ECOLOGIA BALKANICA

2011, Vol. 3, Issue 2 December 2011 pp. 9-14

Studies on the Dung-inhabiting Beetles (Insecta: Coleoptera) Community of Western Anatolia, Turkey

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Abstract. In Bozdağlar Mountain of western Turkey, the diversity and composition of the dung-inhabiting beetles in two locations situated in different altitudes (600 m and 900 m) in 2004 and 2006 assemblages were sampled. A total of 5.709 individuals from 88 species belonging to the families Scarabaeidae, Aphodiidae, Geotrupidae, Carabidae, Hydrophilidae, Histeridae and Ptilidae of the order Coleoptera are recorded.

Key words: Ecology, dung-inhabiting beetles, Coleoptera, Bozdaglar Mountain, Turkey.

Introduction

The recycling of dung in this way improves soil texture and returns nutrients and water to the soil (BORNEMISSZA & WILLIAMS, 1970). The dung-inhabiting insects form a highly diverse community including specialized coprophagous and predatory species of beetles and flies, as well as an array of generalist consumers, which colonize feces during the different stages of decomposition (KOSKELA & HANSKI, 1977; HANSKI, 1987; 1990; 1991; PINERO & AVILA, 2004). Great numbers of beetles frequent in dung of herbivorous mammals. The majority beetle families being especially characteristic: Scarabaeidae, Aphodiidae, Hydrophilidae, Staphylinidae, Histeridae, Ptilidae and Silphidae in the order Coleoptera.

Dung-inhabiting beetles are a frequent topic of many ecological studies as well phenology, population dynamics; dispersal abilities etc. are well-known for many species. The dung insect communities are characterized by the dominance of scarab beetles which also called dung beetles (mainly Scarabaeidae and Aphodiidae). Dung beetles feed mainly on droppings of mammals. Doing this, they decompose dung, thus benefiting both to pasture and animal health. Dung beetles are important enough in manure and nutrient recycling. They compete with pestiferous flies and parasitic nematodes, enrich the soil by burying large quantities of nutrient-rich dung, and effectively mix and aerate soil through tunneling (BERTONE, 2004; BERTONE *et al.*, 2005). Almost all Scarabaeidae and Aphodiidae species are coprophagous. Among other dung-inhabiting beetles, adult Hydrophilidae are coprophagous. Ptiliidae feed on decaying vegetable material and on fungi under bark. Many of the predatory species are found associated with animal dung. The carnivores seem to be very dependent on the number of suitable prey in the droppings. In generally, species belonging to Carabidae, Staphylinidae and Histeridae families in dung are known as predator.

Up to now, there is no comprehensive data on dung inhabiting-beetles have been

published in Turkey. In this paper, it has been presented the results of a study concerning fauna of the order Coleoptera from Bozdağlar Mountain, Manisa province of western Turkey. The results of this study also provide some ecological data of dung-inhabiting beetles.

Material and methods

Study Area

The seasonal activity of the rove beetles was studies in 2004 and 2006 in two locations (ca 3 ha each) situated in different altitudes (600 m a.s.l. and 900 m a.s.l.) near Dagmarmara village, Manisa province of western Turkey. The coordinates of the locations at 600 m and 900 m are 38°23′37″N, 27°49′09″E and 38°20′09″N, 27°50′47″E, respectively (Fig.1).

The location at 600 m a.s.l. is situated about 2 km north of Dagmarmara village within farm lands. There are pastures of various sizes situated among the plantations of *Pinus brutia* Ten., *Quercus* spp., *Castanea sativa* MILL. and the orchards of *Prunus avium* L., *Pyrus malus* L., *Cydonia vulgaris* PERS. on this locality. On the pastures, *Polypodium* sp., *Cistus creticus* L., *Trifolium bocconei* SAVI, *Medicago* × *varia* (MARTYN) ARCANG., *Rubus canescens* L. occur except of grasses. On the pasture where the samples were collected, a total of 30-40 cows and several horses feed all day long on the pasture and they are brought back to their shelters at night.

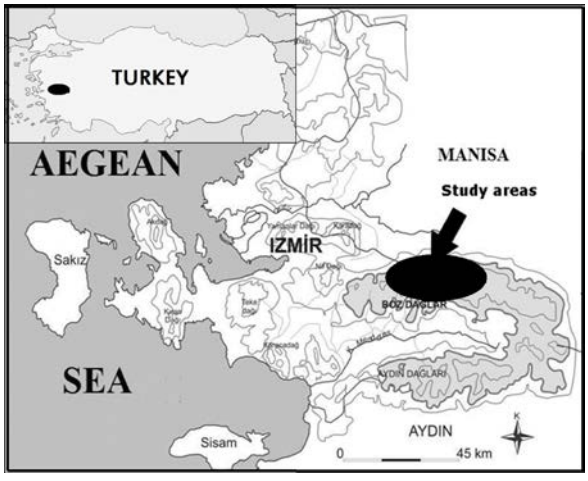

Fig. 1. Location of trapping study area and neighboring fields at Bozdağlar Mountain, western Turkey.

The location at 900 m a.s.l. is situated ca. 5 km southeast of the pasture at 600 m, out of the agricultural land and is therefore less impacted by human activities. The samples were collected on a large pasture surrounded by the forest of *Pinus nigra* (ARNOLD). Except of grasses, *Polypodium* sp., *Verbascum* sp., *Juniperus oxycedrus* L., *Pyrus amygdaliformis* VILL., *Rosa canina* L., *Cistus laurifolius* L. were common on the pasture. In this area, a total of 80-100 cows, without any other mammalians, feed on this pasture all day long without going back to their shelters at night from April up to November.

In generally, variation in humidity was different between two localities. The rainy season from November to May and from June to late October there is a rainless period at these localities. According to our observation, the location at 900 m is more humid than 600 m, with scarce rain even through summer period. Average temperature and average rainfall amount of Manisa province are provided in Fig. 2.

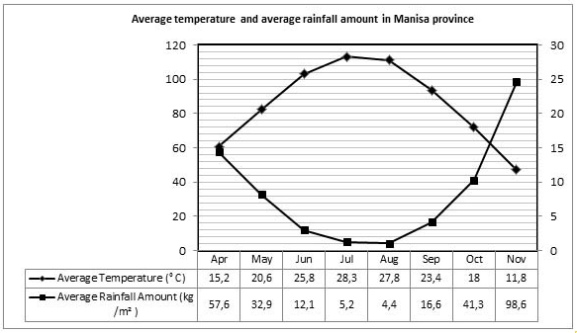

Fig. 2. Average temperature and average rainfall amount in Manisa province, Western Anatolia (MGM, 2011).

It has been classified insects into five trophic groups: predators, opportunistic predators, coprophages, opportunistic coprophages and omnivores. Predators (histerid and staphylinid beetles, especially *Philonthus* species) eat only live prey, whereas coprophages (scarabeid, aphodiid and hydrophylid beetles) eat (exclusively or principally) dung. Omnivores feed both on live prey and dung. Opportunists appear in dung as predators or coprophages, but are not restricted to excrement (carabid, tenebrionid, and some staphylinid and

aphodiid beetles). Classification of species into trophic groups was based on direct observations in the study area and literature (KOSKELA & HANSKI, 1977; CAMBEFORT, 1991; PINERO & AVILA, 2004).

Sampling

For this study, both localities were visited in ca. 14-day intervals from mid-April to the mid November. During the winter, cows were not present on the pastures and the beetles were therefore not sampled in this period. Samples were collected randomly by a handle shovel, placed into a plastic jars and transported to the laboratory, where the insects were separated from the dung. Fifteen samples of ca. 50 g of dung were collected during each visit on the locality. The material referred to in this study is deposited in the Lodos Entomological Museum (LEMT), Department of Plant Protection, Aegean University (Izmir, Turkey) and author's private collections.

In the previous parts of these studies, species belonged to Histeridae (ANLAŞ et al., 2007), Hydrophilidae (ANLAŞ *et al.*, 2008), Scarabaeoidea (ANLAŞ *et al.*, 2011), Staphylinidae (ANLAŞ, in prep.) and Carabidae (ANLAŞ & TEZCAN, in prep.) have been evaluated and published.

Results and Discussion

In this study, totally 5.709 specimens representing 88 species belonging to 10 families (Scarabaeidae, Aphodiidae, Geotrupidae, Staphylinidae, Carabidae, Hydrophilidae, Histeridae, Tenebrionidae, Silphidae and Ptiliidae) of the order Coleoptera were collected in two locations situated in different altitudes (600 m and 900 m) in 2004 and 2006. The beetle families with the highest number of species were Staphylinidae (26 spp.) and Scarabaeidae (23 spp.), while Scarabaeidae (34.6 % of the beetles), Staphylinidae (22.7 %) and Aphodiidae (20.7 %) were the most abundant families (Table 1 and Fig. 3).

Table 1. Number of specimens collected of families at both altitudes during 2004 and 2006 for this study.

Family	Number of species	2004		2006		Sum	Ratios %
		600 m	900 m	600 m	900 m		
Scarabaeidae	23	427	626	320	601	1974	34.6
Aphodiidae	8	266	326	241	347	1.180	20.7
Geotrupidae	2	0	7	0	3	10	< 1
Carabidae	8	12	71	12	54	149	2.6
Staphylinidae	26	325	371	243	357	1.296	22.7
Hydrophilidae	5	188	453	115	173	929	16.3
Histeridae	12	17	66	9	46	138	2.4
Ptiliidae	2	5	2	11	0	18	< 1
Tenebrionidae	1	7	0	3	0	10	< 1
Silphidae	1	0	0	0	5	5	< 1
Total	**88**	**1.247**	**1922**	**954**	**1.586**	**5.709**	**100**
		3.169		**2.540**			

In the previous parts of this study, number of specimens of the recorded species collected at both altitudes during 2004 and 2006 and their dominance values were given before (see references).

The total number of specimens collected in the area located at 600 m was 2.201 and 38.6 % as percentage of the total catch; 3.508 in the area located at 900 m and 61.4 % as percentage of the total catch. In 2004, the number of specimens was 3.169 (55.5 %) and in 2006 it was 2.540 (44.5 %).

The main five species were with the following numbers as percentage of the total catch: *Sphaeridium scarabaeoides*, 12.75 %; *Aphodius fimetarius*, 10.65 %; *Onthophagus*

ruficapillus, 10.40 %; *Onthophagus taurus*, 6.62 % and *Aleochara tristis*, 8.7 %. Results showed that five species of Coleoptera dominated in the 88 species captured in Table 2. Most of the recorded species generally widely distributed those with Euro-asiatic, cosmopolitan, Palaearctic, Holoarctric distribution. Some of them less-widely distributed species such as Mediterranean.

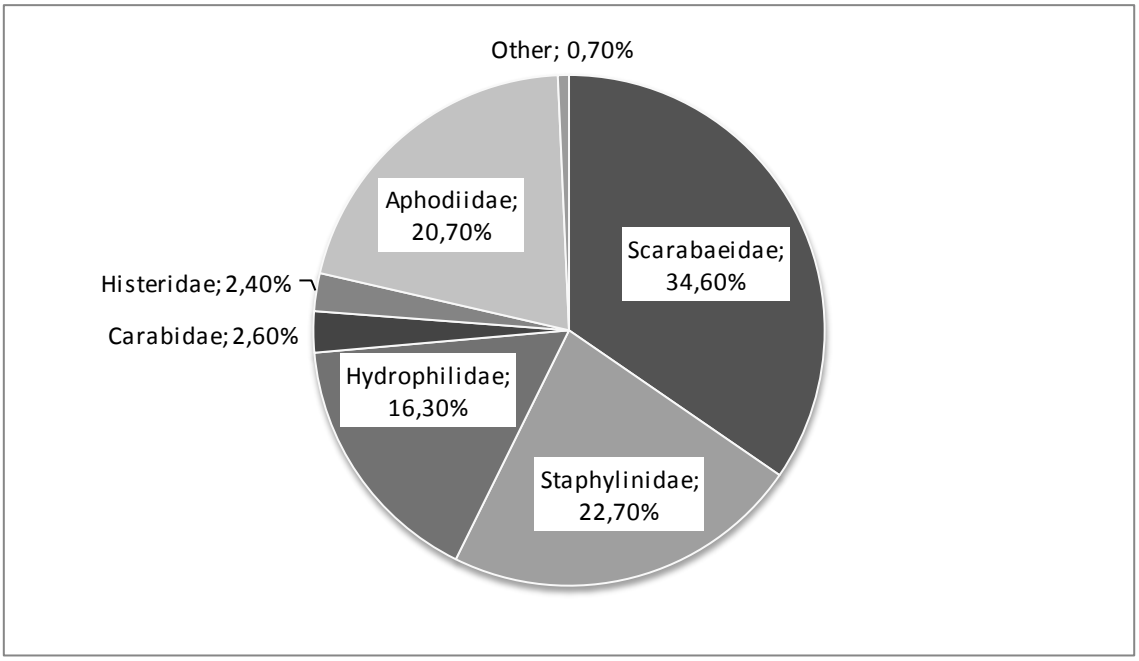

Fig. 3. Ratios of specimens collected of families at both altitudes during 2004 and 2006 for this study.

Table 2. Number of specimens and dominance value of first five species of Coleoptera dominated for this study.

First five dominate species	**Family**	**Number of specimens**	**Dominance value %**
Sphaeridium scarabaeoides (LINNAEUS, 1758)	Hydrophilidae	728	12. 75 %
Aphodius fimetarius (LINNAEUS, 1758)	Aphodiidae	608	10.65 %
Onthophagus ruficapillus BRULLÉ, 1832	Scarabaeidae:	594	10.40 %
Onthophagus taurus (SCHREBER, 1759)	Scarabaeidae	378	6.62 %
Aleochara tristis GRAVENHORST, 1806	Staphylinidae	377	6.60 %

Coprophagous beetles were more abundant in dung pats than predatory beetles (MENÉNDEZ & GUTIÉRREZ, 1997) as well as in our results. Most of the beetle species were coprophages (43 species, 4533 specimens), with more than the species richness than opportunistic coprophagous (2 species, 18 specimens) or predatory beetles (28 species, 473 specimens). In contrast, opportunistic predaceous beetles (8 species, 238 specimens) and omnivores (7 species, 446 specimens) were represented by the lowest number of species. In general, the assemblage was dominated by coprophages

(79.4 % of total abundance), omnivores (7.8 %) and predators (8.3 %), whereas opportunistic detritivores and opportunistic predators were scarce. However, the two sites differed in the abundance of coprophages, opportunistic predators and omnivores.

In this study; the Carabidae specimens which were collected, generally occurred in the whole period of sampling, but it was absent or showing low abundance in August. The peaks were recorded at the end of September and during October. From the staphylinids Oxytelinae species, which are not strongly restricted to dung and use other decaying substrates (SOWIG & WASSMER, 1994), were active mainly in spring period. Oxytelinae species, such as *Anotylus* species, are a saprophagous. *Aleochara tristis,* which are feed commonly on the eggs, larvae, and puparia of various scathophagous and necrophagous Diptera (KLIMAZEWSKI, 1984; LIPKOW, 1992), generally showed highest abundance in autumn months and Staphylininae species, mainly the predator genus *Philonthus*, occurred in the whole period of sampling from spring to autumn period. The scarabeid and aphodiid species of this study were absent or showing low abundance in the period ca. from July to August with peaks in spring and in autumn in both years and on both localities. The hydrophilid species *Sphaeridium scarabaeoides* occurred in the whole period of sampling both in 2004 and 2006, with the peaks in the second half of April, first half of July and in first half of September in both years and on both localities. Histerid species occurred during the whole period of sampling both in 2004 and 2006, with peaks in the second half of May, second half of September. it is generally less abundant in the summer period.

The results of this study from Turkey agree with data from Southern Europe, but differ from those from central and northern Europe especially in earlier onset of high abundance peaks and in low abundance or absence of the beetles during late summer. Comparison of studies of species composition and seasonal dynamics of many dung-inhabiting beetles shows that the precise pattern of the recorded species can differ according to geographic position of the studied localities (e. g. HANSKI & KOSKELA, 1978; LOBO, 1993; WASSMER, 1994; PALESTRINI *et al.*, 1995; PINERO & AVILA, 2004).

It is important to more extensively studies on the in dung-habiting beetles which are a significant biological control agent and recycling of dung, returns nutrients in terrestrial ecosystems. It is hoped that current data will be contributed other studies that will be carried out in other locations in Turkey.

Acknowledgement

I am most grateful to Dr. Serdar Tezcan (Izmir) for valuable contributions in this study.

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Received: 09.08.2011
Accepted: 08.10.2011