

**SPECIES COMPOSITION AND HABITAT SELECTION
OF GROUND BEETLES (CARABIDAE, COLEOPTERA)
COLLECTED BY PITFALL TRAPS IN BOZDAĞLAR MT.,
WESTERN TURKEY**

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[Tezcan, S., Anlaş, S. & Jeanne, C. 2011. Species composition and habitat selection of Ground beetles (Carabidae, Coleoptera) collected by pitfall traps in Bozdağlar Mt., Western Turkey. Munis Entomology & Zoology, 6 (2): 676-685]

ABSTRACT: Carabidae specimens collected by pitfall traps in Bozdağlar Mountain, Western Turkey during the years of 2003-2006 have been evaluated. It has been recorded a total of 1.462 specimens of 45 species belonging to nine subfamilies of Carabidae. *Calathus* (s. str.) *libanensis* Putzeys, 1873 and *Carabus* (*Procrustes*) *coriaceus cerisyi* Dejean, 1826 were the most abundant species in the study with percentages of 22.91 % and 11.49 %, respectively. Seasonal dynamics of *Calathus libanensis* was presented. The majority of the specimens were collected from oaks biotope (384) and meadow biotope (302).

KEYWORDS: Ecology, faunistics, pitfall trap, seasonal dynamics, habitat preferences, Turkey, Carabidae.

The beetle family Carabidae, or ground beetles, represent one of the taxonomically and ecologically best known groups of insects. Carabidae is a rather big family belonging to Coleoptera, with over 40.000 species worldwide. More than 1.100 carabid species have been recorded from Turkey (Casale & Taglianti, 1999).

Ground beetles are usually predator and as well as important biological control agents in agroecosystems and generally regarded as beneficials in field ecosystems (Luff, 1996; Döring et al., 2003; Pearce & Venier, 2006). They are being able to use a wide range of foods, e.g. soil dwelling insects, maggots, wireworms, ants, and other small invertebrates, also feed on carrion and sometimes even on plant material. They occur in many places, the majority of the species are free-living, as well as most often in decaying animal or plant matter, under stones or bark and in leaf litter.

Up to now, the publications of Avgin (2006a, b), Tezcan et al. (2007), Aslan et al. (2008) and Avgin & Luff (2009) are the studies focusing on ecology of ground beetles of Turkey.

The aim of this study is to evaluate the Carabidae fauna in Bozdağlar mountain in Western Turkey by pitfall traps. The results of this study also provide some ecological data of ground beetles in Turkey.

MATERIAL AND METHODS

Study Area

Studies have been conducted at two counties (Dağmarmara and Çikrikçi) at Bozdağlar Mountain (2157 m), western Turkey (Figure 1) (also see Anlaş et al., 2010). Type of vegetation determination the environment found in the counties:

Chestnuts biotopes: Aged 40 to 70 years *Castanea sativa* Miller is the common plant species. There are also *Trifolium bocconeii* Savi, *Salvia fruticosa* Miller, *Anthemis tinctoria* L., *Rubia tinctorum* L., *Medicago xvaria* Martyn, *Prunella vulgaris* L., *Juniperus oxycedrus* L., *Spartium junceum* L., *Rosa canina* L., *Rubus canescens* Dc., *Polypodium vulgare* L., *Cistus salviifolius* L. and *Styrax* sp. as they are rarely seen in the study area.

Pines biotopes: *Pinus brutia* Ten. and *Pinus nigra* (Arnold) are the common plant species in the biotopes. There are also occur *Cistus laurifolius* L. and *Polypodium* sp.

Oaks biotopes: Being the abundant plant species aged 10-35 years is *Quercus ithaburensis* Dacne. subsp. *macrolepis* (Kotschy) and *Quercus infectoria* Olivier. There are also rare ones as *Cistus creticus* L., *Stachys cretica* L. ssp. *smyrnaea* Rech., *J. oxycedrus*, *Pyrus amygdaliformis* Vill., *R. canina* and *Astragalus* sp.

Meadow biotopes: *Euphorbia anacampseros* Boiss, *Coridothymus capitatus* (L.), *P. vulgare*, and *J. oxycedrus*, are the common plant species in meadow biotopes.

Maquis biotopes: *Q. infectoria*, *C. salviifolius*, *R. canina*, *J. oxycedrus*, *Sarcopoterium spinosum* L., and *C. capitatus*, are the common plant species in the biotopes.

Semiaquatic biotopes: *Salix* sp., *Alnus glutinosa* (L.), *R. canescens*, *R. canina*, *Lythrum salicaria* L., *Urtica* sp., *Mentha* sp. are abundant species. In the biotopes, grasses cover the surface of soil. Pitfall traps were placed on sandy and grassy sides of running water.

Fire-influenced biotopes: Once being an oak forest, this habitat that was burnt in July 2000. *J. oxycedrus*, *P. amygdaliformis*, *R. canina*, *Cistus laurifolius* L., *Thymus longicaule* C. Presl and *Verbascum* sp. are common plant species. In the biotope, there are also occur burnt wood pieces and trees.

The material referred to in this study is deposited in the Lodos Entomological Museum (LEMT), and in the private collection of S. Anlaş. Material were identified by C. Jeanne and S. Anlaş. Classification and nomenclature of Carabidae suggested by Löbl & Smetana (2003) have been followed. Material have been collected by pitfall traps method.

Sampling

A total of 6 pitfall traps were placed in each biotope. Pitfall traps consisted of 200 ml cups buried in the soil in such a way that the lip of the trap would be at ground level. They were half filled with ethylen glycol and water mixture at 1:1 ratio. Traps were cleared in two weeks intervals from beginning of April to end of October and then collected material were determined.

Detailed information on the biotopes of pitfall trapping is given in Table 1.

RESULTS

Species composition

In this study, a total of 1.462 specimens of 45 species belonging to nine subfamilies of Carabidae have been recorded by pitfall traps in Bozdağlar Mountain, western Turkey during the years of 2003-2006 have been evaluated (Table 2).

Including the recorded species, the most abundant are the members of subfamily Pterostichinae with 738 specimens (50.47 %) of 12 species. Members of subfamilies Carabinae and Harpalinae followed them with 352 (24.07 %), 207 (14.16 %), specimens and percentages, respectively. Members of the other

subfamilies were rarely found: Lebiinae (76 specimens), Trechinae (62 specimens), Nebriinae (15 specimens), Broscinae (7 specimens), Brachininae (4 specimens), Callistinae (1 specimen).

Five carabid species, *Calathus* (s. str.) *libanensis* Putzeys, 1873 (22.91 %), *Carabus* (*Procrustes*) *coriaceus cerisyi* Dejean, 1826 (11.49 %), *Calathus* (s. str.) *longicollis* Motschulsky, 1864 (9.44 %), *Calathus* (s. str.) *erythroderus* Gemminger & Harold, 1868 (7.87 %) and *Carabus* (*Pachystus*) *graecus morio* Mannerheim, 1830 (7.80 %) comprising ca. 60 % of the total collected, were considered dominant species. In addition, 15 species were present between 1.09-4.51 % and 25 species were accidental (< 1 %) as percentage of the total catch. The most abundant species is *Calathus libanensis* with 335 specimens and this species was found in both Dağmarmara (213) and Çıkrıkçı (122) counties.

The total number of the specimens collected during two years' collection in Dağmarmara was 891 (60.94 %) and in Çıkrıkçı was 571 (39.06 %). From the species evaluated in present study, 8 were recorded only from Dağmarmara and only 16 were recorded from Çıkrıkçı. In addition these, 21 of 45 were reported both Dağmarmara and Çıkrıkçı counties.

Among the biotopes, the majority of the specimens were collected from oaks biotope (384), meadow biotope (302), chestnuts biotope (230) and fire-influenced biotope (167); the least specimens were collected from pines (182), maquis (121) and semiaquatic biotope (76) (Figure 3). The number of species was 27 at meadow biotopes; 23 at oak; 14 at chestnuts and at maquis, 11 at fire-influenced, 8 at semiaquatic; only 5 species at pines biotopes.

We also evaluated that the diversity of carabid species in biotopes according to dominance value for per trapping (Table 3.). The majority of the specimens were collected from chestnuts and oaks biotopes (22.48 and 18.77 %) and after fire-influenced and meadow biotopes (16.32 and 14.76 %). According to our study, the ground beetles were dominant in forest (chestnuts and oaks biotopes) and open-area habitats (fire-influenced and meadow biotopes). On the contrary, carabid species were less abundant in semiaquatic and pines biotopes.

Seasonal dynamics

Of the 45 species recorded during present study, the predominant species, *Calathus libanensis* was collected in higher numbers of specimens in both counties. We evaluated the seasonal dynamics of this species according to localities (Figure 2). Average temperature and rainfall amounts in Manisa province were given in Figure 4.

In Dağmarmara County, *Calathus libanensis* occurred during the whole period of sampling, but it was showing low abundance in August, the peaks were recorded during in June and in autumn (September to October). Phenology of this species is similar in Çıkrıkçı county, the species was recorded in the whole period of sampling too, but it was absent in August. The peak was noticed in October.

We obtained some information of three studies about seasonal dynamics of the ground beetles. In the first study, it was observed the seasonal dynamic of the ground beetles in Poland. It was revealed two appreciable peaks of activity density. The first period of mass activity was noted in the end of July, and the second in second half of August (Aleksandrowicz et al., 2009). The phenology of ground beetles in the study is not similar with our study. It should depend on differences of the studied areas and climatic factors among Poland and Turkey. According to the other studies of Avgin (2006a and b), the carabid species occurred during to whole period of sampling but it was absent or showing low

abundance in summer period, especially in August and the peaks was recorded as identically with present study.

DISCUSSION

In this study, determination of the Carabidae fauna of Bozdağlar Mountain by pitfall traps was aimed for the first time. It was recorded a total of 45 species belonging to nine subfamilies of Carabidae.

According to the study of Aslan et al. (2008), a total of nine species were determined by pitfall traps. Two species (*Calathus longicollis* and *Nebria brevicollis*) recorded in this study are identical with those of present study. Carabid species is collected as most abundant in meadow biotopes in this study.

In other study, Aleksandrowicz et al. (2009) recorded 23 species in Poland. According to this study, the dominant group was open-area species (20 species and 98.83% of specimens) and most of the species were belonging to the genera of *Harpalus* and *Calathus*.

In the similar result were obtained by Avgin (2006a) in Ahır Mountain, Kahramanmaraş province, Turkey. According to this study, the diversity of ground beetles was significantly higher in forest edge and grassland than in the interior part of forest. There was no significant difference in the diversity of ground beetles of the grassland and the forest edge in Ahır Mountain. *Calathus libanensis pluriseriatus* Putzeys, 1873 was the most abundant species among recorded species. Other study was carried out in Baskonus Mountain National Park (Kahramanmaraş, Turkey) by Avgin (2006b) and 31 species of ground beetles were recorded by pitfall traps. The results of present study are identical with results of Avgin (2006a).

Using pitfall traps, a total of 30 species were collected from ecologically managed cherry orchards by Tezcan et al. (2007). 18 of these species were also recorded in present study. The rate of collected specimens of cherry orchards was 87.72%, and it was 67.44% in present study. Among those *Carabus coriaceus cerisyi* was a dominant species and it was collected at both of two studies.

In present study, most of the collected species were collected in forest habitats and their abundance were low in pine and semiaquatic biotopes. Pitfall traps are very useful tools for monitoring ground beetles in agricultural, forested and unforested ecosystems. It is expected that our knowledge on carabid beetles will chiefly rise with further studies in Turkey.

ACKNOWLEDGEMENTS

Authors would like to express their gratitudes to Dr. Memiş Kesdek for his valuable contributions of this study.

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Table 1. Detailed information on biotopes of pitfall trap method.

Region	Prov.	County	Period	Biotopes	Coordinate	Altitude (m)
1	Manisa	Dağmarmara	2003 & 2006	Oak forest	38°22'14"N/ 27°50'39"E	980
				Fire-influenced biotopes	38°22'07"N/ 27°50'16"E	960
				Pine forest	38°22'49"N/ 27°52'12"E	930
				Meadow	38°22'39"N/ 28°04'56"E	880
				Chestnut forest	38°23'37"N/ 27°49'09"E	620
2	Manisa	Çikrikçi	2005 & 2006	Oak forest	38°28'19"N/ 27°49'44"E	220
				Meadow	38°28'19"N/ 27°49'38"E	200
				Pine forest	38°28'23"N/ 27°49'47"E	180
				Semiaquatic biotopes	38°28'24"N/ 27°49'17"E	110
				Maqui forest	38°28'24"N/ 27°49'20"E	150

Table 2. Number of specimens collected by pitfall traps in different counties and their percent dominance values.

Species	Location and year				Sum	Dominance Value (%)
	Dağmarmara		Çıkrıkçı			
	2003	2006	2005	2006		
1. Subfamily Brachininae Bonelli, 1810						
Tribus Brachinini Bonelli, 1810						
<i>Brachinus explodens</i> (<i>Brachynidius</i>) Dufschmid, 1812	0	0	3	1	4	< 1
2. Subfamily Broscinae Hope, 1838						
Tribus Broscini Hope, 1838						
<i>Broscus</i> (s. str.) <i>nobilis</i> (Dejean, 1831)	0	0	0	7	7	< 1
3. Subfamily Callistinae Bonelli, 1810						
Tribus Chlaeniini Brullé, 1834						
<i>Chlaeniellus</i> (s. str.) <i>vestitus</i> (Paykull, 1790)	1	0	0	0	1	< 1
4. Subfamily Carabinae Latreille, 1802						
Tribus Carabini Latreille, 1802						
<i>Calsoma</i> (<i>Acalosoma</i>) <i>inquisitor</i> (Linnaeus, 1758)	1	0	0	0	1	< 1
<i>Calosoma</i> (s. str.) <i>sycophanta</i> (Linnaeus, 1758)	2	0	1	0	3	< 1
<i>Carabus</i> (<i>Procrustes</i>) <i>cortaceus cerisyi</i> Dejean, 1826	48	67	21	32	168	11.49
<i>Carabus</i> (<i>Pachystus</i>) <i>graeus morio</i> Mannerheim, 1830	45	37	15	17	114	7.80
<i>Carabus</i> (<i>Tomocarabus</i>) <i>microderus</i> Chaudoir, 1867	22	27	10	7	66	4.51
5. Subfamily Harpalinae Bonelli, 1810						
Tribus Harpalini Bonelli, 1810						
<i>Carterus</i> (s. str.) <i>dama</i> (Rossi, 1792)	1	2	4	4	11	< 1
<i>Dixus</i> (s. str.) <i>eremita</i> (Dejean, 1825)	6	3	6	7	22	1.50
<i>Dixus</i> (s. str.) <i>obscurus</i> (Dejean, 1825)	8	14	7	9	38	2.60
<i>Harpalus</i> (s. str.) <i>attenuatus</i> Stephens, 1828	17	21	5	0	43	2.94
<i>Harpalus</i> (s. str.) <i>distinguendus</i> (Dufschmid, 1812)	0	0	12	4	16	1.09
<i>Harpalus</i> (<i>Pseudophonus</i>) <i>griseus</i> (Panzer, 1796)	0	0	9	5	14	< 1
<i>Harpalus</i> (<i>Pseudophonus</i>) <i>rufipes</i> (Degeer, 1774)	17	8	16	12	53	3.63
<i>Harpalus</i> (s. str.) <i>smaragdinus</i> (Dufschmid, 1812)	0	0	4	5	9	< 1
<i>Ophonus</i> (s. str.) <i>subquadratus</i> (Dejean, 1829)	0	0	0	1	1	< 1
6. Subfamily Lebiinae Bonelli, 1810						
Tribus Lebiini Bonelli, 1810						
<i>Cymnitis</i> (s. str.) <i>axillaris palliata</i> Waldheim, 1823	9	6	11	16	42	2.87
<i>Lionychnus</i> (s. str.) <i>orientalis</i> K. Daniel, 1900	1	4	0	0	5	< 1
<i>Syntomus</i> (s. str.) <i>pallipes</i> (Dejean, 1825)	7	10	0	0	17	1.16
<i>Syntomus</i> (s. str.) <i>fuscocomaculatus</i> (Motschulsky, 1844)	1	4	0	7	12	< 1

7. Subfamily Nebrinae Laporte, 1834						
Tribus Nebrini Laporte, 1834						
<i>Leistus</i> (s. str.) <i>caucasicus</i> Chaudoir, 1867	4	0	0	0	4	< 1
<i>Nebria</i> (s. str.) <i>brevicollis</i> (Fabricius, 1792)	5	4	2	0	11	< 1
8. Subfamily Pterostichinae Bonelli, 1810						
Tribus Platynini Bonelli, 1810						
<i>Calathus</i> (s. str.) <i>erythroderus</i> Gemminger & Harold, 1868	31	35	27	22	115	7.87
<i>Calathus</i> (<i>Neocalathus</i>) <i>leptodactylus</i> Putzeys, 1873	1	4	0	0	5	< 1
<i>Calathus</i> (s. str.) <i>libanensis</i> Putzeys, 1873	116	97	78	44	335	22.91
<i>Calathus</i> (s. str.) <i>longicollis</i> Motschulsky, 1864	43	66	12	17	138	9.44
<i>Laemostenus</i> (<i>Pristonychus</i>) <i>conspicius</i> (Waltl, 1838)	10	12	3	1	26	1.78
<i>Olisthopus</i> (s. str.) <i>glabricollis</i> (Germar, 1817)	0	0	2	7	9	< 1
Tribus Zabriini Bonelli, 1810						
<i>Amara</i> (s. str.) <i>aenea</i> (DeGeer, 1774)	14	7	5	5	31	2.12
<i>Amara</i> (<i>Paracelata</i>) <i>dalmatina</i> Dejean, 1828	6	10	0	0	16	1.09
<i>Amara</i> (s. str.) <i>eurynota</i> (Panzer, 1797)	8	8	4	1	21	1.44
<i>Amara</i> (s. str.) <i>ovata</i> (Fabricius, 1792)	6	0	4	7	17	1.16
<i>Zabrus</i> (s. str.) <i>asiaticus</i> Castelnau, 1834	1	1	0	0	2	< 1
<i>Zabrus</i> (<i>Pelor</i>) <i>graecus orientalis</i> Apfelbeck, 1904	6	4	8	5	23	1.57
9. Subfamily Trechinae Bonelli, 1810						
Tribus Bembidiini Stephens, 1827						
<i>Bembidion</i> (<i>Metallina</i>) <i>leucoscelis</i> Chaudoir, 1850	0	3	11	18	32	2.19
<i>Bembidion</i> (<i>Metallina</i>) <i>properans</i> (Stephens, 1828)	0	0	2	7	9	< 1
<i>Bembidion</i> (s. str.) <i>quadripustulatum</i> Audinet - Serville, 1821	0	0	3	8	11	< 1
<i>Ocydromus</i> (<i>Peryphus</i>) <i>atlanticus megaspilus</i> (Walker, 1871)	0	0	1	1	2	< 1
<i>Ocydromus</i> (<i>Bembidionetolitzkyi</i>) <i>concoeruleus</i> (Netolitzky, 1942)	0	0	2	0	2	< 1
<i>Ocydromus</i> (<i>Peryphus</i>) <i>cruciatus liberus</i> (Netolitzky, 1937)	0	0	1	0	1	< 1
<i>Ocydromus</i> (<i>Peryphus</i>) <i>femoratus</i> (Sturm, 1825)	0	0	0	2	2	< 1
<i>Ocydromus</i> (<i>Peryphus</i>) <i>subcostatus propevau</i> Fassati, 1944	0	0	1	0	1	< 1
<i>Tachys</i> (<i>Paratachys</i>) <i>bistriatus</i> (Dufschmid, 1812)	0	0	0	1	1	< 1
Tribus Trechini Bonelli, 1810						
<i>Pentleptus</i> (s. str.) <i>areolatus</i> (Creutzer, 1799)	0	0	1	0	1	< 1
TOTAL	437	454	291	280	1.462	100
	891		571			

Table 3. The first three dominant species and their percentages in each biotope (A: Total number of specimens, B: Dominance Value (%), C: Number of avarege specimens for per trapping, D: Dominance Value (%) for per trapping).

Biotores	First three dominant species	A	B %	C	D %
Oaks biotope (both Dağmarmara and Çıkırıkçı: four pitfall trapping)	<i>Carabus coriaceus cerisyi</i> <i>Calathus libanensis</i> <i>Carabus graecus morio</i>	384	26.27	96	18.77
Meadow biotope (both Dağmarmara and Çıkırıkçı: four pitfall trapping)	<i>Calathus libanensis</i> <i>Carabus coriaceus cerisyi</i> <i>Calathus longicollis</i>	302	20.66	75.5	14.76
Chestnuts biotope (only Dağmarmara: two pitfall trapping)	<i>Carabus graecus morio</i> <i>Carabus microderus</i> <i>Calathus libanensis</i>	230	15.73	115	22.48
Pines biotope (both Dağmarmara and Çıkırıkçı: four pitfall trapping)	<i>Calathus libanensis</i> <i>Calathus longicollis</i> <i>Harpalus rufipes</i>	182	12.45	45.5	8.90
Fire-influenced biotope (only Dağmarmara: two pitfall trapping)	<i>Calathus erythroderus</i> <i>Laemostenus conspicuus</i> <i>Calathus libanensis</i>	167	11.42	83.5	16.32
Maquis biotope (only Çıkırıkçı: two pitfall trapping)	<i>Calathus libanensis</i> <i>Bembidion leucoscelis</i> <i>Calathus erythroderus</i>	121	8.28	60.5	11.83
Semiaquatic biotope (only Çıkırıkçı: two pitfall trapping)	<i>Cyminidis axillaris palliata</i> <i>Amara aenea</i> <i>Calathus libanensis</i>	76	5.20	35.5	6.94
TOTAL		1462	100 %	511.5	100 %

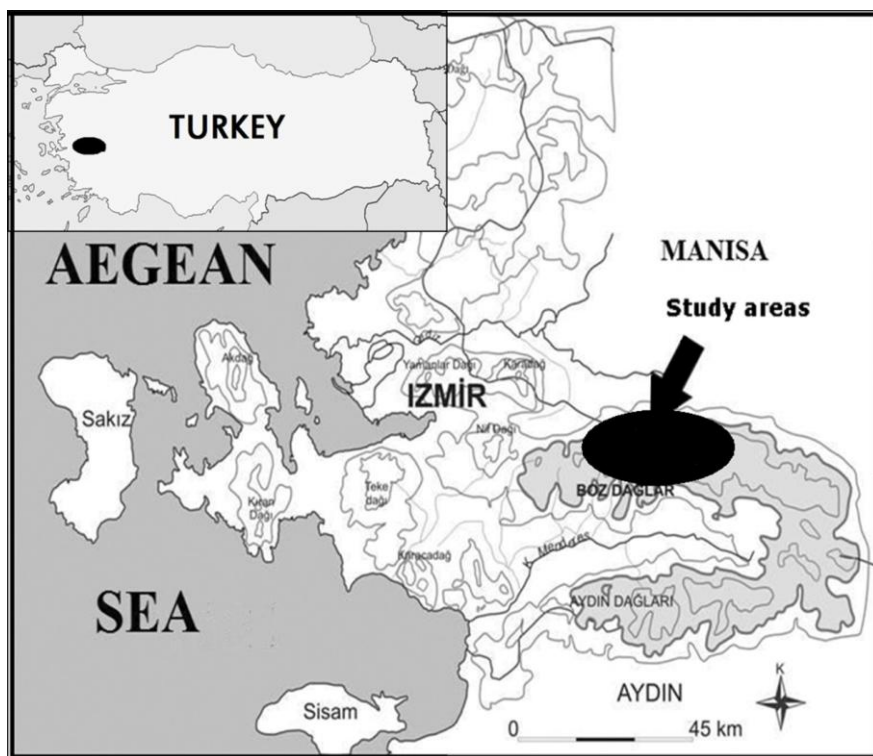


Figure 1. Location of trapping study area and neighbouring fields at Bozdağlar Mountain, western Turkey.

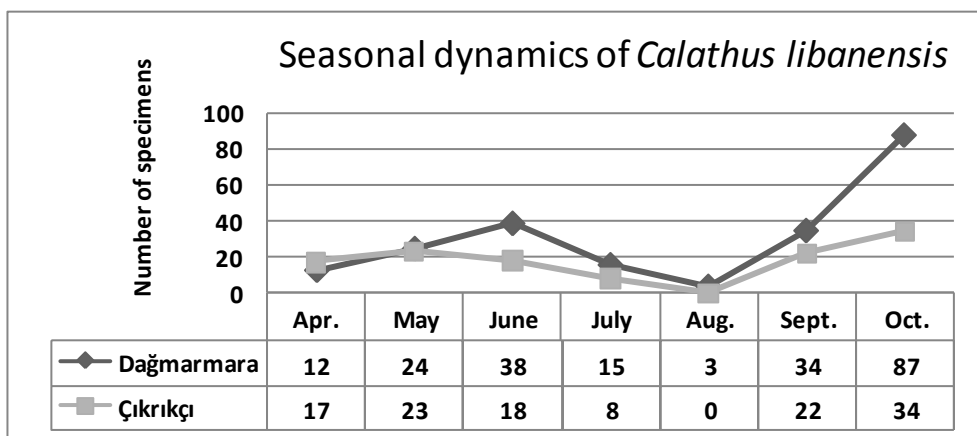


Figure 2. Seasonal dynamics of most abundant species, *Calathus libanensis* during sampling period, April to October, by pitfall traps both in Dağmarmara and Çıkrıkçı counties.

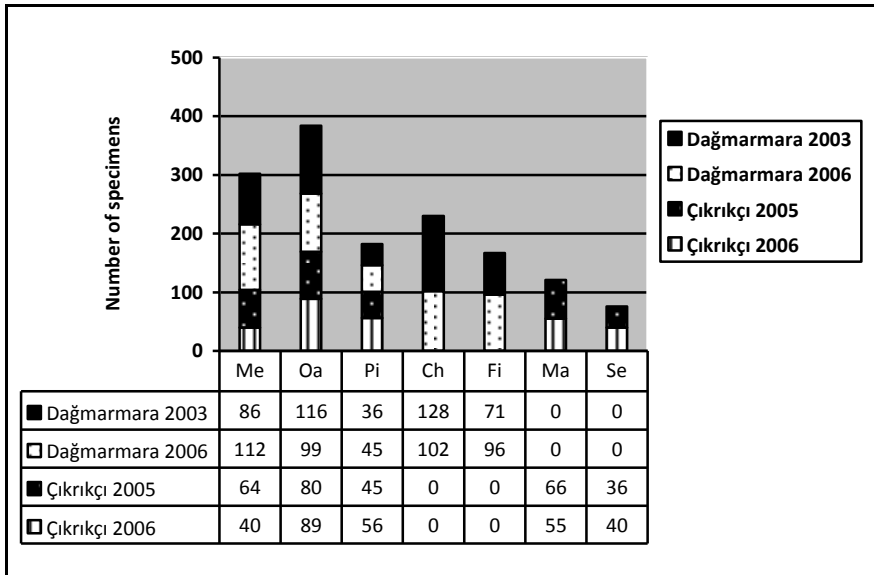


Figure 3. Total number of specimens collected by pitfall traps in different biotopes and counties (Me: Meadow; Oa: Oaks; Pi: Pines; Ch: Chestnut; Fi: Fire-influenced; Ma: Maquis and Se: Semiaquatic biotopes).

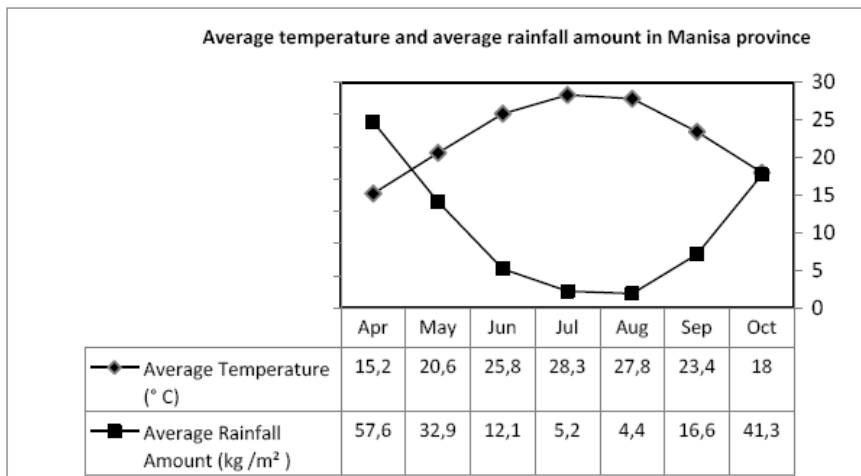


Figure 4. Average temperature and average rainfall amount in Manisa province, W Anatolia (<http://www.dmi.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m= Manisa>).