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Ecological Assessment of Fish Diversity and Water Quality in Purwa and Chachai Waterfalls of Rewa District, Madhya Pradesh, India

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ABSTRACT :

This research paper presents a comprehensive assessment of the ecological and water quality characteristics of Purwa Waterfall and its surrounding environment. The study encompasses an analysis of fish diversity, community structure, and physical-chemical properties of water samples collected from various locations and seasons. Data analysis includes Shannon Diversity Index, evenness, Margalef diversity index, and examination of key physical and chemical parameters. Overall, the findings provide insights into the biodiversity, ecological health, and water quality status of the Purwa Waterfall ecosystem.

Key words : Purwa, Waterfall, biodiversity, ecological, ecological,

I. Introduction:

Purwa Waterfall, located on River Tons at coordinates 24.7827° N, 81.2654° E. is renowned for its majestic beauty and ecological significance. The Falls are 200 feet high (nearly 67 m) and present one heck of a robust view. The falls are intense, and an enormous volume of water falls every second. The Falls are on River Tamas, descending the cliff of Rewa Plateau. However, the falls gain or lose their majesty with season and are best to visit when the rains are in full swing. However, the ecological health of this waterfall and its surrounding environment depends on various factors, including fish diversity and water quality parameters. This paper aims to assess the biodiversity and water quality of Purwa Waterfall through a multidimensional analysis.

II. MATERIALS AND METHODS

2.1 Study Area & Location: ***Fig:1 Location Map***

2.2 Study Period and Methodology:

The study period spanned both Dry and Wet Seasons, with samplings conducted three times between March 2022 and February 2024 at three different locations: Upstream, Midstream, and Downstream of the Purwa waterfall. Fish fauna samples were collected from the riverbank of each reach using a corer with an area of 0.004 m2, previously described and adjusted for accuracy. Three duplicate samples were taken from each reach, carefully labeled, and placed in individual polythene bags for transport to the laboratory. In the lab, the organisms were sieved through meshes with widths of 2 mm and 1 mm to remove debris, sorted, and preserved in 5% buffered formalin for further examination.

Concurrently, the physico-chemical parameters of water, including temperature, pH, dissolved oxygen, free carbon dioxide, alkalinity, hardness, salinity, and total dissolved solids, were analyzed for six alternating months. These analyses were conducted following the protocols outlined in APHA (1998) and Trivedy and Goel (1986) to ensure consistency and accuracy in the measurements.

III. RESULTS

3.1 Water Quality: T

3.1.1 **Temperature:** Throughout the study period, the average water temperature exhibited significant variability, ranging from 15°C during the winter months to 29°C during the monsoon season. Anecdotal evidence from local villagers suggests a noticeable upward trend in average water temperature over time. Previously, during the winter season, water temperatures would commonly drop to as low as 9-10°C.This observed increase in water temperature could be attributed to the broader phenomenon of global warming, given the well-established correlation between water temperature and atmospheric temperature. The implications of this temperature variation are substantial, particularly concerning the ecological dynamics of aquatic ecosystems. As such, changes in water temperature regimes can significantly impact the reproductive cycles and population dynamics of fish species inhabiting the Purwa waterfall ecosystem.

3.1.2 **pH:** The pH levels observed ranged from 7.2 to 7.5, with the highest average pH occurring during the pre-monsoon season (7.2) and the lowest during the monsoon season (7.5). Typically, elevated pH values are linked to increased photosynthetic activity in water, as noted by Hujare (2008). Fluctuations in pH in natural water bodies can be attributed to various factors, including biological activity, the influx of municipal waste, and other contaminants. It's widely recognized that changes in water pH often coincide with alterations in other physicochemical parameters. The relatively low standard deviation of 0.14 suggests a degree of stability in pH levels over the study period.

3.1.3 **Dissolved Oxygen (DO)**: Dissolved oxygen (DO) stands out as a crucial indicator of water quality. In this study, the average lowest DO concentration (8.9 mg/l) occurred during the pre-monsoon period, while the highest (9.8 mg/l) was noted during the post-monsoon phase. It was noted that DO levels tend to rise as temperatures decrease. The concentration of dissolved oxygen is intricately linked to the balance between primary production and respiration activities of aquatic organisms inhabiting the water body.

3.1.4 **Chloride:** The WHO standard for chloride is 200 mg/l. Sample 1, 2, and 3 fall within the acceptable range, while Sample 4 exceeds it with a value of 180 mg/l. The standard deviation (SD) is 25.81, indicating variability among the samples. The mean chloride concentration is 150 mg/l, with a variance (S2) of 666.

3.1.5 **Sulphate:** The WHO standard for sulphate is 200 mg/l. All samples fall within the acceptable range. The SD is 12.58, indicating relatively low variability among the samples. The mean sulphate concentration is 82.5 mg/l, with a variance of 158.3.

3.1.6 **Calcium:** The WHO standard for calcium is 100 mg/l. All samples fall within the acceptable range. The SD is 9.57, indicating moderate variability among the samples. The mean calcium concentration is 82.5 mg/l, with a variance of 91.66.

3.1.7 **Magnesium:** The WHO standard for magnesium is 150 mg/l. Sample 1 and 2 fall within the acceptable range, while Sample 3 and 4 exceed it. Sample 4 has the highest concentration at 120 mg/l. The SD is 26.29, indicating high variability among the samples. The mean magnesium concentration is 82.5 mg/l, with a variance of 691.6.

3.1.8 **Nitrate:** The WHO standard for nitrate is 45 mg/l. All samples fall within the acceptable range. The SD is 4.99, indicating relatively low variability among the samples. The mean nitrate concentration is 31.25 mg/l, with a variance of 24.91.

3.1.9 **Sodium:** The WHO standard for sodium is 130 mg/l. All samples fall within the acceptable range. The SD is 8.05, indicating moderate variability among the samples. The mean sodium concentration is 40.75 mg/l, with a variance of 64.91.

3.1.10 **Potassium:** The WHO standard for potassium is 100 mg/l. All samples fall within the acceptable range. The SD is 7, indicating moderate variability among the samples. The mean potassium concentration is 39.5 mg/l, with a variance of 49.

3.1.11 **Iron:** The WHO standard for iron is 0.3 mg/L. Sample 4 exceeds the standard significantly with a concentration of 0.75 mg/l. The SD is 0.28, indicating relatively low variability among the samples. The mean iron concentration is 0.32 mg/l, with a variance of 0.08.

3.1.12 **Zinc:** The WHO standard for zinc is below 10 µg/L. All samples fall within the acceptable range. The SD is 0.91, indicating relatively low variability among the samples. The mean zinc concentration is 8 µg/L, with a variance of 0.83.

3.1.13 **Dissolved Oxygen (DO):** No WHO standard is provided, but the values seem within a reasonable range for healthy aquatic environments. The SD is 0.38, indicating relatively low variability among the samples. The mean dissolved oxygen concentration is 9.35 mg/l, with a variance of 0.15.

3.1.14 **Alkalinity:** The WHO standard for alkalinity is 250 mg/l. All samples fall within the acceptable range. The SD is 14.79, indicating moderate variability among the samples. The mean alkalinity concentration is 117.5 mg/l, with a variance of 218.75.

3.1.15 **Hardness:** The WHO standard for hardness is 150 mg/l. All samples fall within the acceptable range. The SD is 8.53, indicating moderate variability among the samples. The mean hardness concentration is 91.25 mg/l, with a variance of 72.91.

3.1.16 **Salinity:** The WHO standard for salinity is less than 600 mg/l. All samples fall within the acceptable range. The SD is 31.09, indicating relatively high variability among the samples. The mean salinity concentration is 135 mg/l, with a variance of 966.

3.1.17 **TDS (Total Dissolved Solids):**The standard deviation is 1.82, indicating relatively low variability.The mean TDS is 60, and the variance is 3.33, suggesting a relatively consistent TDS level across the samples.

3.2 Fish Diversity

Fish community's distribution, abundance, and diversity are as follows: Fishes of 17 species belonging to 9 families were gathered from the study sites

Fig:2- % Distribution of fishes

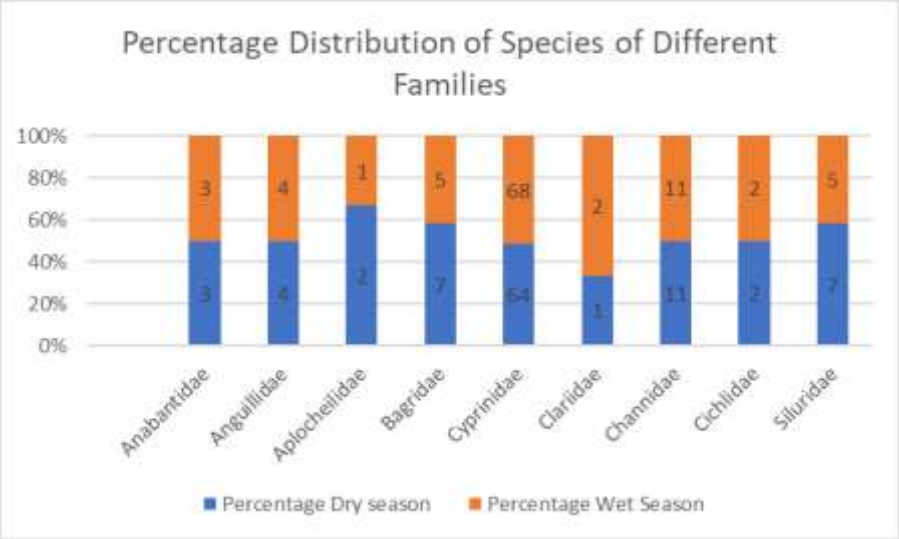

Table 1: Fish Diversity Indices

Shannon diversity index	2.43
Evenness	0.859
Richness (number of species)	17
Total number of individuals	85
Average population size	5

The provided ecological metrics offer insights into the biodiversity and structure of a biological community. Let's interpret each parameter:

Shannon Diversity Index (H = 2.11):

A Shannon Diversity Index of 2.11 indicates a relatively high level of biodiversity within the community. Higher values generally suggest more diverse ecosystems. This diversity considers both the number of species present and their relative abundances.

Evenness (0.822):

Evenness is a measure of how evenly individuals are distributed among different species. A value of 0.822 suggests a relatively balanced distribution, indicating that the community has a more equitable abundance of various species. In other words, no single species dominates the community, and there is a more uniform representation.

Richness (Number of Species = 13):

The richness value of 13 indicates the total number of different species present in the community. A higher richness generally contributes to a higher diversity index, but it's important to consider evenness to understand the balance in species abundance.

Total Number of Individuals (126):

This is the sum of all individuals across the entire community. It's an important parameter to understand the overall size of the community.

Average Population Size (9.69):

The average population size provides an idea of the typical abundance of individuals within each species. In this case, the average population size is approximately 9.69 individuals per species.

The community appears to be diverse with a relatively balanced distribution of individuals among species. While there are 13 different species, none of them overwhelmingly dominate the community, contributing to a higher level of biodiversity. The average population size of around 9.69 individuals per species suggests a moderate abundance across the community.

Margalef diversity index:

The most basic indicator of biodiversity is the species richness index, represented by the letter 'S'. It is a tally of the various species found in a certain region or community. Nevertheless, it is not possible to compile a comprehensive inventory of all species used in real-world applications. The Margalef formula is used by the species richness index calculator to determine the Margalef richness index in biodiversity.

Table .2 Diversity of fishes in Purwa waterfalls during dry (D) and wet (W) seasons in the three sampling sites. r = richness index, d = Shannon weaner diversity index

Reaches Season Item	**Diversity Indices**	**Up-stream**		**Mid -Stream**		**Down Stream**	
		Dry	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**
Fish Species	richness	3.7292	3.88	4.15	2.73	64.23	29.64
	diversity	2.44	2.33	2.32	1.89	2.45	2.46

The up-stream area shows a moderate number of fish species with a slight increase in diversity during the dry season. The mid-stream area experiences a decrease in species richness during the wet season, leading to lower diversity. The down-stream area has the highest species richness during the dry season, but it significantly decreases during the wet season. However, the diversity index remains relatively stable.

These patterns suggest that the impact of seasons on fish species richness and diversity varies across different reaches of the stream. Further investigation into the ecological factors influencing these patterns could provide valuable insights.

DISCUSSION:

The physio-chemical parameters of the river water remained at permissible limit of WHO. Shannon Diversity Index shows a moderate positive correlation with pH (0.729), calcium (0.527), and magnesium (0.352), indicating that higher values of these parameters may be associated with increased biodiversity. SDI has a negative correlation with several parameters, including temperature (-0.421), chloride (-0.603), and TDS (-0.518), suggesting that higher values of these parameters might lead to decreased biodiversity. pH exhibits strong negative correlations with chloride (-0.913) and moderate negative correlations with TDS (-0.258) and salinity (0.076), implying that higher acidity levels may correspond to lower chloride, TDS, and salinity levels .pH shows a strong positive correlation with calcium (0.739), indicating that higher pH values may coincide with higher calcium concentrations. Conductivity has a strong positive correlation with temperature (0.982) and a moderate positive correlation with salinity (0.799), suggesting that higher conductivity values might be associated with elevated temperature and salinity levels. TDS exhibits strong negative correlations with chloride (-0.435) and moderate negative correlations with sulphate (-0.435) and sodium (-0.658), indicating that higher TDS values may coincide with lower chloride, sulphate, and sodium concentrations. Temperature shows a strong positive correlation with conductivity (0.982) and a moderate positive correlation with salinity (0.750), suggesting that higher temperatures may be associated with increased conductivity and salinity levels. Chloride, Sulphate, Calcium, Magnesium, Sodium, Potassium, Iron, Zinc, and Salinity exhibit various correlations with each other and with other variables in the dataset, providing insights into their interrelationships.

The assessment of fish community distribution, abundance, and diversity in the Purwa Waterfall ecosystem provides valuable insights into the health and dynamics of the aquatic environment. The Shannon Diversity Index, with a value of 2.43, indicates a relatively high level of biodiversity within the community, suggesting a diverse array of species and their relative abundances. Evenness, represented by a value of 0.859, highlights a balanced distribution of individuals among different species, signifying a more equitable representation of various species within the community.With a richness value of 17 species, the community demonstrates a diverse composition, contributing to the overall biodiversity of the ecosystem. The total number of individuals, 85, and the average population size of approximately 5 individuals per species reflect a moderate abundance across the community. Furthermore, the Margalef diversity index provides additional insights into species richness, showing variations in richness and diversity indices across different reaches and seasons. Seasonal variations in fish species richness and diversity across upstream, midstream, and downstream areas underscore the dynamic nature of the ecosystem. While some areas experience fluctuations in species richness and diversity, others demonstrate relatively stable

patterns. Overall, the findings suggest a resilient and diverse fish community in the Purwa Waterfall ecosystem, with seasonal and spatial variations contributing to the overall dynamics of the aquatic environment. Continued monitoring and research efforts are crucial for understanding and managing the ecological processes influencing fish community dynamics and maintaining the health and integrity of the ecosystem in the face of environmental changes.

References:

I. Diversity of freshwater fish in Narmada River, Madhya Pradesh Shivani Pathak and Naresh Lavudya-Journal of Entomology and Zoology Studies 2021; 9(2): 704-709

II. Fish Diversity and Physico-chemical Parameters of Hillem River, Arunachal Pradesh, India- 2018 IJRAR August 2018, Volume 5, Issue 3

III. Ichthyofaunal diversity, habitat ecology and their conservation issues of river narmada in jabalpur region (m.p) - International Journal of Current Research Vol. Vol. 7, Issue, 12

IV. Remote sensing and GIS based morphometric characterization of Bichiya river watershed of Rewa district, MP, Laxmi Dwivedi, Roshani Pandey and Shashikant Tripathi- International Journal of Applied Research 2022 ; 8(6): 101-107

V. Distribution and Dynamics of a Tropical Waterfalls Ecosystem- International Journal of Ecosystem, p-ISSN: 2165-8889