



Faunal survey, endemism and possible species loss of Scarabaeinae (Coleoptera: Scarabaeidae) in the western slopes of the moist South Western Ghats, South India

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Abstract

Species composition, distribution patterns and endemism are outlined for the dung beetles in the ecoregions of the western slopes of the moist South Western Ghats, South India. Among the 142 dung beetle species known, 35 are endemic to the Western Ghats; 29 are endemic to the moist South Western Ghats; 25 are regionally endemic to the South Western Ghats montane rain forests ecoregion; and one each to the Malabar Coast moist deciduous forest ecoregion and the South Western Ghats moist deciduous forests ecoregion. Five species, including the 3 flightless species, are local endemics to the upper montane tropical montane cloud forests. The montane rain forests ecoregion has the highest number of endemics in the moist south Western Ghats and the moist deciduous forests ecoregion and Malabar Coast moist deciduous forest ecoregion have the lowest levels of endemism. Of the 137 dung beetle species known prior to the deforestation and habitat modification of the region, only 87 have been collected recently.

Key words: Dung beetles, check list, the Western Ghats, local endemism

Introduction

The Western Ghats is a global hotspot of biodiversity in the southwest of the Indian subcontinent and is well known for the high endemism and species richness (Myers 2003). This area is divided into drier dipterocarp dominated North Western Ghats ecoregion and *Cullenia* forest dominated South Western Ghats ecoregion with Wyanad as the transition area (Rodgers & Panwar 1988, Wikramanayake *et al.* 2002). The South Western Ghats montane ecoregion, especially its moist western slopes, is considered as a region with the highest regional endemism and faunal diversity in the entire Western Ghats (Wikramanayake *et al.* 2002). A search for data on the biogeographic distribution patterns, endemism and flightless montane dung beetles in the South Western Ghats and in the adjoining Malabar Coast moist deciduous forest ecoregion revealed the high occurrence of dung beetles (Arrow 1931, Balthasar 1963) prior to extensive deforestation from 1970–1980 (Nair 1991). However, the use of imprecise locality names dating to the British administration makes it difficult to determine endemism using earlier publication such as Arrow (1931), Paulian (1945), Balthasar (1963, 1974) and Cambefort (1985). There are no data on the extent of species loss between 1970 and 1980 in the Western Ghats or on the current status of Scarabaeinae in the region. Hence it was considered useful to publish an updated checklist of the dung beetles in the moist South Western Ghats, following the classification system of Löbl and Smetana (2006). In addition, details are given of the distribution patterns, endemism, and probable species loss based on recent collection efforts across the ecoregion (Sabu & Vinod 2005; Anu 2006; Sabu *et al.* 2006, 2007; Vinod & Sabu 2007; Vinod 2009; Sabu 2011; Latha *et al.* 2011).

Study region

The study region consists of the windward moist western slopes of the south Western Ghats and the adjoining southern part of the Malabar Coast lying between the South Western Ghats and the Arabian Sea (Fig. 1). Wikra-

manayake *et al.* (2002) refer to this region as the moist western slopes of the South Western Ghats, divisible into South Western Ghats moist deciduous forests ecoregion (MDF) and South Western Ghats montane rain forests ecoregion (MEF). The Malabar Coast is referred as Malabar Coast moist deciduous forest ecoregion (MCF). Isolated patches of stunted montane evergreen forests surrounded by vast montane grasslands referred to as tropical montane cloud forests (TMCF) or cloud forests (Bruijnzeel & Proctor 1995, Sabu *et al.* 2011) and regionally as Shola forests occur in the peaks of South Western Ghats montane rain forests ecoregion. The map (Fig. 1) depicting the three ecoregions in the moist south Western Ghats is adapted from Atree (2009).

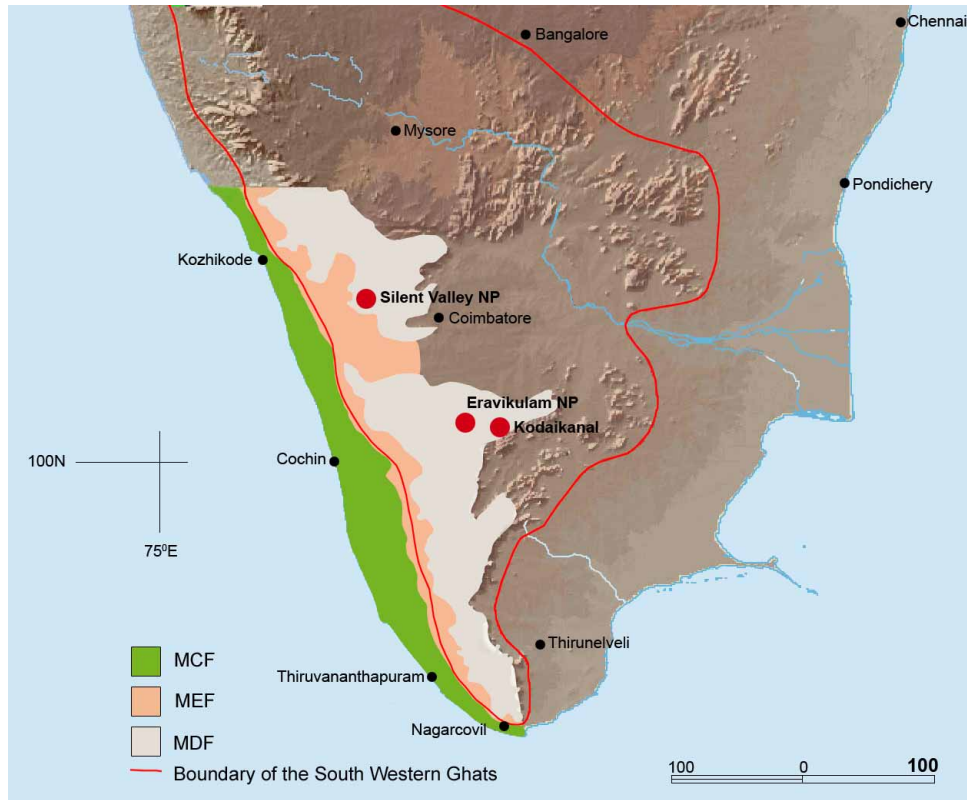


FIGURE 1. Ecoregions in the western slopes of the moist south Western Ghats and regions of local endemism.

Taxon information

Scarabaeinae have been determined following Arrow (1931), Paulian (1945, 1980, 1983), Balthasar (1963, 1974), Frey (1975), Cambefort (1985), Schoolmeesters (2005), Löbl and Smetana (2006) and Krikken (2009). Information on the distribution of scarab species was extracted from the studies made during 2000–2010 period (Sabu & Vinod 2005; Anu 2006; Sabu *et al.* 2006, 2007; Vinod & Sabu 2007; Vinod 2009; Sabu 2011; Latha *et al.* 2011). Records until 1980 are classed ‘old collection effort’ prior to the modification of Western Ghats and those of 2000–2010 ‘recent collection effort’. Two species, *Copris keralensis* collected in 1984 (Gill 1985) and *Onthophagus neocolobus* collected in 1982 (Scheuern 1996) are included in the old record as a matter of convenience.

All species are listed with their valid names, authority, and the year of description. Species are listed systematically by tribe, genus and subgenus. Within subgenera, species are listed alphabetically, and sequentially numbered. Species were broadly categorized as ‘non endemic’, ‘endemic’, ‘regional’, and ‘local’ based on distribution records. Species not recorded in the recent collections and are deemed extirpated are noted with an asterisk and wingless species with the symbol “#” in Table 1. Each species is assigned an alphabetical code (in bold type) corresponding to the distribution pattern and endemism.

TABLE 1. Checklist, species distribution patterns and endemism of Scarabaeinae by ecoregions in the western slopes of the moist South Western Ghats. Species not recorded in the recent collections and are deemed extirpated –*; Wingless species –#; EW: endemic to the Western Ghats; EMSW: endemic to the moist South Western Ghats; MCF: Malabar Coast moist deciduous forest ecoregion; MDF: South Western Ghats moist deciduous forests ecoregion; MEF: South Western Ghats montane rain forests ecoregion; TCMF: Tropical montane cloud forests.

SCARABAEINAE

Tribe GYMNOLEURINI

Genus *Allogymnopleurus* Janssens, 1940

- | | | | | |
|---|--|--|-----|-----|
| 1. <i>A. maculosus</i> (MacLeay, 1821)* | | | MDF | |
| 2. <i>A. spilotus</i> (MacLeay, 1821) | | | MDF | MEF |

Genus *Garreta* Janssens, 1940

- | | | | | |
|---------------------------------------|--|-----|-----|--|
| 3. <i>G. dejeani</i> (Laporte, 1840)* | | MCF | MDF | |
|---------------------------------------|--|-----|-----|--|

Genus *Gymnopleurus* Illiger, 1803

- | | | | | |
|--|--|-----|-----|--|
| 4. <i>G. cyaneus</i> (Fabricius, 1798) * | | MCF | MDF | |
| 5. <i>G. gemmatus</i> Harold, 1871* | | | MDF | |
| 6. <i>G. koenigi</i> (Fabricius, 1775)* | | MCF | MDF | |

Genus *Paragymnopleurus* Shipp, 1897

- | | | | | |
|--|--|--|-----|-----|
| 7. <i>P. melanarius</i> (Harold, 1867) | | | MDF | MEF |
| 8. <i>P. sinuatus</i> (Olivier, 1789) | | | MDF | MEF |

Tribe SISYPHINI

Genus *Sisyphus* Latreille, 1807

Subgenus *Sisyphus*

- | | | | | | |
|--|----|------|-----|-----|-----|
| 9. <i>S. araneolus</i> Arrow, 1927 | EW | EMSW | MDF | MEF | |
| 10. <i>S. crispatus hirtus</i> Wiedemann 1823* | | | MDF | MEF | |
| 11. <i>S. longipes</i> (Olivier, 1789) | | | MCF | MDF | MEF |
| 12. <i>S. mendicus</i> Arrow, 1931* | EW | EMSW | | MEF | |
| 13. <i>S. neglectus</i> Gory, 1833 | | | MCF | MDF | MEF |

Tribe CANTHONINI

Genus *Cassolus* Sharp, 1875

- | | | | | |
|-------------------------------------|--|--|-----|-----|
| 14. <i>C. humeralis</i> Arrow, 1907 | | | MDF | MEF |
|-------------------------------------|--|--|-----|-----|

Genus *Ochicanthon* Vaz-de-Mello, 2003

- | | | | | | |
|--|----|------|-----|-----|------|
| 15. <i>O. devagiriensis</i> Sabu & Latha, 2011 # | EW | EMSW | | | TCMF |
| 16. <i>O. gauricola</i> Cuccodoro, 2011* | EW | EMSW | MDF | MEF | |
| 17. <i>O. laetus</i> (Arrow, 1931) | EW | EMSW | MDF | MEF | |
| 18. <i>O. loebli</i> (Paulian, 1983)* # | EW | EMSW | | | TCMF |
| 19. <i>O. murthy</i> Vinod & Sabu, 2011 | EW | EMSW | MCF | MEF | |
| 20. <i>O. mussardi</i> Cuccodoro, 2011* | EW | EMSW | | MEF | |
| 21. <i>O. nitidus</i> (Paulian, 1980) | EW | EMSW | | MEF | |
| 22. <i>O. tristis</i> (Arrow, 1931) | EW | EMSW | | MEF | |
| 23. <i>O. vazdemelloi</i> Latha & Sabu, 2011 # | EW | EMSW | | | TCMF |

Genus *Panelus* Lewis, 1895

- | | | | | | |
|--|----|------|-----|-----|------|
| 24. <i>P. besucheti</i> Paulian, 1980* | | | MDF | MEF | TCMF |
| 25. <i>P. keralai</i> Paulian, 1980 | EW | EMSW | MDF | MEF | TCMF |
| 26. <i>P. mussardi</i> Paulian, 1980* | EW | EMSW | | MEF | TCMF |

Tribe COPRINI**Genus *Catharsius* Hope, 1837**

- | | | | | | |
|--|--|--|-----|-----|-----|
| 27. <i>C. capucinus</i> (Fabricius, 1781)* | | | MCF | MDF | |
| 28. <i>C. granulatus</i> Sharp, 1875* | | | | | MEF |
| 29. <i>C. molossus</i> (Linnaeus, 1758) | | | | MDF | MEF |
| 30. <i>C. sagax</i> (Quenstedt, 1806) | | | | MDF | MEF |

Genus *Copris* Geoffroy, 1762**Subgenus *Copris***

- | | | | | | |
|---|--|--|-----|-----|-----|
| 31. <i>C. fricator</i> (Fabricius, 1787)* | | | MCF | MDF | MEF |
| 32. <i>C. repertus</i> Walker, 1858 | | | | MDF | MEF |

Genus *Paracopris* Balthasar, 1939

- | | | | | | |
|---|--|--|-----|-----|-----|
| 33. <i>P. cribratus</i> (Gillet, 1927) | | | | MDF | MEF |
| 34. <i>P. davisoni</i> (Waterhouse, 1891) | | | MCF | MDF | MEF |
| 35. <i>P. furciceps</i> (Felsche, 1910) | | | | | MEF |
| 36. <i>P. keralensis</i> (Gill, 1986) | | | | MDF | MEF |
| 37. <i>P. signatus</i> (Walker, 1858) | | | MCF | MDF | MEF |
| 38. <i>P. surdus</i> (Arrow, 1931) | | | | | MEF |

Genus *Heliocopris* Hope, 1837

- | | | | | | |
|--|--|--|--|--|-----|
| 39. <i>H. bucephalus</i> (Fabricius, 1775) | | | | | MEF |
| 40. <i>H. dominus</i> Bates, 1868 | | | | | MEF |

Tribe ONTHOPHAGINI**Genus *Anoctus* Sharp, 1875**

- | | | | | | |
|--|----|------|--|--|-----|
| 41. <i>A. myrmecophilus</i> (Arrow, 1907)* | EW | EMSW | | | MEF |
|--|----|------|--|--|-----|

Genus *Caccobius* Thomson, 1863**Subgenus *Caccophilus* Jekel, 1872**

- | | | | | | |
|--|----|------|-----|-----|-----|
| 42. <i>C. aterrimus</i> (Fabricius, 1798)* | | | MCF | | |
| 43. <i>C. gallinus</i> Arrow, 1907 | EW | EMSW | | MDF | MEF |
| 44. <i>C. indicus</i> Harold, 1867* | | | | | MEF |
| 45. <i>C. meridionalis</i> Boucomont, 1914 | | | MCF | MDF | MEF |
| 46. <i>C. ultor</i> Sharp, 1875 | | | | | MEF |
| 47. <i>C. unicornis</i> (Fabricius, 1798) | | | | | MEF |
| 48. <i>C. vulcanus</i> (Fabricius, 1801) | | | MCF | MDF | MEF |

Genus *Cleptocaccobius* Cambefort, 1984

- | | | | | | |
|--------------------------------------|--|--|--|-----|-----|
| 49. <i>C. arrowi</i> Cambefort, 1985 | | | | MDF | MEF |
|--------------------------------------|--|--|--|-----|-----|

Genus *Digitonthophagus* Balthasar, 1959

- | | | | | | |
|---|--|--|--|-----|--|
| 50. <i>D. gazella</i> (Fabricius, 1787) | | | | MDF | |
|---|--|--|--|-----|--|

Genus *Onthophagus* Latreille, 1802**Subgenus *Onthophagus***

- | | | | | | |
|--|----|------|-----|-----|------|
| 51. <i>O. abacus</i> Boucomont, 1921* | | | MCF | | |
| 52. <i>O. abreui</i> Arrow, 1931* | | | | MDF | |
| 53. <i>O. ampicoma</i> Boucomont, 1914 | | | MCF | MDF | MEF |
| 54. <i>O. amphinus</i> Arrow, 1931 | EW | | | | MEF |
| 55. <i>O. andrewesi</i> Arrow, 1931 | EW | | | | MEF |
| 56. <i>O. bisectus</i> Arrow, 1931* | EW | EMSW | | | TMCF |
| 57. <i>O. brevicollis</i> Arrow, 1907* | | | | | MEF |

58. <i>O. bronzeus</i> Arrow, 1907			MDF	MEF	
59. <i>O. brutus</i> Arrow, 1931				MEF	
60. <i>O. caesariatus</i> Boucomont, 1921*	EW	EMSW	MDF		
61. <i>O. castetsi</i> Lansberge, 1887			MDF	MEF	TMCF
62. <i>O. centricornis</i> (Fabricius, 1798)			MCF	MDF	MEF
63. <i>O. cervus</i> (Fabricius, 1798)			MCF	MDF	MEF
64. <i>O. coorgensis</i> Arrow, 1931*	EW	EMSW		MEF	
65. <i>O. deflexicollis</i> Lansberge, 1883			MDF	MEF	
66. <i>O. devagiriensis</i> Schoolmeesters & Sabu, 2006	EW	EMSW	MDF	MEF	
67. <i>O. difficilis</i> Walker, 1858*	EW	EMSW			TMCF
68. <i>O. duporti</i> Boucomont, 1914			MCF	MEF	
69. <i>O. elongatus</i> Frey, 1954	EW	EMSW		MEF	
70. <i>O. ensifer</i> Boucomont, 1914			MCF	MDF	MEF
71. <i>O. falsus</i> Gillet, 1925			MCF	MDF	MEF
72. <i>O. fasciatus</i> Boucomont, 1914			MCF	MDF	MEF
73. <i>O. favrei</i> Boucomont, 1914			MCF	MDF	MEF
74. <i>O. furcillifer</i> Bates, 1891				MDF	MEF
75. <i>O. germanus</i> Gillet, 1927				MEF	
76. <i>O. griseosetosus</i> Arrow, 1931*				MEF	
77. <i>O. igneus</i> Vigors, 1825*				MEF	
78. <i>O. insignicollis</i> Frey, 1954			MCF	MDF	MEF
79. <i>O. kanarensis</i> Arrow, 1931	EW			MEF	
80. <i>O. kchatriya</i> Boucomont, 1914			MCF	MDF	MEF
81. <i>O. keralensis</i> Frey, 1975*	EW	EMSW	MCF		
82. <i>O. keralicus</i> Biswas & Chatterjee, 1986*	EW	EMSW		MEF	
83. <i>O. laborans</i> Arrow, 1931				MEF	
84. <i>O. laevigatus</i> (Fabricius, 1798)*				MDF	
85. <i>O. lemniscatus</i> Gillet, 1924	EW	EMSW		MEF	
86. <i>O. ludio</i> Boucomont, 1914			MCF	MEF	
87. <i>O. madoqua</i> Arrow, 1931	EW		MCF	MDF	
88. <i>O. malabarensis</i> Boucomont, 1919*			MCF	MDF	MEF
89. <i>O. mauritii</i> Boucomont, 1919*			MCF		MEF
90. <i>O. negligens</i> Walker, 1858			MCF		MEF
91. <i>O. pacificus</i> Lansberge, 1885				MDF	MEF
92. <i>O. parvulus</i> (Fabricius, 1798)*			MCF		
93. <i>O. porcus</i> Arrow, 1931					MEF
94. <i>O. pygmaeus</i> (Schaller, 1783)			MCF	MDF	MEF
95. <i>O. quadridentatus</i> (Fabricius, 1798)			MCF	MDF	MEF
96. <i>O. rana</i> Arrow, 1931*					TMCF
97. <i>O. refulgens</i> Arrow, 1931	EW	EMSW		MEF	TMCF
98. <i>O. sahai</i> Biswas & Chatterjee, 1986	EW	EMSW		MEF	
99. <i>O. socialis</i> Arrow, 1931*				MEF	
100. <i>O. spinifex</i> (Fabricius, 1781)*				MEF	
101. <i>O. tarandus</i> (Fabricius, 1792)*				MEF	

102. <i>O. tritinctus</i> Boucomont, 1914			MDF	MEF
103. <i>O. truncaticornis</i> (Schaller, 1783)*		MCF	MDF	MEF
104. <i>O. turbatus</i> Walker, 1858		MCF	MDF	MEF
105. <i>O. unifasciatus</i> (Schaller, 1783)		MCF	MDF	MEF
106. <i>O. usurpator</i> Balthasar, 1960	EW			MEF
107. <i>O. violaceotinctus</i> Gillet, 1925				MEF
108. <i>O. vladimiri</i> Frey, 1957	EW	EMSW		MEF
109. <i>O.n.sp.</i> (Nithya & Sabu, unpublished data)	EW	EMSW		MEF
Subgenus <i>Micronthophagus</i> Balthasar, 1963				
110. <i>O. cavia</i> Boucomont, 1914			MDF	MEF
111. <i>O. hystrix</i> Boucomont, 1914*		MCF	MDF	
112. <i>O. oculatus</i> Arrow, 1931			MDF	
Subgenus <i>Proagoderus</i> Lansberge, 1883				
113. <i>O. imperator</i> Laporte, 1840*	EW			MEF
114. <i>O. vividus</i> Arrow, 1907		MCF	MDF	MEF
Subgenus <i>Colobonthophagus</i> Balthasar, 1935				
115. <i>O. bengalensis</i> Harold, 1886*				MEF
116. <i>O. dama</i> (Fabricius, 1798)		MCF	MDF	MEF
117. <i>O. ephippioderus</i> Arrow, 1907*				MEF
118. <i>O. neocolobus</i> Scheuern, 1996*				MEF
119. <i>O. pardalis</i> (Fabricius, 1798)*				MEF
120. <i>O. tragus</i> (Fabricius, 1792)				MEF
121. <i>O. urellus</i> Boucomont, 1919				MEF
Subgenus <i>Macronthophagus</i> Ochi, 2003				
122. <i>O. diabolicus</i> Harold, 1877				MEF
123. <i>O. manipurensis</i> Arrow, 1907				MEF
Subgenus <i>Paraphanaeomorphus</i> Balthasar, 1959				
124. <i>O. bifasciatus</i> (Fabricius, 1781)		MCF	MDF	MEF
Subgenus <i>Serrophorus</i> Balthasar, 1963				
125. <i>O. rectecornutus</i> Lansberge, 1883			MDF	MEF
126. <i>O. laevis</i> Harold, 1880			MDF	MEF
Subgenus <i>Parascatonomus</i> Paulian, 1932				
127. <i>O. discedens</i> Sharp, 1875*				MEF
128. <i>O. quaestus</i> Sharp, 1875			MDF	TMCF
Genus <i>Phalops</i> Erichson 1848				
129. <i>P. divisus</i> (Wiedemann, 1823)*			MDF	
Tribe ONITINI				
Genus <i>Onitis</i> Fabricius, 1798				
130. <i>O. falcatus</i> (Wulfen, 1786)		MCF	MDF	MEF
131. <i>O. philemon</i> Fabricius, 1801*				MEF
132. <i>O. singhalensis</i> Lansberge, 1875*				MEF
133. <i>O. siva</i> Gillet, 1911		MCF		MEF
134. <i>O. subopacus</i> Arrow, 1931				MEF

135. *O. virens* Lansberge, 1875 MDF MEF

Tribe ONITICELLINI

Subtribe *Drepanocerina* Lansberge, 1875

Genus *Tibiodrepanus* Krikken, 2009

136. *T. setosus* (Wiedemann, 1823) MCF MEF

137. *T. sinicus* (Harold, 1868) MEF

Subtribe *Oniticellina* Kolbe, 1905

Genus *Euoniticellus* Janssens, 1953

138. *E. pallipes* (Fabricius, 1781) * MEF

Genus *Liatongus* Reitter, 1892

139. *L. indicus* Arrow, 1908 EW EMSW MEF

Genus *Oniticellus* Dejean, 1821

140. *O. cinctus* (Fabricius, 1775) MCF MEF

Genus *Tiniocellus* Péringuey, 1900

141. *T. spinipes* (Roth, 1851) MCF MDF MEF

Tribe ATEUCHINI

Genus *Delopleurus* Erichson, 1847

142. *D. parvus* Sharp, 1875* MDF

Results and discussion

Species richness: 142 species are known from the moist south Western Ghats including five new species reported in 2000–2010. The failure to find 50 species previously recorded indicates that they are either extirpated or have become rare. Maximal species richness occurs in MEF (123 species) and the minimal in MCF (45 species) (Table 2).

Endemism: 35 species (25%) were endemic to the Western Ghats and 29 (20%) to the moist south Western Ghats. High regional endemism of MEF (20 out of 29) indicates that MEF is the key centre for endemics in the South Western Ghats and the MDF and MCF with 1/29 species have the lowest levels of endemism. Five species – *Ochicanthon devagiriensis* Sabu & Latha, *O.vazdemelloi* Latha & Sabu, *O.loebli* Paulian, *Onthophagus bisectus* Arrow and *O.difficilis* Walker – are local endemics to TMCF. Among the five local endemics, the three *Ochicanthon* species (*O.devagiriensis*; *O.vazdemelloi*; *O.loebli*) are wingless and unique to the isolated and distantly placed peaks of the South Western Ghats (Eravikulam in the Anamalais, Kodaikanal in the Palani Hills and Silent Valley in the Nilgiris). This is indicative of the isolation, resource availability and stability in the respective regions.

Distribution: Among the eight tribes recorded from South India and the Indian subcontinent, Scarabaeini has not been recorded from the moist western slopes of the South Western Ghats. Prevalence of the tribe in the drier leeward eastern slopes of the South Western Ghats and in the dry central Indian plains (Arrow 1931, Balthasar 1963) indicates that Scarabaeini prefer drier habitats.

Species loss: Thirteen out of 30 of the species endemic to the Western Ghats and 12 out of 24 of the species endemic to the moist South Western Ghats were not found in the recent collection effort. Highest failure to record rates of endemic (11 species; 41%) and regional endemic species (10 species; 45%) were in MEF. *Anoctus* Sharp, *Phalops* Erichson, *Delopleurus* Erichson, *Garreta* Janssens, *Gymnopleurus* Illiger and *Euoniticellus* Janssens were poorly recorded prior to the modification of the Western Ghats (Arrow 1931, Balthasar 1963). Among these, myrmecophilous *Anoctus* were collected with flight interception traps (Krikken 1971, Krikken & Huibregts 2006). Habits of the other five genera, namely *Phalops*, *Delopleurus*, *Garreta*, *Gymnopleurus* and *Euoniticellus* remain unknown in this region. Therefore, these six genera not recorded in the recent collection efforts are categorized as the rarest dung beetle genera in the moist South Western Ghats and not as extirpated species, mainly because flight

interception traps were not used in the recent collection efforts. Highest species loss in the genus *Panelus* Lewis followed by *Copris* Geoffroy, *Catharsius* Hope and *Allogymnopleurus* Janssens (50%), may indicate that these are vulnerable genera that may disappear due to habitat modifications occurring intensely in the region. Rise in the species richness of *Ochicanthon* (4 to 9 species; 44%) could be due to poor sampling in upper montane forests (TMCF) during earlier collection efforts. *Heliocopris* Hope, *Paragymnopleurus* Shipp, *Paracopris* Balthasar, *Digitonthophagus* Balthasar, *Tiniocellus* Péringuey, *Tibiodrepanus* Krikken, *Liatongus* Reitter, *Oniticellus* Dejean, *Cleptocaccobius* Cambefort and *Cassolus* Sharp with no species loss are considered as the most adapted and less-at-risk groups in the region.

TABLE 2. Species loss of Scarabaeinae by ecoregions in the western slope of the moist South Western Ghats (WGs: The Western Ghats; MCF: Malabar Coast moist deciduous forest ecoregion; MEF: South Western Ghats montane rain forests ecoregion; MDF: South Western Ghats moist deciduous forests ecoregion; TMCF: Tropical montane cloud forests).

Region	Category	Period of collection							
		Recorded through 2010		Recorded through 1980		Recorded during the 2000-2010 period		Species deemed extirpated during 1980-2010	
		Number	%	Number	%	Number	%	Number	%
Moist south WGs	Species richness	142		137		87	64	50	36
	Endemic to WGs	35	25	30	22	17	57	13	43
	Non endemic to WGs	107	75	107	78	70	65	37	35
	Endemic to moist south WGs	29	20	24	18	12	50	12	50
MEF	Endemic & Non endemic to MEF	123	87	118	86	84	71	34	29
	Endemic to WG in MEF	32	23	27	20	16	59	11	41
	Regional endemic to MEF	25	18	22	16	12	55	10	45
MDF	Endemic & Non endemic to MDF	71	50	70	51	52	74	18	26
	Endemic to WGs in MDF	8	6	7	5	5	71	2	29
	Regional Endemic to MDF	1	1	1	1	0	-	1	100
MCF	Endemic & Non endemic to MCF	45	32	44	32	31	70	13	30
	Endemic to WGs in MCF	3	2	2	1	1	50	1	50
	Regional Endemic to MCF	1	1	1	1	0	-	1	100
TMCF	Endemic & Non endemic to TMCF	12	8	10	7	4	40	6	60
	Local Endemic to TMCF	5	4	3	2	0	-	3	100
	Wingless	3	2	1	1	0	-	1	100

Conclusions

Analysis of the distribution pattern of Scarabaeinae in the moist western slopes of the South Western Ghats indicates that the MEF is the most species-rich and endemic taxa rich area. The plausible explanation is that MEF is a transition-zone for species in the windward moist western and leeward dry eastern slopes of the MDF and is comparatively free of plantations activities. Exclusive presence of wingless species corroborates with other studies (Wikramanayake *et al.* 2002, Rice & Madhusudan 2009) that have identified TMCF as a key centre for local endemism.

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