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**AN EVALUATION ON THE PITFALL TRAP
COLLECTED SCARABAEOIDEA (COLEOPTERA)
SPECIES IN WESTERN TURKEY**

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ABSTRACT: Scarabaeoidea species collected by pitfall traps at five areas in Balıkesir (Madra Mountain, Çağış campus and Değirmen Boğazi), Çanakkale (Karabiga) and Denizli provinces, western Turkey, throughout the years of 2007-2012 have been evaluated. It has been determined a total of 29 species and 9 subspecies of 21 genera belonging to seven families of Scarabaeoidea at five sampling area. Totally 142 specimens have been collected. Of these, *Oxythyrea* (s.str.) *cinctella* (Schaum, 1841), *Sisyphus* (s.str.) *schaefferi* (Linnaeus, 1758), *Tropinota* (*Epicometis*) *hirta* (Poda, 1761), *Pentodon* (s.str.) *idiota* (Herbst, 1789) and *Onthophagus* (*Furciphagus*) *furcatus* (Fabricius, 1781) were the most abundant species in this study with percentages of 15.5, 9.9, 9.9, 7.8 and 6.3%, respectively.

KEY WORDS: Scarabaeoidea, pitfall trap, Madra Mountain, Karabiga, Turkey.

Turkey, which at the centre of Asia, Africa and Europe continent, is located between 26°- 45° East longitude and 36°- 42° North altitude. A large portion of the country belongs to Asia continent, is called Asian Minor, the other part belongs to Europe continent (Trakya region). In addition, Turkey is associated to Africa continent so it has a very diverse faunistic in terms of geological, ecological and climate with a connection between Europe and Asia. Pitfall trapping is a method used effectively in the sampling of insects living on soil surface or in soil and under stones. With this method, it is likely to catch species of useful, harmful and neutral insects in soil layers. Pitfall traps are used generally for the survey of ground beetles, especially of Carabidae and Tenebrionidae. Only they often yield by catches such as Cerambycidae, Curculionidae, Silphidae, Staphylinidae and Scarab beetles. So our understanding of insect biodiversity is increasing by being informed about the seasonal fluctuations of this species in ecosystems. Also pitfall trap may catch ground-dwelling like *Lethrus* (*Lethrus*) *apterus* (Laxmann, 1770), species flying close to ground like *Cetonia aurata pallida* (Drury, 1770), *Protaetia* (*Cetonischema*) *speciosa* (Adams, 1817), *P.(Netocia) subpilosa* (Desbrochers des Loges, 1869), *P.(Netocia) vidua* (Gory & Percheron, 1833), *P.(Netocia) afflicta* (Gory & Percheron, 1833), *P.(Netocia) ungarica ungarica* (Herbst, 1790), *P.(Netocia) cuprina* (Motschulsky, 1849), *Tropinota* (*Tropinota*) *squalida* (Scopoli, 1783), *T.(Epicometis) hirta* (Poda, 1761), *Oxythyrea* (s.str.) *funesta* (Poda, 1761), *O.(s.str.) cinctella* (Schaum, 1841), occasionally in traps with rotten bait necrophagous dung beetles like *Onthophagus* (*Palaeonthophagus*) *vacca* (Linnaeus, 1767) and *O.(Furciphagus) furcatus* (Fabricius, 1781). The superfamily Scarabaeoidea comprises worldwide more than 35 000 species

(Ratcliffe & Paulsen, 2008). Scarabaeoidea species was divided into two basic groups based on the position of the abdominal spiracles; The Laparosticti and Pleurosticti. Turkey is consisting of nearly 700 Scarabaeoidea species and Laparosticti and Pleurosticti is being equally represented. Just 20% of the Laparosticti and over than 50% of the Pleurosticti are considered endemic to Turkey (Carpaneto et al., 2000; Löbl & Smetana, 2006). The scarabs were found mainly in dung, in burrow of small mammals, sometimes in ground beetle traps or, more rarely, under stones. With this study is to interpret the ecological relationship and the prevalence of the Scarabaeoidea species at four locations at diverse altitude in western Turkey.

MATERIAL AND METHODS

Studies have been conducted at five areas in three province of western Turkey (Figure 1 and Table 1). Detailed information on sampling areas were given below.

1. Karabiga sampling biotope: Karabiga peninsula is located the zone of olive-pine-evergreen oak. It is included in plant species such as *Erica arborea* L. and especially *Erica verticillata* L., *Arbutus unedo* L., *Arbutus andarchne* L., *Phillyrea latifolia* L., *Genista luncea* L., *Quercus coccifera* L. and *Olea europae* L., *Cistus parvifolius* L., *Cistus monspeliensis* L., *Lavandula stoechas* L., *Pinus pinea* L., *P. brutia* Ten., *P. pinaster* Aiton., *Cedrus* spp.

2. Çağış Campus sampling biotope: The sampling zone (235 m) consist of two vegetation types. These are forest vegetation, *Poliuro-Quercetum infectoriae* unity, and shrub vegetation, *Phillyreo-Pinetum brutiae* unity. *Onopordum illyricum* L., *Centaurea solstitialis* L., *Asparagus tenifolius* Lam., *Linum olympicum* Boiss. *P. brutia* Ten., and *P. latifolia* L. are the common plant species.

3. Değirmen Boğazi sampling biotope: The sampling zone was forested between 1957 and 1963. During the forestation period, a total of 329 741 trees were planted, composed of 51 species, 29 of which were deciduous and 22 were coniferous. The plant species located in the sampling zone are *P. brutia* Ten., *P. nigra* Arn., *P. pinea* L., *P. sylvestris* L., *P. pinaster* Aiton., *Alnus glutinosa* L., *Ulmus* spp., *Acer* spp., *Platanus* spp., *Quercus* spp. and *Salix* spp.

4. Madra Mountain sampling biotope: The sampling zone is located near İvrindi county (1006 m). The most abundant species are *P. brutia* Ten., *P. nigra* Arn., *P. pinea* L., *Quercus* spp. and *Castanea* spp.

5. Servergazi (Denizli) sampling biotope: *Pinus pinea* L., *P. brutia* Ten., *Quercus* spp. *Castanaeum* spp., *Platanus* spp., *Fraxinus* spp. and *Alnus* spp. are the most abundant plant species.

Sampling

In each area, a total of seven pitfall traps consisted of 100 ml cups half filled with ethylen glycol and water mixture as 1 : 1 ratio were used. These cups buried in the soil in such a way that the lip of the trap was at ground level not closer than 25 meters to each other. The beetles were collected and the traps cleared at 15 days intervals from April to September After collecting the material, the places of the traps were changed in the same area (Surgut & Varlı, 2012). Materials were determined by Prof. Dr. Erol Yıldırım (Ataturk University, Faculty of Agriculture, Department of Plant Protection, Erzurum) and Assoc. Prof. Dr. Marco Uliana (Museo di Storia Naturale Di Venezia, Italy). Materials were housed in the collection of Entomology Laboratory of Biology Department of Faculty of Science and Literature of Balıkesir University.

RESULTS

At the end of this study, 142 specimens of 29 species, 9 subspecies belonging to seven families of Scarabaeoidea have been collected by pitfall traps at five areas in Balıkesir (Madra Mountain, Çağış Campus and Değirmen Boğazı), Çanakkale (Karabiga) and Denizli (Servergazi) provinces of western Turkey, throughout the years of 2007-2012 have been evaluated (Table 2). These species and subspecies recorded in study areas are *Scarabaeus* (*Scarabaeus*) *pius* (Illiger, 1803), *S.* (*Scarabaeus*) *typhon* (Fischer, 1824), *Copris hispanus cavolinii* (Petagna, 1792), *C. lunaris* (Linnaeus, 1758), *Lethrus* (*Lethrus*) *apterus* (Laxmann, 1770), *Onthophagus* (*Palaeonthophagus*) *vacca* (Linnaeus, 1767), *O.* (*Furconthophagus*) *furcatus* (Fabricius, 1781), *Sisyphus schaefferi* (Linnaeus, 1758), *Chaetopteropia segetum velutina* (Erichson, 1847), *Anoxia* (*Anoxia*) *asiatica* Desbrochers, 1871, *Anoxia* (*Protanoxia*) *orientalis* (Krynicky, 1832), *Pentodon bidens sulcifrons* Kuster, 1848, *P. idiota* (Herbst, 1789), *P. algerinus dispar* Baudi, 1870, *Cetonia aurata pallida* (Drury, 1770), *Melolontha albida* Frivaldszky, 1835, *Protaetia* (*Cetonischema*) *speciosa* (Adams, 1817), *P.* (*Netocia*) *subpilosa* (Desbrochers des Loges, 1869), *P.* (*Netocia*) *vidua* (Gorry & Percheron, 1833), *P.* (*Netocia*) *afflicta* (Gorry & Percheron, 1833), *P.* (*Netocia*) *ungarica ungarica* (Herbst, 1790), *P.* (*Netocia*) *cuprina* (Motschulsky, 1849), *Blitopertha lineolata* (Fischer von Waldheim, 1824), *Eulasia* (*Vittateulasia*) *pareyssei* (Brullé, 1832), *E.* (*Vittateulasia*) *vittata vittata* (Fabricius, 1775), *Oryctes* (*Oryctes*) *nasicornis kuntzeni* Minck, 1914, *Oxythyrea funesta* (Poda, 1761), *O. cinctella* (Schaum, 1841), *Aplidia turcica* (Kraatz, 1882), *A. vagepuctata* (Kraatz, 1882), *A. lodosi* Baraud, 1990, *Anomala affinis* Ganglbauer, 1882, *Tropinota* (*Tropinota*) *squalida* (Scopoli, 1783), *T.* (*Epicometis*) *hirta* (Poda, 1761), *Amadotrogus truncatus anatolicus* Keith, 2006, *Pygopleurus* (*Pygopleurus*) *foina* (Reitter, 1890), *P.* (*Pygopleurus*) *mithridates* Petrovitz, 1962, *Omaloplia* (*Acarina*) *spireae* (Pallas, 1776).

Those belonging to Cetoniidae was 49 (34.50%) of eleven species (28.94%); and the others respectively were: 46 specimens (32.4%) of seven species (18.4%) belonging to Scarabaeidae; 21 specimens (14.8%) of four species (10.5%) belonging to Dynastidae; 18 specimens (12.7%) of eight species (21.0%) belonging to Melolonthidae; 10 specimens (7.0%) of three species (7.9%) belonging to Rutelidae; 8 specimens (5.6%) of four species (10.5%) belonging to Glaphyridae and 1 specimen (0.70%) of one species (2.7%) belonging to Geotrupidae. The dominant species and their relative abundances were *O. cinctella* (15.49%), *T. hirta* (9.85%), *S. schaefferi* (9.85%), *P. idiota* (7.74%) and *O. furcatus* (6.33%). The relative abundances of other eighteen species changed between 1.41-5.63% and fifteen species changed less than 1%.

As a result of this study, totally 24 species and 8 subspecies namely, *Scarabaeus pius*, *S.typhon*, *Copris hispanus cavolinii*, *C.lunaris*, *Lethrus apterus*, *Onthophagus vacca*, *Chaetopteropia segetum velutina*, *Anoxia asiatica*, *A. orientalis*, *P. bidens sulcifrons*, *P. idiota*, *P. algerinus dispar*, *Cetonia aurata pallida*, *Melolontha albida*, *P. subpilosa*, *P. vidua*, *P. afflicta*, *Protaetia ungarica ungarica*, *P. cuprina*, *Blitopertha lineolata*, *Eulasia pareyssei*, *E.vittata vittata*, *Oryctes nasicornis kuntzeni*, *Oxythyrea funesta*, *O. cinctella*, *Aplidia turcica*, *Anomala affinis*, *Tropinota squalida*, *T. hirta*, *Pygopleurus foina*, *P. mithridates* and *Omaloplia spireae* were present in meadow biotopes.

In addition, four species were found in oak biotopes. These species were *Onthophagus furcatus*, *Pentodon idiota*, *P.bidens sulcifrons* and *Blitopertha lineolata*. Only a species, *O.furcatus*, was found in plantation biotope. Three

species were found in chestnut biotope. These species were *O.furcatus*, *S.schaefferi* and *M.albida*. Nine species, *B.lineolata*, *C.segetum velutina*, *P.speciosa*, *E.vittata vittata*, *O.cinctella*, *Aplidia vegepunctata*, *Amadotrogus truncatus anatolicus*, *P.mithridates*, *T.hirta* were found in pine biotopes. As we compare each sampling province according to the total number of the specimens and the species, the total number of the specimens present as the result of a two year studies in Çağış campus, Madra Mountain, Değirmen bogazi, Karabiga and Servergazi county was 64 (45.0%), 27 (19.0%), 23 (16.2%), 25 (17.6%), 3 (2.1%), respectively. As for the species evaluated in this study, twenty-one species and six subspecies in Çağış Campus, six species in Madra Mountain, four species and two subspecies in Değirmen Bogazi, eight species and three subspecies in Karabiga county and one species and one subspecies in Servergazi county were determined. The majority of the species, with thirty-three species, were recorded from Bahkesir province (86.84%). Secondly, eleven species were recorded from Çanakkale (Karabiga) province (28.94%). Finally, only two species were recorded from Denizli (Servergazi) province (5.26%).

DISCUSSIONS

At the end of this study, a total of 29 species, 9 subspecies belonging to seven families of Scarabaeoidea were collected. Among these thirty species belonging to five families (Cetoniidae, Melolonthidae, Dynastidae, Rutelidae and Glaphyridae) are phytophagous while eight species belonging to two families (Scarabaeidae and Geotrupidae) are coprophagous. *Pentodon idiota* (Dynastidae), *Anoxia orientalis* (Melolonthidae), *Melolontha albida* (Melolonthidae), *Blitopertha lineolata* (Rutelidae) and *Anomala affinis* are harmful species. Some species of Geotrupidae are useful species for agricultural and forest ecosystems by species decomposing dung for benefit both to pasture and animal health. But *Lethrus apterus* belonging to Geotrupidae is a destructive species on plants, especially *Vitis* L. spp. and wild plants (Lodos et al., 1989). Among 38 species, *Scarabaeus pius*, *S. typhon*, *Copris hispanus cavoliini*, *Copris lunaris*, *Onthophagus vacca*, *O. furcatus* and *Sisyphus schaefferi* are corpophagous and useful species. These species live in dung of animal. As taking into account the harmful and useful species, the number of specimens belonging to harmful species was 27, whereas the number of specimens belonging to useful species was 35 and some of the species collected in our study were evaluated as neutral.

Tezcan & Pehlivan (2001) reported a total of 17 species belonging to seven families of Scarabaeoidea by bait traps, pitfall traps as well as knock down methods from ecological cherry orchards in western Turkey. In this study, four species are identical with which of our study *Oxythyrea cinctella*, *Tropinota hirta*, *Pygopleurus foina*, *Onthophagus furcatus*. In their study, *Caccobius histeroides* was collected as the most abundant species by using pitfall traps. Anlaş et al., (2011) reported a total of 17 species belonging to six families of Scarabaeoidea by pitfall traps in Bozdağlar Mountain of western Turkey. In this study, six species are identical with which of our study *O. cinctella*, *T. hirta*, *Blitopertha lineolata*, *Copris lunaris*, *O. furcatus*, *Sisyphus schaefferi*. Among them, *S.schaefferi* was collected as the most abundant by using pitfall traps.

Studies on beetles belonging to Scarabaeoidea are very important for agricultural and forest ecosystems. It is expected that our knowledge on the species belonging to these group of insects will rise with further studies.

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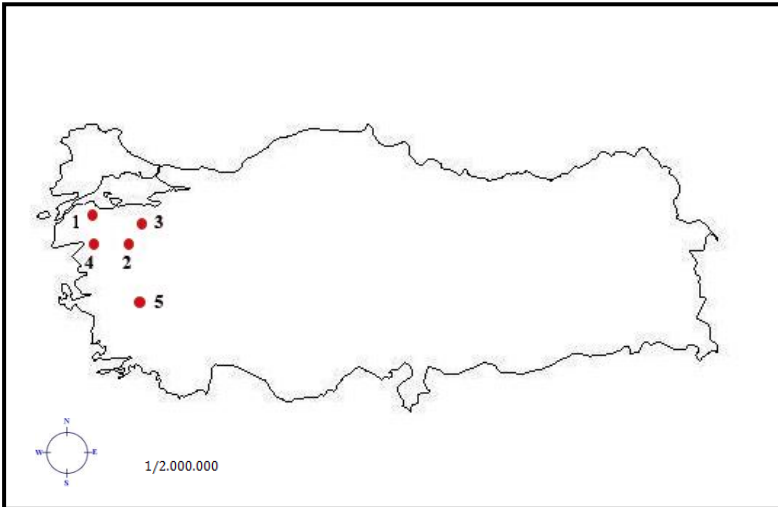


Figure 1. Map of studied areas in western Turkey.

Table 1. Detailed information on the ecological conditions, altitude, coordinates and sampling period of the examined biotopes using pitfall trapping.

Sampling Biotope Number	Province	County	Sampling period	Biotopes	Altitude (m)	Coordinates
1	Çanakkale	Karabiga	2010 & 2011	Oak forest	101	40°24'56"91 N 27°16'14"05 E
				Meadow	2	40°22'33"15 N 27°18'10"98 E
				Plantation	135	40°25'11"86 N 27°15'59"57 E
2	Balıkesir	Çağış Campus	2008 & 2009	Meadow	169	39°53'05"43 N 28°00'39"25 E
3		Değirmen Boğazi	2010 & 2011	Pine forest	225	39°69'00"10 N 27°06'61"57 E
4		Madra Mountain	2007 & 2012	Chestnut forest	792 m	39°23'33"56 N 27°14'10"39 E
				Pine forest	1006 m	39°23'08"42 N 27°15'00"56 E
5	Denizli	Servegazi	2007 & 2008	Pine forest	533	37°39'52"54 N 29°02'50"80 E

Table 2. The number of the specimens collected by pitfall traps in the sampling zones and their rates.

Taxa	Province and county					Year	Sum	Rates (%)
	Balıkesir			Çanakkale	Denizli			
	Çağış Campus	Madra Mountain	Değirmen Boğazi	Karabiga	Servegazi			
SCARABAEIDAE								
<i>Scarabaeus (Scarabaeus) pitus</i> (Illiger, 1803)	4	0	0	0	0	2008	4	2.8
<i>S. (Scarabaeus) typhon</i> (Fischer, 1824)	1	0	0	1	0	2008/2010	2	1.4
<i>Copris hispanus cavolini</i> (Petagna, 1792)	4	0	0	0	0	2008	4	2.8
<i>C. (s.str.) lunaris</i> (Linnaeus, 1758)	0	1	0	0	0	2012	1	<1
<i>Onthophagus (Palaeonthophagus) vacca</i> (L, 1767)	0	0	0	1	0	2010	1	<1
<i>O. (Furconthophagus) furcatus</i> (Fabricius, 1781)	0	5	0	4	0	2010/2012	9	6.3
<i>Sisypus (s.str.) schaefferi</i> (Linnaeus, 1758)	0	14	0	0	0	2012	14	9.9
CETONIIDAE								
<i>Cetonia aurata pallida</i> (Drury, 1770)	3	0	0	0	0	2008/2009	3	2.1
<i>Protaetia (Cetonischema) speciosa</i> (Adams, 1817)	0	0	1	0	0	2011	1	<1
<i>P. (Netocia) subpilosa</i> (D. des Loges, 1869)	1	0	0	0	0	2008	1	<1
<i>P. (Netocia) vidua</i> (Gory & Percheron, 1833)	1	0	0	0	0	2008	1	<1

<i>P. (Netocia) afflicta</i> (Gorry & Percheron, 1833)	1	0	0	1	0	2008/2009	2	1.4
<i>O. (s.str.) cinetella</i> (Schaum, 1841)	8	0	14	0	0	2009/2011	22	15.5
<i>Oxythrea (s.str.) funesta</i> (Poda, 1761)	0	0	0	1	0	2009	1	<1
<i>P. (Netocia) ungarica ungarica</i> (Herbst, 1790)	0	0	0	1	0	2009	1	<1
<i>P. (Netocia) cuprina</i> (Motschulsky, 1849)	1	0	0	0	0	2008	1	<1
<i>Tropinota (Tropinota) squalida</i> (Scopoli, 1783)	1	0	0	1	0	2008/2010	2	1.4
<i>T. (Epicometis) hirta</i> (Poda, 1761)	10	0	4	0	0	2008/2011	14	9.9
MELOLONTHIDAE								
<i>Anoxia (Anoxia) asiatica</i> Desbrochers, 1871	3	0	0	0	0	2008	3	2.1
<i>A. (Protanoxia) orientalis</i> (Krvnicky, 1832)	5	0	0	0	0	2008	5	3.5
<i>Melolontha (s.str.) albida</i> Frivaldszky, 1835	2	2	0	0	0	2008/2011	4	2.8
<i>Aplidia (s.str.) turcica</i> (Kraatz, 1882)	1	0	0	0	0	2008	1	<1
<i>A. (s.str.) vagepunctata</i> (Kraatz, 1882)	0	0	0	0	1	2008	1	<1
<i>A. (s.str.) lodosi</i> Baraud, 1990	0	1	0	0	0	2012	1	<1
GLAPHYRIDAE								
<i>Eulasia (Vittateulasia) pareyssei</i> (Brullé, 1832)	2	0	0	0	0	2008/2009	2	1.4
<i>E. (Vittateulasia) vittata vittata</i> (Fabricius, 1775)	1	0	1	0	0	2008/2011	2	1.4
<i>Pygopleurus (Pygopleurus) foina</i> (Reitter, 1890)	2	0	0	0	0	2008	2	1.4
<i>P. (Pygopleurus) mithridates</i> Petrovitz, 1962	1	0	1	0	0	2009/2011	2	1.4
DYNASTIDAE								
<i>Pentodon bidens sulcifrons</i> Kuster, 1848	2	0	0	6	0	2008/2009/2010	8	5.6
<i>P. (s.str.) idiota</i> (Herbst, 1789)	5	0	0	6	0	2008/2009	11	7.8
<i>P. algerinus dispar</i> Baudi, 1870	0	0	0	1	0	2009	1	<1
<i>Oryctes (Oryctes) nasicornis kuntzeni</i> Minck, 1914	1	0	0	0	0	2008	1	<1
RUTELIDAE								
<i>Chaetopterothia segetum velutina</i> (Erichson 1847)	2	0	2	0	0	2008/2009	4	2.8
<i>Blitopertha (s.str.) lineolata</i> (F.von Waldheim, 1824)	1	1	0	2	0	2008/2010/2012	4	2.8
<i>Anomala (s.str.) affinis</i> Ganglbauer, 1882	2	0	0	0	0	2008	2	1.4
Total	67	24	23	25	3		142	100
		114		25	3			