

## *Notes on Seasonal Dynamics of Paederus fuscipes Curtis, 1826 in Western Anatolia, Turkey (Coleoptera: Staphylinidae: Paederinae)*

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**Abstract.** The seasonal activity of *Paederus fuscipes* Curtis, 1826 was studied between May-November in 2013 and 2014 in ten localities situated of five provinces in western Anatolia, Turkey. In generally, their number start to increase from May, reaches a high level in early and mid-June, decreases in July and August, which is the dry season, and reaches the highest level in early and mid-September. It was determined that *P. fuscipes* reach large populations particularly wet and hot weather and after rain.

**Key words:** Staphylinidae, Paederinae, *Paederus fuscipes*, seasonal dynamics, western Anatolia, Turkey.

### Introduction

Species of the genus *Paederus* Curtis, 1826 are generally 6-10 mm in length, remarkable with the coloring of their body. These species can be found in almost any habitat depending on humidity and water. However, they are more common in the banks of rivers, creeks, lakes and dams, wetlands and wet agricultural areas. According to FRANK (1988), about 600 species are known worldwide. In the Palearctic Region, 95 species are distributed belonging to 9 subgenera (SCHÜLKE & SMETANA, 2015). Six *Paederus* species currently occur in Turkey (ANLAŞ, 2009). At least, 20 species of the genus *Paederus* are known to contain the unique hemolymph toxin pederin, which causes *Paederus* dermatitis (FRANK & KANAMITSU, 1987).

This dermatitis has been described by VORDERMANN (1901) for the first time, and PAVAN & BO (1953) named this toxic

substances causing dermatitis "Pederin", which is very complex and a non-protein substance (QUILICO *et al.*, 1961; VIEIRE *et al.*, 2014). Its importance comes from its very powerful cytotoxic contents, so that it has effects that are more powerful than the toxins of Black Widow Spider (= *Latrodectus* sp.) and Cobra (= *Naja* sp.), about 15 folds (FRANK, 2008). It blocks the protein and DNA syntheses in eukaryotic cells, while it does not impair the prokaryotic cells; however, although it inhibits the DNA synthesis, it does not affect the RNA synthesis (KELLNER & DETTNER, 1996; FRANK & KANAMITSU, 1987; PAVAN, 1963, 1975; SOLDATI *et al.*, 1966). Pederin also cause various lesions on the human skin. Existence and effects of pederin in Chinese sources goes back to past 1300 years; in these sources, it is mentioned that pederin causes swelling and peeling of the skin. It has been reported that pederin was used to function

as caustic (NaOH), against boiling toxic substances and in the treatment of nasal polyp and ringworm. (FRANK & KANAMITSU, 1987; NARQUIZIAN & KOCIENSKI, 2000).

*Paederus fuscipes* Curtis, 1826 one of the most common and best known species in the genus *Paederus* in the world. This species is commonly spread in Afrotropical, Australia and Oriental regions apart from the Palearctic region. *P. fuscipes* is common in settlement and agricultural areas, and they are known as beneficial because it feeds on some insects, e. g. species of *Corcyra* sp., *Heliothis* sp. and *Aphis* sp., that cause significant damages particularly in agricultural landscapes, e. g. in cotton, wheat, rice, maize and vegetable fields (BERGLIND *et al.*, 1997; KRAKERB *et al.*, 2000; DEVI *et al.*, 2003; KOMALA *et al.*, 2003; NASIR *et al.*, 2012). Their light orientation behavior allows them to be observed when flying around bright and powerful light sources at nighttime.

The cases with lesions caused by *Paederus* species in the world were first reported from India (STRICKLAND, 1924), and hundreds, even from some places, thousands of cases have been reported from South America, Africa, Mediterranean Countries, Pakistan, Iraq and Iran. Of these, a very significant portion of these are epidemics caused by *Paederus fuscipes*. There are also some cases reported from Turkey and known as caused by *P. fuscipes*. Likewise, 46 cases have been reported from Aydın province (ŞENDUR *et al.*, 1999). 204 patients have been reported from Çukurova University Hospital, Adana who were affected from this dermatitis and applied between 1995 and 1997 (USLULAR *et al.*, 2002). 16 patients have been recorded in Denizli province (ERDOĞAN *et al.*, 2006). However, it is believed that there are many other unknown cases because adequate records for these cases are not kept in Turkey, and also public health specialists do not know this dermatitis.

Too little studies have been carried out on the ecology and phenology on *Paederus fuscipes*, which is important in both public health and agricultural senses up to now.

Knowing about the seasonal activity of this species will be beneficial for the future ecological studies on this species.

Up to now, there is no comprehensive data on seasonal dynamics of *Paederus fuscipes* have been published in Turkey. In this study, seasonal activity of *Paederus fuscipes* was determined with a study spread to two years, for the first time in the world.

## Material and Methods

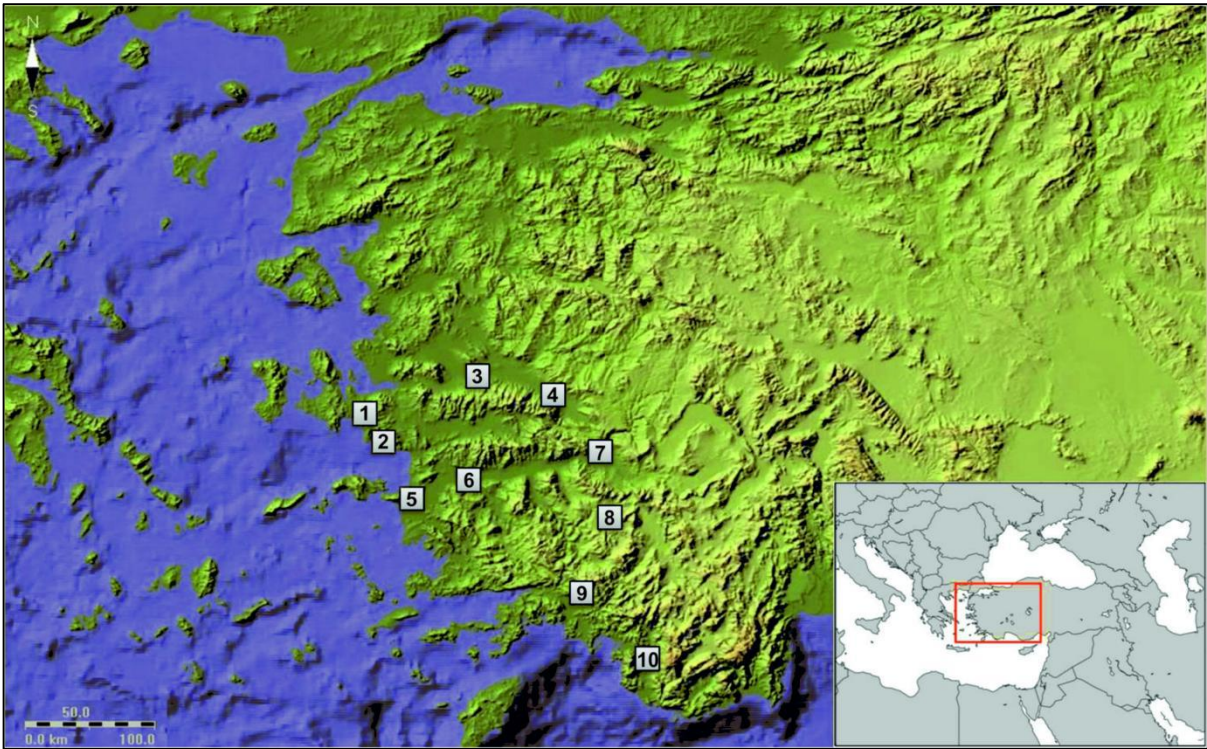
*Study Area.* To determine the seasonal activity of *P. fuscipes*, ten light traps were laid in two areas in each of the five provinces; Izmir: Menderes and Seferihisar; Manisa: Alaşehir and Turgutlu; Aydın: Söke and central district; Denizli: Buldan and Tavas; Muğla: Fethiye and Köyceğiz (Table 1; Fig. 1); in western Anatolia between May and November in 2013 and 2014. The maps (Fig. 1) were generated using Earth Explorer 6.1 and the online mapping tool of the Seaturtle website (Seaturtle.org, 2002).

Western Anatolia includes in the Mediterranean climate, which is characterized by dry, hot summers and mild, moist winters. But, variation in temperatures and average rainfalls different from study areas. In generally, the rainy season from November to May and from June to late October there is a rain-less period at these localities. Average temperature and average rainfall amount of studied localities are provided in Fig. 2.

*Sampling.* For this study, ten light traps were settled in 1 May 2013 and all localities were visited in ca. 14-day intervals from mid May to the ending of November during 2013 and 2014. All insect samples were placed into a plastic jars and transported to the laboratory, where *Paederus* species were separated from insect material. The specimens were preserved in 70 % alcohol. The morphological studies were conducted using a Stemi 2000-C microscope (Zeiss, Germany). The collected specimens referred to in this study are deposited in the collection of the Alaşehir Zoological Museum, Manisa (AZMM) of the Celal Bayar University.

**Table 1.** Provinces and localities of light trapping study area.

Provinces	Localities	2013-2014
Izmir	1. Seferihisar, 38°12'10"N, 26°50'23"E	1 May-1 November
	2. Menderes, Tahtalı Dam, 38°05'52"N, 27°01'55"E	
Manisa	3. Turgutlu, Çıkrıkçı, 38°28'06"N, 27°49'06"E	1 May-1 November
	4. Alaşehir, Baklacı, 38°22'23"E, 28°31'36"E	
Aydın	5. Central district, Adnan Menderes University, Agriculture Faculty garden, 37°45'37"N, 27°45'27"E	1 May-1 November
	6. Söke, Güllübahçe, 37°40'02"N, 27°18'59"E	
Denizli	7. Buldan, Yenicekent, 38°02'48"N, 28°56'13"E	1 May-1 November
	8. Tavas, 37°34'05"N, 29°03'18"E	
Muğla	9. Köyceğiz, Yaylaköy, 37°01'50"N, 28°45'02"E	1 May-1 November
	10. Fethiye, Girmeler, 36°36'51"N, 29°22'11"E	

**Fig. 1.** The localities of light trapping study area in western Anatolia, Turkey.

### Results and Discussion

Based on the results obtained, 10.332 specimens of *Paederus fuscipes* were collected by the ten light traps were laid in two areas in each of the five provinces in western Anatolia between May and November in 2013 and 2014 (Table 2). The location that specimens of the *P. fuscipes* species were found most intensely was determined as the central district of Aydın province with 3.410 specimens, followed by Turgutlu (Manisa

province) with 1.404 specimens and Buldan (Denizli) with 1.392 specimens. The location that specimens with smallest number were collected was Köyceğiz (Muğla) with 165 specimens. Total 2.671 and 7.651 specimens were collected in the years 2013 and 2014, respectively.

The seasonal activities of *P. fuscipes* in the areas that light traps were laid were evaluated separately below (Fig. 3A-J): in the locality of Menderes (Izmir), this specimen reached the highest number in the



first half of June; number of specimens collected in 2014, with 764 specimens, are greater than seven folds of the number collected in 2013, with 105 specimens. (Fig. 3A). 549 specimens in total were collected from Seferihisar (Izmir) locality within both years. Considering the activities of the *P. fuscipes* caught urban area, it is understood that they exist throughout the collection period. Based on this, it was found that they continued their activities during July and August, even with low levels. The reason for this was related to the presence of wet or damp areas (parks and gardens) continuously within the city (Fig. 3B).

Central District of Aydın province was the area that the seasonal activity of this species was studied the best. While 1.167 specimens have been collected within the first year; specimens in a record number, that is, 2.243 specimens were caught within the second year. While the numbers were less throughout July and August, they were seen throughout the entire collecting period. They were collected in great numbers particularly throughout May and the first half of June and within September. The number reached 613 particularly in the first half of September, 2014 (Fig. 3E). In the light trap laid in Söke (Aydın), *P. fuscipes* species first appeared in the first period of May 2013; however, it then started to become gradually lower in number, and it was never collected between the second half of July and early September. After this time, the number increased gradually and reached the highest number in the first half of October with 43 specimens, and then the number started to decrease again. It was never seen after the second half of October. Activity of this species in 2014 is similar to that of 2013. However, in contrast with 2013, intensity of the species continued till the mid-June (Fig. 3F).

Buldan (Denizli) is one of the locations that this species is found abundantly. While 389 specimens have been collected in 2013, 1003 specimens were caught in 2014. Seasonal activity of the species resembles the activity in central district, Aydın province (Fig. 3G). Tavas (Denizli) is a location that specimens were found in small

numbers, and it has been found that the highest number was reached in the second half of May. Specimens were either not collected at all, or collected in very small numbers (Fig. 3H).

Turgutlu (Manisa) is the locality that specimens in the greatest numbers were collected after the central district of Aydın. 274 specimens were collected in the first year of the sampling period, and 1.130 specimens were collected in the second year. It is seen that the seasonal activity of the species resembles the activities in localities in Aydın and Denizli provinces (Fig. 3C). This species reached the highest numbers in May and in the first half of May in 2013 in Alaşehir (Manisa) locality. While only 9 specimens were collected in July and August 2013, total 128 specimens were found in 2014. In addition, presence of specimens in a significant number in July, 2014 is related with the precipitations in this period (Fig. 3D).

The light trap laid in Fethiye (Muğla) is the only locality that *P. littoralis* species was caught together with *P. fuscipes*; however, only three specimens were caught. When the seasonal activity of *P. fuscipes* species is considered, it is seen that while 66 specimens were collected in 2013, 731 specimens were collected in 2014. Although the number of specimens collected in 2013 is small, it was possible to collect specimens throughout the year. However, no specimens were caught in August, 2014. The greatest number of specimens was found in the second half of May and first half of September in 2014 (Fig. 3J). Köyceğiz (Muğla) locality was the area that specimens of this species were caught in the smallest numbers. It was possible to collect only 30 specimens in 2013 and 135 specimens in 2014. It is thought that the altitude of the village that the trap was set was about 1.000 meters and therefore temperatures at the evening and night are low. The small number of the specimens of the species caught does not allow the evaluation of the seasonal activity (Fig. 3I).

When the seasonal activity of *P. fuscipes* is considered in the general sense, it is seen that, despite the small differences between

areas, their number start to increase from May, reaches a high level in early and mid-June, decreases in July and August, which is the dry season, and reaches the highest level in early and mid-September. It is also seen that their numbers decrease with the lowering temperatures, and reach the lowest number in November. Based on both the specimens caught in the light trap and our observations, it was determined that *P. fuscipes* reach large populations particularly wet and hot weather and after rain.

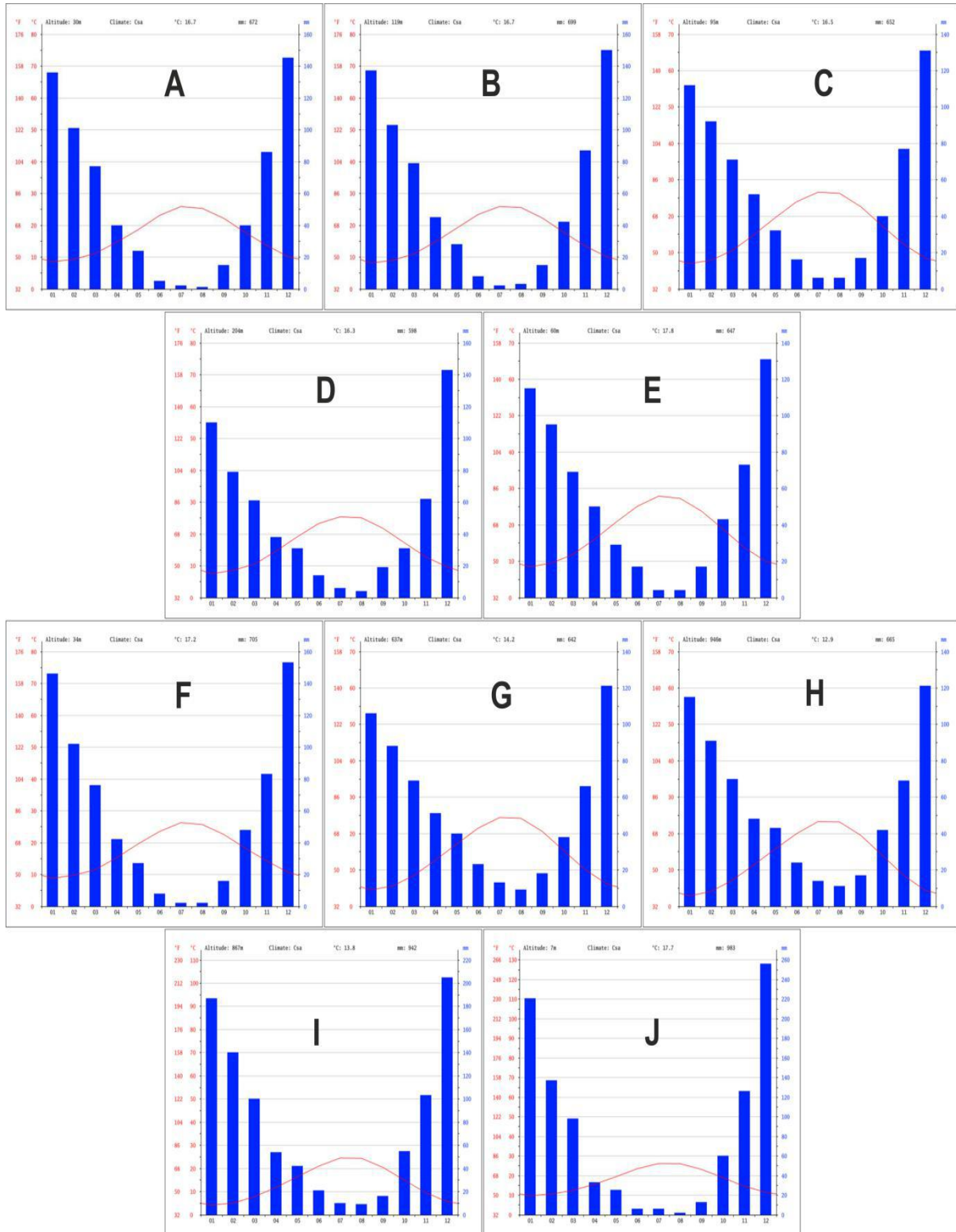
There are only a few publications about, even partially, the intensities and seasonal activities of *Paederus* species. In a study, on the three *Paederus* species found in Iran, it has been reported that these species are active between May and September, and the *P. fuscipes* species is mostly active between 09:00 p.m. and 10:00 p.m. (ABBASIPOUR & TAGHAVI, 2005). In another study, ZAGARI *et al.* (2003), *Paederus* species

were more active in hot and damp weather and were seen between May and September in Iran. Similar findings are seen in some other studies also (e. g. MANLEY, 1977; NASIR *et al.*, 2012). A study carried out on insects of Iran with medical significance have shown that *Paederus* species are most commonly seen between May and August based on the specimens collected with the help of a light trap (NIKBAKHTZADEH & TIRGARI, 2008). AL-DHALIMI (2008) found that this species was mostly active in May based on the cases seen in Najaf City in Iraq.

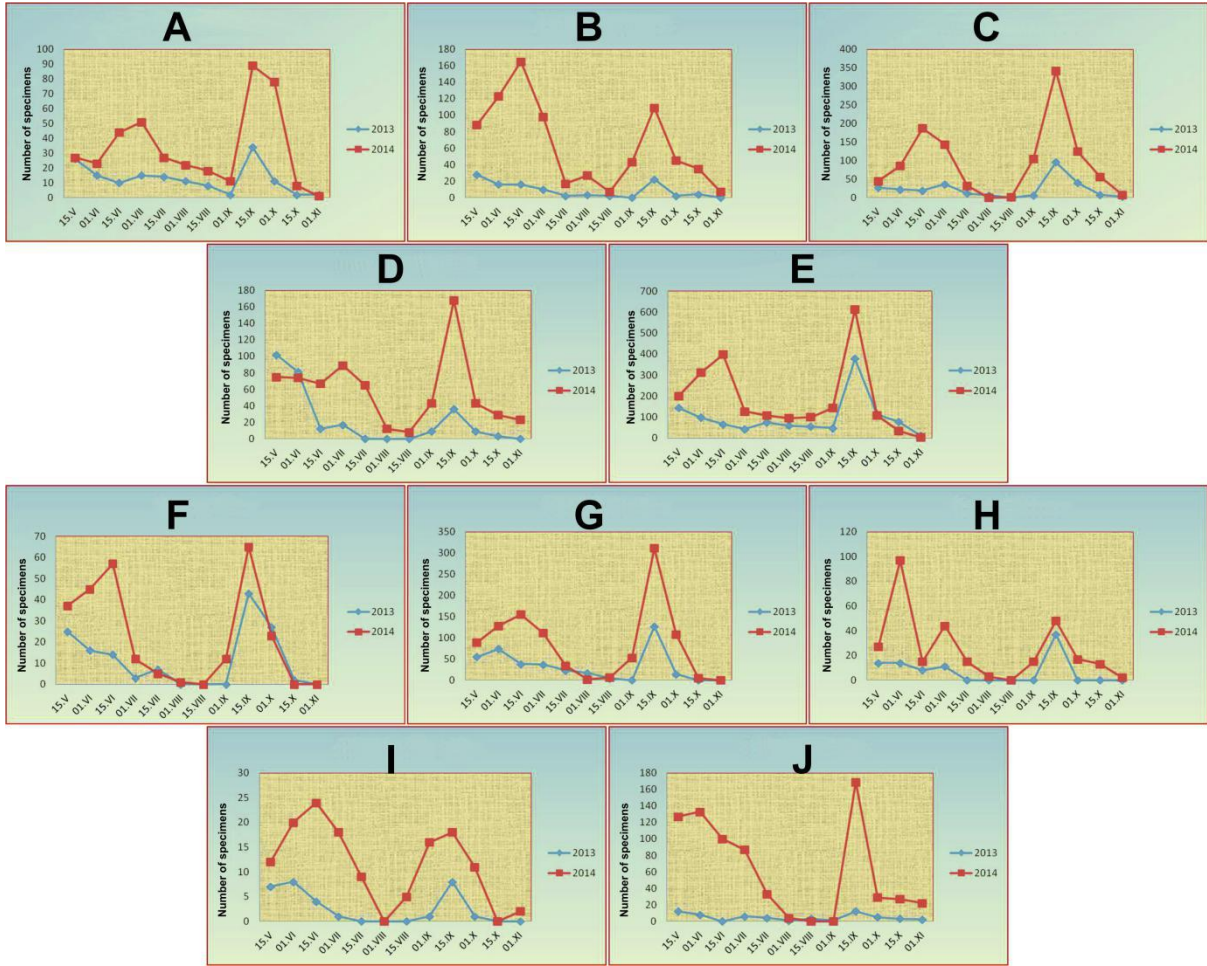
All those said in the studies cited above related to the seasonal activities of species are basically observational and short-term data, and they have been taken here without being adequately based on digital and/or statistical data. However, it has been seen upon comparison with our study, it was seen that they were generally consistent with our results.

**Table 2.** Number of *Paederus fuscipes* specimens collected in the studied localities in western Anatolia during 2003 and 2004 for this study.

Provinces	Localities	Year	Collecting dates												Total
			15.V	01.VI	15.VI	01.VII	15.VII	01.VIII	15.VIII	01.IX	15.IX	01.X	15.X	01.XI	
Izmir	Menderes	2013	28	16	16	10	2	3	2	-	22	2	4	-	105
		2014	88	123	165	98	17	27	7	43	109	45	35	7	764
	Seferihisar	2013	26	15	10	15	14	11	8	2	34	11	2	2	150
		2014	27	23	44	51	27	22	18	11	89	78	8	1	399
Manisa	Turgutlu	2013	27	22	19	36	11	6	-	6	96	40	8	3	274
		2014	45	86	187	144	32	-	1	105	342	124	56	8	1.130
	Alaşehir	2013	102	81	12	17	-	-	-	9	36	9	3	-	269
		2014	75	74	67	89	65	12	8	43	168	43	29	23	696
Aydın	Central District	2013	144	97	66	43	74	60	54	48	377	114	78	12	1.167
		2014	201	312	399	127	108	96	100	143	613	107	34	3	2.243
	Söke	2013	25	16	14	3	7	-	-	-	43	27	2	-	137
		2014	37	45	57	12	5	1	-	12	65	23	-	-	257
Denizli	Buldan	2013	55	74	38	37	23	17	4	-	127	14	-	-	389
		2014	89	128	155	111	34	2	6	53	312	108	5	-	1.003
	Tavas	2013	14	14	8	11	-	-	-	-	37	-	-	-	84
		2014	27	97	15	44	15	3	-	15	48	17	13	2	296
Muğla	Köyceğiz	2013	7	8	4	1	-	-	-	1	8	1	-	-	30
		2014	12	20	24	18	9	-	5	16	18	11	-	2	135
	Fethiye	2013	12	8	6	6	4	1	3	1	12	5	3	2	63
		2014	127	133	100	87	33	4	-	-	169	29	27	22	731
TOTAL		2013 and 2014	1.168	1.392	1.406	960	480	265	216	508	2.725	808	307	87	10.322



**Fig. 2A-J.** Average temperature and average rainfall amount in the studied localities in western Anatolia: A - Seferihisar, B - Menderes, C - Turgutlu, D - Alaşehir, E - Aydın, central district, F - Söke, G - Buldan, H - Tavas, I - Köyceğiz, J - Fethiye. (Source: [tr.climate-data.org](http://tr.climate-data.org)).



**Fig. 3A-J.** Seasonal dynamics of *Paederus fuscipes* on the studied localities in western Anatolia during 2003 and 2004. A - Seferihisar, B - Menderes, C - Turgutlu, D - Alaşehir, E - Aydın, central district, F - Söke, G - Buldan, H - Tavas, I - Köyceğiz, J - Fethiye.

### Conclusions

The data obtained in the current study showed that the most dominating and common species in the western Anatolia is *Paederus fuscipes*, with 10.322 specimens. This, also indicates that it can reach high numbers large enough to threaten public health.

According to our findings, the months that have high risk of epidemics caused by *Paederus dermatitis* in the western Anatolia includes May, June and September. The most risky province is the Aydın province. Particularly, the large number of specimens trapped in the traps we have laid in the Adnan Menderes University, Agriculture Faculty garden located in the center of Aydın province had led to the conclusion that Aydın province can encounter the risk

of *Paederus* epidemics from time to time. However, their presence in large numbers in the agricultural lands in Aydın (particularly in cotton fields), as seen in our field studies, is a positive sign for agriculture, because *Paederus fuscipes* is the predator of many harmful species in the agricultural sense. We estimate that specimens collected in 2014 being larger in number as compared to those collected in 2013 is related to the heavy showers recorded in June and September following the winter and spring seasons that were dry. However, no such intense rain was recorded in these months of 2013. *P. fuscipes* species had reached large numbers especially following the showers, and therefore they were caught in our traps. Seasonal activities of *Paederus* species are closely related with the humidity level.



Based on our observations, their population reached large numbers particularly in humid weathers and following rain in all light trapping localities.

Although the *Paederus* species and pederin substance are important in medicine and agriculture, they have not been investigated adequately yet. The reasons for this can be listed as the difficulties of the identification of *Paederus* species, taxonomic confusions in their classification, inadequacies in the information related to their distribution and inadequate information about their seasonal activities. On the other hand, the statements related to *Paederus* studies made in the few studies that have been carried out have been reported without being supported sufficiently with digital and/or statistical data. With all these reasons, as a result of this study aiming at removing some deficiencies of knowledge in the literature, the species known in Turkey and the Aegean Region have been determined, and the seasonal activity of the *P. fuscipes* species with a study spread to two years as a first in the world. Based on our observations, *Paederus* species do not hide below under stones or in the soil in contrast with other staphylinids, and wander around borders of damp places, and their flights and being oriented to light (fluorescent lamps, specially) coincide with evening and night hours. Thus, they reach large numbers particularly at evening hours in hot and moist spring and summer months.

Global warming and changes in precipitation regimes specific to the climatic changes in the world that have been speeded up especially within the last 30 to 40 years have started to affect Turkey and adjacent countries also. With this reason, we foresee that changes will be seen in the seasonal activities of *Paederus* species, and their numbers can increase rapidly in relation with sudden showers during the hot summer months with the possibility of causing significant health problems. Likewise, the variations in the numbers of specimens trapped between 2013 and 2014 according to both years and months and the numbers of specimens trapped after rain in

summer months in our study confirm this foresight.

More studies on the ecology and phenology of *Paederus* species are needed, which is important in both public health and agricultural senses. It is hoped that current data on the species of *Paederus* will be contributed more studies that will be carried out in other countries.

### Acknowledgments

This study was supported by the Scientific and Technological Research Council of Turkey (TUBITAK, project no. 112T907).

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Received: 03.02.2017  
Accepted: 26.06.2017