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Dermaptera (Insecta) fauna of Bozdağlar Mountain, Western Turkey

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A b s t r a c t : Dermaptera specimens collected by pitfall traps and hibernation trap-bands in Bozdağlar Mountain, Western Turkey during the years of 2001-2007 have been evaluated. We have recorded a total of 7 species belonging to 4 genera and some ecological considerations on those species are given. The species are (alphabetic order): *Forficula aetolica* BRUNNER 1882; *F. auricularia* LINNAEUS 1758; *F. lurida* FISHER 1853; *F. smyrnensis* AUDINET-SERVILLE 1839; *Guanchia hincksi* (BURR 1947); *Isolaboides kosswigi* (BURR 1947); *Labidura riparia* (PALLAS 1773).

K e y w o r d s : Ecology, faunistics, hibernation trap-bands, pitfall trap, Turkey, Asia minor, Dermaptera, *Forficula*, *Guanchia*, *Isolaboides*, *Labidura*.

Introduction

The Dermaptera or earwigs constitute a comparatively small order of insect and comprises about 2.200 species (HAAS 2003a).

Throughout their evolutionary history since the Triassic, they preserved a fairly uniform and unique morphology: they are all long and slender insects with prognathous heads, three pairs of simple walking legs, inserting on the sides of the thorax, and a long, slender and highly movable abdomen, which is completed with a pair of cerci modified to forceps (also called pincers of claspers). The cerci are have no subdivision and are used in a variety of contexts, such as defence, attack on prey in carnivorous species, to open the wings and in male-male interaction in mating behaviour. In contrast to what is said in the literature, the male cerci never hold or pinch the female abdomen during copulation but are push under the female and elevate the abdomen slightly. The male abdomen is twisted to almost 180 at this occasion, so its sternites are facing upwards.

Maternal care for the egg batch and first to second instar nymphs is obligatory, and sets Dermaptera apart from most other insects. The same is true for the highly complex wing folding, which requires the cerci to be involved in order to open them (HAAS 2003b).

Since Dermaptera are morphologically quite uniform, mis-identifications at the order level are rare. The only taxon prone to be confused with Dermaptera are the Staphylinidae (Coleoptera), having equally short tegmina/elytra and sometimes abdominal protrusion, bearing some resemblance to cerci, with which they have nothing to do. Counting the

number of tarsomeres quickly resolves the issue: Staphylinidae have always five tarsomeres, while Dermaptera without exception three.

The species are distributed all over the world, however as they prefer warm and somewhat humid climate the greatest concentration of species is found in the tropics around the world. Deserts and semi-deserts are not a preferred habitat, neither are the more northern areas such as Europe for its cold winters.

Turkey's Dermaptera fauna has not been studied in the appropriate detail. Turkey is linking major faunal regions: Europe, Asia minor and Asia, and thus also Africa. Add to this, the rich and varied cultural history of this region, were major civilisations (Hittites, Egyptians, Greeks, Romans, Persians, and finally Turks) settled or using the region as major trade route (such as the silk road). One would expect that the large scale movement of people and goods across continents has left traces in the fauna of this regions, esp. though tramp species and, in case of crops and domesticated animal with associated parasites, in the fauna and flora of this region.

Therefore, it is surprising to find only casual studies for this region: starting with WERNER in 1901, then BURR (1947, 1952a, b), WEIDNER (1957) and MARAN (1977) to HAAS & HENDERICKX (2002) mark the major steps in the research. ÖNDER et al. (1999) listed data of the Dermaptera collection of LEMT (Lodos Entomological Museum, Izmir, Turkey), KOCAREK (2007) added a new record to the Turkish earwig fauna, and TEZCAN & KOCAREK (2009) examined the fauna of cherry orchards in western Turkey. So far, 21 species and subspecies belonging to 5 genera of Dermaptera have been recorded from Turkey (HAAS 2010).

The publication of TEZCAN & KOCAREK (2009) is the only study focusing on ecology of Dermaptera of Turkey, while all other mentioned contributions are concerned with taxonomic or faunistic problems.

The aim of this study is to evaluate the Dermaptera fauna in Bozdağlar mountain in Western Turkey. The results provide ecological and faunistic data of earwigs in Turkey.

Material and Methods

Study Area

Studies have been conducted at five counties at Bozdağlar Mountain (2157 m), Western Turkey (Figure 1). Type of vegetation and agricultural practices determination the environment found in the counties:

1. Natural areas (chestnuts, pines and oaks forest):

Chestnuts biotopes: Aged 40 to 70 years *Castanea sativa* MILLER is the common plant species. There are also *Trifolium bocconei* 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.

2. Seminatural areas (near edges of running water, various types of unforested habitats such as meadows and other grassland, burnt forest, maquis forest):

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.

3. Cultivated landscapes (orchards of cherries, walnuts, apples, figs, pears and olives):

In the gardens which have only occur the related trees (each orchard has only one tree species).

The material referred to in this study is deposited in the Lodos Entomological Museum (LEMT), Department of Plant Protection, Aegean University (Izmir, Turkey) and in the private collection of the first author. Material were identified by the first and second author. Taxonomy and higher classification follows HAAS (2009). Material have been collected by two methods. Those were pitfall traps method and using hibernation trap bands.

Sampling

a) Pitfall traps:

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.

Table 1: Detailed information on biotopes of pitfall trap methods.

Region	Prov.	County	Period	Biotopes	Coordinate	Altitude (m)
1	Izmir	Bozdağ	2001	Meadow	38°20'28"N/ 28°06'49"E	1470
				Oak forest	38°18'27"N/ 28°02'02"E	1310
				Chestnut forest	38°19'97"N/ 28°06'59"E	1160
				Maqui forest	38°18'23"N/ 28°02'04"E	1030
				Semiaquatic biotopes	38°24'39"N/ 28°04'26"E	1050
2	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
3	Manisa	Çıkrıkçı	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

b) Hibernation trap-bands:**Table 2:** Detailed information on biotopes of hibernation trap-band methods (*setting period of trap-bands (October), collected February the following year).

Region	Prov.	County	Years*	Biotopes	Coordinate	Altitude (m)
1	Manisa	Çıkrıkçı	2005 & 2006	Fig	38°28'24"N/ 27°49'30"E	120
				Olive	38°28'22"N/ 27°49'28"E	120
				Pear	38°28'21"N/ 27°49'31"E	120
2	Manisa	Kuşlar	2004, 2005 & 2006	Cherry	38°21'44"N/ 27°49'58"E	820
				Chestnut	38°21'48"N/ 27°49'57"E	820
				Walnut	38°21'41"N/ 27°49'56"E	820
3	Manisa	Ovacık	2005 & 2006	Apple	38°22'45"N/ 27°51'06"E	930
				Cherry	38°22'45"N/ 27°51'06"E	930
				Pine	38°22'45"N/ 27°51'06"E	930

At each biotope hibernation trap bands in 70 x 250 m size made of hemp sack were rounded to the trunk of six trees in the beginning of October and removed in next February and collected material were determined. A total of 18 hibernation trap-bands were placed in each biotope. Detailed information on the biotopes of hibernation trap-bands is given in Table 2.

Results

In total, 1318 specimens of 7 species belonging to 4 genera of Dermaptera have been recorded by pitfall traps and hibernation trap-bands in Bozdağlar Mountain, Western Turkey during the years of 2001-2007 have been evaluated. Those species are *Forficula aetolica* BRUNNER 1882; *F. auricularia* LINNAEUS 1758; *F. lurida* FISHER 1853; *F. smyrnensis* AUDINET-SERVILLE 1839; *Guanchia hincksi* (BURR 1947) (Forficulidae); *Isolaboides kosswigi* (BURR 1947) (Spongiphoridae) and *Labidura riparia* (PALLAS 1773) (Labiduridae).

Pitfall trap studies

Table 3: Number of specimens collected by pitfall traps in different counties and their percent dominance values.

Location and year	Bozdağ		Dağmarmara		Çıkrıkçı		Sum	Dominance Value (%)
Species	2001	2003	2006	2005	2006			
<i>F. aetolica</i>			1		3	4	0.39	
<i>F. auricularia</i>		5	9	7	2	23	2.22	
<i>F. lurida</i>	1	1	2	30	19	53	5.11	
<i>F. smyrnensis</i>		2				2	0.19	
<i>L. riparia</i>				2	2	4	0.39	
<i>I. kosswigi</i>	84	418	448			950	91.70	
Total	85	426	460	39	26	1036	100.00	
	85	886		65		1036		

A total of 1036 specimens representing six species of Dermaptera were collected at three counties between the years of 2001-2006 (Table 3). Among these, four species belonged to Forficulidae, while the other two species are members of Labiduridae and Spongiphoridae. The most frequently caught species in three counties was *F. lurida*, with percent dominance value of 5.11 %. *F. aetolica*, *F. auricularia* and *I. kosswigi* were collected at two counties and *F. smyrnensis*, *L. riparia* were caught at one location.

The most abundant species is *I. kosswigi* with 950 specimens and percent dominance value of 91.70 %. This species was not found in Çıkrıkçı. The species of *F. aetolica*, *F. smyrnensis*, *L. riparia* were collected only occasionally, with the abundance being less than 1 %.

The total number of the specimens collected during two years' collection in Dağmarmara was 886 (85.52 %) and in Çıkrıkçı was 65 (6.27 %). It was 85 (8.20 %) in Bozdağ during one year collection period.

The number of collected specimens and species by pitfall traps at each biotope is given in Table 4.

Table 4: The number of collected specimens and species by pitfall traps at each biotope in Western Turkey [Ch (Chestnuts), Ma (Maquis), Me (Meadow), Oa (Oaks), Sa (Semiaquatic), Pi (Pines), Fi (fire-influenced)].

Biotores	Ch	Ma	Me	Oa	Sa	Pi	Fi	Total
<i>F. aetolica</i>			1	3				4
<i>F. auricularia</i>		1	7	11		4		23
<i>F. lurida</i>		4	13	23	1	12		53
<i>F. smyrnensis</i>	2							2
<i>L. riparia</i>					4			4
<i>I. kosswigi</i>	132	17	84	327	33	336	21	950
Number of specimens	134	22	105	364	38	352	21	1036
Number of species	2	3	4	4	3	3	1	6

Among the biotores, the majority of the specimens were collected from oaks biotope (364) and pines biotores (352); the least specimens were collected from fire-influenced biotores (21) and maquis biotores (22). The number of species was 4 at meadow and oak biotores; 3 at maquis, semiaquatic and pines biotores; 2 at chestnuts biotores and 1 at fire-influenced biotores.

Seasonal dynamics

Of seven species recorded during this study, only *I. kosswigi*, *F. lurida* and *F. auricularia* were collected in higher number of specimens that allows us to evaluate their seasonal dynamics on the localities (Fig. 2). Three species were collected in April, August and October and four species were collected in May, June, July and September. A total of 325 specimens were collected in July.

F. auricularia was recorded in spring period (April and May) as well as in autumn (September and October), but it was absent in June and August. This species were recorded from biotores in Çıkrıkçı and Dağmarmara 150-980 m above sea level.

I. kosswigi, occurred in the whole period of sampling among April to October. The number of specimens of this species increased from April to July and reached peak level in July. In August and September it decreased again and in October the number reached up to 159. All specimens of *I. kosswigi* were recorded from Bozdağ and Dağmarmara altitudes between 620 to 1470 m. The localities (Bozdağ and Dağmarmara) are more humid, with scarce rain even through summer period. For that reason the species occurred with peaks in the whole period of summer.

F. lurida occurred in the whole period of sampling among April to October with peaks in May and September. The number of specimens of this species is less abundant in April and August. Most of specimens of *F. lurida* were recorded from Çıkrıkçı altitudes between 110-220 m. from May to October there is a rainless period at this locality. For that reason the species is less abundant in the whole period of summer.

Hibernation trap-band studies

Totally 282 specimens representing six species of Dermaptera were collected at three counties during the autumn and winter periods of the years of 2005-2007 (Table 5). Among these, five species belong to Forficulidae, while only one belongs to Spongiphoridae. The most frequently collected species in three counties were *F. lurida*

and *I. kosswigi* with percent dominance value of 50.71 and 41.49 %, respectively. *F. smyrnensis* and *F. aetolica* were collected at two counties with percent dominance values of 3.90 and 1.42 %, respectively. *F. auricularia* and *G. hincksi* were caught at one location with percent dominance values of 1.77 and 0.71 %, respectively.

Table 5: Number of specimens collected by hibernation trap-bands at different counties and their percent dominance values.

Location and year	Ovacık		Kuşlar			Çıkrıkçı		Sum	Dominance Value (%)
	2006	2007	2005	2006	2007	2006	2007		
<i>F. aetolica</i>		1				3		4	1.42
<i>F. auricularia</i>						1	4	5	1.77
<i>F. lurida</i>	1		1	3	2	91	45	143	50.71
<i>F. smyrnensis</i>	3		2	1	5			11	3.90
<i>G. hincksi</i>				2				2	0.71
<i>I. kosswigi</i>	33	25	24	22	11	2		117	41.49
Total	37	26	27	28	18	97	49	282	100.00
	63		73			146		282	

The total number of specimens collected during two years in Çıkrıkçı was 146 (51.77 %) and in Ovacık 63 (22.34 %). It was 73 (25.89 %) in Kuşlar during three years collection period.

The number of collected specimens and species of each biotope is given in Table 6.

Table 6: Biotopes of Dermaptera species collected by hibernation trap-bands in Western Turkey [Ol (Olive), Ap (Apple), Fg (Fig), Pe (Pear), Ce (Cherry), Wl (Walnut), Pi (Pine), Ch (Chestnut)].

Biotopes	Ol	Ap	Fg	Pe	Ce	Wl	Pn	Ch	Total
<i>F. aetolica</i>	3	1							4
<i>F. auricularia</i>	2		3						5
<i>F. lurida</i>	56	1	58	22	6				143
<i>F. smyrnensis</i>		2			9				11
<i>G. hincksi</i>					2				2
<i>I. kosswigi</i>		19	2		13	21	39	23	117
Number of specimens	61	23	63	22	30	21	39	23	282
Number of species	3	4	3	1	4	1	1	1	6

The number of specimens at fig was 63 and olive was 61 among eight biotopes. Their numbers changed between 21 and 39 in other biotopes. Number of species was 4 at apple and cherry biotopes and it was 3 at olive and fig biotopes. The number of species was one at the biotopes of pear, walnut, pine and chestnut.

Discussion

In this study to determine the Dermaptera fauna of Bozdağlar Mountain, we used pitfall traps and hibernating trap bands to collect them. Using pitfall traps is a standard method to collect earwigs. But hibernation trap-bands were used for the first time with respect to Dermaptera. Artificial hibernation trap-bands have great importance in both the protection of fauna and also in extending its life-span. In this study, the artificial hibernation

places that have been used as hibernation trap-bands, are utilized for the evaluation of fauna of different biotopes.

In total, 1.318 specimens of the Dermaptera were collected at all location by different methods. 1036 of which were collected by pitfall traps and 282 by hibernation trap-bands. *I. kosswigi* is the most abundant species with 1067 specimens (81 %), 950 of which were collected by pitfall traps and 117 by hibernation trap-bands. *F. lurida* other dominant species with 196 specimens (15 %), 143 of which were collected by hibernation trap-bands and 53 by pitfall traps.

L. riparia is an important biological control agent in at least some field crops such as soybeans and peanuts, attacking lepidopterous pests such as *Helicoverpa* spp. (PRICE & SHEPARD 1978; GODFREY et al. 1989; KARBOUTLI & MACK 1991). The specimens collected were found sandy parts along the running water, which is the typical preferred substrate of its species. The very low number of specimens found (about 8) suggest a negligible predation at the studied site, which may have to – unexamined and not mutually exclusive explanations – that they are generally rare or do not penetrate, in general, into the examined habitats but prefer the on sandy underground.

F. auricularia is a cosmopolitic earwig species, probably distributed by man, since it is one of the few species to appear synanthropic, and causes considerable damage in orchards and garden ornamentals where it destroys both fruit and flowers. However, according ALBOUY & CASSANEL 1990, this species is omnivorous, sometimes with carnivorous or herbivorous preferences. So *F. auricularia* is also an important predator in fruit orchards and is capable of suppressing outbreaks of pest species, such as pear psyllid and various apple aphid species. However, *F. auricularia* populations are very unstable, showing large between-year variation in densities, which limits their practical use (MOERKENS et al. 2008). This species is not common in the study area, especially cultivated landscape, which may suggest competitive disadvantages for *F. auricularia* compared to the other *Forficula* species.

According to HAAS & HENDERICKX (2002), *F. lurida* is carnivorous, based on the examination of the gut of a few specimens. Little is known of its remaining biology but it is certainly the most abundant of the examined *Forficula* species. Our data suggest a preference of lowland climate, possibly avoiding low winter extremes.

ALBOUY & CASSANEL (1990) suggested that *F. smyrnensis* is herbivorous, which was confirmed by a gut contents examinations (HAAS & HENDERICKX 2002). KINAL (2007), presented a study for its biology in Hungary, around Lake Balaton.

I. kosswigi the most abundant species in the study, but nothing is known on its feeding habitats. According to our observations on field trips through Western Turkey and this study, *I. kosswigi* prefers high elevations, obviously physiologically or behaviourally resistant to low temperatures and was very abundant between 620 to 1470 m in our sample.

The biology of *F. aetolica* and *G. hincksi* are unknown and our study can not add significantly to this for the low number of specimens found. It is hoped that current data will be contributed other studies that will be carried out in Turkey.

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Zusammenfassung

Aus diversen Fallen im Zeitraum 2001 bis 2007 gesammeltes Dermapterenmaterial vom Bozdağlar Gebirge in der Westtürkei wurde untersucht. Folgende 7 Arten aus 4 Gattungen konnten nachgewiesen werden: *Forficula aetolica* BRUNNER 1882, *F. auricularia* LINNAEUS 1758, *F. lurida* FISHER 1853, *F. smyrnensis* AUDINET-SERVILLE 1839, *Guanchia hincksi* (BURR 1947), *Isolaboides kosswigi* (BURR 1947) und *Labidura riparia* (PALLAS 1773).

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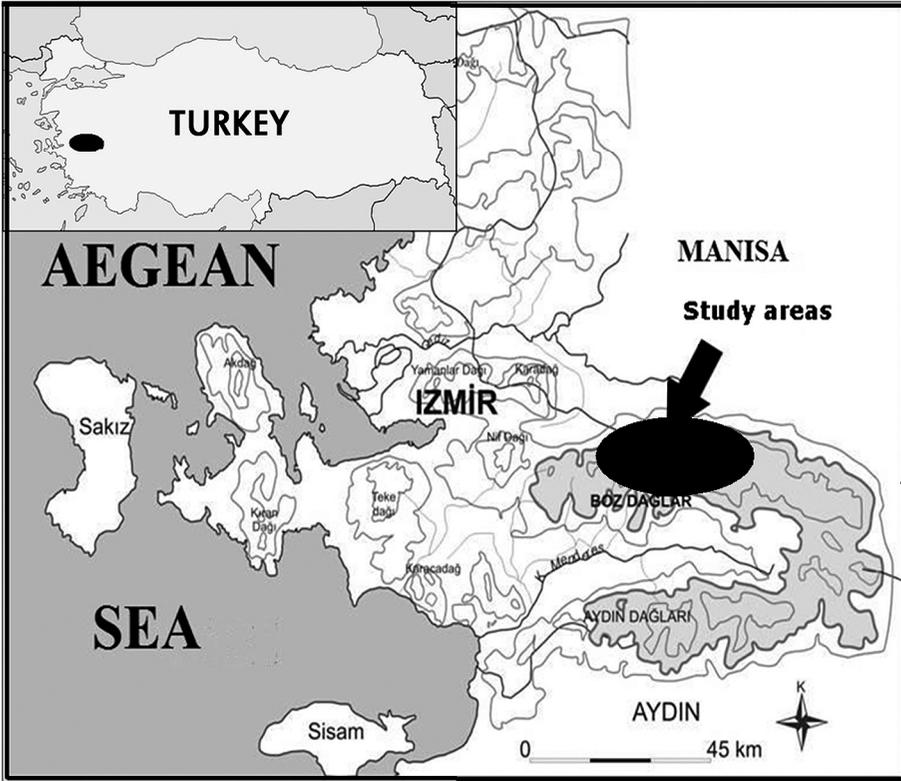


Fig. 1: Study areas at Bozdağlar Mountain, Western Turkey.

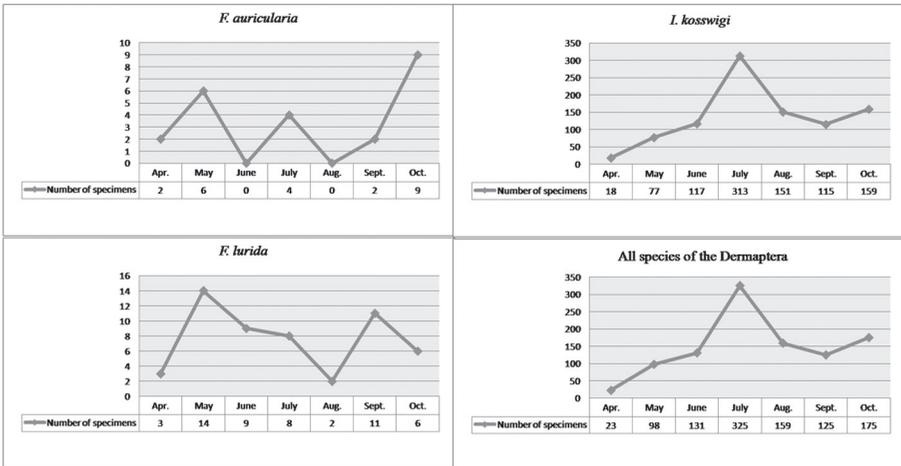


Fig. 2: Total number of specimens of *F. auricularia*, *I. kosswigi*, *F. lurida* and all species of the Dermaptera during sampling period, April to October, by pitfall traps.

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