World Journal of Zoology 6 (1): 73-79, 2011
ISSN 1817-3098

Diversity and Abundance of Scarab Beetles (Coleoptera: Scarabaeidae) in Kolkas Region of Melghat Tiger Reserve (MTR), District Amravati, Maharashtra, India

[1]V.G. Thakare, [1]V.S. Zade and [2]K. Chandra

[1]Government Vidarbha Institute of Science and Humanities, Amravati-444604
[2]Zoological Survey of India, Central Zone Regional Centre, Jabalpur, Madhya Pradesh

Abstract: A survey of scarab beetle faunal diversity, abundance and composition were studied in Kolkas region of Melghat Tiger Reserve, Amravati, Maharashtra, during May to October 2009. Scarab beetles were collected by dung baited pitfall traps and handpicking in five transects with different vegetation type and microhabitat. Total 26 species of scarab beetles belonging to 14 genera and 8 subfamilies were reported. Scarabaeinae was the dominant subfamily with respect to species diversity (15 species) and abundance. *Onthophagus* Latreille, 1802 is the dominant genus observed in the study area.

Key words: Scarabaeidae · Coleoptera · Insecta · Melghat Tiger Reserve · Amravati · Maharashtra

INTRODUCTION

The family Scarabaeidae is the largest family of insects which contains more than 30000 species in the world [1]. The scarab beetles of the order Coleoptera include both useful as well as harmful insects. The coprophagus beetles generally known as dung beetles, play an important role in nature's sanitation by feeding on the dung and the phytophagus beetles commonly known as chafers are pest of agricultural crops, plantation and forests [2]. Dung beetles are taxonomically as well as functionally very important component of terrestrial ecosystem [3]. They are nature's scavengers, burying quantities of dung into the ground and thus cleaning up the earth surface of excreta left mostly by large and medium sized herbivorous mammals [4]. The dung beetle communities are excellent models to evaluate and to monitor to what degree the changes in the vegetation alter the animal communities [5]. A variety of factors may influence the presence and distribution of coprophagus beetles in a given area, including fauna, flora, solar radiation, temperature, soil type, soil pH and most importantly the supply of excrement for food [6]. These insects are important for the dynamics of matter in ecosystem because they remove detritus of the soil surface [7]. Dung beetles in different habitats have different structures [8]. Some dung beetles are generalists and are able to use maure of very specific animals. Hanski and Cambefort [9] reported that mammal diversity, hence, influences diversity of dung beetles. Therefore, dung beetles can be used to assess animal biodiversity in agro-ecosystems.

Since a comprehensive study on coleopteran diversity of Amravati District is lacking completely; hence an effort was made to study the diversity of scarab beetles in the Kolkas region of Melghat Tiger Reserve of district Amravati.

MATERIALS AND METHODS

Study Area: A study was conducted from May to October 2009 at different sites of Kolkas forest region in the Melghat Tiger Reserve (MTR) with geographical location 21°29. 96'N, 077°12.338' E. Melghat Tiger Reserve is located at southern offshoot of Satpuda hill range in Central India also called as Gawilgarh hill range in Maharashtra. The Kolkas forest is tropical and dry deciduous in nature dominated with teak trees (*Tectona grandis*). The study area was divided into total five transects to study the diversity of Scarab beetles (Fig. 1).

Corresponding Author: Varsha Zade, Government Vidarbha Institute of Science and Humanities, Amravati-444604.
E- mail: zvarsha27@gmail.com.

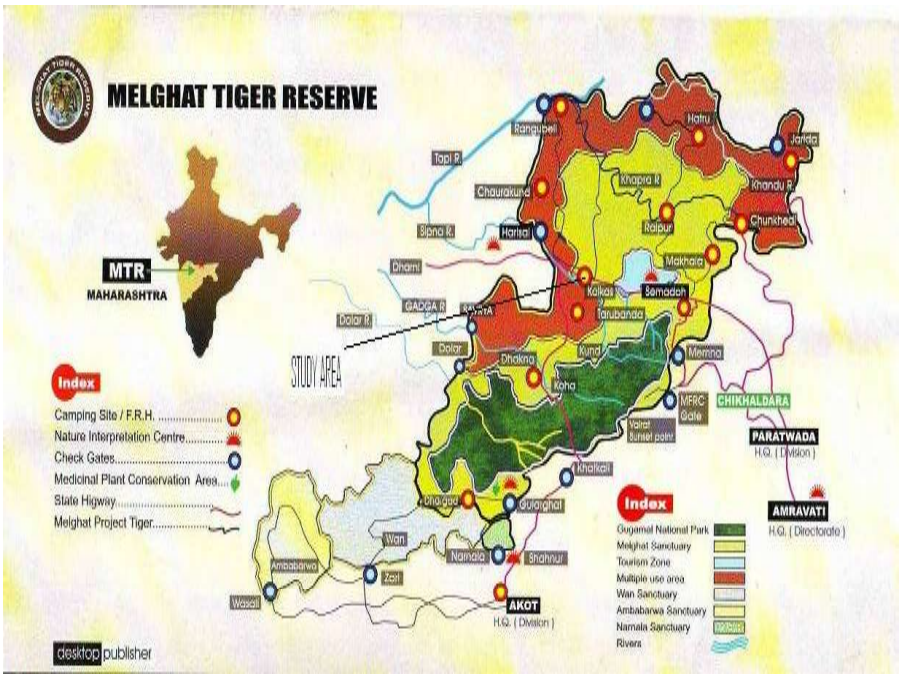


Fig. 1: Study Area (Kolkas Region of Melghat Tiger Reserve)

Transect I - Area containing the river & the surrounding herbs.

Transect II - Dry area with shrubs.

Transect III - Area predominant with teak trees *Tectona grandis* (Linnaeus 1781)

Transect IV - The area containing stones & rocks

Transect V - Shruby area near the streams.

Field Methods: Beetle sampling was carried out at each transect at an interval of 15 days.

In order to adequately sample the beetles from various habitats, a wide variety of collecting and trapping methods were used. Most beetles are harmless and were handpicked and for some, dung baited pitfall traps were used. Each trap consisted of 2.5 qt. plastic container 15 cm in diameter and 16 cm deep buried in the soil. Insects falling into the traps were killed by water [10]. The collected scarab beetles were sorted and preserved in labeled container of 70% alcohol. In addition to trapping method described above, an intensive all out search to physically collect representative of as many species of scarab beetles as possible was made in each habitat. In handpicking collection, two observers walked randomly around each location and the effort involved in this was kept consistent. No attempt was made to estimate abundance by this method. Collected beetle species were identified using standard identification manuals. The nomenclature is mainly following Arrow [11-13]. Specimens were sent to specialist (Zoological Survey of India, Jabalpur) to confirm their identity.

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 [14]. Morista-Horn similarity index, Sorenson classic and Jaccard classic indices were calculated as a measure of β-diversity. Several estimates were calculated using the software EstimateS [15]. Sample based rarefraction and other community composition methods were calculated using Biodiversity Pro software version 2 [16].

RESULTS

Scarab Beetle Species Composition: Overall 14 species comprising 26 beetle species from 8 subfamilies were recorded during the present study (Table 1). Of the family Scarabaeidae, the scarabaeinae was the dominant subfamily in terms of species richness (15 species) and

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

	Genera		Species		Individuals	
Subfamily	No	%	No	%	No	%
Geotrupinae	1	7.14	1	3.84	2	1.65
Hybosorinae	1	7.14	1	3.84	4	3.30
Orphninae	1	7.14	1	3.84	3	2.47
Scarabaeinae	5	35.71	15	57.69	76	62.80
Melolonthinae	2	14.28	3	11.53	20	16.50
Rutelinae	1	7.14	2	7.69	7	5.78
Cetoniinae	2	14.28	2	7.69	6	4.95
Dynastinae	1	0.71	1	3.84	3	2.47
Total (8)	14	100.00	26	100.00	121	100.00

abundance, followed by Melolonthinae (2 species), Rutelinae (2 species) and Cetoniinae (2 species) and the subfamilies Geotrupinae, Hybosorinae, Orphninae & Dynastinae were represented by only 1 species in the surveyed area. 8 species could be identified to the species level. The *Onthophagus* was the most species rich genera with 6 species followed by *Onitis* (3 species), *Copris* (2 species), *Anomala* (2 species) and *Catharsius* (2 species) (Table 2).

Species Diversity and Abundance Pattern: During the present study the beetles from 5 different transect were compared and Shannon's indices were calculated as a measure of diversity within the habitat. The Shannon diversity index indicated that transect I was relatively diverse (1.32) followed by transect II (1.25), transect V (1.02), transect IV (0.88) and lastly the transect III (0.73). The Simpson and Shannon J (evenness) indices also revealed almost the same order (Table 3).

Table 2: List of scarab beetles recorded in the study area

Subfamily	Genera	Species
Geotrupinae	*Balboceras*	*Sp.1*
Hybosorinae	*Hybosorus*	*Sp.1*
Orphninae	*Orphnus*	*impressus*
Scarabaeinae	*Heliocopris*	*bucephalus*
	Catharsius	*Sp. 1*
		molossus
	Onitis	*Sp. 1*
		Sp. 2
		Sp. 3
	Copris	*Sp. 1*
		Sp. 2
		Sp. 3
	Onthophagus	*Sp. 1*
		Sp. 2
		Sp. 3
		Sp. 4
		Sp. 5
		catta
Melolonthinae	*Holitrichia*	*Sp. 1*
		Sp. 2
	Scizonycha	*Sp. 1*
Rutelinae	*Anomala*	*Sp. 1*
		bengalensis
Cetoniinae	*Chiloloba*	*acuta*
	Clinteria	*clugi*
Dynastinae	*Phyllognathus*	*dionysius*
Total (8)	14	26

The shared species statistics between pair of different transects are given in Table 4. For the comparison of diversity between transects, similarity indices viz. Jaccard classic and Sorenson classic were calculated in addition to Morista- Horn index. The Morista- Horn index indicated 87% of similarity between

Table 3: Alpha diversity indices for different (habitat types) transects at Kolkas, Melghat Tiger Reserve, Amravati, Maharashtra

Index	Transect I	Transect II	Transect III	Transect IV	Transect V
Shannon H'	1.320	1.252	0.736	0.887	1.027
Simpsons (D)	0.033	0.034	0.111	0.028	0.067
Shannon J	1.380	1.301	0.778	0.903	1.079

Table 4: Shared species statistics for different transects

First Sample	Second sample	SOB I	SOB II	Shared Species	Jaccard Classic	Sorenson Classic	Morista Horn
1	2	24	20	18	0.692	0.818	0.871
1	3	24	6	6	0.250	0.400	0.331
1	4	24	8	6	0.231	0.375	0.337
1	5	24	12	11	0.440	0.611	0.630
2	3	20	6	5	0.238	0.385	0.381
2	4	20	8	7	0.333	0.500	0.462
2	5	20	12	7	0.280	0.438	0.406
3	4	6	8	4	0.400	0.571	0.331
3	5	6	12	3	0.200	0.333	0.198
4	4	8	12	4	0.250	0.400	0.238

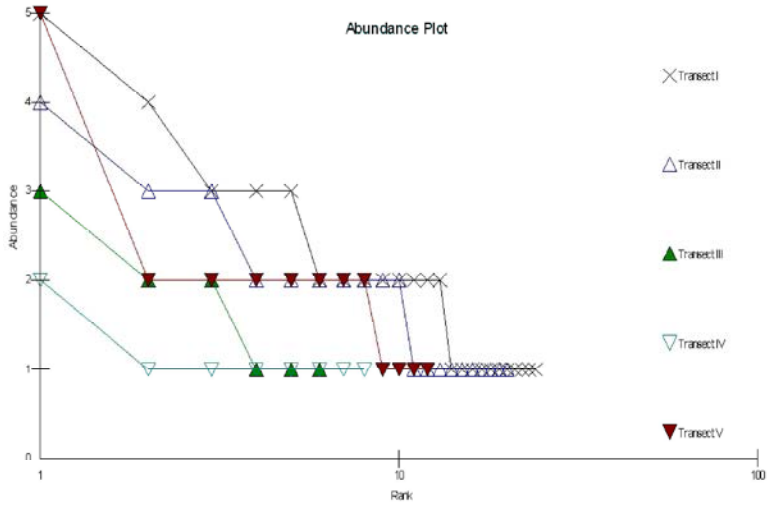


Fig. 2: Species rank abundance plot for five different transects

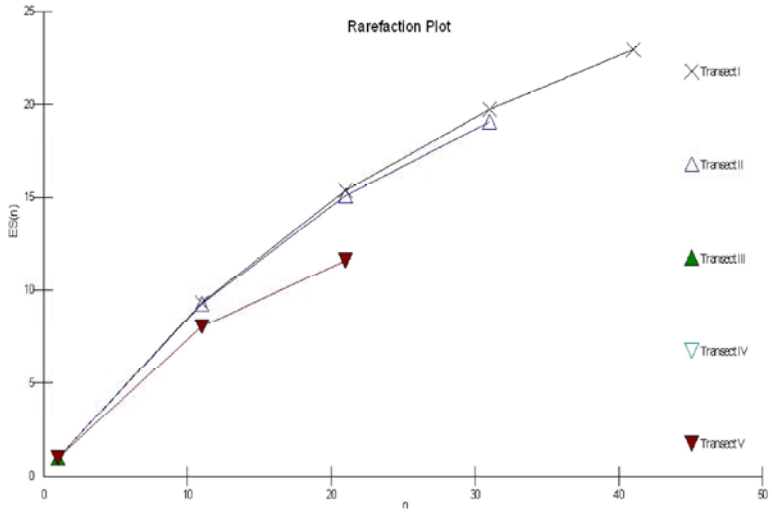


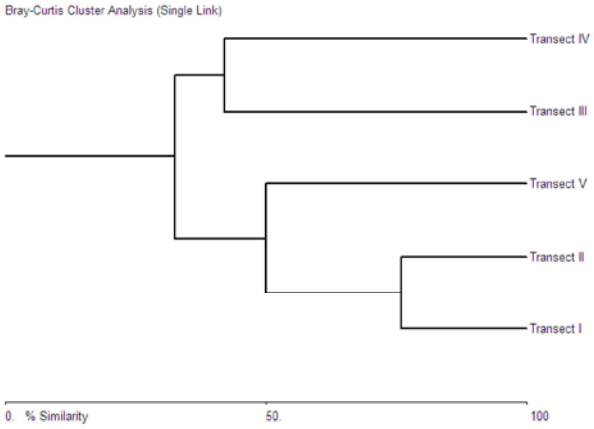
Fig 3: Sample based rarefraction curve for different transects

the transect I and transect II. 63% similarity was observed between the transect I and V. Similarity between transect III and V was at the minimum. The incidence based Sorenson Classic index showed higher degree of similarity (82%) in species composition between transect I and transect II. Jaccard classic also indicated the similar pattern.

Species were ranked according to their abundance. Common species are displayed on the left and the rare species are on the right (Fig. 2).

Sample Based Rarefraction Curve for Five Different Transects: Rarefraction curve is shown in Fig. 3. Expected number of species have been plotted against number of individuals. This plot provides a measure of species diversity. Steeper curve indicated more diverse communities. A steeper curve was observed for transect I because of its high species diversity. Transect II was almost equally rich followed by transect V. Transect III and IV were low in diversity.

Comparison of Species Turnover among Transects: To visualize difference in species composition between the habitats, Bray Curtis coefficient matrix was carried out. The dendrogram clustering of habitats grouping was drawn (Fig. 4). Bray Curtis coefficient clustering was calculated based on the similarity, richness and abundance of scarab beetle taxa. Transect I and II formed a single cluster & transect III and IV formed another



(Bray-curtis similarity matrix-abundance)

Fig. 4: Dendrogram comparing different transects by their beetle species assemblage

Table 5: Distribution profiles of scarab beetle fauna at Kolkas Region of Melghat Tiger Reserve

Species	Variance	Mean	Chi-sq	d.f.	Probablity	Aggregation
Species 1	0.3	0.4	3	4	0.5605026	Random
Species 2	0.7	0.8	3.5	4	0.5203377	Random
Species 3	0.8	0.6	5.3333	4	0.2537639	Random
Species 4	0.2	0.8	1	4	0.9089377	Random
Species 5	0.3	0.4	3	4	0.5605026	Random
Species 6	2	1	8	4	0.0903743	Random
Species 7	1.2	0.8	6	4	0.1977535	Random
Species 8	3.3	2.6	5.0769	4	0.2787275	Random
Species 9	1.7	1.2	5.6667	4	0.2242205	Random
Species 10	0.8	1.4	2.2857	4	0.6866165	Random
Species 11	0.2	0.8	1	4	0.9089377	Random
Species 12	0.7	1.2	2.3333	4	0.6779598	Random
Species 13	1.8	1.4	5.1429	4	0.272116	Random
Species 14	0.8	0.6	5.3333	4	0.2537639	Random
Species 15	0.3	0.4	3	4	0.5605026	Random
Species 16	0.3	0.4	3	4	0.5605026	Random
Species 17	0.8	0.6	5.3333	4	0.2537639	Random
Species 18	5.3	1.6	13.25	4	0.0102384	Aggregated
Species 19	0.8	1.6	2	4	0.7387682	Random
Species 20	0.8	0.6	5.3333	4	0.2537639	Random
Species 21	3.2	1.8	7.1111	4	0.1286797	Random
Species 22	0.8	0.6	5.3333	4	0.2537639	Random
Species 23	0.7	0.8	3.5	4	0.5203377	Random
Species 24	1.5	1	6	4	0.1977535	Random
Species 25	0.2	0.2	4	4	0.4068319	Random
Species 26	0.8	0.6	5.3333	4	0.2537639	Random

cluster. However transect V stood apart from the other transects. Overall species composition and population structure at transect I & II were more similar compared to III and IV. Whereas transectV was completely different from these two groups.

Species Distribution: Species distribution of scarab beetle fauna in different transects was assessed. Groups of species were distributed on the availability of resources and suitability to survival. Majority of the species showed random species distribution (Table 5).

DISCUSSION

The results indicated that the diversity of the beetle fauna of Kolkas region of Melghat Tiger Reserve was quite high (14 genera and 26 species). Chandra (2) recorded 94 species of scarab beetles belonging to 30 genera & 9 subfamilies from Madhya Pradesh. Chandra and Uniyal [17] recorded 9 pleurostict scarab beetles belonging to 4 subfamilies from Great Himalayan National Park, Himachal Pradesh, India. The beetle fauna in the present study were dominated by the subfamily Scarabaeinae which comprises 62.8 % of the total species, followed by the Melolonthinae (16.5%). Nurhariyanto *et al.* [18] also recorded similar findings.

In the present study the Jaccard Classic and Morista-Horn index showed more similarity between transect I and II. This similarity was due to microhabitat & area disturbance. Changes in beetle composition and abundance parallel the environmental changes [19, 20]. Moreover the conventional Bray Curtis detected the distinctness of ecologically dissimilar habitat because of its lesser abundance. The observed dissimilarity in community composition between transect III and V could be due to variability in soil characteristic & vegetation type.

The other method of measuring diversity which was widely used with invertebrate data is the rarefraction method [21]. This is a graphical method of expressing diversity, where in steep curve indicates high diversity and shallow curve indicates low diversity. Scarab beetles community composition at transect I, II and V were richer than transect III and IV.The scarab beetle assemblage at Kolkas forest was dominated by subfamily Scarabaeinae with many rare species and few abundant species.

ACKNOLEDGEMENT

The authors are grateful to Director & experts of Zoological Survey of India (ZSI), Central Zone Regional Centre, Jabalpur, Madhya Pradesh, India for their assistance and help in identification of scarab beetles. Special thanks to The Principal Chief Conservator of Forest (PCCF), Government of Maharashtra for giving necessary permission to enter and reside in Melghat Tiger Reserve, Amravati for the purpose of collection of beetles.

REFERENCES

1. Fincher, G.T., W.G. Monson and G.W. Burton, 1981. Effect of cattle faeces rapidly buried by dung beetles on yield and quality of coastal Bermudagrass. Agronomy J., 73: 775-779.
2. Chandra, K., 2000. Inventory of Scarab beetles (Coleoptera) from Madhya Pradesh, India. ZOOS' Print J., 15(11): 359-362.
3. Kakkar, N. and S.K. Gupta, 2009. Temporal variations in dung beetle (Coleoptera: Scarabaeidae) assemblages in Kurukshetra, Haryana, India. J. Threatened Taxa, 1(9): 481-483.
4. Hingston, R.W.G., 1923. A Naturalist in Hindustan. H.F. and G. Witharby, London, pp: 292.
5. Halffter, G. and M.E. Favila, 1993. The Scarabaeinae (Insecta: Coleoptera) an animal group for analyzing, inventory and monitoring biodiversity in tropical rainforest and modified landscapes. Biol. International, 27: 15-23.
6. Fincher, G.T., T.B. Stewart and R. Davis, 1970. Attraction of coprophagus beetles to feces of various animals. J. Parasitol., 56: 378-383.
7. Haffter, G. and E.G. Matthews, 1966. The natural history of dung beetles of the subfamily Scarabaeinae (Coleoptera: Scarabaeidae). Folia Entomologica, Mexicana, 12-14: 1-313.
8. Davis, A.J. and S.L. Sutton, 1998. The effects of rainforest canopy loss on arboreal dung beetles in Borneo: implications for the measurement of biodiversity in derived tropical ecosystems. Diversity and Distributions, 4: 167-173.
9. Hanski, I. and Y. Cambefort, 1991. Dung beetle ecology, pp: 481. Princeton University Press, Princeton, New Jersey.
10. Price, D.L., 2004. Species diversity & seasonal abundance of Scarabaeid dung beetles (Coleoptera: Scarabaeidae, Geotrupidae & Trogidae) attracted to cow dung in central New Jersey. J. New York Entomological Society, 112(4): 334-347.
11. Arrow, G.J., 1910. The Fauna of British India including Ceylon and Burma. *Col, Lamellicornia* I, (Cetoniinae and Dynastinae) Taylor & Francis. London V-XIV, pp: 322. + 76figs.+2pls.
12. Arrow, G.J., 1917. The Fauna of British India including Ceylon and Burma. *Col, Lamellicornia* II, (Rutelinae, Desmonychinae and Euchirinae). Taylor & Francis. London: V-XIII, pp: 387. + 77figs.+5pls.
13. Arrow, G.J., 1932. A new few species of Melolonthinae, Coleoptera. Annals and Magazine of Natural History, 10(9): 189-197.
14. Ganeshaiah, K.N., A. Chandrasekara and A.R.V. Kumar, 1997. A new measure of Biodiversity based on biological heterogeneity of the communities. Current Science India, 73(2): 128-130.

15. Colwell, R.K., 1997. EstimateS: Statistical estimation of species richness and shared species from samples. Version 7.5. Available from: http://viceroy. eeb.uconn.edu/estimates.
16. Neil McAleece, P.J., D. Lambshead and G.L.J. Paterson, 1997. BiodiversityPro (Version 2). The Natural History Museum, London.
17. Chandra, K. and V.P. Uniyal, 2007. On a collection of pleurostict Scarabaeidae (Coleoptera) from the Great Himalayan National Park, Himachal Pradesh, India. ZOOS' Print J., 22(9): 2821-2823.
18. Nurhariyanto, L. Joshi and E. Martini, 2008. Dung beetles (Coleoptera: Scarabaeoidea) diversity: indicator of animal diversity? World Agroforestry Centre- ICRAF, SEA Regional Office, Bogor, Indonesia.
19. Sackmann, P. and A.G. Farji-Brener, 2006. Effect of fire on ground beetles and ant assemblages along an environmental gradient in NW Pantagonia: does habitat type matter? Ecoscience, 13: 360-371.
20. Sackmann, P., A. Ruggiero, M. Kun and A.G. Farji-Brener, 2006. Efficiency of a rapid assessment of the diversity of ground beetles and ants, in natural and disturbed habitats of the Nahuel Huapi region (NW pantagonia, Argentina). Biodiversity and Conservation, 15: 2061-2084.
21. Sanders, H.L., 1968. Marine benthic diversity: a comparative study. Am. Nat., 102: 243-282.