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Comparative Analysis of Faunal Diversity concerning Anthropogenic Influence on Urban Ponds in Jodhpur City"

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Abstract
Background: This study investigates the comparative analysis of faunal diversity in relation to anthropogenic influences on urban ponds in Jodhpur City.
Method: In our study, eight ponds were categorized into four zones (A, B, C, D) and further selected for comparative analysis, in this study each zone contains two ponds and verifies the levels of human activity related to ponds. Faunal diversity and abundance were assessed using the Shannon-Weiner diversity index, revealing an inverse relationship between species richness and diversity in certain areas.
Results: Ponds with minimal anthropogenic impacts exhibited higher biodiversity, while those with greater human interference showed reduced diversity and species abundance.
Conclusions: The findings highlight the significant role human activities play in shaping urban biodiversity, underscoring the need for conservation efforts to mitigate the negative impacts of urbanization on aquatic ecosystems in Jodhpur. The study provides essential insights into the ecological dynamics of urban water bodies and calls for sustainable management practices to preserve urban biodiversity.

Keywords: Faunal diversity, Anthropogenic influence, Urban ponds, Urbanization, Aquatic ecosystems, Conservation

1. Introduction

Urbanization is an inevitable outcome of socio-economic change (Ansary et al., 2013). As cities expand, natural ecosystems such as forests, wetlands, and grasslands are cleared to make way for buildings, roads, and infrastructure, leading to a shift in biodiversity patterns (Shitole, 2024). Biodiversity refers to the wide variety of life forms on Earth, including plants, animals, and microorganisms (Rawat & Agarwal, 2015). Urban biodiversity is significantly influenced by human activities such as land use, construction, and economic, social, and cultural dynamics, making its study crucial (Mehra et al., 2024). One of the habitats most affected within cities is water bodies, particularly urban ponds (Laloo & Ranjan, 2017), which play a crucial role in maintaining local biodiversity (Oertli & Parris, 2019). However, these ecosystems are often highly susceptible to anthropogenic disturbance (Angeler & Moreno, 2007). Jodhpur, a historic urban center in Rajasthan, is rapidly growing surrounded by sandstone mining, rocky areas, fallow land, and industrial zones, with commercial activities and unplanned settlements (Borana & Yadav, 2017). Urban ponds play crucial roles in both ecological and cultural landscapes. They serve essential functions such as retaining water during monsoonal downpours, storing water in the dry season, recharging groundwater, and treating sewage (Zimmer et al 2020). Traditionally, these bodies of water have supported a wide variety of life, providing habitats for numerous species of aquatic and terrestrial fauna, including birds, bats, insect pollinators, and other mammals (Hill et al., 2021). However, rapid urbanization and human activities such as water disposal, deforestation, construction, and increased human presence have significantly changed the ecological dynamics of these water bodies (Akhtar et al, 2021). Jodhpur's climate is defined by intense dryness, a broad range of temperature extremes, and irregular and unpredictable rainfall (Mathur 2015). The avian species richness in this area is largely due to the presence of water bodies (Ghosh et al. 1996). These bodies of water serve as a hub for regional social and cultural events in urban areas (Bhat et al., 2020).

In Jodhpur, 5 large lakes located on the outskirts of the city, 40 talabs, 8 inside the city and 32 outside, 25 nadis, 5 inside and 20 outside, 5 tanks, 8 jhalaras - 2 inside and 6 outside, 125 open wells; SDS traced 98 - 41 inside and 57 outside and 45 baoris, 16 inside the city and 29 outside. They located 229 different water bodies; of these, 75 were surface and 154 groundwater bodies (Balzani, Jain, & Rossato, 2019). Jodhpur receives a significant amount of water through the Indira Gandhi Canal (Singh, 2003).

As a result, environmental conditions have changed substantially. This has led to the replacement of several desert species and a significant increase in avian diversity. The number of bird species has risen from 125 in 1992 to 232 in the year 2002 (Singh, 2014).

Large flocks of Demoiselle cranes were recorded wintering at Satlana Pond in Jodhpur. These migrating birds are attracted to Jodhpur in the Marwar region because of the available food grains, the pleasant temperature and climate, and the area's proximity to historical sites, which offers them safety. The entire food chain draws them to this place when the fields are harvested (Meena et al., 2021). Ponds play a crucial role in human existence, but various human activities are currently threatening the structure and functioning of these freshwater ecosystems (Rajput et al., 2023). Ponds in developed countries lost 50-70% due to declining agricultural and industrial functions, urbanization, and intensified agriculture in the late 19th and early 20th centuries (Hassall, 2014).

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Industrial units in Jodhpur release effluents into water bodies and land, affecting soil and faunal diversity, and potentially hindering ecosystem services due to their detrimental effects (Kumar & Tripathi, 2019). From 1960s to 1980s, 11 microbat and one megabat species were recorded in Jodhpur, now only eight species, with significant changes at roosting sites (Purohit & vyas, 2009). Pollution and the development of harmful bacteria in the Jojari River are the primary threats to the bird population and potential danger to mammals and birds (Das & Tripathy, 2020). The entire biological balance of Gulab Sagar Pond has been disrupted by idol immersion, which is a clear example of the consequences of water pollution during festival season. Consequently, in order to prevent these water bodies from being extinct in a matter of years, the Municipal Corporation needs to move quickly to protect them and return them to their natural state (Makwana, 2020).
Comparative studies of urban ponds between different climatic and urban settings are scarce. Comparing Jodhpur's ponds with those in other regions, especially in terms of faunal diversity and human impact, could provide a broader context and fill a gap in global urban biodiversity studies.

2. Materials and Methodology:

2.1 Study Areas:

Jodhpur city, also referred to as the "Blue City" and the "Sun City," is a gateway to the Great Indian Thar Desert. It is situated in the Marwar region of western Rajasthan in north-western India (Saurabh et al., 2020). The study was undertaken on wetlands, areas of Jodhpur. Jodhpur is located in the western part of Rajasthan. It stretches between 26° and 27° 37" north latitude and 72° 55" and 73° 52" east longitude. Eight ponds in Jodhpur were selected for present study which have been categorized into four specific zones. Each zone contains two ponds, one of which experiences low levels of anthropogenic influence, while the other is subject to higher degrees of human impact. In Zone A, the ponds are Guro ka talab, and Ganglav talab, in Zone B, the ponds are fatehsagar and Naya tala. Zone C includes Ranisar, and Bai ji ka Talab, while Zone D consist of Shekha ji pond and Ratanada pond.
This division allows for a comparative analysis of the biodiversity and ecological conditions increases with varying levels of human activities.

Table 1: General profiles of study ponds

Zone	Name of Pond	Area	Latitude	Longitude	Anthropogenic activity
Zone A	Guro ka Talab	0.03 km²	26.28909°	72.98173°	Low
	Ganglao Talab	4.1km²	26.29337°	73.01146 °	High
Zone B	Fateh sagar pond	4.1 km²	26.29679°	73.02831°	Low
	Naya Talab	4.1 km²	26.3002°	73.0333°	High
Zone C	Ranisar pond	4.1 km²	26.2992°	73.0160°	Low
	Bai ji Talab	4.1 km²	26.28617°	73.01892°	High
Zone D	Shekha ji Talab	0.1km²	26.29307°	73.05582°	Low
	Ratanada pond	0.03 km²	26.2748°	73.0391°	High

2.2 Sampling Period:

The sampling for this study was conducted over an extended timeframe, with surveys performed thrice daily to capture variations in faunal activity and diversity**.** This approach aimed to document the presence and behaviour of different species throughout various daily activity patterns. Each pond was surveyed weekly for three months, resulting in 12 sampling sessions per pond.

2.2.1 Data Collection Methods

A. Faunal Survey:

- Avian Species: Visual observations and point counts were conducted in the early mornings and late afternoons. Binoculars (e.g., 10x50) and bird identification guides are used to record bird species.
- Aquatic Fauna (Fish, Insects): Sampling was conducted using visual observation. Field guides and expert consultations are employed to identify the problem.
- Terrestrial Fauna (Mammals, Reptiles): Camera traps and manual tracking were employed around the pond's periphery to capture images of terrestrial species

B. Habitat Assessment:

- Vegetation Survey: The type and density of aquatic and terrestrial vegetation noted in each pond's vicinity to assess the habitat's suitability for faunal species.
- Anthropogenic Pressure Assessment: The level of human activity around each pond noted (e.g., pollution, construction, recreational use). Surveys and interviews with local residents and authorities conducted to gather historical and current data.

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C. Biodiversity Indices:

- Shannon-Wiener Index (H') used to quantify the faunal diversity in each pond.

This index was used to evaluate the bird species diversity. It assumes that individuals are randomly sampled from an independent large population and all the species are represented in the sample. Shannon diversity is very widely used index for comparing diversity between various habitats (Clarke and Warwick, 2001). It was calculated in order to know the species diversity in different habitat (Hutchison, 1970) based on the formula:

H' = - [sum Pi * ln (Pi)]

Where, H' = Diversity Index, Pi = is the proportion of each species in the sample, In Pi= natural logarithm of this proportion

D. Equipment:

- Field equipment: Binoculars, camera traps, GPS devices, water quality test kits, dip nets, and fish trap.

3. Result and Discussion

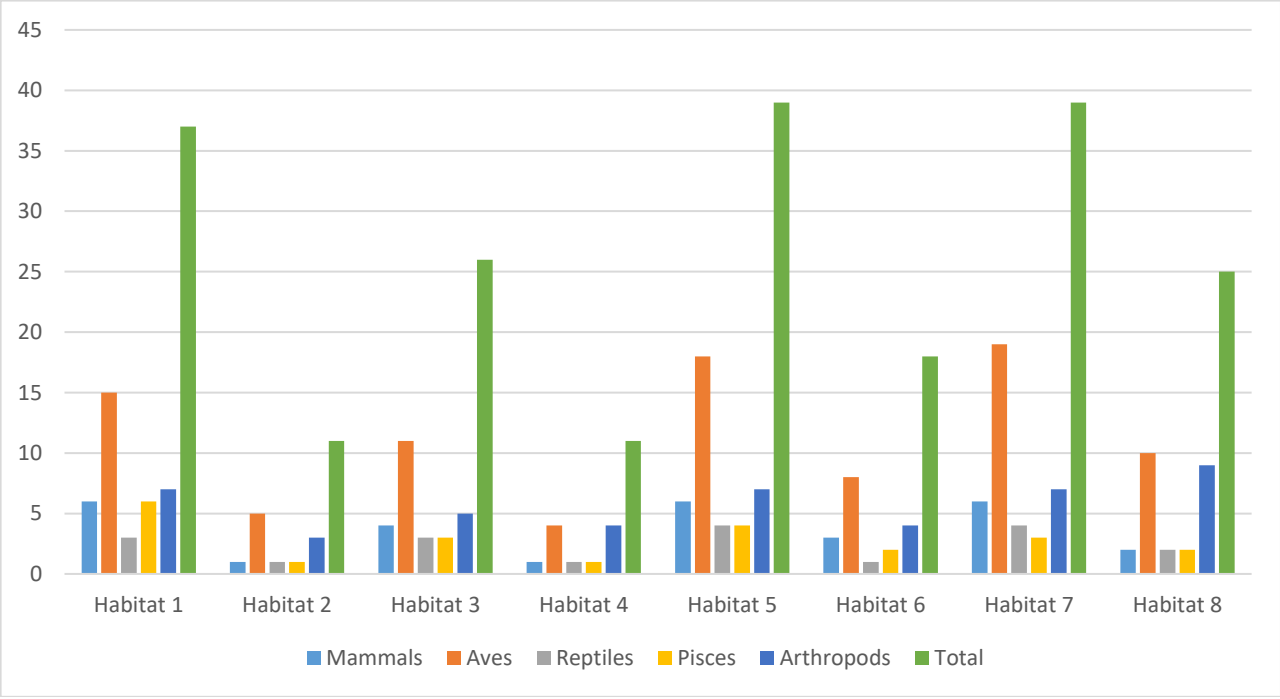
3.1 Total Species Count per Habitat

The total number of animal species was counted for each habitat as shown in Table 2. In Table 2, habitat 1 represents Guro ka Talab, habitat 2 represents Ganglao Talab, habitat 3 represents Fateh Sagar Pond, habitat 4 represents Naya Talab, habitat 5 represents Ranisar Pond, habitat 6 represents Bai ji ka Talab, habitat 7 represents Shekha ji Talab, and habitat 8 represents Ratanada Pond.

Table 2: Species Distribution Across Faunal Groups in Various Urban Pond habitats

Habitat	Mammals	Aves	Reptiles	Pisces	Arthropods	Total
Habitat 1	6	15	3	6	7	37
Habitat 2	1	5	1	1	3	11
Habitat 3	4	11	3	3	5	26
Habitat 4	1	4	1	1	4	11
Habitat 5	6	18	4	4	7	39
Habitat 6	3	8	1	2	4	18
Habitat 7	6	19	4	3	7	39
Habitat 8	2	10	2	2	9	25

Figure 1: Species Composition with Anthropogenic Impacts across Eight Urban Ponds



- **Low Anthropogenic Impact**: Habitat 1, Habitat 3, Habitat 5, Habitat 7
- **High Anthropogenic Impact:** Habitat 2, Habitat 4, Habitat 6, Habitat 8

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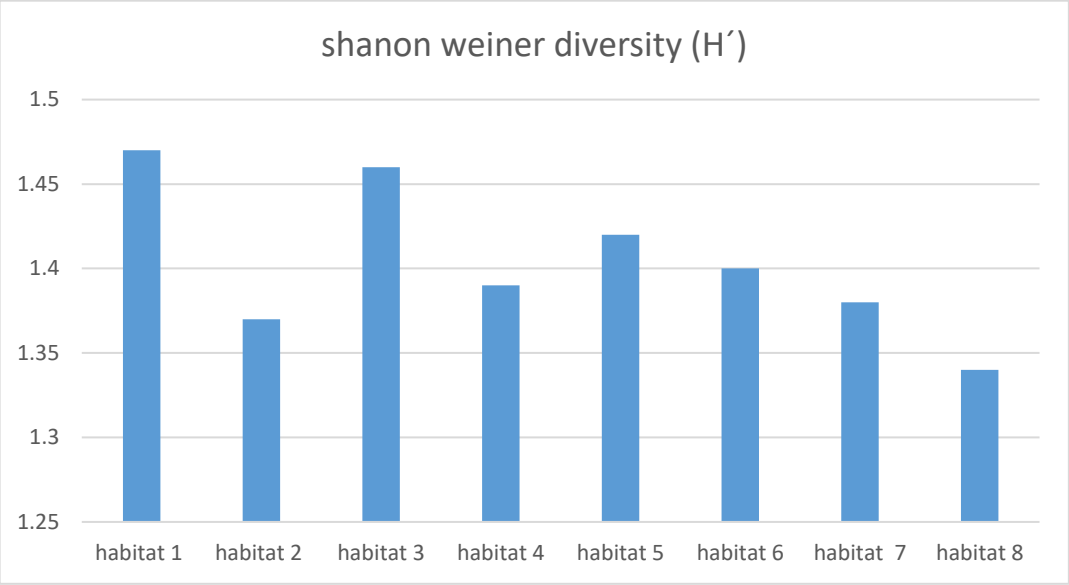
Shannon- Weaver diversity Index of Habitat 1 to Habitat 8

- Habitat 1: H′=1.47
- Habitat 2: H′=1.37
- Habitat 3: H′=1.46
- Habitat 4: H′=1.39
- Habitat 5: H′=1.42
- Habitat 6: H′=1.40
- Habitat 7: H′=1.38
- Habitat 8: H′=1.34

Figure 2: chart is showing shanon weiner diversity of eight habitats



The Shannon-Weiner diversity index was calculated for each pond across the four designated zones, which included one pond with low anthropogenic impact and one pond with high anthropogenic impact in each zone. The analysis revealed a consistent trend where ponds exhibiting lower levels of anthropogenic influence showed significantly higher diversity indices compared to their high-impact counterparts. Here's a summary of the results:

- **Habitat 1** has the highest biodiversity with an index of **1.47**, indicating greater species diversity and evenness compared to the others.
- **Habitat 3** follows closely with an index of **1.46**, suggesting a similar but slightly lower level of biodiversity.
- **Habitat 5** and **Habitat 6** have moderate biodiversity with indices of **1.42** and **1.4**, respectively.
- **Habitat 4** and **Habitat 7** are very close in biodiversity, with indices of **1.39** and **1.38**.
- **Habitat 2** has an index of **1.37**, reflecting a relatively lower biodiversity than the first few habitats but still substantial.
- **Habitat 8** shows the lowest biodiversity among the group, with an index of **1.34**.

Overall, the habitats exhibit a range of biodiversity, with Habitat 1 having the highest diversity and Habitat 8 the lowest, although the differences between most habitats are relatively small.

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Table 3: Activity Patterns of Faunal Species Around Urban Ponds

Faunal group	Species	6-8am	12-2pm	6-8 pm	Notes
Birds	Duck	Active foraging near water	Resting or preening near pond edge	Foraging before dusk, preparing to roost	Active in cooler morning and evening hours
	Black headed Gull	Feeding, scavenging	Less active, occasional foraging	Active, scavenging, and flying	Diurnal scavenger, prefers cooler parts of the day
	House sparrow	Foraging around pond, drinking	Resting in shaded areas, occasional activity	Gathering in trees, reduced activity	Active during the day, peaks in early morning
	Grey Heron	Actively hunting fish	Resting near water, low activity	Hunting at dusk	Herons often hunt in low light periods
Mammals	Brown Rat	Low activity, resting	Foraging near pond edges	High activity, scavenging at dusk	Nocturnal, but may be seen in late evening
	Domestic dog	Exploring their surroundings, searching for food	Resting in cooler place near the pond	Active, often scavenging or patrolling the area	Often scavenges near human activity, adaptable to various environments.
	Common Pipistrelle(bat)	Inactive, roosting in near by	Inactive, roosting	Active, hunting insects over pond	Nocturnal insectivore, active after sunset
	Squirrel	Active foraging for seeds, nuts, and fruits	Resting in shaded areas	Active, prepare their burrows or nest for the ni	Active during the day, particularly in the morning and evening, often seen gathering food or nesting near trees.
Insects	Dragonfly	Highly active, hunting insects over water	Active, hunting	Reduced activity, resting	Diurnal hunter, most active during daylight hours
	Mosquito	Low activity	Resting, breeding in pond	High activity, biting near water	Peaks in the early evening, especially near ponds
	Water beetle	Active, foraging in water	Active, foraging	Reduced activity	Mostly diurnal, prefers still water bodies
Fish	Cyprinus Carpio (common carp)	Active feeding near the surface	Less active, staying deeper in water	Active, foraging near pond edges	Activity increases in cooler parts of the day
	Labeo rohita (Rohu)	Active feeding near the surface	Less active, staying deeper in water	Active, foraging near pond edges	Activity increases in cooler parts of the day
	Cirrhinus Mrigala (Mrigal)	Active feeding near the surface	Less active, staying deeper in water	Active, foraging near pond edges	Activity increases in cooler parts of the day
Reptiles	Pond turtle	Basking in the sun, active	Basking or resting on rocks	Reduced activity, preparing to rest	Turtles are diurnal, preferring basking in mid-morning

Table 4: Dominant Tree Species as Key Supporters of Faunal Diversity in Urban Ponds

Dominant Trees	Fauna Supported (Animal, Birds, Insects)	Relationship
Peepal (Ficus religiosa)	Birds (e.g., pigeons, bulbuls), fruit bats, butterflies, ants	Shelter and food (figs); supports birds and small mammals.
Neem (Azadirachta indica)	Birds (e.g., sparrows, drongos), insects, honey bees	Nectar and Pollen for pollinators; acts as a habitat for small birds and insects.
Acacia (Vachellianilotica)	Insects, herbivores (e.g., sheep, goat), birds (e.g., kites, hawks)	Food (pods), habitat for birds and insects; attracts herbivores.
Jamun (syzygiumcumini)	Birds (e.g., crows, barbets), bats, fruit-eating insects	Fruits provide food; supports pollinators and frugivores
Banyan (Ficus benghalensis)	Birds (e.g., parrots, mynas), bats, squirrels, Bees	Provides nesting and food (fruits); supports pollinators like bees.
Ashoka (Saracaasoca)	Birds (e.g., magpie robins), insects (e,g., caterpillars), Bats	Shelter and shade; nectar for insects and small birds.

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4. Conclusion

The research on the faunal diversity of urban ponds in Jodhpur City highlights the significant impact of human activities on biodiversity in aquatic ecosystems. Ponds experiencing lower levels of human interference, such as Ranisar, Guro ka Talab, Fateh Sagar Talab, and Shekha Ji Ka Talaab, exhibited higher species richness and more balanced faunal communities. Conversely, ponds subjected to higher human activity, including pollution and habitat encroachment, like Ganglao Talab, Naya Talab, Bai Ji Ka Talab, and Ratanada pond, showed reduced faunal diversity, with certain species dominating due to their resilience to disturbed conditions.

The research confirms that human activities, such as waste disposal, urban encroachment, and water contamination, lead to ecological imbalances, with sensitive species disappearing and more tolerant species proliferating. This has critical implications for urban biodiversity and ecosystem health, as reduced diversity weakens ecosystem resilience and function.

To preserve and enhance the faunal diversity of these urban ponds, it is crucial to implement sustainable urban management practices. This includes improving waste management, limiting harmful human activities around pond ecosystems, and engaging in habitat restoration efforts. Without such interventions, urbanization will continue to erode the biodiversity of these vital water bodies, impacting the broader ecological health of the region.

Further research and continuous monitoring are recommended to track the long-term effects of human influences and to assess the effectiveness of conservation strategies. The findings from this study emphasize the need for integrated efforts between local communities, authorities, and researchers to protect Jodhpur's urban ponds and their rich biodiversity.

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