

Species Diversity of Phytophagous Scarab Fauna (Coleoptera: Scarabaeidae) in Western Ghats of Kerala, India

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Abstract

Surveys were carried out during March to August months of 2021 and 2022 to document the species diversity of phytophagous scarabs in selected locations of four districts of Kerala viz., Wayanad, Malappuram, Palakkad and Idukki, which cover rich biodiversity hotspots in the Western Ghats. The explorations yielded 1953 specimens belonging to 60 species under 18 genera of subfamilies Melolonthinae, Rutelinae and Dynastinae, of which Melolonthinae is the most speciose representing 11 genera. Various diversity indices revealed variations in species diversity in terms of species richness and evenness among the surveyed locations. Six species viz., *Anomalachela bicolor* (Brenske, 1892), *Sophrops karschi* (Brenske, 1892), *Apogonia proxima* Waterhouse, 1877, *Apogonia* sp.1, *Maladera rufocuprea* (Blanchard, 1850) and *Anomala communis* (Burmeister, 1844) were found to be common in all the four surveyed districts while ten species each were observed to be specific to Palakkad and Idukki districts. The species distribution and dynamics across the districts are discussed.

Keywords: Scarabaeidae, Species diversity, Wayanad, Malappuram, Palakkad, Idukki, Kerala

Introduction

Insects are the most abundant of all life forms on the earth. Insecta is the largest class within the phylum Arthropoda, and Subphylum Hexapoda. More than 40% of all living things and nearly 80% of all animal species in the Kingdom Animalia are insects. Out of the 10,32,000 documented species of animals on earth, it is estimated that 9,50,000 species are insects and this number is rising every year (Kumar, 2014). Order Coleoptera comprising beetles and weevils, is the largest order of Class Insecta occurring in almost all habitats and ecosystems. The diversity and abundance are mainly due to structural and physiological adaptations (Booth *et al.*, 1979). Coleoptera has four suborders, Adephaga, Polyphaga, Myxophaga and Archostemata, with Polyphaga being the largest with 144 families and 16 superfamilies. The superfamily Scarabaeoidea is divided into 12 families,

43 subfamilies, 118 tribes and 94 subtribes (Smith 2006) and is one of the largest superfamilies that include family Scarabaeidae. It is estimated that around 30, 000 species of Scarabaeids occur worldwide (Ratcliffe and Jameson, 2004), consisting of six major subfamilies: Scarabaeinae, Aphodiinae, Cetoniinae, Rutelinae, Melolonthinae, and Dynastinae. The first two of these include coprophagous (dung feeders) and are termed as Laprosticti, while the last four are phytophagous and are termed as Pleurosticti.

The Western Ghats in Indian Subcontinent is a 1,600 km long chain of mountains running parallel to India's western coast. It is one of the world's eight "biodiversity hotspots" attributed to the high levels of biodiversity and endemism. It has outstanding geological, scenic, and cultural values and has a significant impact on the peninsular India's rainfall patterns. (Bawa *et al.*, 2007). Hence, a study has been carried

out to explore and document the diversity of phytophagous scarab fauna in the Western Ghats region of Kerala.

Methodology

A systematic study was carried out in three to four locations in four districts in the Western Ghats region of Kerala viz. Wayanad (11°27'-15°58'N, 75°47'-70°27' E) Malappuram (10°09'-12°0'N, 75°53'-77°0' E), Palakkad (10°21'-11°14'N, 76°02'-76°45'E) and Idukki (09°16'-10°21'N, 76°38'-77°24'E) at regular intervals for collection of scarabs during their emergence period from March to August, 2021 and 2022. The collection of adult scarab beetles was made through light traps with mercury vapour lamp of 160 Watt as light source and manual scouting at selected locations. The light traps were operated between 6 pm to 12 midnight and collections were made at fortnight intervals. Adult beetles attracted towards the light trap were collected into the bottles containing 95% alcohol and brought to the laboratory. The specimens were cleaned under running tap water to remove the dirt and mud and then relaxed in a relaxing chamber with several layers of wet paper towels. The specimens were sorted based on morphological characters, pinned, stretched and labelled. The male specimens were identified based on the shape of the hind tibial spurs and the genitalia was extracted, which was mounted on the point card and pinned along with the adult specimen. The specimens were then identified up to species level with the reference collection and available literature (Brenske, 1892; Arrow, 1910; 1917; Frey, 1972; Ahrens and Fabrizi, 2009 2016).

The number of species and relative abundance were calculated for each district. Species abundance and diversity analysis were carried out through diversity indices viz., Shannon-Weiner Index, Simpson dominance index (Magurran, 1988), Margalef's diversity index, Menhinick's index, Jaccard's coefficient and Pielou's evenness index.

Results and Discussion

A collection of 1953 beetle specimens resulted in 60 species belonging to 18 genera of subfamilies Melolonthinae, Rutelinae and Dynastinae. Melolonthinae represented by 11 genera is speciose and predominant over Rutelinae and Dynastinae which was represented by four and three genera, respectively. Houston and Weir (1992) reported that Melolonthinae is the largest of all the subfamilies of Scarabaeidae with nearly 800 genera comprising almost

12,000 species worldwide. The species *Anomalachela bicolor* (Brenske, 1892), *Sophrops karschi* (Brenske, 1892), *Apogonia proxima* Waterhouse, 1877, *Apogonia* sp.1, *Maladera rufocuprea* (Blanchard, 1850) and *Anomala communis* (Burmeister, 1844) were present in all the four surveyed districts. Ten species each were observed to be specific to Palakkad and Idukki districts. *Maladera keralensis* (Frey, 1972) (29.90%) and *Apogonia proxima* (26.21%) were found to be abundant which together constituted 56.11 % of the total population (Table 1). Genus *Apogonia* was found to be predominant in Wayanad, Malappuram and Palakkad districts (Fig 1-4), whereas *Sophrops karschi* was found to be the predominant species in Idukki district. The preliminary survey data subjected to various diversity indices revealed variations in species diversity in terms of species richness and evenness among the surveyed locations. Studies carried out by Suchithra Kumari and Kumar (2018) in cardamom ecosystem of Mudigere, Chikkamagaluru district, Karnataka revealed that Melolonthinae was the predominant subfamily with respect to species abundance and richness. Similarly, Aparna *et al.* (2018) has reported 34 species of phytophagous scarabs from six ecosystems of Puttur region in Dakshina Kannada during 2015, of which the subfamily Melolonthinae was speciose with 18 species.

In present investigation, the dominant genus in subfamily Melolonthinae was found to be *Maladera* represented by 13 species viz., *Maladera burmeisteri* alternans (Frey, 1975), *M. calicutensis* (Frey, 1972), *M. keralensis* (Frey, 1972), *M. magnicornis* (Moser, 1920), *M. rufocuprea* (Blanchard, 1850), *M. seriatoguttata* (Ahrens and Fabrizi, 2016), *M. vernacula* (Ahrens and Fabrizi, 2016), *M. indica* (Blanchard, 1850), *M. praviforceps* (Ahrens and Fabrizi, 2016), *Maladera nr. keralensis*, *Neoserica submaculosa* (Ahrens and Fabrizi, 2016), *Maladera* sp.1 and *Maladera* sp.2.

Species diversity in terms of richness, evenness and abundance was calculated and compared using Shannon Wiener index, Simpson dominance index, Margalef's diversity index, Menhinick's index and Pielou's evenness. The species diversity was relatively high in Idukki district as evidenced by Shannon Wiener index (2.56), Simpson dominance index (0.88), Margalef's index and Menhinick's index (5.39 and 2.04 respectively) and Pielou's evenness (0.75). Wayanad district exhibited low diversity as indicated by Shannon-Wiener index (1.71), Simpson dominance index (0.70), Margalef's index and Menhinick's index being (3.74 and 0.75 respectively), while Pielou's evenness was 0.51 (Table 2).

The preliminary investigations revealed that the collections made from a few locations of Western Ghats region of Kerala resulted in 60 species belonging to subfamilies Melolonthinae, Rutelinae and Dynastinae. Among the surveyed locations, Idukki exhibited high species diversity

in terms of species richness and evenness while Wayanad exhibited low diversity. More exploratory surveys need to be made to further document and interpret the scarab species diversity in these regions of Kerala.

Table 1. Species composition of Phytophagous scarab in Western Ghats of Kerala

Sl. No.	Name of the species	Wayanad		Malappuram		Palakkad		Idukki	
		Total	Relative abundance (%)	Total	Relative abundance (%)	Total	Relative abundance (%)	Total	Relative abundance (%)
1.	<i>Holotrichia serrata</i>	1	0.07	5	3.78	-	-	2	0.93
2.	<i>Holotrichia sculpticollis</i>	78	5.72	2	1.51	-	-	4	1.86
3.	<i>Holotrichia fissa</i>	-	-	1	0.75	39	15.98	11	5.11
4.	<i>Holotrichia</i> sp. 1	-	-	-	-	-	-	1	0.46
5.	<i>Holotrichia</i> sp. 2	-	-	-	-	-	-	3	1.39
6.	<i>Holotrichia</i> sp. 3	-	-	-	-	-	-	1	0.46
7.	<i>Holotrichia</i> sp. 4	-	-	-	-	-	-	1	0.46
8.	<i>Holotrichia</i> sp. 5	-	-	-	-	1	0.40	-	-
9.	<i>Holotrichia</i> sp. 6	3	0.22	-	-	-	-	-	-
10.	<i>Holotrichia</i> sp. 7	1	0.07	-	-	-	-	-	-
11.	<i>Anomalachela bicolor</i>	33	2.42	2	1.51	4	1.63	22	10.23
12.	<i>Brahmina mysorensis</i>	-	-	-	-	18	7.37	-	-
13.	<i>Miridiba excisa</i>	6	0.44	-	-	1	0.40	-	-
14.	<i>Luecopholis burmeisteri</i>	1	0.07	2	1.51	-	-	-	-
15.	<i>Sophrops karschi</i>	17	1.24	6	4.54	9	3.68	53	24.65
16.	<i>Sophrops</i> sp.1	-	-	-	-	-	-	5	2.32
17.	<i>Sophrops</i> sp.2	-	-	-	-	-	-	1	0.46
18.	<i>Apogonia proxima</i>	434	31.86	52	39.39	25	10.24	1	0.46
19.	<i>Apogonia</i> sp.1	50	3.67	11	8.33	46	18.85	6	2.79
20.	<i>Apogonia</i> sp.2	-	-	10	7.57	3	1.22	7	3.25
21.	<i>Apogonia</i> sp.3	-	-	-	-	1	0.40	-	-
22.	<i>Schizonycha fuscescens</i>	-	-	-	-	39	15.98	-	-
23.	<i>Schizonycha ruficollis</i>	-	-	1	0.75	-	-	-	-

Sl. No.	Name of the species	Wayanad		Malappuram		Palakkad		Idukki	
		Total	Relative abundance (%)	Total	Relative abundance (%)	Total	Relative abundance (%)	Total	Relative abundance (%)
24.	<i>Maladera keralensis</i>	582	42.73	-	-	-	-	2	0.93
25.	<i>Maladera burmeisteri</i>	6	0.44	-	-	-	-	5	2.32
26.	<i>Maladera magnicornis</i>	1	0.07	-	-	-	-	-	-
27.	<i>Maladera vernacula</i>	5	0.36	-	-	-	-	1	0.46
28.	<i>Maladera rufocuprea</i>	5	0.36	3	2.27	7	2.86	1	0.46
29.	<i>Maladera calicutensis</i>	-	-	1	0.75	-	-	-	-
30.	<i>Maladera indica</i>	-	-	6	4.54	-	-	1	0.46
31.	<i>Maladera praviforceps</i>	-	-	2	1.51	-	-	-	-
32.	<i>Maladera nr. keralensis</i>	-	-	-	-	-	-	1	0.46
33.	<i>Maladera seriattoguttata</i>	-	-	-	-	-	-	1	0.46
34.	<i>Neoserica submaculosa</i>	-	-	-	-	-	-	1	0.46
35.	<i>Neoserica granigera</i>	-	-	-	-	1	0.40	6	2.79
36.	<i>Tetraserica sp.</i>	1	0.07	-	-	-	-	-	-
37.	<i>Maladera sp. 1</i>	8	0.58	-	-	-	-	-	-
38.	<i>Maladera sp. 2</i>	-	-	-	-	1	0.40	-	-
39.	<i>Adoretus mus</i>	-	-	-	-	1	0.40	-	-
40.	<i>Adoretus nr. nitidus</i>	-	-	-	-	16	6.55	-	-
41.	<i>Adoretus bicaudatus</i>	-	-	-	-	1	0.40	-	-
42.	<i>Adoretus sp</i>	-	-	5	3.78	1	0.40	1	0.46
43.	<i>Adoretus sp.1</i>	6	0.44	-	-	-	-	-	-
44.	<i>Adoretus sp.2</i>	22	1.61	-	-	1	0.40	-	-
45.	<i>Adoretus sp. 3</i>	-	-	2	1.51	1	0.40	-	-
46.	<i>Adoretus sp. 4</i>	-	-	-	-	2	0.81	-	-
47.	<i>Adoretus versutus</i>	23	1.68	-	-	16	6.55	-	-
48.	<i>Anomala communis</i>	11	0.80	3	2.27	3	1.22	35	16.27
49.	<i>Anomala varicolor</i>	1	0.07	-	-	-	-	27	12.55
50.	<i>Anomala elata</i>	5	0.36	-	-	-	-	3	1.39
51.	<i>Anomala ruficapilla</i>	5	0.36	2	1.51	-	-	1	0.46

Sl. No.	Name of the species	Wayanad		Malappuram		Palakkad		Idukki	
		Total	Relative abundance (%)	Total	Relative abundance (%)	Total	Relative abundance (%)	Total	Relative abundance (%)
52.	<i>Anomala dussumieri</i>	9	0.66	6	4.54	-	-	-	-
53.	<i>Anomala</i> sp. 1	-	-	-	-	2	0.81	4	1.86
54.	<i>Anomala</i> sp. 2	-	-	4	3.03	-	-	-	-
55.	<i>Anomala</i> sp. 3	-	-	-	-	1	0.40	-	-
56	<i>Popillia</i> sp.	1	0.07	-	-	2	0.81	-	-
57.	<i>Mimela xanthorhina</i>	46	3.37	2	1.51	-	-	-	-
58.	<i>Deplicus bidens</i>	-	-	1	0.84	1	0.40	-	-
59.	<i>Xylotrupes gideon</i>	-	-	-	-	-	-	7	3.25
60.	<i>Heteronychus</i> sp.	1	0.07	3	2.27	1	0.40	-	-
	TOTAL	1362		132		244		215	

Table 2. Diversity indices of Phytophagous scarab in Western Ghats of Kerala

Diversity indices	Wayanad	Malappuram	Palakkad	Idukki
Total number of individuals (N)	1362	132	244	215
Number of species (S)	28	23	28	30
Shannon-Weiner index (H)	1.71	2.54	2.49	2.56
Simpson dominance index (D)	0.70	0.82	0.88	0.88
Evenness (J)	0.51	0.81	0.74	0.75
Margalef's s index	3.74	4.50	4.91	5.39
Menhinick's index	0.75	2.00	1.79	2.04

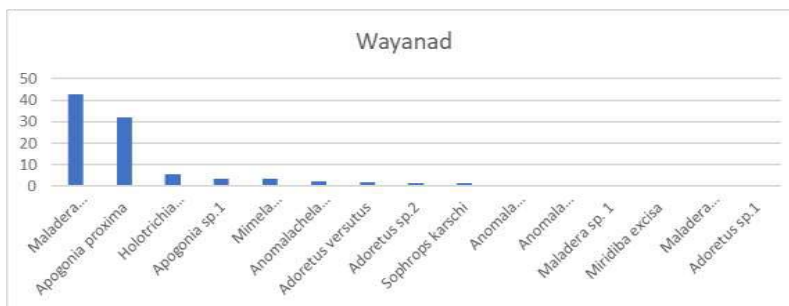


Fig. 1

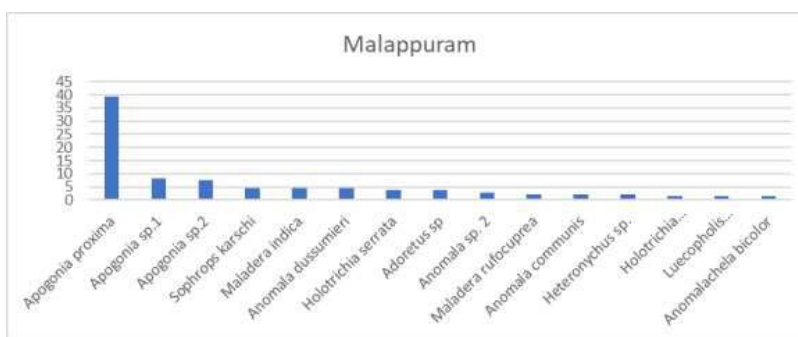


Fig. 2

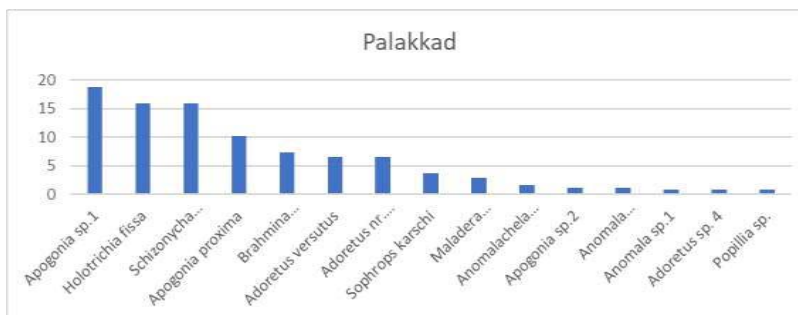


Fig. 3

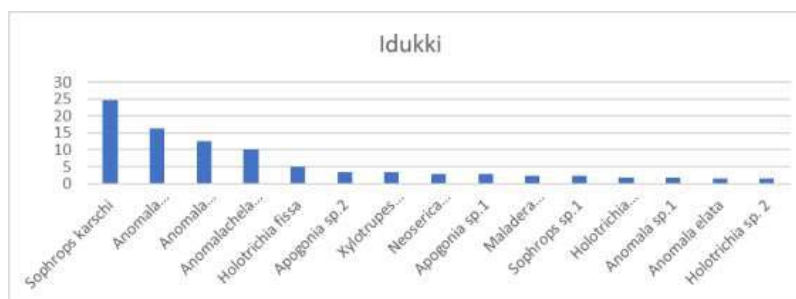
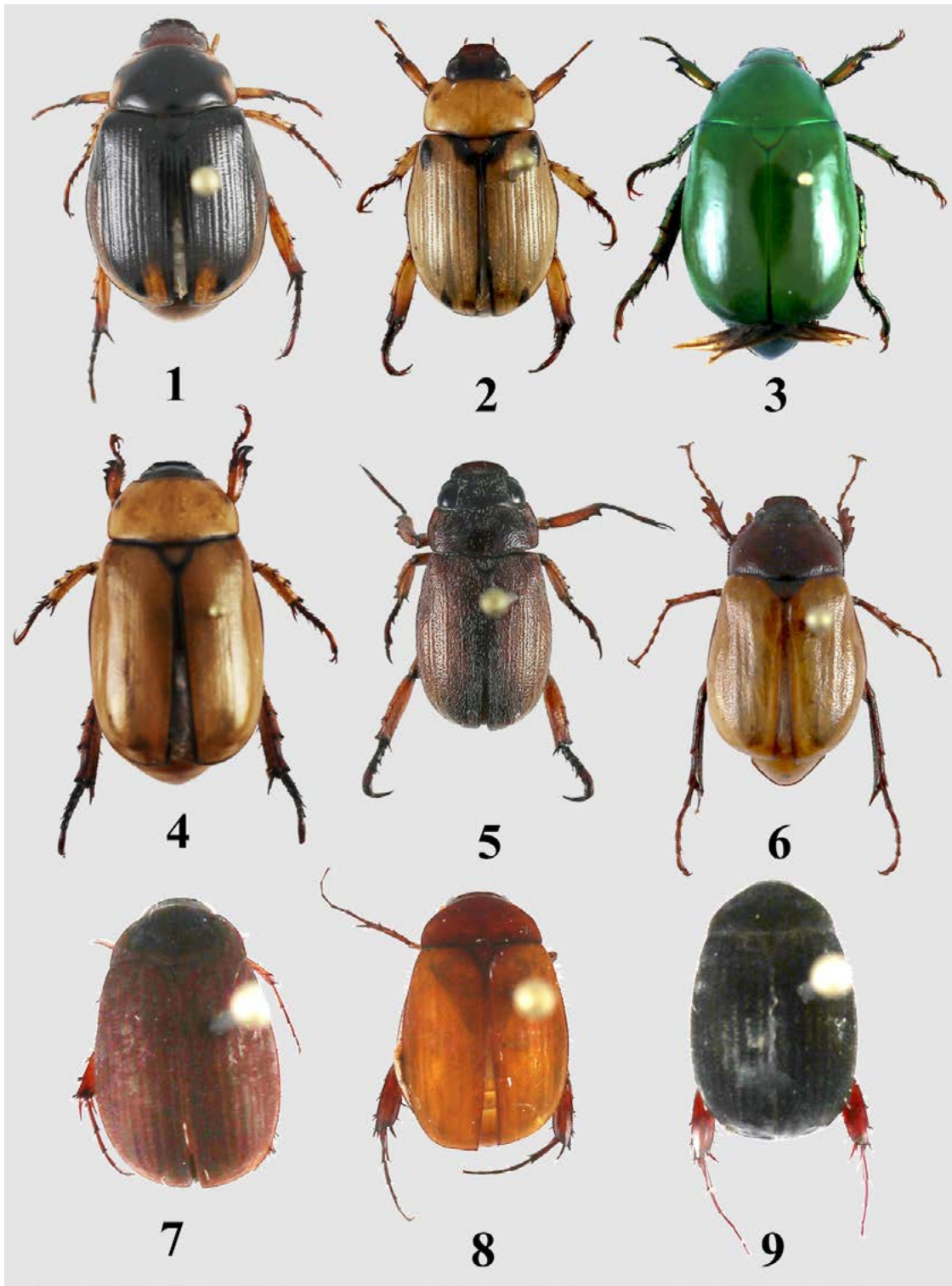
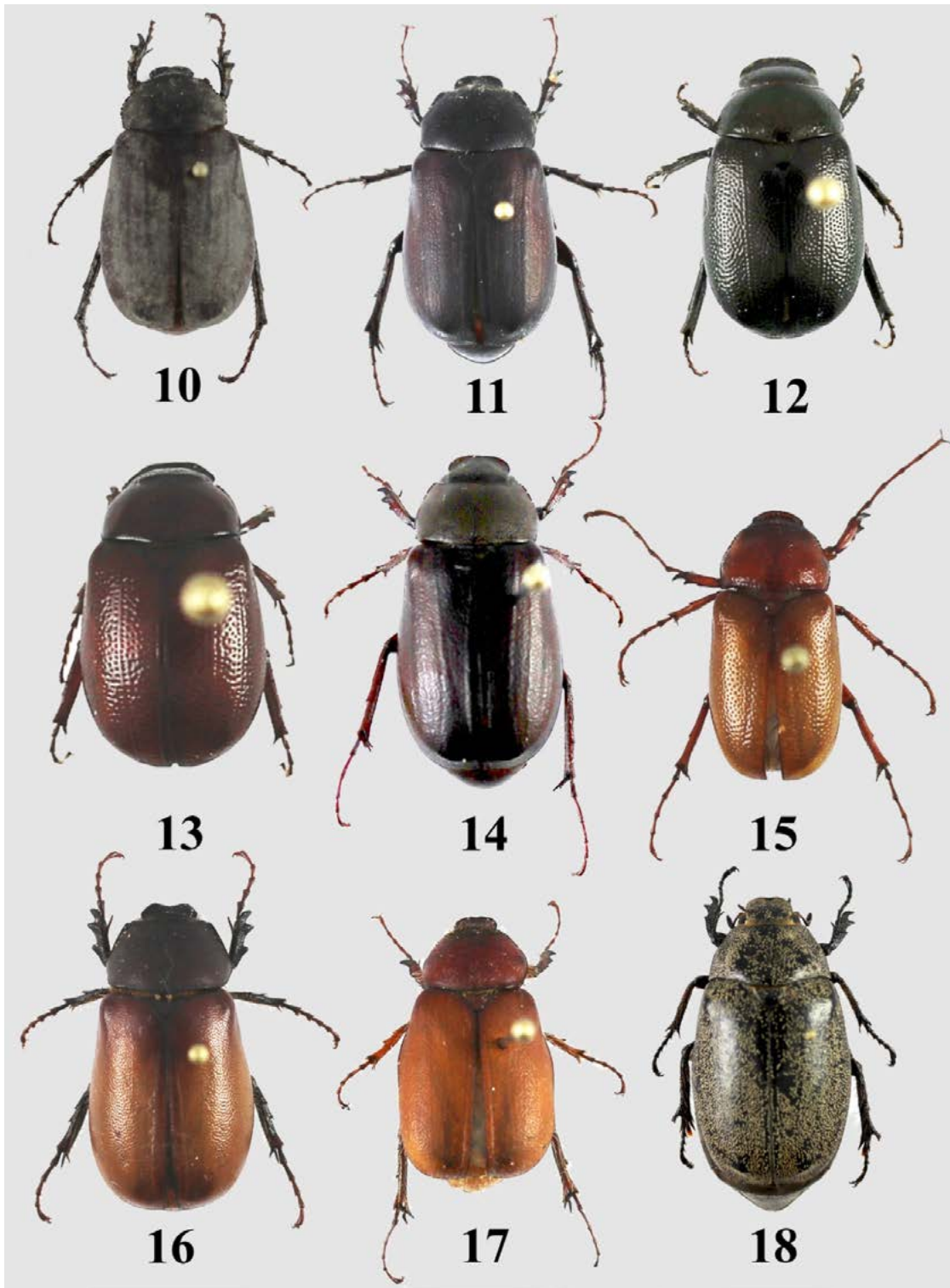


Fig. 4

Fig. 1-4 Relative abundance (%) of phytophagous scarabs in surveyed districts



1. *Anomala* sp; 2. *Anomala communis* (Burmeister, 1844); 3. *Anomala dussumieri* (Blanchard, 1850); 4. *Anomala elata* (Fabricius, 1792); 5. *Adoretus versutus* Harold, 1869; 6. *Anomalachela* Brenske, 1892; 7. *Maladera keralensis* (Frey, 1972); 8. *Maladera rufocuprea* (Blanchard, 1850); 9. *Maladera burmeisteri* (Brenske, 1898)



10. *Holotrichia serrata* (Fabricius, 1781); 11. *Holotrichia fissa* Brenske, 1894; 12. *Apogonia proxima* Waterhouse, 1877; 13. *Apogonia* sp. 1; 14. *Sophrops karschi* (Brenske, 1892); 15. *Schizonycha ruficollis* (Fabricius, 1781); 16. *Miridiba excisa* (Moser, 1913); 17. *Brahmina mysorensis* Frey, 1971; 18. *Leucopholis burmeisteri* Brenske, 1894

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