farming, the reservoir also serves as grazing area and watering point for livestock. The reservoir was prepared in 1973.

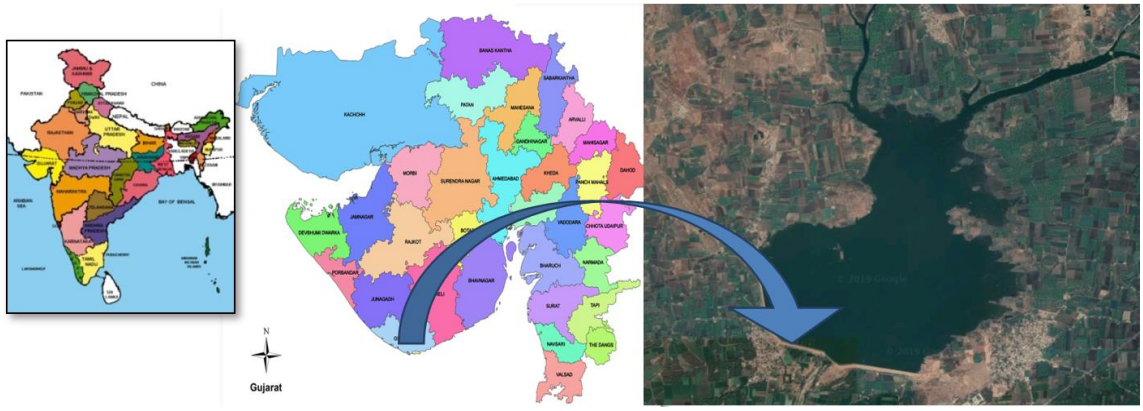

Fig 1: Google Map of Hiran-II reservoir in the Saurashtra region in Gujarat

2.2 Water sample collection and Analysis

Water samples from Hiran-II Reservoir were collected every month from July, 2018 to March, 2019 at 9 A.M – 10 A.M in clean plastic air tight bottles. For Dissolved Oxygen (DO) analysis, water sample was collected in clean 100 ml of glass bottles. The water and air temperature were recorded by glass thermometer, pH by pH meter (PCS Tester-35 multi parameter), conductivity by conductivity meter (Himedia), dissolved oxygen by Winkler's method, alkalinity, hardness, total dissolved solid, total suspended solid, nitrate, and phosphate by [10] and [11].

2.3 Sampling Process

Finfishes were collected from selected site by random sampling method and data were taken at every 15 days interval. At the sampling sites fishes were collected from reservoir water using by different types of gear and crafts with the help of local fishermen. The fishermen were mainly using local fishing nets for fishing and captured fishes were recorded. Immediately photograph of fish samples were captured. Sample fishes were taken at College of Fisheries, Veraval with the help of insulated icebox and preserve in 5% formalin (40% conc.) solution in separate specimen jar (1000 ml, 2000 ml) according to their size. Collected fish sample was measure and identify up to the species level, with the help of standard keys, book and standard taxonomic references like [12, 13, 14, 15, 16].

3. Results and Discussion

3.1 Water quality parameters of Hiran-II reservoir

In the present study the highest temperature value 28.43°C were recorded in pre-monsoon season, (March) and lower value 21.77°C in monsoon season, highest pH value 8.43 were recorded in pre-monsoon season, (March) and lower value 7.57 in monsoon season, (September). Similar results observed by [17] from Savitri reservoir, poladpur, Raigad district, Maharashtra, [18], Kolar, Kaliasote and Kerwa Dam, Bhopal (M.P.), India and from Harsool-Savangi Dam, Aurangabad, India [19]. According to [20], the pH range between 6 and 8.5 was medium productive reservoirs, more than 8.5 were highly productive and less than 6 were low productive reservoirs. The highest electrical conductivity value 367.7 µmhos/cm were recorded in post-monsoon season, (December) and lower value 284.3 µmhos/cm in pre-monsoon season, (March), highest transparency 30.26 cm were recorded in post-monsoon season, (December) and lower value 19.67/cm in pre monsoon season, (March) [21]. observed similar results from Tawa and Halali reservior of Bhopal, India [22]. from Mhaswad reservoir of Satara district (Maharashtra) India. Highest dissolved oxygen 9.33 mg/l were recorded in monsoon season, (July) and lower 6.77 mg/l in pre-monsoon season, (January). Dissolved oxygen is very necessary for the metabolism of aerobic organisms and influences inorganic chemical reactions. Oxygen is considered a limiting factor, especially in water body with a heavy load of organic material [23]. BOD was ranged between 6.27 to 8.47 mg/l. The highest biochemical oxygen demand value were recorded in monsoon season, (July) and lower value were recorded in pre-monsoon season, (March). The biodegradation of organic materials exerts oxygen tension in the water and increases the biochemical oxygen demand [24] total hardness was ranged between 145 to 194 mg/l. The elevated value of hardness in summer and low in winter show that the water may be suitable for the growth of the fish [25], total alkalinity was ranged between 212.33 to 254.67 mg/l, total suspended solids 38.90 mg/l were recorded in monsoon season, (July), due to increase suspended particles in the water and lower value 25.87 mg/l in post-monsoon season, (December). The high amount of the total suspended solids is mainly due to the discharge of domestic as well as industrial waste [26]. Total dissolved solids ranged 212.3 to 271.7 mg/l. The heavy quantity of total dissolved solids in water distressed the environmental balance due to osmotic regulation and suffocation caused in aquatic fauna [27]. Nitrate value 2.04 mg/l were recorded in pre-monsoon season, (February) and 0.92 mg/l in monsoon season, (August), phosphate 0.90 mg/l were recorded in pre-monsoon season, (March) and 0.59 mg/l were recorded in post- monsoon season, (December). [28] observed phosphate ranged 0.72 mg/l minimum to 1.48 mg/l maximum from Kalisayot Dam, (M.P.), India.

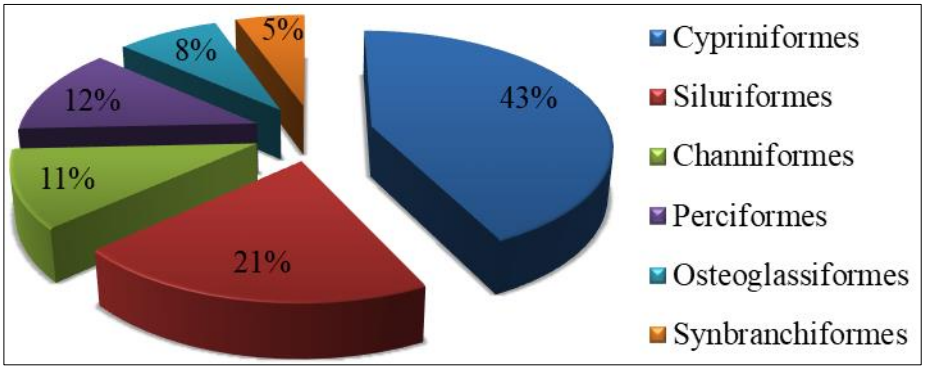

Fig 2: Graphical representation of percentage contribution of genera in an order.

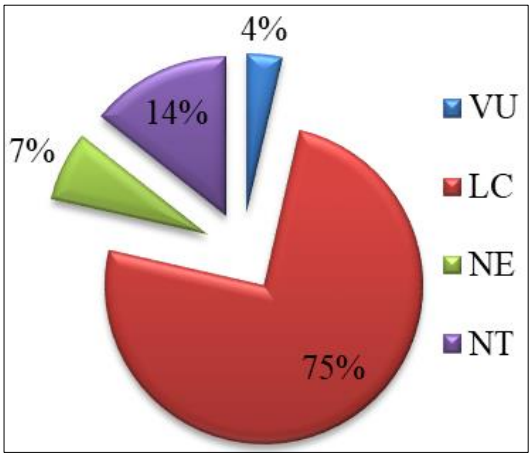

Fig 3: Percentage occurrence of fish species under IUCN (2018-19) conservation status in Hiran-II reservoir.

3.2 Total fish diversity recorded in Hiran – II reservoir

Distribution and diversity of icthyofaunal depends on abiotic and biotic factor, length and age of water body, depth, shape, size, types of ecosystems, morphometric and morphoedaphic factors, water fluctuation level and great bottom implications etc. The hydro-biological features of the collection centers also play an efficient role in fisheries output largely [5]. There are other factors responsible for fish retardation other than physical stability like over fishing, dynamiting, pollution threats, etc.

All the fishes of Hiran-II reservoir have commercial value. In this study 28 fish species belonging to 19 genera and 10 families in 6 orders were characterized. Investigated the occurrence of Cypriniformes was dominant (13 species) followed by Siluriformes (6 species), Perciformes (3 species), Channiformes (3 species), Osteoglossiformes (2 species) and Synbranchiformes (1 species) (Table: 1).

Similar results were found by many researchers, during the Ichthyofaunal studies of Visapur reservoir in relation to fish culture, Ahmednagar district, reported the occurrence of 15 fish species belonging to 5 orders, 7 families and 12 genera. Cypriniformes were dominated by 8 species [29].

Among the collected species, Cypriniformes was the foremost dominant constituting 43% followed by Siluriformes constituting 21%, Perciformes 12%, Channiformes 11%, Osteoglossiformes 8% and Synbranchiformes 5% constituting of the total fish species (Fig: 2).

Most of the fish species recorded from the studied reservoir they were, *Labeo calbasu, Labeo rohita, Catla catla, Cirhinus mrigala, Ctenopharyngodon idella, Cyprinus carpio, Hypophthalmicthyes molitrix, Puntius sophore, Puntius ticto, Amblypharyngodon mola, Cirhinus reba, Esomus dandricus and Labeo bata* comes under Cypriniformes. *Wallago attu, Ompok pabda, Pangasius pangasius, Heteropneustes fossilis, Mystus bleekeri* and *Mystus vittatus* comes under Siluriformes. *Channa marulius, Channa punctatus* and *Channa striatus* comes under Channiformes. *Chanda nama, Chanda ranga* and *Oreochromis niloticus* comes under Perciformes. *Notopterus notopterus, Notopterus chitala* comes under Osteglossiformrs and *Mastacembelus armatus* belong from the Synbranchiformes. A systematic list of fishes observed from the reservoir has been provided in (Table: 1).

Similar type of explorations were carried out by [30] studied the ichthyofauna of Jawalgaon reservoir in Maharashtra and reported the occurrence of 23 fish species belonging to 7 orders. Recently [9] reported 35 Species from Shirsathwadi reservoir, Mohari reservoir and Manikdaundi reservoir of Nagar District Maharashtra State. They further illustrated 18 species form order Cypriniformes, five species in order Siluriformes, four species in Preciformes, one species each for order Clupeiformes, Channiformes, Mastacemboeliformes, Mugiliformes and Beloniformes. The order Cypriniformes was dominant.

Threat and conservation status of the Hiran-II reservoir fishes, checked in IUCN red list (IUCN, 2018-19). A total of 28 fish species collected from the study sites out of which 1 species (4%) was in the vulnerable, 2 species (7%) are not evaluated, 4 species (14%) are near threatened, 21 species (75%) are least concern category and there is no any (0%) species recorded from the Hiran-II reservoir, which are comes under, endangered, lower risk near threatened, lower risk least concern and data deficient (Fig: 3)

Table 1: List of fishes and their order, family, species, common name, economic value and IUCN status of Hiran-II reservoir.

Order	Family	Scientific Name	Common Name	IUCN Status	Economic Value
Cypriniformes	Cyprinidae	*Labeo calbasu*	Black rohu	LC	Food fish
	Cyprinidae	*Labeo rohita*	Rohu	LC	Food fish
	Cyprinidae	*Catla catla*	Catla	LC	Food fish
	Cyprinidae	*Cirhinus mrigala*	Mrigal	LC	Food fish
	Cyprinidae	*Ctenopharyngdon idella*	Grass carp	NE	Food fish
	Cyprinidae	*Cyprinus carpio*	Common carp	VU	Food fish
	Cyprinidae	*Hypophthalmicthyes molitrix*	Silver carp	NT	Food fish

	Cyprinidae	*Puntius sophore*	Pool barb	LC	Ornamental fish
	Cyprinidae	*Puntius ticto*	Ticto barb	LC	Ornamental fish
	Cyprinidae	*Amblypharyngodon mola*	Mola carpet	LC	Ornamental fish
	Cyprinidae	*Cirrhinus reba*	Reba carp	LC	Food fish
	Cyprinidae	*Esomus dandricus*	Flying barb	LC	Ornamental fish
	Cyprinidae	*Labeo bata*	Minor carp	LC	Food fish
Siluriformes	Siluridae	*Wallago attu*	Freshwater shark	NT	Food fish
	Siluridae	*Ompok pabda*	Pabda cat fish	NT	Food fish
	Pangasidae	*Pangasius pangasius*	Pangas cat fish	LC	Food/Ornamental fish
	Heteropneustidae	*Heteropneustes fossilis*	Stinging cat fish	LC	Food/Ornamental
	Bagridae	*Mystus bleekeri*	Day's mystus	LC	Food fish
	Bagridae	*Mystus vittatus*	Striped dwarf cat fish	LC	Food fish
Channiformes	Chaannidae	*Channa marulius*	Great snakehead	LC	Food fish
	Chaannidae	*Channa punctatus*	Spotted snakehead	LC	Food fish
	Chaannidae	*Channa striatus*	Stiped snakehead	LC	Food fish
Perciformes	Ambasidae	*Chanda nama*	Glassfish	LC	Ornamental fish
	Ambasidae	*Chanda ranga*	Indian Glass fish	LC	Ornamental fish
	Chichlidae	*Oreochromis nilotiocus*	Nile Tilapia	NE	Food fish
Osteoglassiformes	Notopteridae	*Notopterus notopterus*	Bronze featherback	LC	Food/Ornamental fish
	Notopteridae	*Notopterus chitala*	Humped featherback	NT	Food/Ornamental fish
Synbranchiformes	Mastacembelidae	*Mastacembelus armatus*	Zig-zag spiny Eel	LC	Food/Ornamental fish

IUCN red list status (2018-19): EN- Endangered; VU- Vulnerable: LRnt- Lower risk near threatened; LRlc- Lower risk least concern; LC- Least concern; DD- Data Deficient; NE- Not evaluated, NT-Near threatened.

4. Conclusion

Present study deal with the ichthyofaunal diversity of Hiran-II reservoir. Study indicates that all the water quality parameters of the selected reservoir is within permissible limits, this represents that the reservoir is non-polluted and can be used for fish culture as well as agriculture. Reservoir in the Saurahtra region of Gujarat is an important reservoir, this supports diverse type of fish fauna and each species frequently consists of numerous native groups with a distinct genetic structure, studied observed that post-monsoon period was the most productive period in respect of abundance species and biodiversity in Hiran-II reservoir, but the level of fish production is not so adequate in other season due to inequitable tropic structure. The use of illegal process to take fish should be prohibited in this area to avoid the depletion of fresh water fish resources for the fisheries development of the reservoir fish faun need to conserve for future generation.

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