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DIVERSITY OF AQUATIC BEETLES IN RELATION TO WATER QUALITY FROM KHADAKWASLA DAM, PUNE

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ABSTRACT

Physicochemical factors like pH, temperature, conductivity, total dissolved solids, salinity, and dissolved oxygen, are important water quality parameters of freshwater ecosystems. The present study is focused on the diversity of aquatic beetles and assessing physicochemical parameters. Water samples for physio-chemical analysis and aquatic beetles were collected from the Khadakwasla dam monthly throughout 2022. Results showed that pH (7.6-8.1), temperature (30.5^{0}C to 32.5^{0}C), conductivity (210 to 232 µs), total dissolved solids (175 to 192ppm), salinity (130-146ppm) and dissolved oxygen (5.8 -6.8 mg/L) were good for the aquatic fauna according to WHO and Indian standard values. The findings revealed a total of 15 species belonging to 9 genera and 4 families. The family Dytiscidae is the most abundant followed by Hydrophilidae, Noteridae, and Gyrinidae. The high diversity of aquatic beetles indicates the availability of good physicochemical variables, food, and vegetation that serve as breeding sites.

Key words: Maharashtra, abiotic factors, distribution, dissolved oxygen, fauna, Mutha River, habitat, Coleoptera, Dytiscidae, Hydrophilidae, Noteridae, Gyrinidae

The order Coleoptera constitute about 25% of all known life forms. Aquatic Coleoptera diversity consists of 13000 species, distributed throughout the globe (Short, 2017) of which 776 species of aquatic coleopterans have been documented from India (Jaiswal et al., 2021). Freshwater is one of the most diverse components of universal biodiversity (Sala and Jackson, 2006) and it has high conservation value but freshwater ecosystems are constantly despoiled by increasing interference of manmade activities (Margherita et al., 2010). Aquatic Coleoptera are potentially ideal indicator of aquatic ecosystem and play a vital role in maintaining the food chain and food web of freshwater ecosystem. The changes in the physico-chemical properties of water can adversely affect the diversity, distribution and species abundance. They represent a promising group for environmental impact assessments (EIAs) studies due to niches inhabited by the aquatic beetle, their diversity, distribution and abundance (Balke et al., 1999; Hendrich et al., 2004). A prominent attraction in Pune, Khadakwasla Dam is situated on Mutha River which is a reservoir and the main source of water for Pune and its suburbs. The Mutha River in Pune region originates in the Western Ghats and flows eastward which has been dammed twice first at the Panshet Dam and the second at Khadakwasla**.** As this dam is surrounded by many scenic places it is also a very popular tourist place. The current study is focused on the diversity of aquatic Coleoptera along with the physicochemical parameters of Khadakwasla Dam.

MATERIALS AND METHODS

The capacity of Khadakwasla Dam (18.4423° N, 73.7671° E) is 374 m cu mr with length and height of 1939 m and 31.79 m, respectively. The sampling was done every month from January to December 2022. The water samples along with collected specimens were brought to the laboratory for physico-chemical analysis and identification. The physico-chemical parameters viz. pH, temperature, total dissolved solids, conductivity and salinity was recorded with the help of multi parameter Eutech PCS Tester35 and dissolved oxygen was recorded with the help of Digital Bench top DO meter (Aquasol AB-DO-01). The obtained data subjected to statistical analysis. Identification of specimens are done based on Sharp (1882); Vazirani (1968;1984); Pederzani (1995); Toledo (2008); Nasserzadeh and Komarek (2017); Sheth et al. (2018); and Girón and Short (2021). Species synonyms are only based on the original and the latest citation (Nilsson, 2011; Ghosh and Nilsson, 2012; Nasserzadeh and Komarek, 2017; Wewalka, 2020; Girón and Short, 2021). The latest citation is indicated by a colon symbol (:) between species and author's name.

Fig. 1. Dorsal habitus of aquatic beetles from Khadakwasla Dam, Pune: A. *Dineutus (Protodineutus) indicus*, B. *Hydaticus (Prodaticus) vittatus*, C. *Hydaticus (Prodaticus) luczonicus*, D. *Hydaticus (Prodaticus) fabricii*, E. *Hyphydrus intermixtus* F. *Hyphydrus flavicans*, G. *Laccophilus flexuosus*, H. *Laccophilus inefficiens*, I. *Copelatus neelumae*, J. *Canthydrus laetabilis*, K. *Canthydrus morsbachi*, L. *Berosus (Berosus) pulchellus*, M. *Helochares anchoralis*, N. *Sternolophus rufipes*, O. *Sternolophus inconspicuus*

RESULTS AND DISCUSSION

All the variables studied include pH, temperature, total dissolved solids, conductivity, salinity and dissolved oxygen. The temperature was 30.97± 0.338^{0}C, with pH of 7.77± 0.186; total dissolved solids was 184.7± 7.201 ppm, with conductivity of 222.5± 9.710 µs, salinity of 136.7± 5.750 ppm and dissolved oxygen of 6.21± 0.325 mg/ l. According to WHO 2017, the temperature varied between the ranges of 30.5^{0}C to 32.5^{0}C. The pH value ranges from 7.6-8.1 were in permissible limits. The values of conductivity varied 210 to 232 µs whereas the total dissolved solids ranged from 175 to 192 ppm respectively. The palatability of water with a total dissolved solids level of less than about 600mg/L is generally consider being good. The optimum concentration of dissolved oxygen of water obtained were in the range of 5.8-6.8 mg/ L and these values are in between the standards values with WHO 2008 and 2017. The salinity was recorded to be in the range of 130-146 ppm. The finding indicates parameters of the water quality in accordance with WHO norms and this indicate that the water deemed to be good for human consumption and most aquatic biota. Aquatic insects are influenced by the physical, chemical and biological factors of the water body thus they are an excellent indicator of water quality (Jarjees et al., 2019).

A. Checklist of species

In the present study a total of 120 examples of aquatic Coleoptera were identified belonging to 15 species under 9 genera and 4 families. Family Dytiscidae was found to be the most abundant followed by Hydrohilidae, Noteridae and Gyrinidae. The diversity may be due to existence of phytoplankton, aquatic vegetation and algal blooms as they provide good food resource, shelter and nesting ground for the beetles (Jarjees et al., 2019; Ruitton et al., 2000).

Gyrinidae Latreille, 1802
Gyrininae Latreille, 1810
Dineutus Macleay, 1825
Protodineutus Ochs, 1926

1. *Dineutus (Protodineutus) indicus* Aube, 1938

Dytiscidae Leach, 1815
Dytiscinae Leach, 1815
Hydaticus Leach, 1817
Prodaticus Sharp, 1882

2. *Hydaticus (Prodaticus) vittatus* (Fabricius, 1775)
3. *Hydaticus* (*Prodaticus*) *luczonicus* Aube, 1838
4. *Hydaticus* (*Prodaticus*) *fabricii* Macleay, 1825

Hyphydrus Illiger, 1802

5. *Hyphydrus intermixtus* Walker, 1858
6. *Hyphydrus flavicans* Regimbart, 1892

Laccophilinae Gistel, 1856
Laccophilus Leach, 1815

7. *Laccophilus flexuosus* Aube, 1938
8. *Laccophilus inefficiens* (Walker, 1859)

Copelatinae Branden, 1885
Copelatus Erichson, 1832

9. *Copelatus neelumae* Vazirani, 1973

Noteridae Thomson, 1816
Noterinae Regimbart, 1878
Canthydrus Sharp, 1882

10. *Canthydrus laetabilis* (Walker, 1858)
11. *Canthydrus morsbachi* (Wehncke, 1876)

Hydrophilidae Latreille, 1802
Hydrophilinae Latreille, 1802
Sternolophus Solier, 1834

12. *Sternolophus rufipes* (Fabricius, 1792)
13. *Sternolophus inconspicuus* (Nietner, 1856)

Berosus Leach, 1817
Berosus Leach, 1817

14. *Berosus (Berosus) pulchellus* MacLeay, 1825

Helochares Mulsant, 1844
Helochares anchoralis Sharp, 1890

B. Systematic account (Fig. 1)

1. *Dineutus (Protodineutus) indicus* Aube, 1938

1938. *Dineutus indicus* Aube, Species Coleopters, 6: 772.

1984. *Dineutus indicus*: Vazirani, Fauna of India, Coleop, p. 22.

Distribution: India: Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere: Pakistan

2. *Hydaticus (Prodaticus) vittatus* (Fabricius, 1775)

1775. *Dytiscus vittatus* Fabricius, Syst. Ent.: 825.

2020. *Hydaticus (Prodaticus) vittatus*: Wewalka, Koleopterologische Rundschau, 90: 29

Distribution: India: Andhra Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Pondicherry, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere: Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, Sri Lanka, China, Indonesia, Japan, Korea,

Philippines, Taiwan, Thailand, Vietnam, Australian region.

3. *Hydaticus* (*Prodaticus*) *luczonicus* Aube, 1838

1838. *Hydaticus luczonicus* Aube, in Dejean's Species Coleopt., 6: 179.

2012. *Hydaticus luczonicus*, Ghosh and Nilsson, Skorvnopparn Umel supplement, 3: 26.

Distribution: India: Bihar, Delhi, Gujarat, Haryana, Jharkhand, Madhya Pradesh, Maharashtra, Meghalaya, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere: Indonesia, Philippines, Sri Lanka, Thailand, and Vietnam.

4. *Hydaticus* (*Prodaticus*) *fabricii* Macleay, 1825

1825. *Colymbetes fabricii* W.S. Macleay, Annulosa Javanica, Paris, p.134.

2012. *Hydaticus fabricii*: Ghosh and Nilsson, Skorvnopparn Umel supplement, 3: 25.

Distribution: India: Andaman and Nicobar Islands, Andhra Pradesh, Assam, Bihar, Delhi, Goa, Gujarat, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal.

Elsewhere: Afghanistan, Myanmar, Nepal, Pakistan, Sri Lanka; China, Indonesia, Iran, Japan, Philippines, Taiwan, Thailand, Vietnam; Australian region.

5. *Laccophilus flexuosus* Aube, 1838

1838. *Laccophilus flexuosus* Aubé: 430.

2012. *Laccophilus flexuosus*: Ghosh and Nilsson, Skörvnöpparn, Umeå, Suppl., 3: 48

Distribution: India: Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Delhi, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Puducherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, and West Bengal.

Elsewhere: Bangladesh, Cambodia, China, Myanmar, Nepal, Pakistan, Sri Lanka, Indonesia, Iran, Iraq, Japan, Taiwan, and Vietnam.

6. *Laccophilus inefficiens* (Walker, 1859)

1859. *Hydroporus inefficiens* Walker, Ann. Mag. Nat. Hist, 3: 51.

2012. *Laccophilus inefficiens*: Ghosh and Nilsson, Skorvnopparn supplement, 3: 49.

Distribution: India: Andaman and Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Punjab, Rajasthan, Sikkim, Tripura, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal.

Elsewhere: Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, Sri Lanka, Indonesia, Iran, Malaysia.

7. *Copelatus neelumae* Vazirani, 1973

1973. *Copelatus neelumae* Vazirani, Jr. of the Bombay Nat. Hist. Soc., 70: 224

2018. *Copelatus neelumae:* Sheth, Ghate and Hajek, Zootaxa, 4459: 248

Distribution: India: Goa, Karnataka, Kerala, Maharashtra, Tamil Nadu.

Elsewhere: Sri Lanka and Nepal.

8. *Canthydrus laetabilis* (Walker, 1858)

1858. *Hydroporus laetabilis* Walker, Ann. Mag. Nat. Hist., 3(2): 205

2012. *Canthydrus laetabilis*: Nilsson. World Catalogue of the Family Noteridae, Version 16. VIII. 2011, p. 13.

Distribution: India: Andhra Pradesh, Assam, Bihar, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Uttar Pradesh and West Bengal.

Elsewhere: Bangladesh, Myanmar, Sri Lanka, Nepal, Pakistan.

9. *Canthydrus morsbachi* (Wehncke, 1876)

1876. *Hydrocanthus morsbachi* Wehncke, Deutsche Ent. Zeitscher 20: 222 pp.

2012. *Canthydrus angularis*: Nilsson, A. World Catalogue of the Family Noteridae, Version 16. VIII. 2011, p. 15.

Distribution: India: Kerala, Maharashtra, Orissa and Tamil Nadu.

Elsewhere: Andaman Islands, Cambodia, China, Indonesia, Malaysia, Myanmar, Singapore, Sri Lanka, Thailand, Vietnam.

10. *Sternolophus rufipes* (Fabricius, 1792)

1792. *Hydrophilus rufipes* Fabricius, Entom. Syst., 1: 183.

2017. *Sternolophus rufipes*: Nasserzadeh and Komarek, Zootaxa, 4282(2): 237.

Distribution: India: Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jammu and

Kashmir, Kerala, Maharashtra, Manipur, Meghalaya, Odisha, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.

Elsewhere: Bhutan, Cambodia, China, Macau, Indonesia, Japan, Malaysia, Myanmar, Nepal, Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam.

11. *Sternolophus inconspicuus* (Nietner, 1856)

1856. *Hydrous inconspicuus* Nietner, Unkown publisher, Colombo, 2: 15

2017. *Sternolophus rufipes*: Nasserzadeh and Komarek, Zootaxa, 4282(2): 223.

Distribution: India: Madhya Pradesh, Maharashtra, Meghalaya, Tamil Nadu, Uttar Pradesh.

Elsewhere: Cambodia, China, Hong Kong, Indonesia, Japan, Laos, Myanmar, Nepal, Philippines, South Korea, Sri Lanka, Taiwan, Thailand, Vietnam.

12. *Berosus (Berosus) pulchellus* MacLeay, 1825

1817. *Berosus pulchellus* Macleay, Annul. Jav, 35.

1999. *Berosus* (*Berosus*) *pulchellus*: Hansen, World Cat. Insect., 2, Hydrophilioidea (s. str.) (Coleoptera): 92.

istribution: India: Andaman and Nicobar Island, Haryana, Karnataka, Kerala, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal.

Elsewhere: Australia, Bangladesh, China, Iran, Japan, Saudi Arabia, Indonesia, Laos, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Taiwan, Thailand and Vietnam.

13. *Helochares anchoralis* Sharp, 1890

1890. *Helochares (Hydrobaticus) anchoralis* Sharp, Trans. Ent. Soc. Lond. p. 352

2021. *Helochares anchoralis*: Giron and Short, ZooKeys 1045:168

Distribution: India: Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Maharashtra, Manipur, Tripura, Uttar Pradesh and West Bengal.

Elsewhere: Bangladesh, Cambodia, China, Indonesia, Japan, Laos, Philippines, Sri Lanka, Thailand, Vietnam.

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AUTHOR CONTRIBUTION STATEMENT

The authors confirm their vontribution in the present stud. Rita Deb: Identification of specimens, writing the manuscript, photographing the specimens; Pallavi Takawane: Collection of specimens, analysing water quality parameters, writing the manuscript; Rashmi Morey and Sadeep Pokale: Reviewing the manuscript; Bithika Baidya and Akash Bagade: Helped in collection specimens. All authors read and approved the final version of the manuscript

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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