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Diversity, Abundance and Species Composition of Water Beetles (Coleoptera: Dytiscidae, Hydrophilidae and Gyrinidae) in Kolkas Region of Melghat Tiger Reserve, Central India

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Abstract: The diversity & abundance of aquatic beetles at 5 different sites in Kolkas region of Melghat were studied from May 2009 to February 2010. Kolkas is located in the Melghat Tiger Reserve (MTR) in the state of Maharashtra, Central India. Total 13 species of water beetles belonging to families Dytiscidae, Hydrophilidae and Gyrinidae were recorded. Dytiscinae was the dominant subfamily with respect to species diversity (10 species) and abundance. Hills diversity index indicated that site I was richest (11 species) followed by site II and III (10 species each), site V (9 species) and site IV (8 species). Abundance ranking showed that Site IV had less number of rare species and more number of common species as compared to other sites. Overall species composition and population structure at sites I and II were more similar compared to sites III and IV whereas site V was completely different from these two groups.

Key words: Coleoptera · Water beetles · Melghat tiger reserve · India

INTRODUCTION

Water beetles are very integral part of the biotic component of any water body or wetland. Aquatic beetles are a diverse group and are excellent indicators of habitat quality, age and 'naturalness [1]. They are indicator of ecological diversity and habitat characteristics [2-6] as they meet most of the criteria generally accepted in the selection of indicator taxa [7]. Temporary and permanent standing waters represent the most important habitats for this group of insects. Today, these fragile ecosystems are under threat due to intensive anthropogenic influences (draining, waste waters, etc.) [8-10]. Around 400 species of British beetle live in water for a significant proportion of their lives, including the familiar diving beetles. Many species have shown significant and dramatic contractions in range since the mid 20th century, in response to a variety of factors, particularly agricultural intensification and associated drainage of wetlands and increases in diffuse pollution, leading to eutrophication [1].

The diversity assessment and preparation of the water beetle inventories is considered an essential task now a days, due to the importance of wetlands in the conservation planning and endeavours [11]. Water beetles were examined for use as potential biodiversity indicators in continental aquatic ecosystems in a semiarid Mediterranean region, the Segura river basin (SE Spain) [12]. In view of the important role played by water beetle in the ecosystem, the present work was conducted to determine the diversity, abundance and species composition of these beetles in the Kolkas region of Melghat Tiger Reserve, Amravati, Maharashtra, India.

MATERIALS AND METHODS

The Study Area: The study was conducted from May 2009 to February 2010 at 5 different sampling sites in Kolkas forest region in the Melghat Tiger Reserve (MTR), in the state of Maharashtra, India (Fig. 1). The Melghat Tiger Reserve is located as a southern offshoot of Satpuda hill range called Gawilgarh hill in the state of Maharashtra in Central India. The Kolkas forest is tropical, dry deciduous in nature dominated with teak *Tectona grandis.*

Sampling Sites: Five artificial tanks located at a distance of 150-200m from each other in Kolkas forest region were selected as sampling sites for the collection of water beetles. The geographical coordinates were noted using a GPS recorder as follows:

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Fig. 1: Map of the study area (Kolkas Region of Melghat Tiger Reserve)

Site I 21°29.96'N, 077°12.338' E
Site II 21°29.96'N, 077°12.390' E
Site III 21°30.020'N, 077°12.515'E
Site IV 21°30.034'N,077°12.540' E
Site V 21°30.107'N,077°12.578' E

These sites were sampled twice every month from May 2009 to February 2010.

Field Methods: Beetle sampling was carried out at each site at an interval of 15 days. The water beetles were collected from the study area with the help of aquatic nets. The collected water beetles were sorted and preserved in 70 % alcohol. The collected specimens were then brought back to the laboratory, pinned, dried and identified with the help of standard identification manuals and published literature [13-16].

Identity of the beetle specimens were later confirmed by the experts from Zoological Survey of India, Pune, India.

Data Analysis: Two components, namely α-diversity (diversity within the habitat) & β-diversity (between the habitats) were calculated. Measures of α-diversity, the widely used Shannon diversity indices were calculated because it is well accepted that, all species at a site, within and across systematic groups contribute equally to its biodiversity [17]. β- diversity, Sample based rarefraction and other community composition methods were calculated using Biodiversity Pro software version 2 [18].

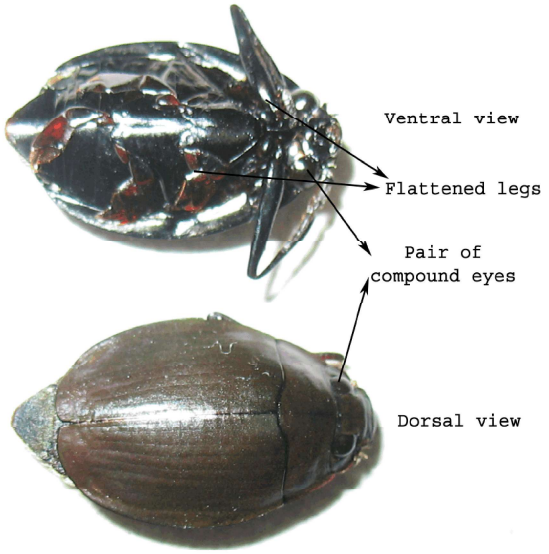
RESULTS

In the present work 13 water beetles belonging to family Dytiscidae, Hydrophilidae & Gyrinidae were recorded from the Kolkas region of Melghat Tiger Reserve. Literature survey has revealed that all the species have been recorded for the first time from Melghat Tiger Reserve. The maximum numbers of dytiscid beetles were observed in the month of September 2009. Some specimens had filiform antennae which were not pubescent, palps not enlarged; the hindlegs of all species were flattened and fringed with long hairs to form excellent paddles characteristics of family Dytiscidae. These specimens had eyes unnotched at antennal bases and males had protarsal segments 1-3 modified to form a large, broad, oval palette, often with variable number of suckers on the ventral surface, characteristic of subfamily

Fig. 2: Different morphological characters of Family Dytiscidae

Fig. 3: Different morphological characters of Family Hydrophilidae

Dytiscinae (Fig. 2). Two of the collected beetles were oval, somewhat convex that could be recognized by the short clubbed antennae and the long maxillary palps characteristics of family Hydrophilidae (Fig. 3). Most of the species of Hydrophilidae are aquatic and very similar in appearance to the Dytiscidae. The aquatic species are generally black in color and the metasternum in many species is prolonged posteriorly as a sharp spine [13]. The Gyrinids are oval black beetles that are commonly seen swimming in endless gyrations on the surface of pond



Dineutes indicus (Family: Gyrinidae)

Fig. 4: Different morphological characters of Family Gyrinidae

and quite streams.They are extremely rapid swimmers swimming principally by means of the highly flattened middle and hindlegs; the front legs are elongate and slender. They have a pair of compound eyes.

Water Beetle Species Composition: Overall 8 genera comprising 13 beetle species from 3 families were recorded during the present study (Table 1). Of the family Dytiscidae, the Dytiscinae was the dominant subfamily in terms of species richness (10 species) and abundance, followed by Hydrophilidae (3 species) and Gyrinidae (1 species) in the surveyed area. All specimens could be identified to the species level. The *Hydaticus* and *Sandracottus* were the most species rich genera with 3 species respectively followed by *Cybister* (2 species), *Eretes* (1 species), *Rhantaticus* (1 species), *Hydrophilus* (1 species), *Sternolophus* (1 species) and *Dineutus* (1 species) (Table 2).

Species Diversity & Abundance Pattern: The beetles collected from five different sites were compared and Shannon's indices were calculated as a measure of diversity within the habitat. Hills diversity index indicated that site I was richest (11 species) followed by site II and III (10 species each), site V (9 species) and site IV (8 species).The sample size of the five different sites were compared and Fisher's α diversity and Shannon diversity indices were calculated as a measure of diversity within a habitat. The Shannon diversity index indicated that site I was relatively diverse (3.29) followed by site II (3.14),

Table 1: Total number and percentage of species, genera and individuals observed per Family

	Genera		Species		Individuals	
Subfamily	No	%	No	%	No	%
Dytiscidae	5	62.50	10	76.92	75	67.56
Hydrophilidae	2	25.00	2	15.38	16	14.41
Gyrinidae	1	12.50	1	7.69	20	18.01
Total (3)	8	100.00	13	100.00	111	100.00

Table 2: List of water beetles recorded from the study area

Family	Subfamily	Tribe	Genus, Species	Length in Cm
Dytiscidae (Leach,1815)	Dytiscinae (Leach,1815)	Cybistrini (Sharp,1882)	*Cybister confusus* (Sharp, 1882)	2.6
Dytiscidae (Leach,1815)	Dytiscinae (Leach,1815)	Cybistrini (Sharp, 1882)	*Cybister tripunctatus* (Sharp, 1882)	3.7
Dytiscidae (Leach,1815)	Dytiscinae (Leach,1815)	Eretini (Crotch,1873)	*Eretes sticticus* (Linnaeus, 1833)	1.3
Dytiscidae (Leach,1815)	Dytiscinae (Leach,1815)	Hydaticini (Sharp, 1882)	*Hydaticus fabricii* (MacLeay,1833)	1.1
Dytiscidae (Leach,1815)	Dytiscinae (Leach,1815)	Hydaticini (Sharp, 1882)	*Hydaticus vittatus* (Fabricius, 1838)	1.5
Dytiscidae (Leach,1815)	Dytiscinae (Leach,1815)	Hydaticini (Sharp, 1882)	*Hydaticus luczonicus* (Aube,1838)	1.4
Dytiscidae (Leach,1815)	Dytiscinae (Leach,1815)	Thermonectini (Sharp, 1882)	*Rhantaticus congestus* (Klug, 1833)	1.5
Dytiscidae (Leach,1815)	Dytiscinae (Leach,1815)	Thermonectini (Sharp, 1882)	*Sandracottus dejeanii* (Aube, 1838)	1.4
Dytiscidae (Leach,1815)	Dytiscinae (Leach,1815)	Thermonectini (Sharp, 1882)	*Sandracottus mixtus* (Blanchard, 1853)	1.5
Dytiscidae (Leach,1815)	Dytiscinae (Leach,1815)	Thermonectini (Sharp, 1882)	*Sandracottus* sp. (Sharp,1882)	1.1
Hydrophilidae (Latreille,1802)	Hydrophilinae (Latreille,1802)	Hydrophilini (Latreille,1802)	*Hydrophilus olivaceous* (Muller,1764)	3.1
Hydrophilidae (Latreille,1802)	Hydrophilinae (Latreille,1802)	Hydrophilini (Latreille,1802)	*Sternolophus rufipes* (Solier,1834)	1.3
Gyrinidae (Latreille,1810)	Enhydrinae (Latreille,1810)	Enhydrini (Regimbart, 1882)	*Dineutus indicus* (Aube,1838)	1.5

Table 3: Alpha diversity indices for different sites at Kolkas region of Melghat Tiger Reserve

Index	Site I	Site II	Site III	Site IV	Site V
Fisher α-diversity	8.27	7.957	7.478	3.947	5.965
Shannon H'	3.295	3.146	3.001	2.588	2.892
Simpsons (D)	0.071	0.079	0.11	0.166	0.119
Hills No (H0)	11	10	10	8	9
Shannon J	0.952	0.947	0.903	0.863	0.912

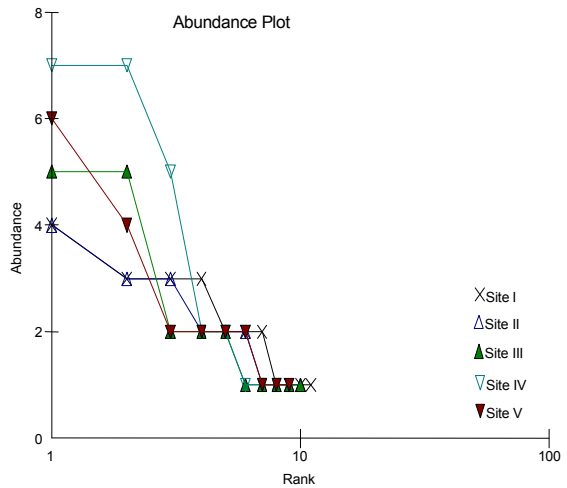


Fig. 5: Species rank abundance plot for five different sites

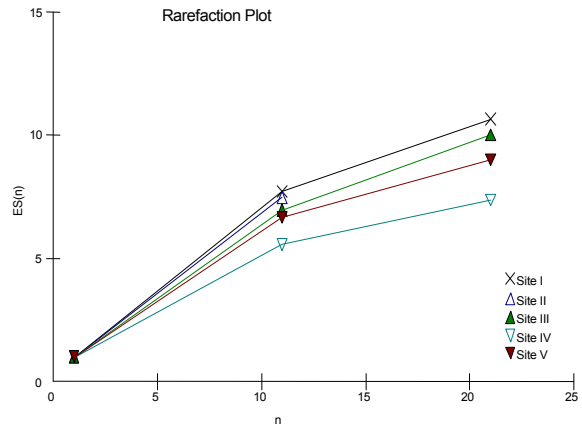
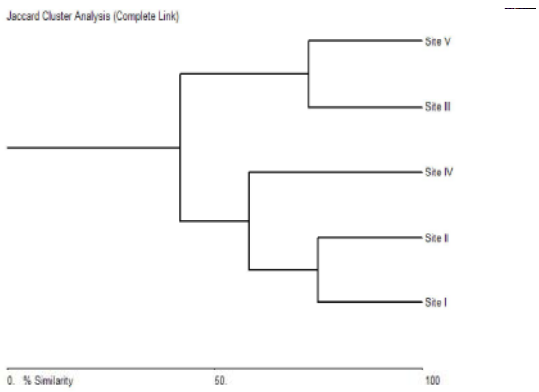


Fig. 6: Sample based rarefraction curve for different sites



(Jaccard similarity matrix- presence/absence)

Fig. 7: Dendrogram comparing different sites by their water beetle species assemblage

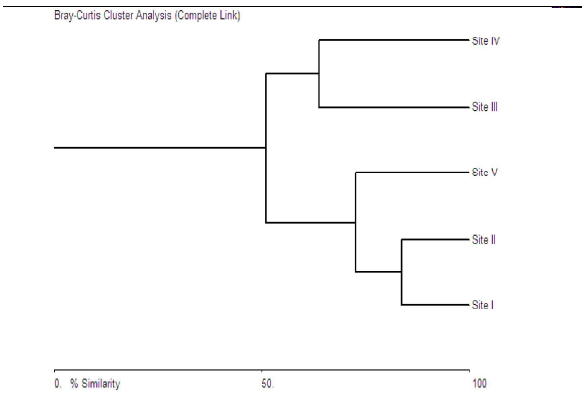
site III (3.00), site V (2.89) and lastly the site IV (2.58). The Simpson and Shannon J (evenness) indices also revealed almost the same order of diversity of sites (Table 3).

Species were ranked according to their abundance. Common species are displayed on the left and the rare species are on the right (Fig. 5). Abundance ranking showed that Site IV had less number of rare species (i.e. abundance value 2) and more number of common species (i.e. abundance value 7) as compared to other sites. Site I and II were comparable to each other and so was the case with site III and V.

Sample Based Rarefraction Curve for Five Different Transects: Rarefraction curve is shown in Fig. 6. Expected number of species [ES(n)] has been plotted against number of individuals (n). This plot provides a measure of species diversity. Steeper curve indicated more diverse communities. A steeper curve was observed for site I because of its high species diversity. Site II was almost equally rich followed by site III. Sites V and IV were low in diversity.

Comparison of Species Turnover among Transects: To visualize difference in species composition between the different sites (habitats), a complete linkage of Jaccard similarity and Bray Curtis coefficient matrix was carried out. The dendrogram clustering of the species grouping and habitats grouping was drawn. Jaccard similarity indices were calculated based on presence and absence of particular taxa at different study sites of Kolkas region, whereas Bray Curtis coefficient clustering was calculated based on the similarity richness and abundance of water beetle taxa.

The Jaccard similarity matrix showed very close similarity between the site V and site III which form a single cluster and site I and site II formed another cluster.



(Bray Curtis similarity matrix- abundance)

Fig. 8: Dendrogram comparing different sites by their water beetle species profile

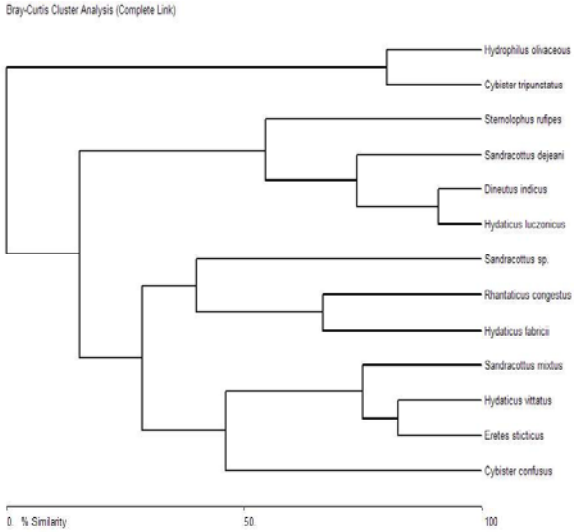


Fig. 9: Dendrogram based on the species association of water beetle fauna at Kolkas

Site IV stood apart as an outgroup of the cluster consisting of site I and II (Fig. 7). Overall species composition and population structure at sites I and II were more similar compared to site III and IV whereas site V was completely different from these two groups (Fig. 8)

Comparison of Species Turnover among Habitats: The clustering of the species based on their occurrence and abundance at different sites were compared by using Bray Curtis complete linkage clustering (Fig. 9). A striking similarity was observed between *Hydrophilus olivaceus* and *Cybister tripunctatus*. About 80% similarity was observed between *Dineutus indicus* and *Hydaticus luczonicus*. Similarity in their association pattern was observed between *Rhantaticus congestus* and *Hydaticus fabricii* and *Eretes sticticus* and *Hydaticus vittatus*. *Sandracottus* species (*Sandracottus mixtus, Sandracottus dejeanii* and an unknown *Sandracottus* species) stood as an outgroup. Whereas *Sternolophus rufipes* and *Cybister confusus* were found to be more independent.

Habitat Preference Species Distribution: Species distribution of water beetle fauna at different sites was assessed. Almost all the species of water beetle showed random species distribution (Table 4).

DISCUSSION

Aquatic beetles have their greatest abundance and diversity in the temperate regions [19]. Aquatic Coleoptera constitute an important part of the macrozoobenthos of freshwater habitats. Small and temporary water bodies have more species than large and

Table 4: Distribution profile of water beetle fauna at Kolkas region of Melghat Tiger Reserve

Species	Variance	Mean	Chi-sq	d.f.	Probability	Aggregation
Cybister confusus	0.3	0.6	2	4	0.7387682	Random
Cybister tripunctatus	0.3	0.4	3	4	0.5605026	Random
Eretes sticticus	0.5	2.0	1	4	0.9089377	Random
Hydaticus fabricii	0.7	0.8	3.5	4	0.5203377	Random
Hydaticus vittatus	0.8	1.4	2.2857	4	0.6866165	Random
Hydaticus luczonicus	1.7	4.8	1.4167	4	0.8426009	Random
Rhantaticus congestus	0.3	0.4	3	4	0.5605026	Random
Sandracottus dejeanii	1.7	2.8	2.4286	4	0.660714	Random
Sandracottus mixtus	1.2	1.2	4	4	0.4068319	Random
Sandracottus sp.	0.8	0.6	5.3333	4	0.2537639	Random
Hydrophilus olivaceous	0.3	0.6	2	4	0.7387682	Random
Sternolophus rufipes	3.8	2.6	5.8462	4	0.2096018	Random
Dineutus indicus	4.0	4.0	4	4	0.4068319	Random

permanent ones [20]. These insects are not selective in their choice of water bodies and occur in a wide variety of habitats [21], although many species may prefer certain types of water bodies [22]. Many of them, especially dytiscids and many hydrophilids, are generally found in habitats of small shallow water bodies or on the margin of rivers and marshes and they occupy the zone of emergent vegetation, mats of plant debris, or flooded terrestrial vegetation along the shoreline [23].

In the present study all the 13 species of water beetles were collected from temporary water tanks. Sanchez-Fernandez [12] while investigating the indicator value of water beetle fauna found that the correlation values and the percentage of species represented by family, genus and species complementary networks were similar and suggested that the higher taxa of water beetles (genera or families) can be used as biodiversity surrogates for cost-effective practical surveys.

Kiyak *et al.* [24] collected 31 aquatic beetle specimens from the provinces Denizli, Aydin, Isparta and Antalya in South-West Mediterranean region of Turkey. Ostovan *et al.* [25] studied the diversity, abundance and biology of aquatic insects, including aquatic beetles, in Ardabil and Fars Provinces. Cox and C ox [26] studied water beetles of the families Dytiscidae, Hydrophilidae, Gyrinidae and Haliplidae in Amir-Kolayeh and the part of Anzali.

In the present study diversity of water beetles belonging to 3 families Dytiscidae, Hydrophilidae & Gyrinidae constituting 13 water beetle species were recorded.

Fauziah [11] studied the diversity of coleopteran water beetles in Kenyir Water catchment of Terengganu, Malaysia in which both diversity and abundance was found to be low with only four species of water beetles, indicating that the ecosystem is under stress. The results indicated that the diversity of the water beetle fauna of Kolkas region was relatively high (8 genera and 13 species). The water beetle fauna in the present investigation were dominated by the family Dytiscidae which comprised of 76.92% of the total species, followed by the Hydrophilidae (15.38%) and Gyrinidae (7.69%).

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