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ASSESSMENT OF INSECT DIVERSITY (HEMIPTERA & COLEOPTERA) IN HIMAYAT SAGAR AND OSMAN SAGAR LAKES OF HYDERABAD TELANGANA.

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Abstract:
This study investigates the diversity of Hemiptera and Coleoptera in Himayat Sagar and Osman Sagar lakes during monsoon 2023. We recorded a total of 47 species at each lake, with Himayat Sagar showing higher species richness and more even distribution compared to Osman Sagar. The Shannon-Wiener and Simpson's indices were used to quantify diversity and evenness, revealing that Himayat Sagar supports a more balanced and diverse insect community. These findings highlight the impact of environmental conditions on insect populations and provide recommendations for conservation.

Key points: Species Richness, Species Evenness, Conservation.

1. INTRODUCTION

1.1 Background and Rationale

Lakes are crucial freshwater ecosystems that support diverse biological communities and provide essential ecosystem services. Among aquatic ecosystems, lakes serve as habitats for a wide range of organisms, including insects from various orders such as Hemiptera (true bugs) and Coleoptera (beetles). These insects play vital roles in aquatic ecosystems, influencing nutrient cycling, serving as prey for other organisms, and acting as bioindicators of environmental health.

Himayat Sagar and Osman Sagar, two significant reservoirs located in Hyderabad, India, are prominent examples of freshwater ecosystems in urban areas. These lakes not only provide water for municipal and agricultural purposes but also support a variety of aquatic life.

1.2 Insect Diversity in Freshwater Ecosystems

Insects from the orders Hemiptera and Coleoptera are particularly noteworthy in freshwater ecosystems due to their ecological roles. Hemiptera includes species like water striders and backswimmers, which are important for controlling aquatic insect populations and serving as indicators of water quality. Coleoptera, encompassing water beetles, contribute to the breakdown of organic matter and are crucial in the food web.

Understanding the diversity and distribution of these insects helps in assessing the ecological health of freshwater bodies. High species richness and evenness generally indicate a balanced and healthy ecosystem, while a decline in diversity can signal environmental stress or degradation.

1.3 Research Objectives

This study aims to:

1. **Document and Compare Insect Diversity**: Identify and compare the species of Hemiptera and Coleoptera present in Himayat Sagar and Osman Sagar during monsoon 2023.
2. **Analyze Species Richness and Evenness**: Evaluate the species richness and evenness at both lakes to understand the distribution and abundance of insect species.
3. **Assess Environmental Impact**: Investigate how environmental factors, such as water quality and habitat conditions, influence insect diversity and distribution in these lakes.

1.4 Significance of the Study

The findings of this study are significant for several reasons:

- **Ecological Understanding**: By documenting the diversity of Hemiptera and Coleoptera, this study provides insights into the ecological dynamics of Himayat Sagar and Osman Sagar. Understanding which species are present and their relative abundance can reveal the overall health of these aquatic ecosystems.
- **Conservation and Management**: The results will inform conservation efforts aimed at improving water quality and restoring habitats. By identifying species that are sensitive to environmental changes, the study can help prioritize conservation actions to protect these important ecosystems.
- **Urban Ecosystem Research**: Given the urban setting of Hyderabad, this study contributes to our understanding of how urbanization affects freshwater biodiversity. The results can be used to develop strategies for mitigating the impact of urbanization on freshwater habitats.

1.5 Study Area

Himayat Sagar and **Osman Sagar** are both large reservoirs situated in Hyderabad, India. Himayat Sagar, constructed in 1927, is known for its relatively clear water and abundant vegetation. Osman Sagar, built in 1920, is located nearby and is characterized by slightly higher pollution levels and more disturbed habitats. Both lakes serve as important recreational and water sources, making them ideal locations for studying aquatic insect diversity.

2. REVIEW OF LITERATURE:

Aquatic Insects has been studied by some of the authors from Indian freshwater ecosystem. It was initiated by Vazirani (1968, 1969a, 1969b, 1969c, 1970, 1971, 1972,1973, 1977, 1980, 1984). Later it has been continued by Balfour Brown (1939), Wewalka (1975), Mukhopadhyay and Ghosh (2003, 2007). Jachand Balke (2008), Ghosh (1996, 2007, 2010, 2011, 2012, 2013, 2014, 2015) Deepa & Rao (2007, 2010, 2011). Vazirani (1952) described a new species of *Neptosternus* from the Mettur Dam of Salem District, Tamil Nadu. Mukhopadhyay and Ghosh 2007 were documented 53 species under 19 genera belonging to families of Dytiscidae, Hydrophilidae, Gyrinidae, Noteridae and Holiplidae from the state of Andhra Pradesh. Swetapadma & Sanmitr (2017), Studied the aquatic Insects diversity of South Coastal Odisha, India and the authors documented 12 species under 7 genera belongs to family dytiscidae and the the authors are also studied the seasonal variation in estuaries of South coastal Odisha. Ramar et al., 2018 documented two species of aquatic Insects from Sirumallai Hills. The authors studied the biodiversity of insects and distribution pattern from Eastern Ghats, Tamil Nadu, South India. Deepa *et al*., 2020 was reported two new records of genus *Peschetius* from the state of Telangana which is also part of eastern ghats. The based on the available literature it shows that the aquatic Insects documentation and diversity analysis from eastern ghats is scattered and limited, the present aimed to explore the aquatic Insects diversity of Eastern Ghats along with their habitat ecology and molecular systematics.

In India, most of the information on morphology, classification, phylogeny and biogeography has derived from the monographic work of Andersen (1982). Faunistic knowledge on Gerromorpha is limited to the taxonomic studies by Distant (1903, 1910a and b), Dover (1928), Hafiz and Mathai (1938), Hafiz and Riberio (1939), Hafiz and Pradhan (1947), Pradhan (1950a, b and 1975), Gupta (1981), Roy et al. (1988), Ghosh et al. (1989), Polhemus and Starmuhlner (1990), Bal and Basu (1994, 1997, 2000), Chen and Zettel (1999), Thirumalai (1986, 1989, 1992,1994a and b, 1996, 1999, 2000, 2002), Chandra et al., (2012), Jehamalar and Chandra (2013a, b). The revisionary work of Andersen (1982), Polhemus (1994), Polhemus and Polhemus (1994, 1995), Chen and Nieser (1993a and b), Chandra and Jehamalar (2012a), Jehamalar and Chandra (2013c, d), Basu et al., (2014, 2016) on few genera of Gerridae has also been done. A noteworthy study on Gerromorpha by Andersen (1982) has revealed the ability to walk (pleustonic) on water surface of

Gerromorphan bugs on all kinds of lentic and lotic water bodies (Mesoveliidae, Hebridae, Paraphrynoveliidae, Macroveliidae,Gerridae, Veliidae, Hydrometridae and Hermatobatidae).

Deepa (2013) has made an attempt to study the aquatic insects of Hyderabad, it reveals that 14 species of Aquatic Hemiptera belonging to 5 families and 8 genera, which forms the first report of this group from insects of lakes of Hyderabad. It also comprises of 31 species of aquatic coleopteran accommodated under 20 genera and four families. But it shows that very limited and scattered documents because not much study has been chosen and lack in habitat ecology. It needs systematic study to document accurate aquatic insect composition and diversity along with habitat ecology would be very helpful to the water body conservation and management.

3. METHODOLOGY

3.1 Study Area Description

Himayat Sagar and Osman Sagar are two prominent reservoirs located in Hyderabad, India. These lakes are crucial to the region's water supply and have distinct ecological characteristics:

- Himayat Sagar: Constructed in 1927, this reservoir is known for its relatively clear water and abundant aquatic vegetation. Its surrounding area is less disturbed compared to Osman Sagar.
- Osman Sagar: Completed in 1920, this reservoir is situated nearby and is characterized by slightly higher pollution levels and more disturbed habitats. It has a history of water quality issues due to urban runoff and industrial discharges.

3.2 Sampling Design and Collection Methods

3.2.1 Sampling Locations

Sampling was conducted at multiple locations around each lake to capture a representative diversity of insect species. The locations were chosen based on varying environmental conditions such as vegetation density and proximity to inflow and outflow points.

3.2.2 Sampling Techniques

To ensure comprehensive sampling of Hemiptera and Coleoptera, the following methods were employed:

1. **Sweep Netting:**
    - Description: A sweep net with a fine mesh was used to capture flying and floating insects on the water surface and in aquatic vegetation.
    - Procedure: Sweep netting was performed along the shorelines and in shallow areas. Each location was sampled for approximately 30 minutes.
2. **Pitfall Traps:**
    - Description: Small containers (pitfalls) were buried in the ground at various points

to capture ground-dwelling insects.

- Procedure: The pitfall traps were filled with a preservative solution (e.g., ethanol) to prevent insect decomposition. Traps were placed in areas with dense vegetation and around the lake's edge. Each trap was left for 48 hours before collection**.**

3.3 Sample Processing and Identification

1. **Specimen Preservation:**
   - Collected insects were preserved in 70% ethanol for further identification and analysis.
   - Specimens were labelled with collection date, location, and sampling method for accurate record-keeping.
2. **Identification:**
   - Insects were identified to the species level using taxonomic keys and guides specific to Hemiptera and Coleoptera.
   - Identification was confirmed through comparison with reference specimens and consultation with entomological experts.
3. **Data Recording:**
   - Detailed records of each species' abundance and location were maintained.
   - Data included the number of individuals for each species and the sampling method used.

3.4 Data Analysis

1. **Species Richness:**
   - Calculation: Total number of unique species observed at each lake was recorded.
   - Purpose: To determine the species richness at Himayat Sagar and Osman Sagar.
2. **Species Evenness:**
   - Calculation: Pielou's Evenness Index was used to assess how evenly the individuals are distributed among the species.
   - **Formula:**

$$\text{Evenness} = \frac{H'}{\ln(S)}$$

Where H′ is the Shannon-Wiener diversity index and Sis the total number of species.

3. **Diversity Indices:**
   - Shannon-Wiener Index (H'):

$$H' = -\sum_{i=1}^{S}(p_i \cdot \ln(p_i))$$

where p_i is the proportion of individuals of species i.

- Simpson's Index (D):

$$D = \sum_{i=1}^{S} (p_i^2)$$

where p_i is the proportion of individuals of species i.

- Simpson's Diversity Index (1 - D):

$$1 - D = 1 - \sum_{i=1}^{S} (p_i^2)$$

3.5 Statistical Analysis:

- Data were analyzed using statistical software to compute the diversity indices and compare species richness and evenness between the two lakes.

4. RESULT AND DISCUSSION

Table 1: various species of insects identified in Himayat Sagar and Osman Sagar

Sl No	Location Name	Himayat Sagar	Osman Sagar
	Species		
	Dytiscidae		
1	*Laccophilus sharpi*	1	6
2	*Hydrovatus acuminataus*	3	3
3	*Hydroglyphus flammulatus*	8	6
4	*Cybister convexus*	1	
5	*Peschetius quadricostatus*	1	
6	*Laccophilus parvulus*		
7	*Hydaticus ricinus*	3	1
8	*Hydaticus sp*		
9	*Laccophilus sp*	3	
10	*Hydrovatus sp*	1	
	Hydrophilidae		
11	*Helocharus pallen*	3	

12	*Berosus indicus*	3	
13	*Berosus pulchellus*	6	3
14	*Sternolophus rufipes*	4	2
15	*Hydrophilus olivaceus*	2	1
16	*Amphiops mater*	10	1
17	*Helochares sp*	2	3
18	*Regimbartia attenuata*	6	
19	*Helocharus sp*	2	
20	*Laccobius sp*	12	
21	*Enochares sp*		
22	*Paracymus*	2	
	Noteridae		
23	*Canthydrus luctuosus*	4	
24	*Canthydrus laetabilis*	2	2
25	*Neohydrocoptus subvittulus*	6	2
	Hydraenidae		
26	*Ochthebius sp*	13	
27	*Limnebius sp*	20	
	Belostomatidae		
22	*Diplonychus molestus*	2	3
23	*Diplonychus rusticus*	4	3
	Nepidae		
24	*Ranatra digitata*	3	3
25	*Ranatra varipes varipes*	1	1
26	*Ranatra varipes atropha*	2	3
27	*Cercotmetus sp*	1	
28	*Laccotrephes ruber*	4	4
29	*Laccotrephes griseus*	3	3
	Micronectidae		
30	*Micronecta scutellaris scutellaris*	5	
31	*Micronecta haliloides*	1	1
32	*Micronecta ludibunda ludibunda*	5	5
33	*Micronecta quadristrigata*	2	

	Pleidae		
34	*Paraplea frontalils*	3	3
35	*Paraplea liturata*	3	2
	Notonectidae		
36	*Anisops breddini*	2	1
37	*Anisops bouvieri*		
38	*Anisops kuroiwae*	4	3
39	*Enithares ciliata*	2	3
	Gerridae		
40	*Limnogonus fossarum fossarum*	1	2
41	*Limnogonus nitidus*	2	2
42	*Limnometra fluviorum*	2	1
43	*Aquarius adelaidis*		1
	Hydrometridae		
44	*Hydrometra greeni*		
	Microveliidae	4	4
45	*Microvelia douglasi*		
	Mesoveliidae		
46	*Mesovelia vittigera*	2	
47	*Mesovelila horvathi*	2	

5.1 Species Richness

Species richness refers to the number of different species present in each location. For each lake, we count the total number of unique species observed.
Species Richness Calculation:

- **Himayat Sagar:**
  - Dytiscidae: 8 species
  - Hydrophilidae: 12 species
  - Noteridae: 3 species
  - Hydraenidae: 2 species
  - Belostomatidae: 2 species
  - Nepidae: 4 species
  - Micronectidae: 4 species
  - Pleidae: 2 species
  - Notonectidae: 4 species
  - Gerridae: 3 species

- Hydrometridae: 1 species
- Microveliidae: 1 species
- Mesoveliidae: 2 species

Total Species Richness for Himayat Sagar: 44 species

- **Osman Sagar:**
  - Dytiscidae: 8 species
  - Hydrophilidae: 9 species
  - Noteridae: 3 species
  - Hydraenidae: 2 species
  - Belostomatidae: 2 species
  - Nepidae: 4 species
  - Micronectidae: 4 species
  - Pleidae: 2 species
  - Notonectidae: 4 species
  - Gerridae: 1 species
  - Hydrometridae: 1 species
  - Microveliidae: 1 species
  - Mesoveliidae: 2 species

Total Species Richness for Osman Sagar: 42 species

5.2 Abundance Data: from the above table 1

Himayat Sagar: 139
Osman Sagar: 64

5.3 Calculations:

1. Shannon-Wiener Index (H')

The Shannon-Wiener Index is calculated as follows:

$$H' = -\sum_{i=1}^{S}(p_i \cdot \ln(p_i))$$

where p_i is the proportion of each species.

For Himayat Sagar: -127.433734
For Osman Sagar: -37.00650631

2. Pielou's Evenness Index (J')

Pielou's Evenness Index is calculated as:

$$J' = \frac{H'}{\ln(S)}$$

where S is the total number of species.

Table 2: Biodiversity Metrics for Himayat Sagar and Osman Sagar Reservoirs

Location	No of species	H max	Shannon index value	Pielou's Evenness Index (J′)
Himayat Sagar	44	1.643452676	-127.433734	77.54025185
Osman Sagar	42	1.62324929	-37.0065063	22.79779608

6 DISCUSSION AND CONCLUSION:

Species Richness and Shannon Index Species Richness:

- Himayat Sagar: 44 species
- Osman Sagar: 42 species

Himayat Sagar exhibits a marginally higher species richness compared to Osman Sagar. This suggests that Himayat Sagar supports a slightly more diverse aquatic beetle community. This variation in species richness could be influenced by several factors, including habitat heterogeneity, water quality, and availability of resources in Himayat Sagar compared to Osman Sagar.

Shannon Index (H'):

- Himayat Sagar: 1.643
- Osman Sagar: 1.623

The Shannon index reflects the overall diversity of the community, taking into account both the number of species and the evenness of their distribution. The Shannon index is slightly higher in Himayat Sagar (1.643) compared to Osman Sagar (1.623). This indicates that Himayat Sagar not only supports a greater number of species but also has a more balanced distribution of individuals among those species.

This higher Shannon index suggests a more stable and resilient ecosystem in Himayat Sagar, where no single species dominates excessively.

Pielou's Evenness Index (J'):

- **Himayat Sagar**: 77.54
- **Osman Sagar**: 22.80

Pielou's Evenness Index measures how evenly the individuals are distributed among the species in a community. The higher evenness value in Himayat Sagar (77.54) compared to Osman Sagar (22.80) suggests a more even distribution of species in Himayat Sagar. This means that in Himayat Sagar, the species are more equally represented, whereas in Osman Sagar, there is a more pronounced dominance by a few species. High evenness is often associated with greater ecological stability, as it indicates that resources are more evenly utilized among species.

7. CONCLUSION:

Himayat Sagar exhibits higher species richness, a slightly greater Shannon index, and a more balanced Pielou's Evenness Index compared to Osman Sagar. These metrics suggest that Himayat Sagar supports a more diverse and evenly distributed aquatic beetle community. This indicates better ecological balance and stability in Himayat Sagar. The findings underscore the importance of environmental factors in shaping species diversity and highlight the need for continued monitoring and research to understand the underlying causes of these differences.

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