



Diversity of Selected Ichthyofauna (Fish) with Monitoring of Water Quality of Sapna and Kosmi Dams

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Abstract : Surface water is a good source for a wide variety of organisms that live in certain conditions of the water's properties. The analysis of physico-chemical parameters such as temperature, conductivity, turbidity, pH, free CO₂, DO, BOD, COD, TH, chloride, fluoride, phosphate, nitrate, sodium, potassium improves water quality. Water mineral is essential substitute in proper standard form which is good for aquatic organisms. Surface water resources are well suited for the formation of the variety of fish species. Some common fish species are found in the water of Sapna and Kosmi dams like *M. pancalus*, *C. catla*, *C. mrigala*, *C. batrachus*, *C. carpio*, *H. molitrix*, *L. rohita*, and *M. cavasius*. The water quality of Sapna Dam is good for the growth of above fish species as compared to Kosmi Dam.

INTRODUCTION

The study of different fish species is monitored by sequencing the diversity in the water bodies and their physico-chemical characteristics along with various biological factors for fish habitat [1]. The presence of certain heavy metals in reservoir water is a pollution factor for the aquatic environment which is a worldwide problem as heavy metals are the most important pollutants, and affect water quality [2]. At present only half of the potential of aquatic resources is being tapped for the fisheries sector, which can be increased from a scientific point of view, especially through management of catchment area activities and application of new technologies. The study will attempt to assess the impact of catchment area activities on water quality, fish diversity in two very important wetlands. Correspondence analysis some abiotic parameters explained the importance of water as well as the high cumulative variance of the composition of living organisms [3]. In order to improve water quality, the biological characteristics of water at different locations are measured with the help of limnological measurement instruments [4]. This increase is attributed to the withdrawal of rainwater into the soil of favorable conditions during the change of seasons such as the summer, monsoon and winter periods of a year. The number of organisms that fluctuate in relation to the physico-chemical and other environmental conditions of the pond is discussed [5]. Ichthyofauna communities are accompanied by a stillness of water; Elevated conditions affected ichthyofauna composition and are selected for in a hypotrophic environment [6,7].

Different types of ichthyofauna communities have documented differences and similarities in species composition, abundance and biomass over a year by examining the variations [8]. Aquatic ecosystems are affected by many health stresses, which greatly reduce biodiversity [9]. The diversity and density of fish depends on the nutritional status of the water body, non-living abiotic factors and the state of the food chain along with the life cycle. Abundance is an ecological concept and is usually measured as the total number of individuals of a species found per sample within a given area [10].

Generally, feeding on some important plankton such as phytoplankton and zooplankton for high production of fish is ubiquitous in the ecosystem of the water body. Plankton found in freshwater reservoirs including ponds, dams, lakes and oceans are good indicators of a healthy environment [11–13]. Fish production farming is a profitable business in the commercial sector [14]. The sector of fish production is one of the most important indirect employment sectors in India [15]. The nutrients and cheap price found in fish make it a good and inexpensive source of protein, omega fatty acids and minerals [16]. Study of ichthyofauna is including nine fish such as species *Macrognathus pancalus*, *Catla catla*, *Cirrhinus mrigala*, *Clarias batrachus*, *Cyprinus carpio*, *Hypophthalmichthys molitrix*, *Labeo rohita*, and *Mystus cavasius*.

MATERIALS AND METHODS

Samples collection

The study area of Sapna and Kosmi dams in Betul district was observed at monthly intervals during the period of one year (March 2019 to February 2020). Water samples containing live organisms were collected from the study sites from 8:00 a.m. to 10:00 a.m. Sample collections were selected areas, in which water samples and fish were collected mainly from limnetic zone sterilized with 70% ethanol in wide mouth bottles capacity at 20 liters for analysis of water quality and living organisms [17-19]. Successful collection of samples was basically dependent on the selection of suitable material, time duration of collection and water depth in the study area.

Physico-chemical analysis

The study area water samples of dams were examined during a period of one year at monthly intervals. The water samples were analyzed for the following physical and chemical properties, determined at the location of collection sites and in laboratory tests [20].

Physical properties

The physical properties are most abundant of quality improved the water samples were know such as Temperature was the most important thing for the development of aquatic organisms, the Scale temperature was maintained at 0.1 °C on the mercury thermometer for each water sampling location [21,22]. The conductivity meter was used for measuring the conductivity of dams water samples. Transparency the presence of molecules and particles size can scatter light. Secchi disc was used for transparency measurement of dam water. Turbidity caused by a large number of individual particles were The measurement of turbidity in NTU suspension test of water quality [23,24].

Chemical properties of water

The chemical properties are most abundant of quality improved of the water samples to participate in biological reaction and cellular metabolisms were estimation with water quality know such as pH analysis The pH was a value of Various samples measure the pH value by immersing the electrode in the sample for 1 min [25,26]. The determination of other chemical properties of water samples used standard protocols for estimation and quantification of water properties such as Free CO₂, DO (dissolved oxygen), BOD, COD, TH (Total hardness), Chloride, Fluoride, Phosphate, Nitrate, Sodium, Potassium etc [23,24,27,28].

Mesh net for fish

Quantities obtained from filtered water for specific phytoplanktons and zooplanktons were available along with valuable amounts of plankton qualitative. Although the collection of plankton was implemented on the Mesh nets made of silk and nylon were used to collect a variety of plankton and a variety of trap sizes from 65µm to 2 mm. The net size of the trap material was designed to influence the type of plankton collected by the trap, which was best suited to the size of the pore. The 0.2 mm mesh size of monofilament nylon is commonly used to collect plankton for various types of phytoplankton and related taxonomic and productivity studies in zooplankton. In addition to the size, type, length and mouth area of the trap, rope speed, collection time and haul type will determine the quality and quantity of plankton [29].

RESULTS AND DISCUSSIONS

Monitoring and evaluation of available water, plankton and fish quality from the selected three sites of Sapna and Kosmi dams, indicating sites like S1, S2 and S3 and the results of the investigation were as follows. During the one-year study, the data (from March 2019 to February 2020) was segmented into respective three seasons, namely summer (March, April, May and June), monsoon (July, August, September and October), and winter (November, December, January and February). Water samples containing plankton including phytoplankton, zooplankton and ichthyofauna were collected from monitoring sites from 8:00 am to 10:00 am. Water samples were stored in clean bottles for analysis of properties of conductivity, pH, TDS, temperature, turbidity and chemical tests such as alkalinity, free CO₂, DO, BOD, COD, Total hardness, chloride, fluoride, phosphate, nitrate, sodium, potassium, etc.

Tabel 1. Physico-chemical properties of water of Sapna and Kosmi Dams

Parameters	Standard	Sapna Dam	Kosmi Dam	Segregation
Temp (°C)	23-27	25.58	25.88	0.30
pH value	6.5-8.5	7.36	6.43	0.93
Cond (°)	200-800	476.69	630.47	153.78
CO ₂ (mg/l)	0-10	6.59	6.00	0.60
Turb (NTU)	1.0-5.0	5.11	7.10	1.99
DO (mg/l)	6.5-8.0	6.49	5.00	1.49
BOD (mg/l)	3.0-5.0	4.62	3.06	1.56
COD (mg/l)	20-200	105.17	160.44	55.28

TH (mg/l)	120-180	204.71	322.31	117.60
Cl (mg/l)	250-600	31.82	33.49	1.67
P (mg/l)	1.0-1.17	0.47	0.49	0.03
N (mg/l)	0-10	0.49	0.51	0.02
Na (mg/l)	30-60	5.71	6.65	0.94
K (mg/l)	0-20	2.96	2.63	0.33
TDS (mg/l)	150-300	243.11	321.41	78.30
F (mg/l)	1.0-1.5	1.66	2.44	0.78

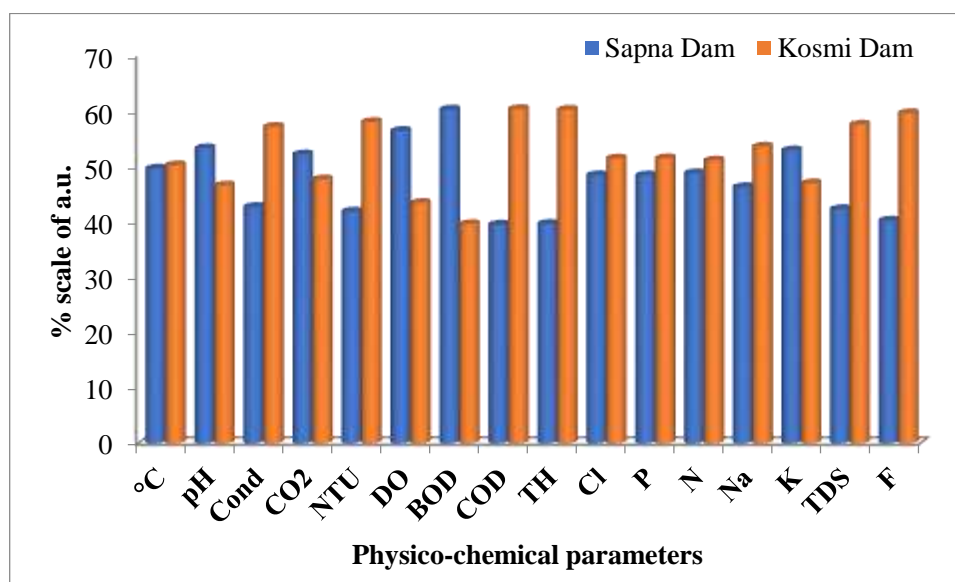


Figure 1: Percentage variation of physico-chemical parameters of water from Sapna and Kosmi dams.

Diversity of Ichthyofauna

Sapna and Kosmi dams are used not only for irrigation but also for various kinds of fish production in this catchment area involved of local fishermen communities. The both dams were structured for most fish community, fish distribution, and ichthyofauna diversity. Both dams fish diversity in relation to water quality were show inadequate to frame of a tangible fisheries programmed.

Analysis of Ichthyofauna (Fish)

In the basic analysis, biomass of the Ichthyofauna species was measured through numerical counted individual and their weight of fish species in quantification systems. The term biomass refers to the weight of living matter present in Ichthyofauna samples. Total Ichthyofauna present in the water samples were estimated of biomass. The total fish volume was determined to be smaller than that of the collected ichthyofauna samples.

Weight Measurement methods

The weight measurement method used for determination to qualities of species was expressed as weight in grams per specie of Ichthyofauna estimates was done by different size net collected to fish species. The weight of the ichthyofauna species average data analyzed were taken at pre-determined plan for one year and the weight recorded in grams per species in every month from whole water body of both dams.

Diversity of fish in Sapna Dam

The analysis of quantities of available total eight fish species in March 2019 of whole Sapna dam were show the frequencies maximum number of species 32 of *C. catla* and Minimum number of species 5 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 5-32 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 629.50 g. of *M. pancalus* and minimum average weight 145.25 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 145.25-629.50 g. The details were shown in figure 2. The analysis of quantities of available total eight fish species in April 2019 of whole Sapna dam were show the frequencies maximum number of species 34 of *C. catla* and Minimum number of species 5 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 5-34 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 604.5 g. of *M. pancalus* and minimum average weight 148.5 g. of *C. mrigala* and while other species were shown the average weight of frequencies between

range 148.5-604.5 g. The details were shown in figure 3. The analysis of quantities of available total seven fish species in May 2019 of whole Sapna dam were show the frequencies maximum number of species 33 of *C. catla* and Minimum number of species 6 of *M. cavasius* and while the other species were shown the numbers of frequencies range between 6-33 species. The analysis of qualities average weight (g.) from seven fish species were shown the maximum frequencies of average weight 572.75 g. of *C. batrachus* and minimum average weight 151.25 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 151.25-572.75 g. The details were shown in figure 4. The analysis of quantities of available total eight fish species in June 2019 of whole Sapna dam were show the frequencies maximum number of species 33 of *C. catla* and Minimum number of species 1 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 1-33 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 497.25 g. of *C. batrachus* and minimum average weight 129.25 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 129.25-497.25 g. The details were shown in figure 5. The analysis of quantities of available total eight fish species in July 2019 of whole Sapna dam were show the frequencies maximum number of species 45 of *H. molitrix* and Minimum number of species 2 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 2-45 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 440.25 g. of *L. rohita* and minimum average weight 110.75 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 110.75-440.25 g. The details were shown in figure 6. The analysis of quantities of available total seven fish species in August 2019 of whole Sapna dam were show the frequencies maximum number of species 46 of *H. molitrix* and Minimum number of species 3 of *M. cavasius* and while the other species were shown the numbers of frequencies range between 3-46 species. The analysis of qualities average weight (g.) from seven fish species were shown the maximum frequencies of average weight 432.50 g. of *L. rohita* and minimum average weight 120.25 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 120.25-432.50 g. The details were shown in figure 7. The analysis of quantities of available total seven fish species in September 2019 of whole Sapna dam were show the frequencies maximum number of species 43 of *C. catla* and Minimum number of species 8 of *M. cavasius* and while the other species were shown the numbers of frequencies range between 8-43 species. The analysis of qualities average weight (g.) from seven fish species were shown the maximum frequencies of average weight 457.00 g. of *L. rohita* and minimum average weight 127.75 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 127.75-457.00 g. The details were shown in figure 8. The analysis of quantities of available total eight fish species in October 2019 of whole Sapna dam were show the frequencies maximum number of species 45 of *C. catla* and Minimum number of species 1 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 1-45 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 517.50 g. of *L. rohita* and minimum average weight 121.50 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 121.50-517.50 g. The details were shown in figure 9. The analysis of quantities of available total eight fish species in November 2019 of whole Sapna dam were show the frequencies maximum number of species 42 of *L. rohita* and Minimum number of species 2 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 2-42 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 531.50 g. of *M. cavasius* and minimum average weight 126.25 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 126.25-531.50 g. The details were shown in figure 10. The analysis of quantities of available total eight fish species in December 2019 of whole Sapna dam were show the frequencies maximum number of species 40 of *C. catla* and Minimum number of species 2 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 2-40 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 536.50 g. of *L. rohita* and minimum average weight 137.25 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 137.25-536.50 g. The details were shown in figure 11. The analysis of quantities of available total eight fish species in January 2020 of whole Sapna dam were show the frequencies maximum number of species 39 of *C. catla* and Minimum number of species 7 of *M. pancalus*, *M. cavasius* and while the other species were shown the numbers of frequencies range between 7-39 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 576.00 g. of *L. rohita* and minimum average weight 149.50 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 149.50-576.00 g. The details were shown in figure 12. The analysis of quantities of available total eight fish species in February 2020 of whole Sapna dam were show the frequencies maximum number of species 45 of *C. catla* and Minimum number of species 4 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 4-45 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 591.00 g. of *L. rohita* and minimum average weight 149.00 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 149.00-591.00 g. The details were shown in figure 13.

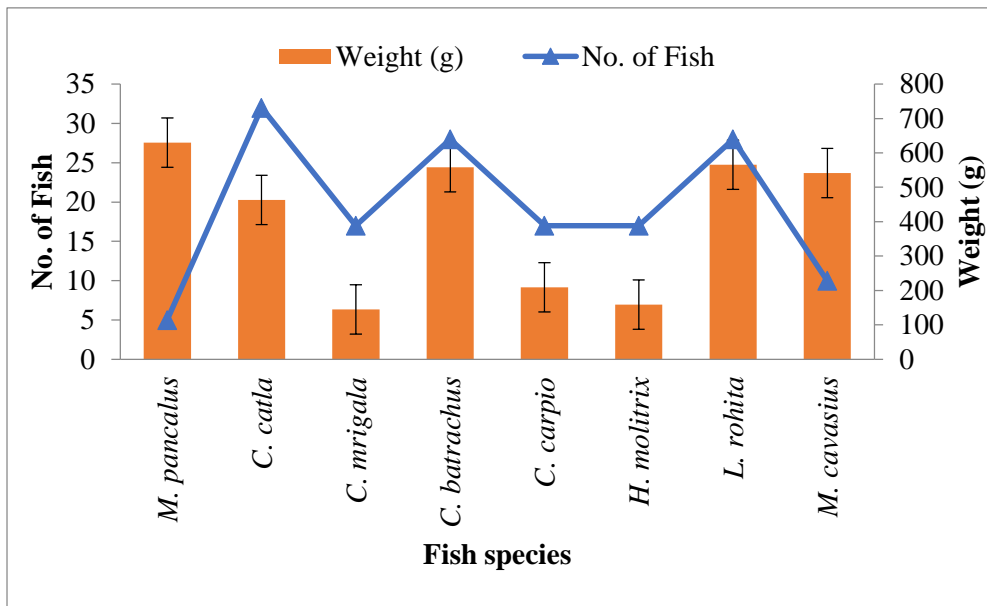


Figure 2: Analysis of Ichthyofauna in Sapna Dam (March-2019).

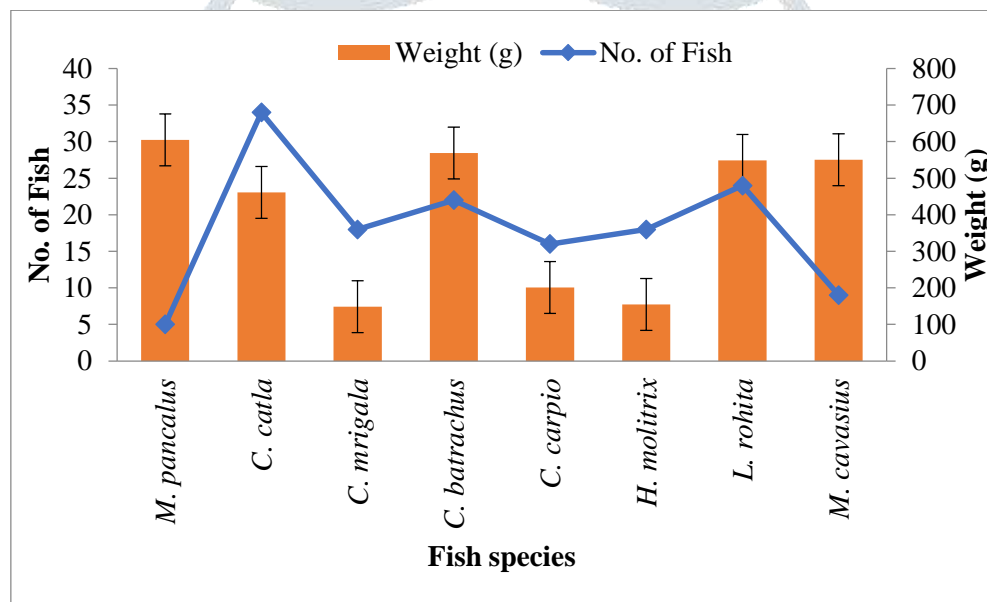


Figure 3: Analysis of Ichthyofauna in Sapna Dam (April-2019).

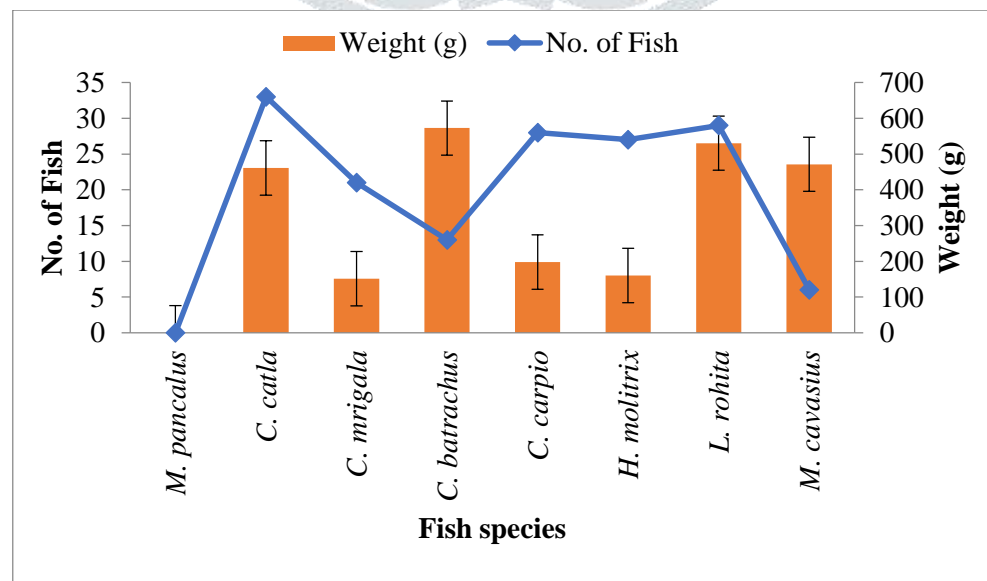


Figure 4: Analysis of Ichthyofauna in Sapna Dam (May-2019).

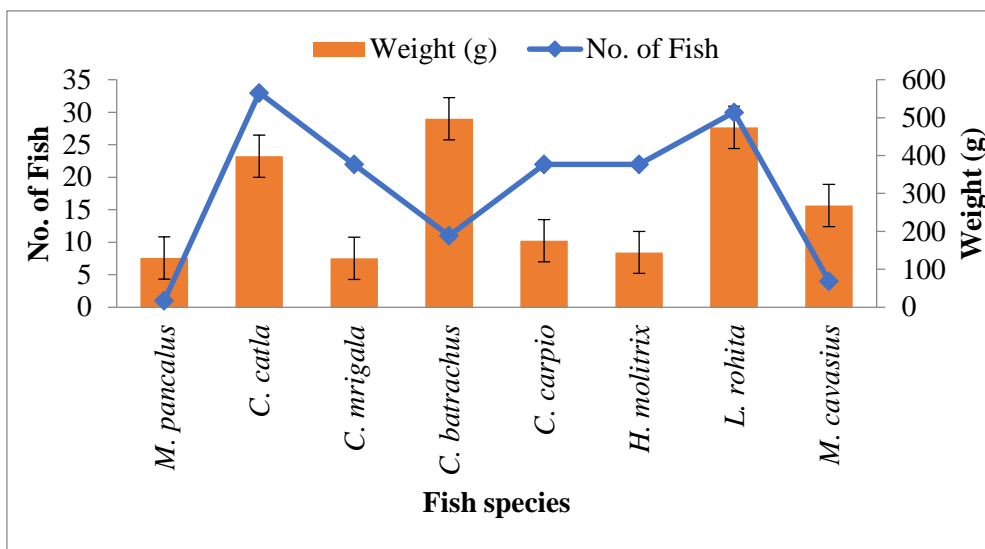


Figure 5: Analysis of Ichthyofauna in Sapna Dam (June-2019).

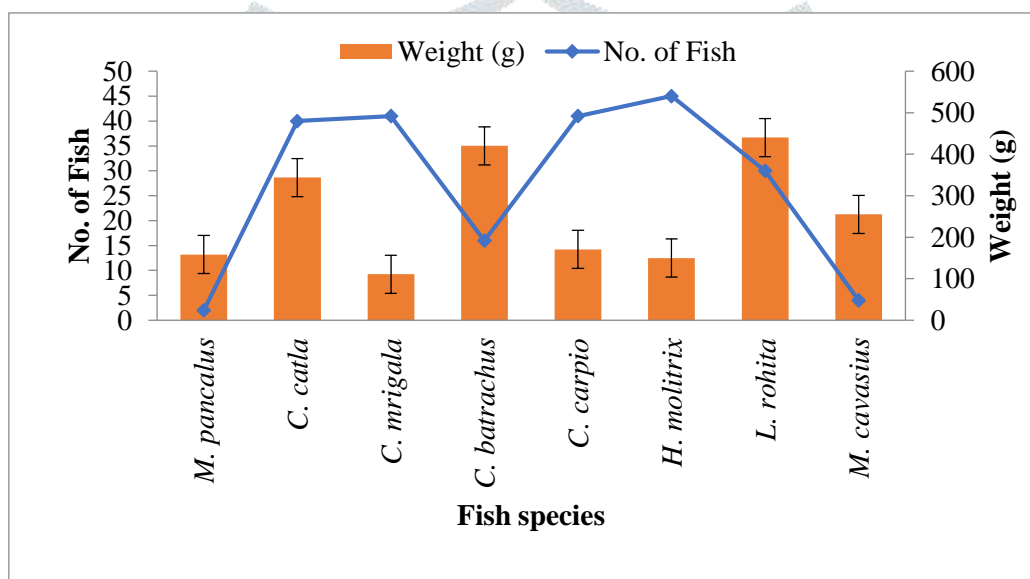


Figure 6: Analysis of Ichthyofauna in Sapna Dam (July-2019).

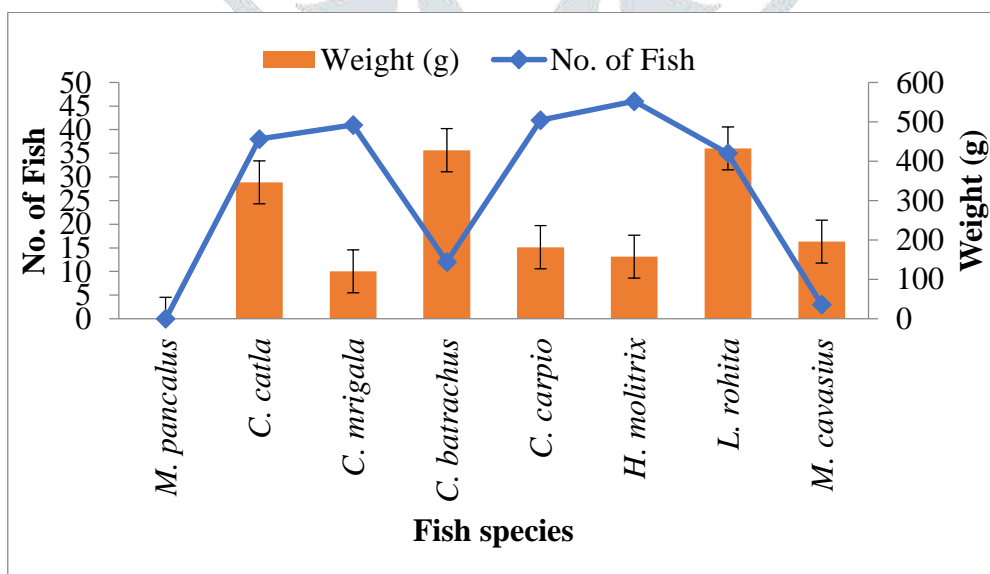


Figure 7: Analysis of Ichthyofauna in Sapna Dam (August-2019).

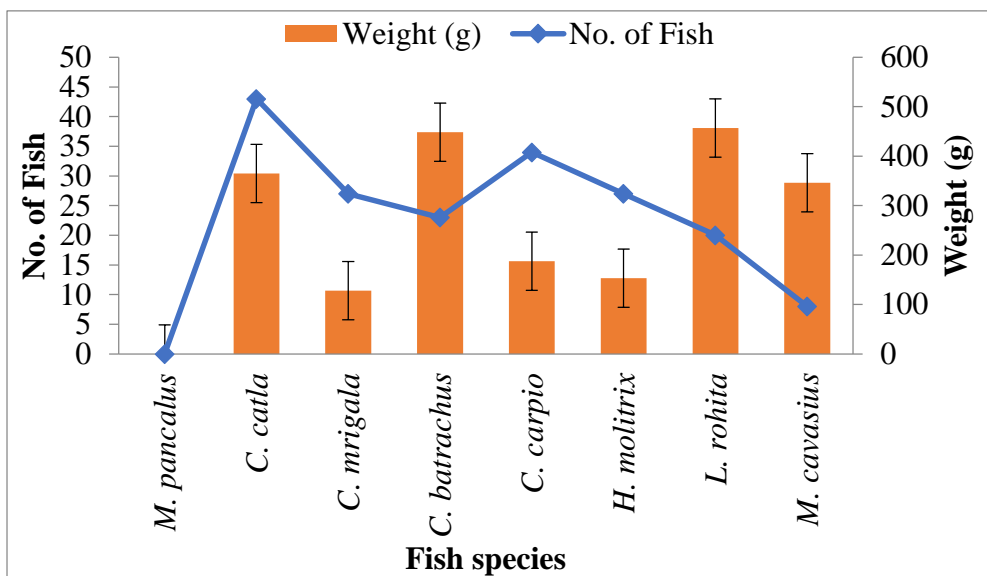


Figure 8: Analysis of Ichthyofauna in Sapna Dam (September-2019).

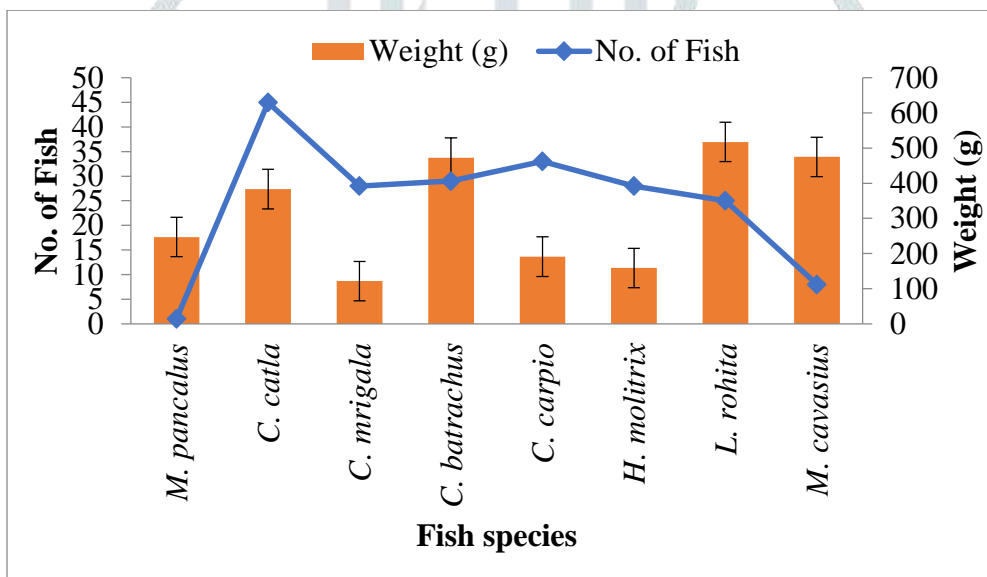


Figure 9: Analysis of Ichthyofauna in Sapna Dam (October-2019).

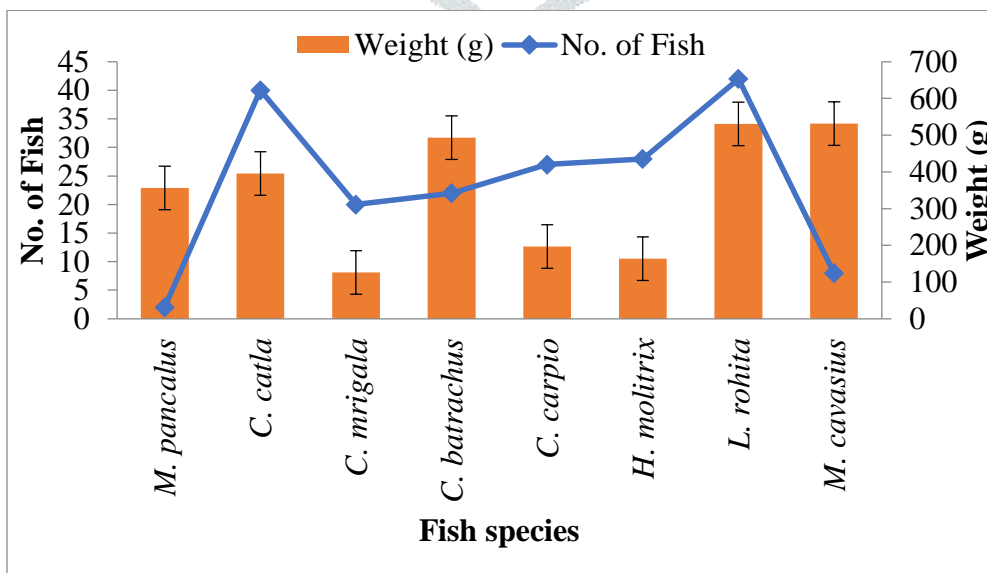


Figure 10: Analysis of Ichthyofauna in Sapna Dam (November-2019).

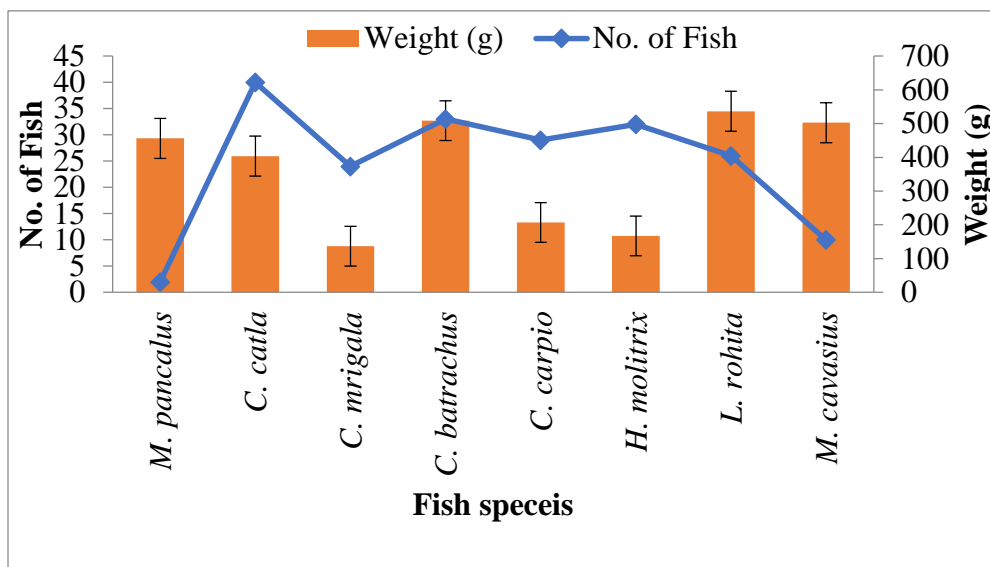


Figure 11: Analysis of Ichthyofauna in Sapna Dam (December-2019).

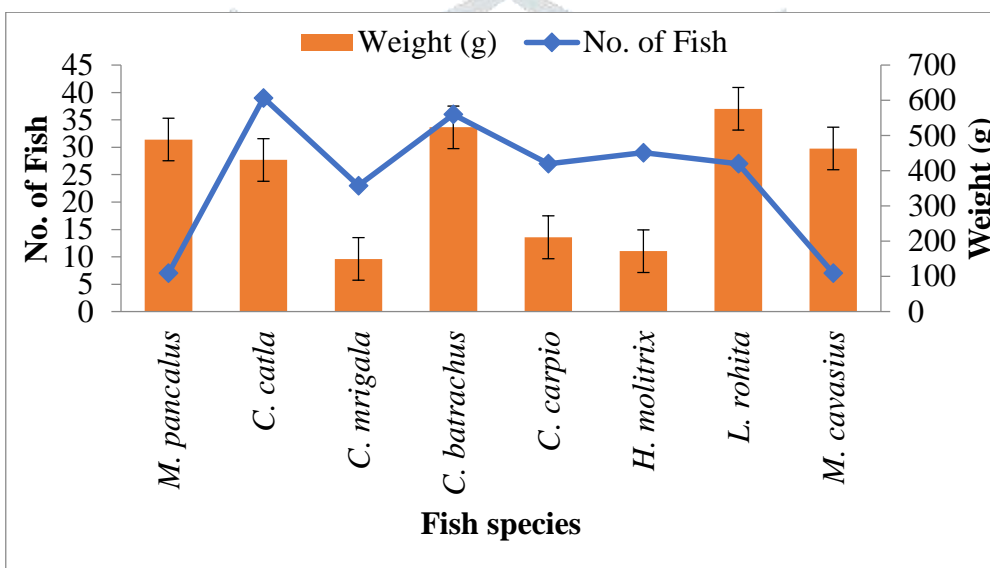


Figure 12: Analysis of Ichthyofauna in Sapna Dam (January-2020).

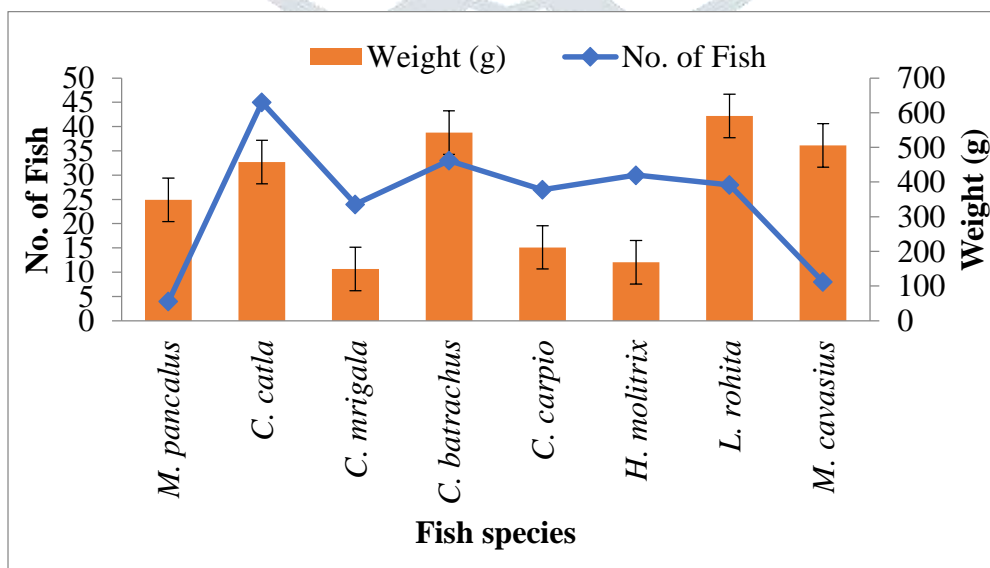


Figure 13: Analysis of Ichthyofauna in Sapna Dam (February-2020).

Diversity of fish in Kosmi Dam

The analysis of quantities of available total eight fish species in March 2019 of whole Kosmi dam were show the frequencies maximum number of species 32 of *C. catla* and Minimum number of species 3 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 3-31 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 573.00 g. of *L. rohita* and minimum average weight 147.50 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 147.50-573.00 g. The details were shown in figure 14. The analysis of quantities of available total eight fish species in April 2019 of whole Kosmi dam were show the frequencies maximum number of species 39 of *C. catla* and Minimum number of species 3 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 3-39 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 568.00 g. of *C. batrachus* and minimum average weight 143.00 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 143.00-568.00 g. The details were shown in figure 15. The analysis of quantities of available total eight fish species in May 2019 of whole Kosmi dam were show the frequencies maximum number of species 40 of *C. catla* and Minimum number of species 1 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 1-40 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 570.00 g. of *C. batrachus* and minimum average weight 154.50 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 154.50-570.00 g. The details were shown in figure 16. The analysis of quantities of available total seven fish species in June 2019 of whole Kosmi dam were show the frequencies maximum number of species 25 of *C. catla* and Minimum number of species 2 of *M. cavasius* and while the other species were shown the numbers of frequencies range between 2-25 species. The analysis of qualities average weight (g.) from seven fish species were shown the maximum frequencies of average weight 576.50 g. of *C. batrachus* and minimum average weight 148.50 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 148.50-576.50 g. The details were shown in figure 17. The analysis of quantities of available total eight fish species in July 2019 of whole Kosmi dam were show the frequencies maximum number of species 37 of *C. catla* and Minimum number of species 2 of *M. pancalus*, *M. cavasius* and while the other species were shown the numbers of frequencies range between 2-37 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 427.00 g. of *L. rohita* and minimum average weight 95.00 g. of *M. cavasius* and while other species were shown the average weight of frequencies between range 95.00-427.00 g. The details were shown in figure 18. The analysis of quantities of available total seven fish species in August 2019 of whole Kosmi dam were show the frequencies maximum number of species 37 of *C. catla* and Minimum number of species 1 of *M. cavasius* and while the other species were shown the numbers of frequencies range between 1-37 species. The analysis of qualities average weight (g.) from seven fish species were shown the maximum frequencies of average weight 454.00 g. of *L. rohita* and minimum average weight 74.00 g. of *M. cavasius* and while other species were shown the average weight of frequencies between range 74.00-454.00 g. The details were shown in figure 19. The analysis of quantities of available total seven fish species in September 2019 of whole Kosmi dam were show the frequencies maximum number of species 32 of *C. catla* and Minimum number of species 3 of *M. cavasius* and while the other species were shown the numbers of frequencies range between 3-32 species. The analysis of qualities average weight (g.) from seven fish species were shown the maximum frequencies of average weight 433.50 g. of *C. batrachus* and minimum average weight 128.50 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 128.50-433.50 g. The details were shown in figure 20. The analysis of quantities of available total seven fish species in October 2019 of whole Kosmi dam were show the frequencies maximum number of species 31 of *C. catla* and Minimum number of species 3 of *M. cavasius* and while the other species were shown the numbers of frequencies range between 3-31 species. The analysis of qualities average weight (g.) from seven fish species were shown the maximum frequencies of average weight 503.50 g. of *L. rohita* and minimum average weight 117.00 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 117.00-503.50 g. The details were shown in figure 21. The analysis of quantities of available total eight fish species in November 2019 of whole Kosmi dam were show the frequencies maximum number of species 23 of *C. catla* and Minimum number of species 1 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 1-23 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 531.50 g. of *L. rohita* and minimum average weight 127.00 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 127.00-531.50 g. The details were shown in figure 22. The analysis of quantities of available total eight fish species in December 2019 of whole Kosmi dam were show the frequencies maximum number of species 26 of *C. catla* and Minimum number of species 2 of *M. pancalus* and while the other species were shown the numbers of frequencies range between 2-26 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 556.50 g. of *M. cavasius* and minimum average weight 126.00 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 126.00-556.50 g. The details were shown in figure 23. The analysis of quantities of available total eight fish species in January 2020 of whole Kosmi dam were show the frequencies maximum number of species 23 of *C. catla* and Minimum number of species 4 of *M. pancalus*, *M. cavasius* and while the other species were shown the numbers of frequencies range between 4-23 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 543.50 g. of *L. rohita* and minimum average weight 149.00 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 149.00-543.50 g. The details were shown in figure 24. The analysis of quantities of available total eight fish species in February 2020 of whole Kosmi dam were show the frequencies maximum number of species 30 of *C. catla* and Minimum number of species 4 of *M. cavasius* and while the other species were shown the numbers of frequencies range between 4-30 species. The analysis of qualities average weight (g.) from eight fish species were shown the maximum frequencies of average weight 609.50 g. of *L. rohita* and minimum average weight 150.50 g. of *C. mrigala* and while other species were shown the average weight of frequencies between range 150.50-609.50 g. The details were shown in figure 25.

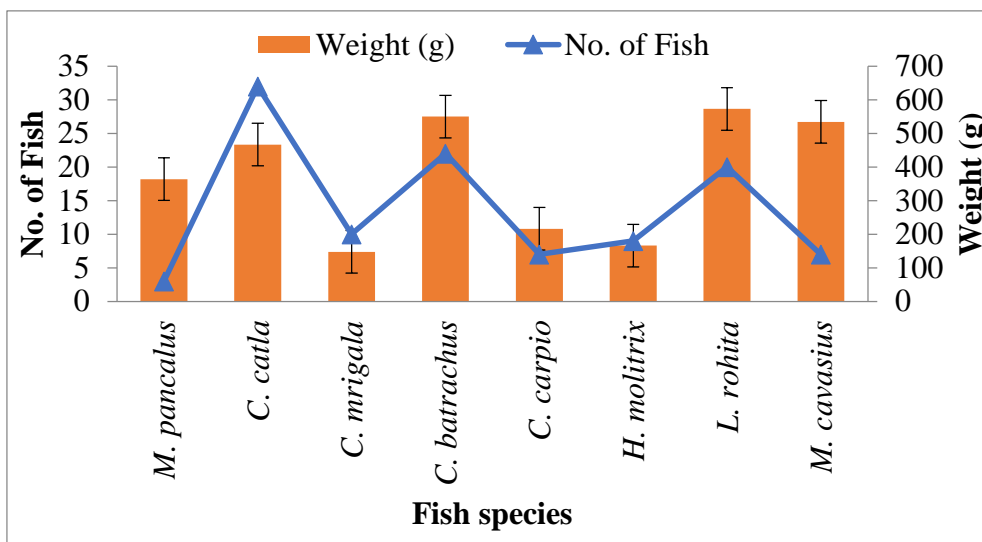


Figure 14: Analysis of Ichthyofauna in Kosmi Dam (March-2019).

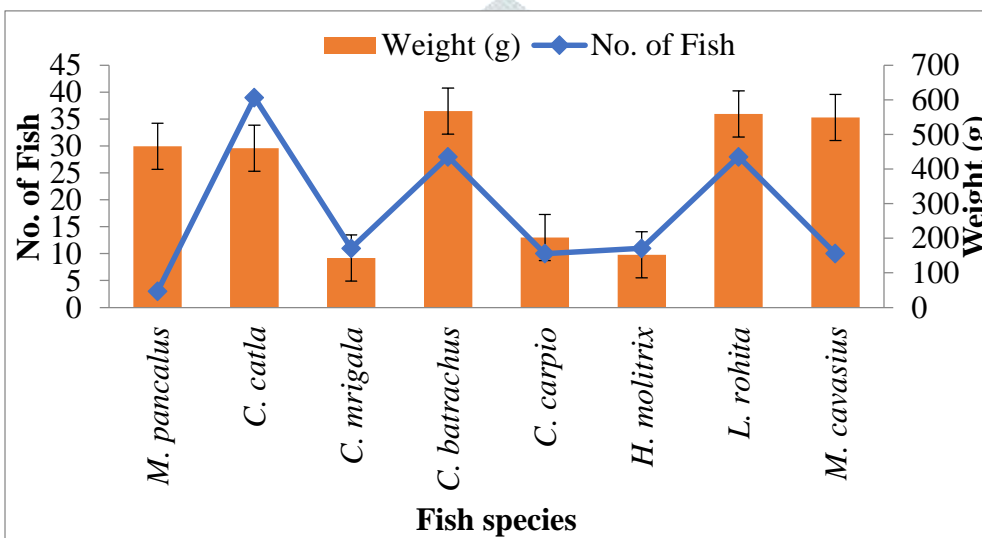


Figure 15: Analysis of Ichthyofauna in Kosmi Dam (April-2019).

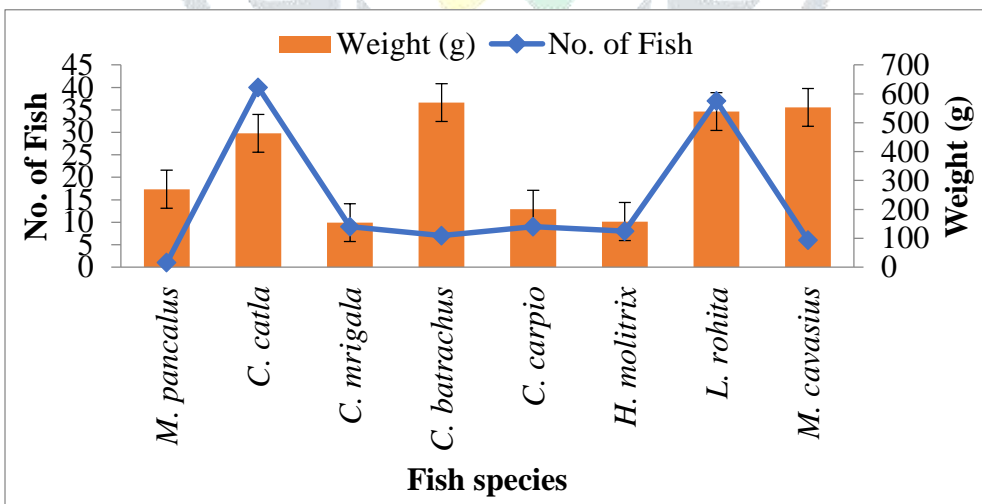


Figure 16: Analysis of Ichthyofauna in Kosmi Dam (May-2019).

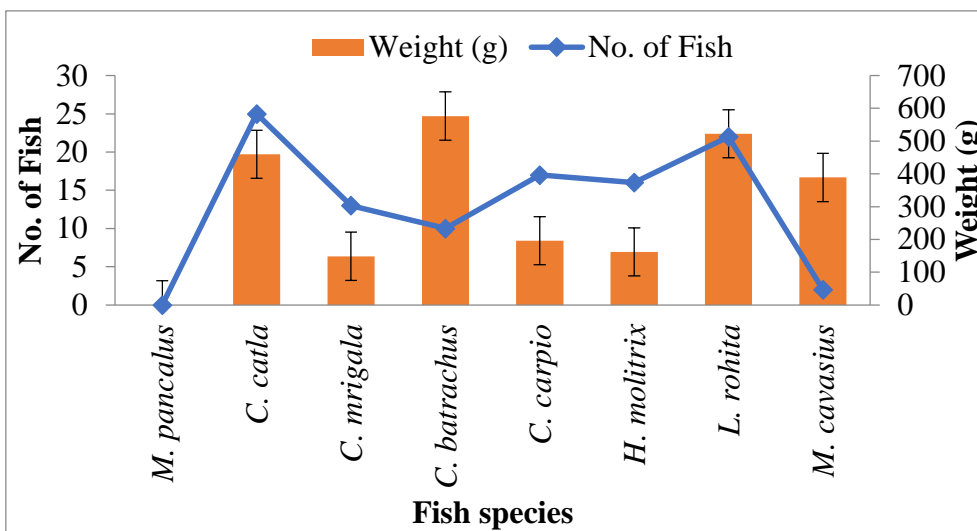


Figure 17: Analysis of Ichthyofauna in Kosmi Dam (June-2019).

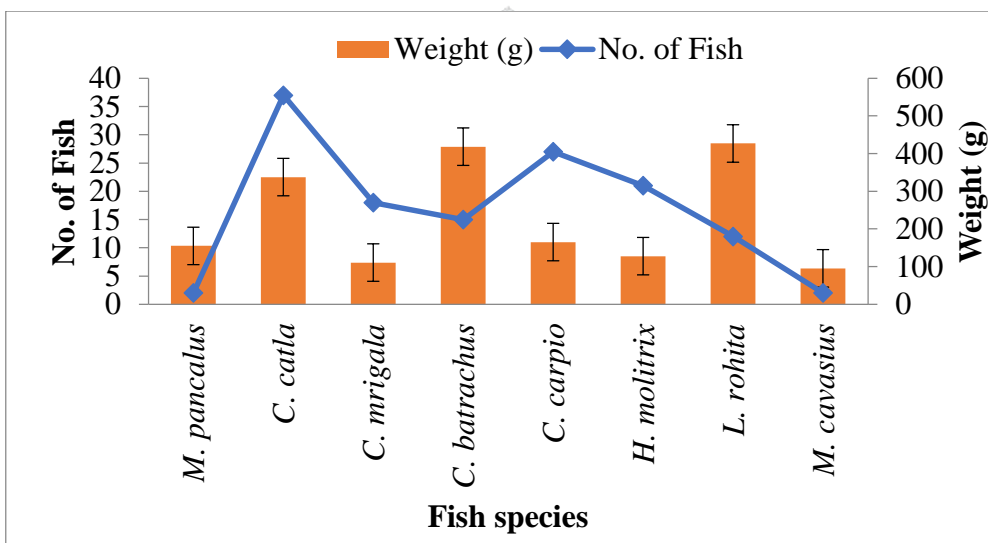


Figure 18: Analysis of Ichthyofauna in Kosmi Dam (July-2019).

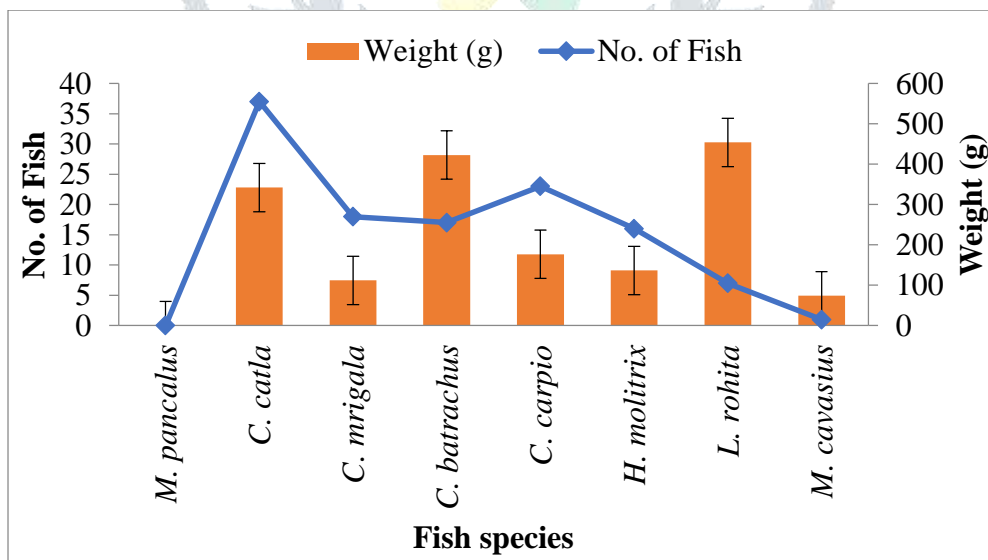


Figure 19: Analysis of Ichthyofauna in Kosmi Dam (August-2019).

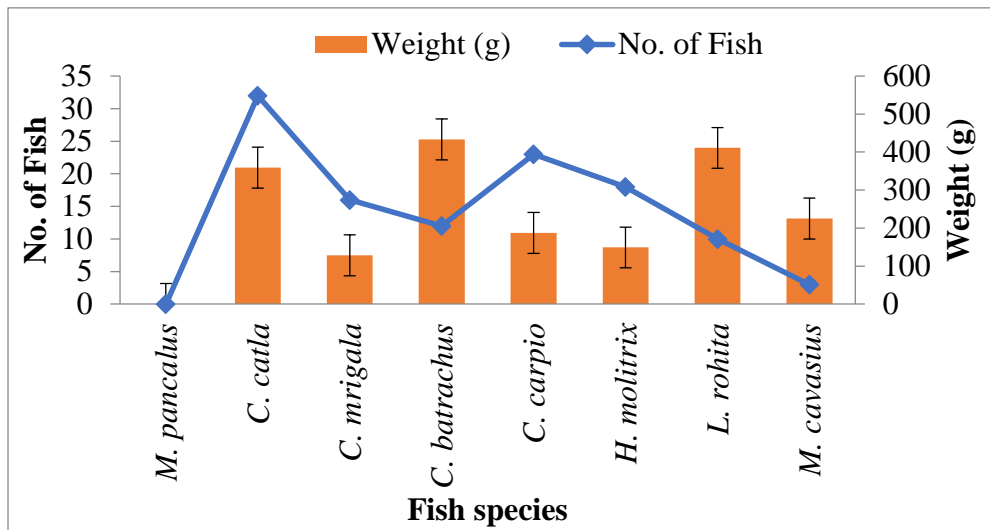


Figure 20: Analysis of Ichthyofauna in Kosmi Dam (September-2019).

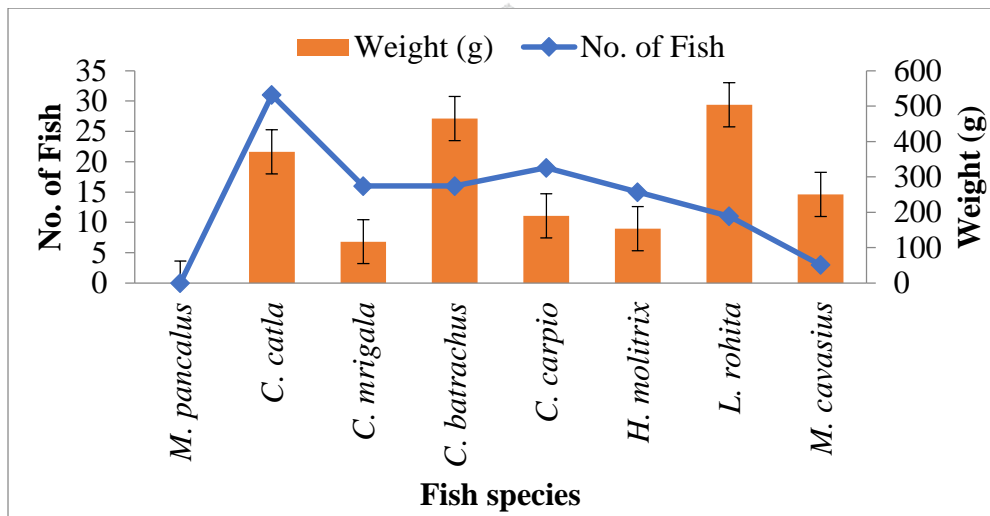


Figure 21: Analysis of Ichthyofauna in Kosmi Dam (October-2019).

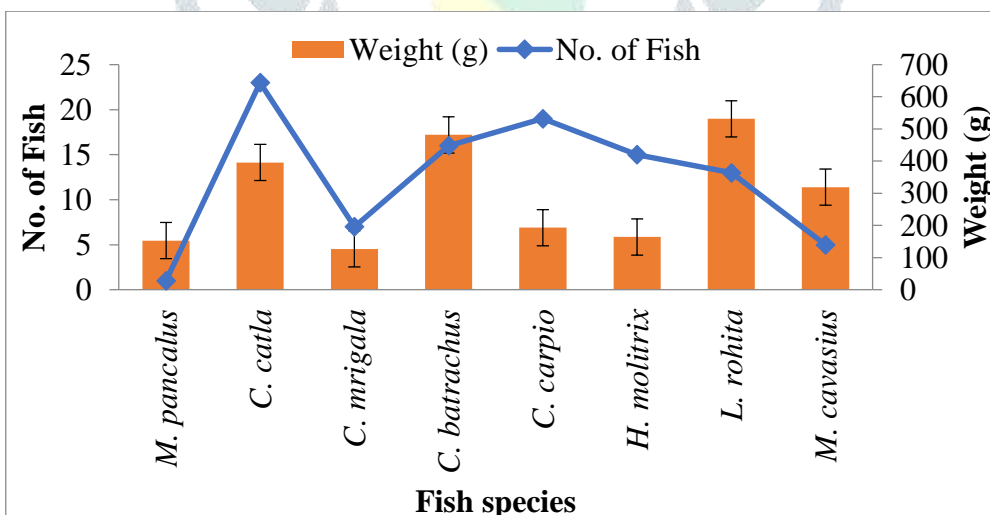


Figure 22: Analysis of Ichthyofauna in Kosmi Dam (November-2019).

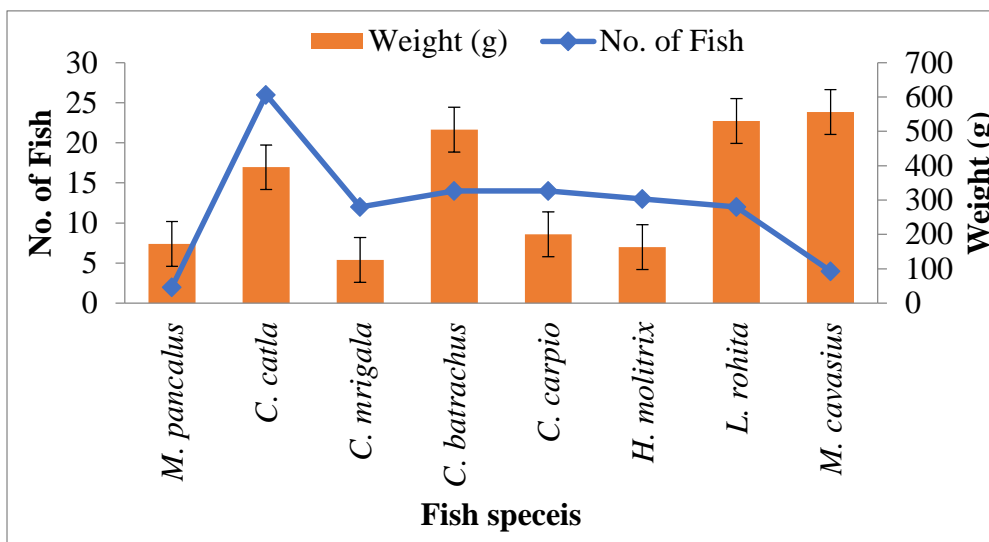


Figure 23: Analysis of Ichthyofauna in Kosmi Dam (December-2019).

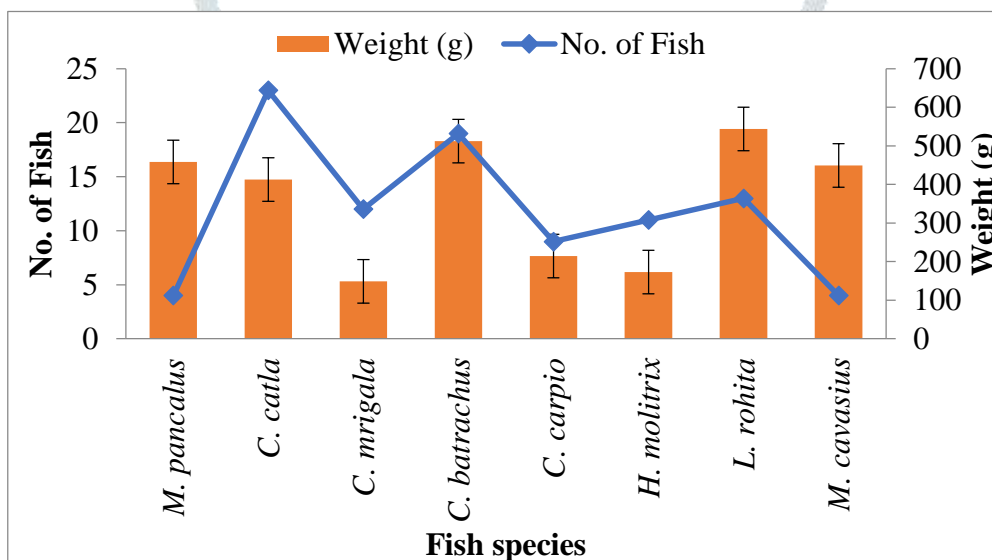


Figure 24: Analysis of Ichthyofauna in Kosmi Dam (January-2020).

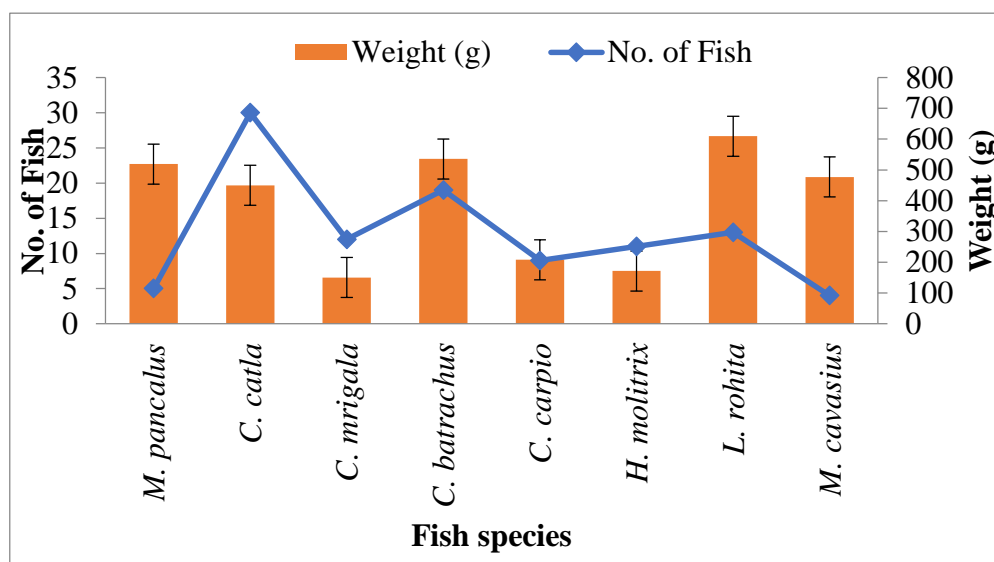


Figure 25: Analysis of Ichthyofauna in Kosmi Dam (February-2020).

CONCLUSIONS

Trace the diversity of ichthyofauna in both the dams according to the physico-chemical properties of the water in the limonitic regions. The water quality of Kosmi Dam has been found to be slightly worse than that of Sapna Dam. The results obtained show some selected common fish species from both the dams i.e. nine fishes namely *Macrognathus pancalus*, *Catla catla*, *Cirrhinus mrigala*, *Clarias batrachus*, *Cyprinus carpio*, *Hypophthalmichthys molitrix*, *Labeo rohita*, and *Mystus cavasius*. The water of Sapna Dam has been found suitable for the growth of above fish species as compared to Kosmi Dam.

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