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Full Length Research Paper

Studies on the annual population and effect of weather factors on the activity of certain Staphylinidiae species indicated by two different light traps in Qena Governorate, Egypt, with reference to height effect

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In the present work, four light traps were operated from sunset to sunrise once every three nights (from March, 2007 to February, 2009); these are Robinson mercury vapor light trap and "Jermy-type" light trap, to demonstrate the annual population fluctuations, height effect and effect of weather factors on the activity of four species of family Staphylinidae, namely *Atheta gregaria, Paederus alfierii, Philonthus quisquiliarius* and *Philonthus turbidus.* It is important to hint that, studying the annual population fluctuations of some Staphylinidae species indicates the number of generations per year of considerable number of species differ among the two years. *Paederus alfierii* had two generations per year, while the other species had three generations per year. The largest numbers of individuals were recorded at traps (A and B), and the lowest numbers were recorded at traps (C and D). On the contrary the largest number of *Paederus alfierii* Koch was recorded at traps (C and D), and the lowest number was recorded at traps (A and B). The effect of weather factors on the activity of these species carried out by partial correlation coefficient values on the maximum temperature, minimum temperature, relative humidity and wind velocity at the two levels and for two types of light traps.

Keywords: Weather factors, population, staphylinidiae species and temperature.

INTRODUCTION

The use of different trapping methods has an important role in field samplings of insect populations and assemblages. Taking into consideration that the majority of insect species are active at night, a regular and quantitative survey of their abundance may only be conducted with traps operating automatically.

In 1961, JERMY published the description of his successfully tested light trap type, its directions for use, and the short history of the 10-years-long development of the network (Jermy, 1961).

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The seasonal fluctuation of nocturnal Coleoptera has received much attention, like nocturnal Lepidoptera. In Egypt, Hanna and Hamad (1975d) demonstrated that *Peaderus alfierii* kouch, had two generations per year at Assuit, Hamad and Aly (1985) studied the seasonal fluctuation of certain species of nocturnal Coleoptera.

Several authors studied the effect of elevation on the distribution of insects. Hamad (1972) recorded the flight activity of nocturnal Lepidoptera at different levels as indicated by light traps at Assiut. Aly (1987) on the nocturnal Hemiptera at two levels by light traps at Qena Menendez and Gutierrez (1996) pointed that the elevation and habitat type, often acting together.

There were a lot of studies give attentions to the effect of weather factors on daily fluctuations of nocturnal

Coleoptera in various parts of the world. Hanna and Hamed (1975b) found that daily abundance of *Paederus alfierii* was closely correlated with weather conditions especially at 3.9 and 29.5 feet. Aly (1981) recoded the temperature was the important factors which effect on the distribution and the activity of some species of order Coleoptera. Mohamed (1997) found that temperature had a positive and significant effect on the activity of Coleoptera at station "Agriculture A" during winter 1995 with constant humidity or wind velocity and on *Paederus alfierii* at station "Agriculture B" during autumn 1994 with constant wind velocity.

MATERIALS AND METHODS

The present work was carried out in Qena Governorate (610 Km, southern Cairo) for two years, (from March , 2007 to February, 2009) . The survey was carried out in the experimental farm of Agriculture Faculty, Qena. This area has been cultivated with wheat, clover, corn, alfalfa, vegetables and some ornamental plants.

Sampling Methods

Four light traps were operated from sunset to sunrise once every three nights**.** Records were made (from March 2007 to February 2009) by the first light trap (A) and (from March 2008 to February 2009) by traps (B, C, D). The traps were divided into two groups; each group contains two types of light traps. Robinson mercury vapor light trap fitted with 250 watt bulb (Philips HPL type 57236 G/97), and " Jermy-type" light trap , First group containing traps (A and B) at (latitude 26°11'25.18"N and longitude 32°44'21.08"E), at 1.5 meter from the ground level. Second group, containing traps (C and D) at (latitude 26°11'24.79"N and longitude 32°44'20.61"E), at 12 m from the ground level. Killing box, containing sodium cyanide, was placed beneath the mouth of the trap.

Identification

The Coleoptera species were identified in the Department of Entomology, Faculty of science, Cairo of University.

RESULTS AND DISCUSSION

Results of the present work can be discussed on the light of the literatures that collected. The discussed results will be the annual population fluctuations, effect of height and effect of weather factors.

Annual Population Fluctuations

Four abundant species are chosen to study the annual population fluctuations. The individual's numbers of each species in the two trapping years are given in table 1. The four species namely *Atheta gregaria (Casey, 1856), Paederus alfierii Koch, 1934, Philonthus quisquiliarius (Gyllenhal, 1810)* and *Philonthus turbidus Erichson, 1839.* The annual population fluctuation was calculated by five running means in order to smooth the curve; the smoothed curve was superimposed on the histogram to have an idea about the number of generations. Where, one added to the daily numbers of each species to avoid the zero catches, the numbers were transformed into logarithms Williams (1935, 1937).
It is notes that, there were no catches (from late November to end February).

Atheta gregaria (Casey, 1856)

In the first year, the largest number of individuals was recorded in June at trap (A). In the second year, the largest number of individuals was trapped in July at trap (A) in August at trap (C) and in April at traps (B and D). On other hand, the lowest number of individuals was one and two specimens founded in March at trap (A) of the first year and traps (A and C) of the second year , respectively, in October at trap (B) , and one specimen was recorded in March at trap (D) Table 1.

The annual population fluctuations of this species had three annual peaks in the year. The first peak started from mid March to early May, the second peak started from mid May to early July and the third peak started from early July to early October, Figure 1.

It is obvious that, the largest number of individuals was recorded in August at trap (C). Whereas, the lowest number of individuals was recorded in March at all traps, Table 1.

Paederus alfierii Koch, 1934

In the second year, the largest number of individuals was recorded in June at traps (B and D). On other hand, no catch recorded at trap (A) in the first year, low catch was recorded at traps (A and C) in the second year.

The annual population fluctuations of this species had two annual peaks. The first peak started from late March to early July, the second peak started from early July to mid November at trap (D) Figure 2.

It is obvious that, the largest number of *Paederus alfierii* was recorded in June at trap (B). Whereas, the catches was too low at traps (A and C) of the second year, and there are no catch recorded at trap (A) of the first year Table 1.

Table 1. The monthly fluctuation of four abundant species of family Staphylinidae in each month in the two trapping years (2007-2008 and 2008-2009).

Species	year	Trap	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Atheta gregaria (Casey,1856)	2007-2008	A	1	7	61	123	84	58	19	36	0	0	0	0
	2008-2009	A	2	30	37	55	62	59	13	0	0	0	0	0
		B	0	27	12	0	18	20	0	10	0	0	0	0
		C	2	129	59	94	119	259	33	14	0	0	0	0
		D	1	32	12	0	18	13	0	13	0	0	0	0
Paederus alfierii Koch, 1934	2007-2008	A	0	0	0	0	0	0	0	0	0	0	0	0
	2008-2009	A	0	0	0	1	0	0	1	1	0	0	0	0
		B	2	11	4	79	12	16	9	22	2	0	0	0
		C	0	0	0	0	0	0	0	1	0	0	0	0
		D	2	2	1	47	0	6	4	10	2	0	0	0
Philonthus quisquiliarius (Gyllenhal, 1810)	2007-2008	A	12	28	174	106	105	148	204	42	0	0	0	0
	2008-2009	A	90	90	302	167	127	241	177	41	0	0	0	0
		B	7	12	4	19	18	50	2	20	6	0	0	0
		C	131	166	279	235	240	258	103	61	0	0	0	0
		D	5	5	6	1	20	24	0	23	0	0	0	0
Philonthus turbidus Erichson, 1839	2007-2008	A	0	16	172	131	113	155	42	35	1	0	0	0
	2008-2009	A	17	33	36	142	52	10	6	2	1	0	0	0
		B	0	3	2	8	2	0	2	0	2	0	0	0
		C	27	23	24	61	41	44	30	3	0	0	0	0
		D	0	0	2	31	0	3	0	0	0	0	0	0

***Philonthus quisquiliarius* (Gyllenhal, 1810)**

In the first year, the largest number of individuals was recorded in September at trap (A). In the second year, the largest number of individuals was recorded in May at traps (A and C) and in August at traps (B and D) individuals in each trap. On other hand, the lowest number of individuals was recorded in March at trap (A) of the first year, and in October at traps (A and C) of the second year, and only one and two specimens was recorded in June and September at traps (B and D) , respectively Table 1.

The annual population fluctuations of this species had three annual peaks. The first peak started from early March to early May at all traps, the second peak started from mid May to early August and the third peak started from mid August to late November, Figure 3.

It is obvious that, the largest number of individuals was recorded in May at trap (A) of the second year. Whereas, the lowest number of individuals was recorded in June at trap (D), Table 1.

***Philonthus turbidus* Erichson, 1839**

The largest number of individuals was recorded in May at trap (A) of the first year. In the second year, the largest number of individuals was recorded in June at traps (A, B, C and D). On other hand, the lowest number of individuals was

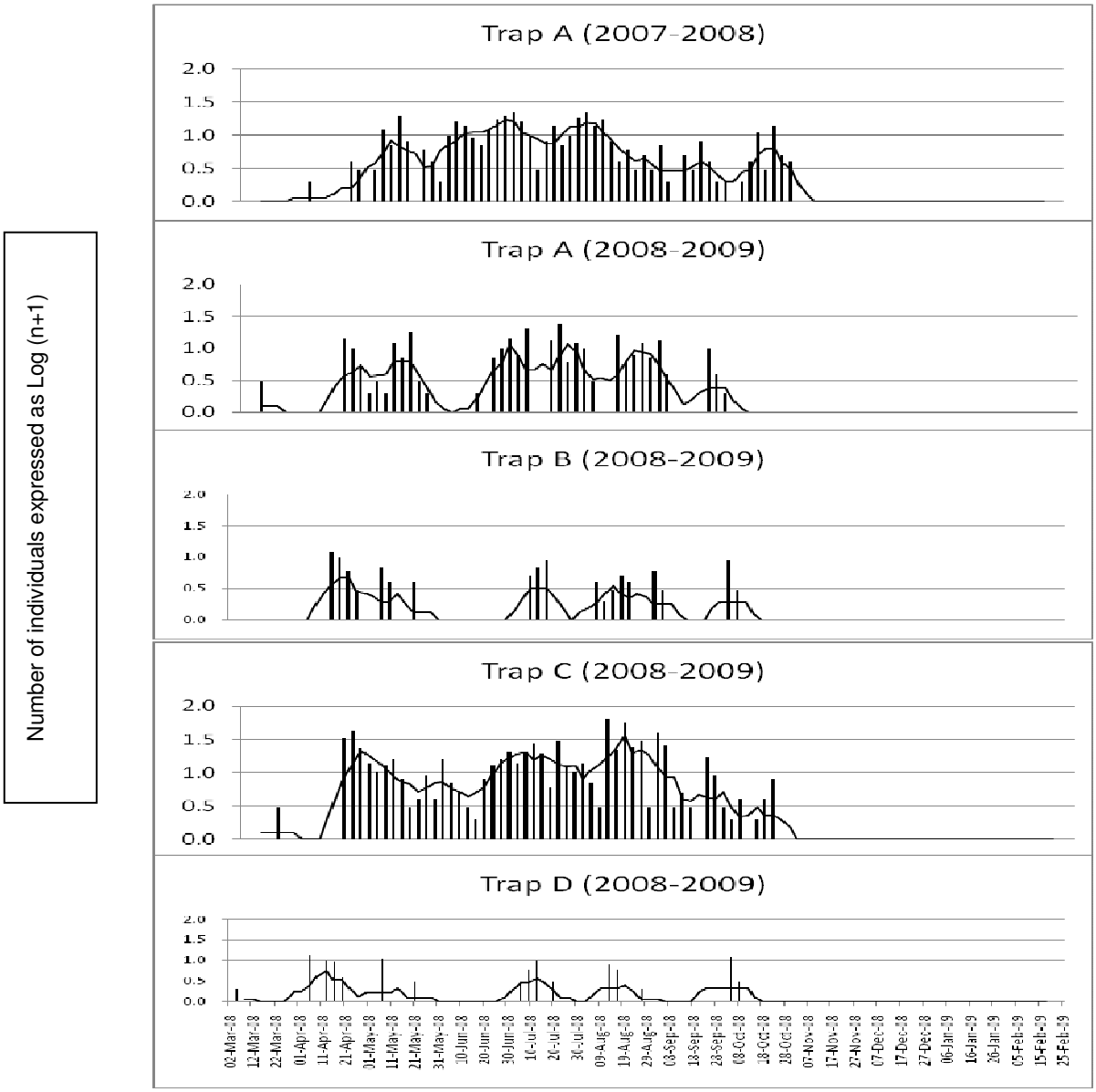

Figure 1. The monthly fluctuations of *Atheta gregaria* (Casey,1856) , superimposed curve on histogram represents the smoothed 5-day running mean

recorded in November at traps (A) of the two trapping years, in October at trap (C), in May at trap (D) , and the catch was too low at trap (B) Table 1.

The annual population fluctuations of this species had three annual peaks. The first peak started from late March to mid May at trap (A) of the two trapping years , and from mid march to late May at trap (C) , the second peak started from mid May to late July at traps (A) of the two years , and from late May to mid July at trap (C) and the third peak started from late July to early October at traps (A) of the two years, and from mid July to early October at trap (C) Figure 4.

It is obvious that, the largest number of individuals was recorded in May at trap (A) of the first year. Whereas, the low number of individuals was recorded in November. On other hand, the number of individuals recorded at traps (B and D) was too low, Table 1.

From the previous results founded that three species

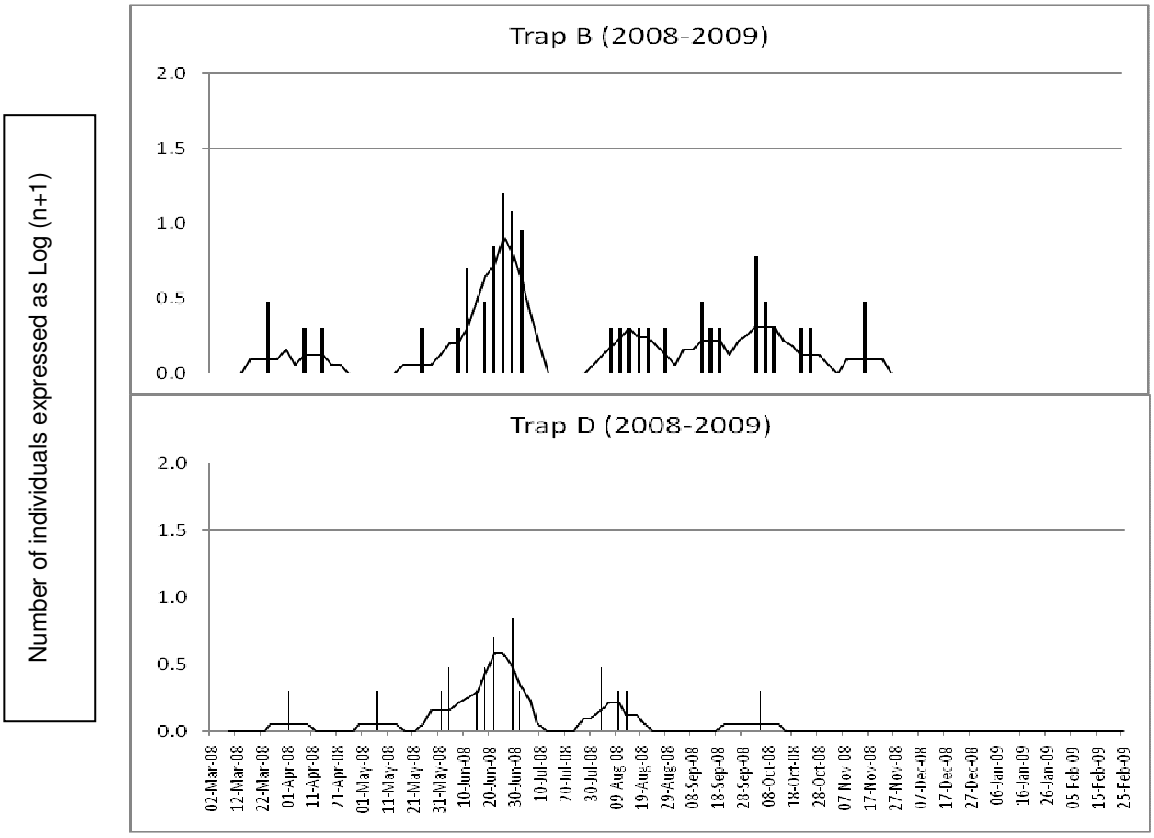

Figure 2. The monthly fluctuations of *Paederus alfierii* Koch, 1934 , superimposed curve on histogram represents the smoothed 5-day running mean

(*Atheta gregaria, Philonthus quisquiliarius* and *Philonthus turbidus*) having three annual peaks and one species (*Paederus alfierii*) having two annual peaks. Hafez (1939) found that, from the dung collections that *Philonthus quisquiliarius*, have two generations per year. Hanna (1969) reported that *Paederus alferii* have one generation. Hamad and Aly (1985) reported that *Paederus alferii* and *Philonthus concinnus* having two generations per year.

Mohamed (1997) reported that, the highest Staphylinid population was recorded in October in the first year and in July in the second year, while the lowest population was recorded in February in the first year and in March in the second year.

Effect of Height

The largest individuals numbers of species *Atheta gregaria*, *Philonthus quisquiliarius* and *Philonthus turbidus* were recorded at traps (A and B), and the lowest numbers were recorded at traps (C and D). On the contrary, the largest individuals numbers of *Paederus alfierii* were recorded at traps (C and D), and the lowest individuals numbers were recorded at traps (A and B), Table 2, Figure 5. These results agrees with Chung (2004) reported that, Staphylinidae were prominently sampled at the ground level while at the 6-m and 12-m levels, many of Staphilinids feed on smaller arthropods which are usually abundant on the ground. Hanna (1973) reported that, *Cicindela. nilotica* preferred flight at 65.6 feet.

Effect of Weather Factors

The effect of weather factors on daily abundance of four species of family Staphylinidae has been studied. The species are: *Atheta gregaria* (Casey, 1856); *Paederus alfierii* Koch, 1934*; Philonthus quisquiliarius* (Gyllenhal,

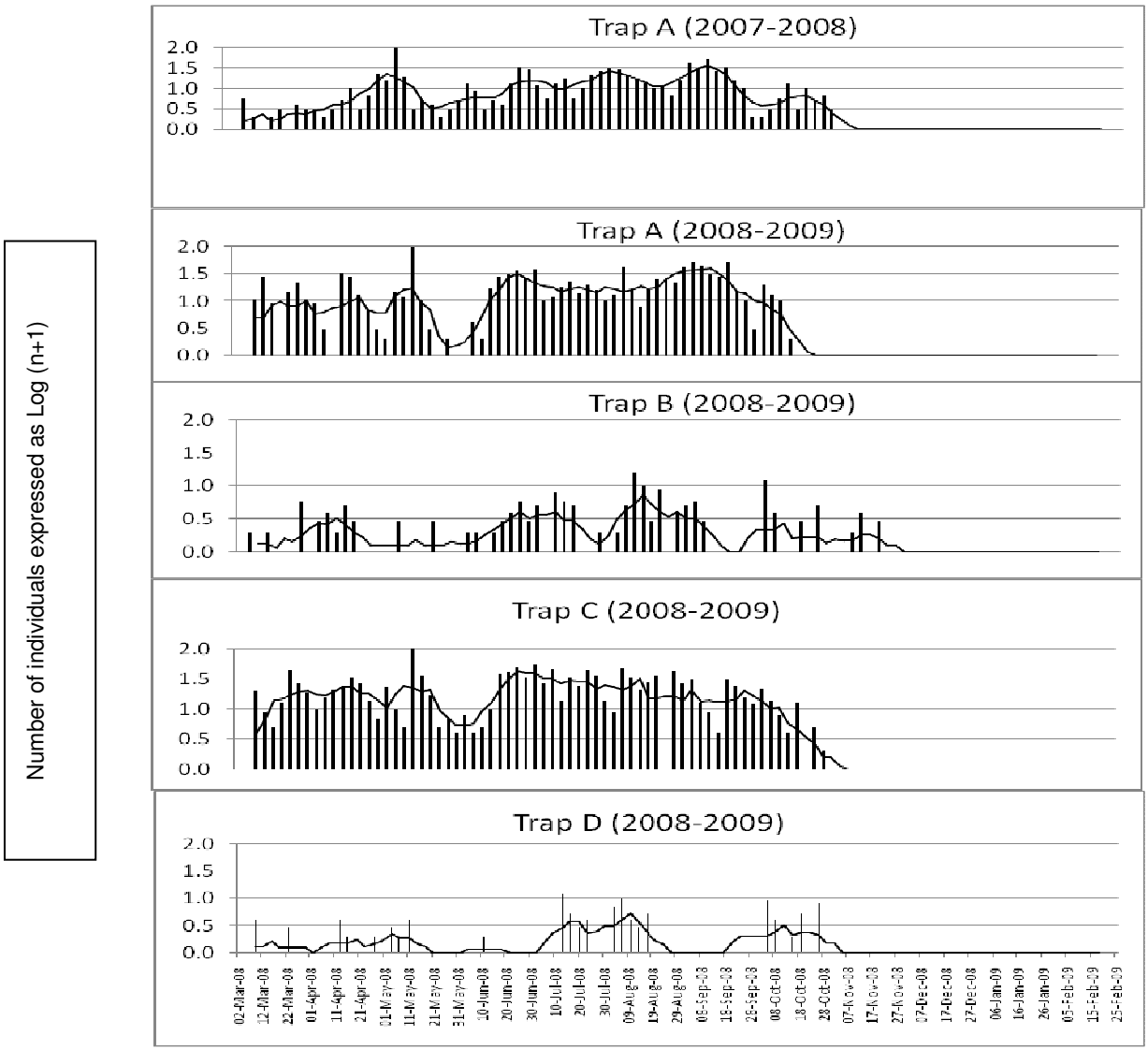

Figure 3. The monthly fluctuations of *Philonthus quisquiliarius* (Gyllenhal,1810) , superimposed curve on histogram represents the smoothed 5-day running mean .

1810) and *Philonthus turbidus* Erichson, 1839 Tables 3-6.

Maximum Temperature

For *Atheta gregaria*, the partial correlation coefficient values on maximum temperature had positive and highly significant effect at 1% levels of probability; this result suggests that, the population of this species rise in high temperature, at trap A of the second year during all months at constant minimum temperature. For *Atheta gregaria* and *Philonthus turbidus*, the partial correlation coefficient values on maximum temperature had positive and significant effect at 5% levels of probability; at trap A of the first year during all months at constant minimum temperature and relative humidity, and at trap A of the first year during spring, autumn and all months at constant minimum temperature, relative humidity and wind velocity, respectively.

On other hand, *Philonthus quisquiliarius*, the partial correlation coefficient values on maximum temperature had negative and highly significant effect at 1% levels of probability; this result suggests that, the population of this species decreases in high temperature, at traps A of the

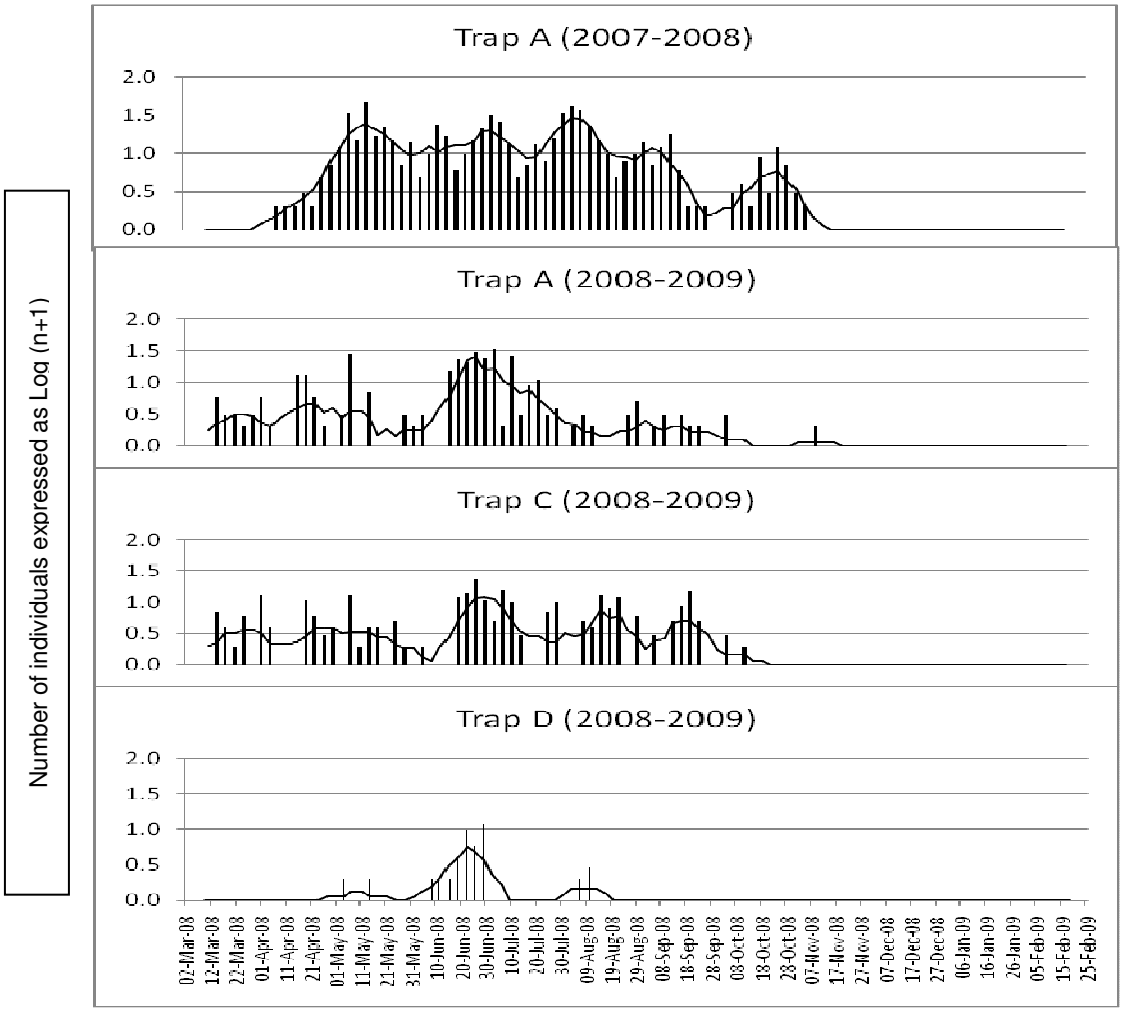

Figure 4. The monthly fluctuations of *Philonthus turbidus* Erichson, 1839, superimposed curve on histogram represents the smoothed 5-day running mean.

second year and B during all months at constant minimum temperature, relative humidity and wind velocity.

For *Atheta gregaria*, *Paederus alfierii* and *Philonthus quisquiliarius,* the partial correlation coefficient values on maximum temperature had negative and significant effect at 5% levels of probability; at trap A of the first year during autumn at constant wind velocity, at traps (B and D) during spring and summer at constant minimum temperature and wind velocity, at traps A of the two years, B, C and D during summer and all months at constant minimum temperature, relative humidity and wind velocity, respectively. Hanna and Hamad (1975d) pointed out the maximum temperature had highly significant correlation on the activity of *Paederus alfierii* at 3.9 feet. Aly (1981) found that the maximum temperature had highly significant correlation for some species of order Coleoptera.

Minimum Temperature

For *Philonthus quisquiliarius* the partial correlation coefficient values on minimum temperature had positive and highly significant effect at 1% levels of probability; this result suggests that, the population of this species rise in low temperature, at traps A of the second year, B, C and D) during all months at constant relative humidity, wind velocity and maximum temperature.

For *Atheta gregaria* and *Philonthus turbidus* the partial

Table 2. The numbers of four abundant species of family Staphylinidae (from March 2008 to February 2009)

Species	A	B	C	D
Atheta gregaria (Casey,1856)	258	87	709	89
Paederus alfierii Koch, 1934	3	157	1	74
Philonthus quisquiliarius (Gyllenhal, 1810)	1235	138	1473	84
Philonthus turbidus Erichson, 1839	299	19	253	36

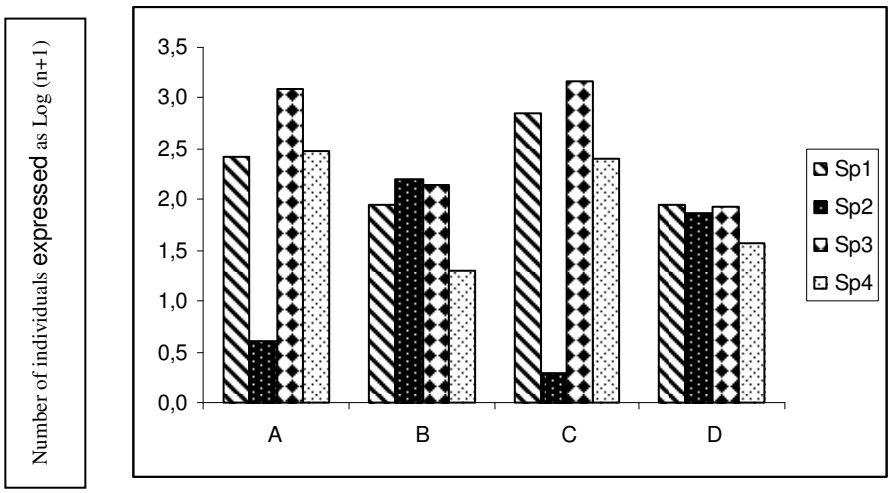

Figure 5. The number of individuals captured at different light traps (A,B,C,D) at different heights

(Sp1) *Atheta gregaria* (Casey,1856) , (Sp2) *Paederus alfierii* Koch, 1934, (Sp3) (*Philonthus quisquiliarius* (Gyllenhal, 1810) , (Sp4) *Philonthus turbidus* Erichson, 1839

correlation coefficient values on minimum temperature had positive and significant effect at 5% levels of probability, at trap (B) during autumn and all months at constant relative humidity and maximum temperature, at traps A of the first year, and C during spring and all months at constant relative humidity and maximum temperature, respectively.

On other hand, For *Philonthus quisquiliarius* the partial correlation coefficient values on minimum temperature had negative and highly significant effect at 1% levels of probability; this result suggests that, the population of this species decreases in low temperature, at traps A of the second year and C during all months at constant wind velocity.

For *Philonthus quisquiliarius Paederus alfierii* and *Philonthus turbidus* the partial correlation coefficient values on minimum temperature had negative and significant effect at 5% levels of probability; at traps A of the first year, B and D during spring, summer and autumn at constant wind velocity and maximum temperature , at traps B and D during spring, summer and autumn at constant relative humidity and maximum temperature, at trap (C) during all months at constant wind velocity, respectively. Hanna and Hamed (1975d) found that correlations on minimum temperature had no effect on the flight activity of *Paederus alfierii* at 3.9 feet.

Relative Humidity

For *Atheta gregaria* , *Paederus alfierii , Philonthus quisquiliarius* and *Philonthus turbidus,* the partial correlation coefficient values on relative humidity had positive and highly significant effect at 1% levels of prob-

Table 3. Partial correlation coefficient values of weather factors affecting on flight activity of *Atheta gregaria* (Casey,1856) ,in different seasons at four traps in two trapping years

Trap	year	season	Df	Max.T. at constant			Min. T. at constant			R.H. at constant			W.V. at constant		
				Min.T.	R.H.	W V	R.H.	W.V.	Max.T.	W.V.	Max.T.	Min.T.	Max.T.	Min.T.	R.H.
A	2007-2008	**Spring**	24	0.3258	0.1253	0.0826	0.1360	-0.1577	0.3134	-0.0051	**0.5819****	**0.5885****	**0.6520****	**0.6637****	-0.3723
		Summer	24	0.2280	-0.2849	-0.2507	-0.2301	-0.0327	**-0.4876***	-0.0670	**-0.4904***	-0.1625	**-0.5046****	-0.1088	-0.2051
		Autumn	23	0.1275	0.0938	**-0.4242***	-0.0319	**-0.4584***	0.0789	-0.1393	0.3849	0.3875	**0.5506****	**0.5793****	-0.1742
		All	99	**0.2371***	**0.2341***	0.0880	0.0120	-0.0047	0.0682	0.0744	**0.5361****	**0.5688****	**0.6357****	**0.6562****	**-0.4038****
A	2008-2009	**Spring**	24	-0.0308	-0.0280	-0.1261	-0.0972	-0.1903	0.1256	-0.1367	0.0975	0.0575	0.1898	0.2042	-0.1740
		Summer	25	0.0178	-0.0709	0.0485	-0.0534	0.0566	-0.0620	0.0459	-0.0759	-0.0076	-0.0609	-0.0323	-0.0522
		Autumn	22	0.0116	-0.0324	0.2027	-0.0165	0.2010	-0.0293	0.1962	-0.0388	0.0016	0.0729	-0.0623	0.0462
		All	99	**0.0285****	-0.0747	0.0104	-0.1382	-0.0533	0.1328	0.0313	**0.2504***	**0.2442***	**0.3963****	**0.3807****	**-0.3263****
B	2008-2009	**Spring**	24	-0.2554	0.1288	-0.2311	-0.0867	-0.2729	0.3486	-0.2305	0.2631	0.0206	0.2723	0.1917	-0.1467
		Summer	25	0.1264	0.0924	-0.3596	0.0008	**-0.4626***	0.1633	-0.3486	0.2645	0.2273	0.2653	**0.3893***	0.0112
		Autumn	22	-0.0869	0.3431	-0.1941	**0.4110***	0.0349	-0.2842	0.1369	-0.1484	-0.0739	-0.3599	-0.1568	**0.4463***
		All	99	-0.1011	-0.0575	-0.0945	-0.1343	-0.1194	**0.2015***	-0.0813	0.1688	0.1120	**0.3180****	**0.2787****	**-0.2751****
C	2008-2009	**Spring**	24	-0.0315	0.0990	-0.0336	-0.0809	-0.1679	0.2527	-0.0459	0.3364	0.2247	0.4031	0.3612	-0.2565
		Summer	25	0.0492	-0.2183	-0.3332	-0.2008	-0.3563	-0.0784	-0.3503	-0.1132	0.0381	-0.0681	0.1370	-0.2289
		Autumn	22	-0.0863	0.0499	0.0210	0.0331	0.0557	0.0087	0.0423	0.0110	-0.0781	-0.0010	-0.1001	0.0610
		All	99	0.0402	-0.0811	-0.0882	-0.1565	-0.1730	0.1539	-0.0574	**0.3031****	**0.2968****	**0.4892****	**0.4894****	**-0.4051****
D	2008-2009	**Spring**	24	-0.2729	0.1085	-0.3723	-0.0808	**-0.3953***	0.3218	-0.3707	0.1957	-0.0422	0.2010	0.1718	-0.1121
		Summer	25	0.1447	0.0179	-0.2647	-0.0406	-0.3528	0.0544	-0.2641	0.1415	0.1974	0.1449	0.3081	-0.0306
		Autumn	22	-0.0869	0.3158	-0.1795	0.3837	0.0419	-0.2744	0.1337	-0.1488	-0.0768	-0.3449	-0.1571	0.4206
		All	99	-0.0981	-0.0774	-0.1147	-0.1370	-0.1319	0.1714	-0.1163	0.0998	0.0529	**0.2569***	**0.2260***	**-0.2502***

Df = Degree of freedom Max. T. = Maximum temperature, Min.T. = Minimum temperature, R.H. = Humidity, W. V. = Wind velocity.
* Significant at 5% level. ** Significant at 1% level.

ability; this result suggests that, the population of this species rise with increasing in relative humidity, at trap A during spring and all months of the first year at constant maximum and minimum temperature, at trap (B) during all months at constant maximum temperature, at traps A of the two years, B, C and D during autumn and all months at constant wind velocity, maximum and minimum temperature, at trap A of the first year during spring, autumn and al months at constant maximum and minimum temperature, respectively.

For *Atheta gregaria*, *Paederus alfierii*, *Philonthus quisquiliarius* and *Philonthus turbidus*, the partial correlation coefficient values on relative humidity had positive and significant effect at 5% levels of probability; at trap A of the two years during spring and all months at constant maximum and minimum temperature. At trap (B) during all months at constant minimum temperature. At trap (C) during all months at constant maximum temperature. Mohamed (1997) reported that relative humidity had a positive significant effect on the activity of *Paederus alfierii*

Table 4. Partial correlation coefficient values of weather factors affecting on flight activity of *Paederus alfierii* Koch, 1934, in different seasons at four traps in two trapping years

Trap	year	season	Df	Max.T. at constant			Min. T. at constant			R.H. at constant			W.V. at constant		
				Min.T.	R.H.	W V	R.H.	W.V.	Max.T.	W.V.	Max.T.	Min.T.	Max.T.	Min.T.	R.H.
A	2008-2009	Summer	25	-0.3598	-0.0811	-0.2179	-0.0362	-0.1242	0.1670	-0.2227	-0.0384	-0.3179	-0.0219	-0.2735	-0.0883
		Autumn	22	0.1375	0.1951	-0.2320	0.2468	-0.2059	-0.1282	-0.0967	-0.0022	0.1618	-0.1972	0.1725	0.1789
		All months	99	0.0204	0.0259	0.0426	0.0057	0.0253	0.0261	0.0627	0.1072	0.1030	0.1056	0.0985	-0.0494
B	2008-2009	Spring	24	-0.2775	0.1265	-0.2982	-0.0436	-0.2940	0.2891	-0.2950	0.1627	-0.0741	0.1163	0.0617	-0.0294
		Summer	25	**-0.3832***	-0.2801	0.1400	-0.3030	0.2199	**0.3997***	0.1240	0.1803	-0.1784	0.2429	-0.2693	-0.3160
		Autumn	22	0.0788	0.3664	-0.2567	**0.4356***	-0.1243	-0.2437	0.0248	-0.0567	0.1200	-0.3242	0.0590	**0.4104***
		All months	99	-0.0226	-0.0040	0.1177	-0.0823	0.0787	0.1625	0.1511	**0.2669****	**0.2302***	**0.3261****	**0.2747****	**-0.2158***
C	2008-2009	Autumn	22	-0.2622	-0.1803	-0.3003	-0.0916	-0.0075	-0.2490	-0.1217	-0.3491	-0.3263	-0.4057	-0.2974	-0.0576
		All months	99	-0.0227	-0.0073	-0.0705	-0.0297	-0.0834	0.0537	-0.0644	0.0576	0.0422	0.1147	0.1131	-0.0954
D	2008-2009	Spring	24	**-0.4236***	-0.0432	**-0.4010***	-0.2413	-0.3806	**0.4251***	**-0.4112***	0.0465	-0.2388	0.1476	0.0412	-0.1766
		Summer	25	-0.3705	-0.2992	0.1015	-0.3020	0.1992	0.3144	0.0871	0.0757	-0.2233	0.1451	-0.3010	-0.3179
		Autumn	22	0.0378	0.4013	-0.2229	0.4213	-0.1495	-0.1257	-0.0113	0.0741	0.1038	-0.2122	0.0566	0.3903
		All months	99	-0.0398	-0.0271	0.0786	-0.0896	0.0537	0.1434	0.0990	0.1862	0.1521	**0.2527***	**0.2063***	-0.1856

Df = Degree of freedom Max. T. = Maximum temperature, Min.T. = Minimum temperature, R.H. = Humidity, W. V. = Wind velocity.
* Significant at 5% level. ** Significant at 1% level.

at station "El-sail A" during all months collectively of 1994 with constant wind velocity.

On other hand, the partial correlation coefficient values on relative humidity had negative and highly significant effect at 1% levels on the activity of *Philonthus quisquiliarius*; this result suggests that, the population of this species decreases with increase in relative humidity, at traps (B and C) during all months at constant wind velocity and minimum temperature.

For *Atheta gregaria*, *Paederus alfierii* and *Philonthus quisquiliarius,* the partial correlation coefficient values on relative humidity had negative and significant effect at 5% at trap A of the first year during summer at constant maximum temperature, at trap (D) during spring at constant wind velocity, at trap A of the first year and D of the second year during summer and all months at constant wind velocity and minimum temperature, respectively. Hanna and Hamed (1975d) found that negative and highly significant correlations on humidity for *Paederus alfierii* in autumn of both years. Mohamed (1997) reported that negative significant correlation was recorded for *Paederus alfierii* at station "Agriculture B" during summer 1995 with constant temperature and wind velocity.

Wind Velocity

For *Atheta gregaria* , *Paederus alfierii , Philonthus quisquiliarius* and *Philonthus turbidus ,* the partial correlation coefficient values on wind velocity had positive and highly significant effect at 1% levels , this result suggests that, the population of this species rise in windy days, at traps A of the two years, B and C during spring , autumn and all months at constant maximum and minimum temperatures , at trap (B) during all months at constant maximum and minimum temperature, at traps A of the two years, B and C during all

Table 5. Partial correlation coefficient values of weather factors affecting on flight activity of *Philonthus quisquiliarius* (Gyllenhal, 1810),in different seasons at four traps in two trapping years

Trap	year	season	Df	Max.T. at constant			Min. T. at constant			R.H. at constant			W.V. at constant		
				Min.T.	R.H.	W V	R.H.	W.V.	Max.T.	W.V.	Max.T.	Min.T.	Max.T.	Min.T.	R.H.
A	2007-2008	**Spring**	24	0.2286	0.0839	0.1013	0.1180	-0.0387	0.1500	0.0445	0.3855	**0.4246***	**0.4552***	**0.4739***	-0.2600
		Summer	24	0.2090	0.0451	**-0.4738***	0.0902	-0.3838	-0.1737	**-0.4034***	-0.0542	0.1511	-0.2817	0.0425	-0.0718
		Autumn	23	0.0873	0.3619	0.3152	0.1020	0.3128	0.2403	**0.5225****	**0.6583****	**0.5661****	**0.4409***	0.3875	-0.0512
		All months	99	0.1110	0.1031	0.0635	0.0634	-0.0004	0.1095	0.0643	**0.4645****	**0.4591****	**0.5196****	**0.5170****	**-0.2813****
A	2008-2009	**Spring**	24	0.0812	-0.1060	-0.0073	-0.0632	-0.0372	-0.0510	-0.0154	-0.0609	0.0207	0.0336	0.0804	-0.0941
		Summer	25	-0.1246	0.2644	-0.1116	0.1532	-0.1372	0.3636	-0.0992	**0.4032***	0.0502	0.3518	0.1111	0.1556
		Autumn	22	0.1917	0.1979	-0.1080	0.1232	-0.3064	0.1915	-0.1929	0.2983	0.2576	0.1634	0.3282	0.0043
		All months	99	-0.0198	**-0.2308***	**-0.3855****	**0.4310****	**-0.6735****	**0.6162****	**0.7026****	**0.5437****	-0.1538	**0.7355****	**0.7247****	**0.7956****
B	2008-2009	**Spring**	24	-0.2653	0.2386	-0.3657	0.0688	-0.3538	0.2503	-0.3569	0.2151	-0.0424	0.0606	0.0462	0.0867
		Summer	25	0.0497	0.0110	-0.2373	0.0681	-0.2232	-0.2104	-0.2282	-0.2056	-0.0699	-0.2207	0.0155	0.0487
		Autumn	22	-0.0959	0.1576	-0.0599	0.2201	0.1179	-0.2145	0.1506	-0.1539	-0.1027	-0.2407	-0.1780	0.2776
		All months	99	**-0.4014****	**-0.4831****	**-0.2096***	**0.5106****	**0.4403****	**0.6405****	-0.1818	**0.6355****	**-0.4270****	**0.5518****	**-0.4073****	**0.3089****
C	2008-2009	**Spring**	24	0.0366	-0.2497	0.0442	-0.2143	0.0086	0.0197	0.0252	-0.1357	-0.0467	0.0934	0.0883	-0.2276
		Summer	25	-0.2036	0.1030	-0.1126	0.1019	-0.0710	0.1665	-0.1088	0.0973	-0.1524	0.0752	-0.1101	0.0771
		Autumn	22	-0.0704	0.2892	-0.1604	0.2901	-0.0697	-0.0780	-0.0006	0.0409	-0.0332	-0.1611	-0.0630	0.2869
		All months	99	0.1002	-0.0496	**-0.2491***	**0.6687****	**-0.4368****	**0.7961****	**-0.7950****	**0.6234****	**-0.2902****	**0.8427****	**0.5691****	**0.9025****
D	2008-2009	**Spring**	24	-0.2099	-0.0520	-0.1846	-0.1867	-0.2145	0.2787	-0.1975	0.0861	-0.0662	0.2033	0.1365	-0.2042
		Summer	25	0.3387	-0.0353	-0.1643	0.0074	-0.2246	-0.3922	-0.1560	-0.2617	0.1560	-0.2650	0.2252	0.0187
		Autumn	22	-0.1738	0.2354	-0.1817	0.2605	0.0031	-0.1514	0.0286	-0.0759	-0.1618	-0.2557	-0.2018	0.2872
		All months	99	**-0.2206***	**-0.2636***	0.0175	**0.2784****	**0.6026****	**0.3552****	0.1232	**0.3559****	**-0.2396***	**0.2204***	**-0.5832****	-0.0371

Df = Degree of freedom Max. T. = Maximum temperature, Min.T. = Minimum temperature, R.H. = Humidity, W. V. = Wind velocity.
* Significant at 5% level. ** Significant at 1% level.

months at constant maximum temperature, minimum temperature and relative humidity, at traps A of the two years and C during spring , autumn and all months at constant maximum and minimum temperature, respectively.

For *Atheta gregaria* , *Paederus alfierii* , *Philonthus quisquiliarius* and *Philonthus turbidus ,* the partial correlation coefficient values on wind velocity had positive and significant effect at 5% , at traps (B and D) during summer, autumn and all months at constant maximum temperature, minimum temperature and relative humidity, at traps (A of the first year and D) during spring, autumn and all months at constant maximum and minimum temperature, at trap (A of the second year) during

Table 6. Partial correlation coefficient values of weather factors affecting on flight activity of *Philonthus turbidus* Erichson, 1839,in different seasons at four traps in two trapping years

Trap	year	season	Df	Max.T. at constant			Min. T. at constant			R.H. at constant			W.V. at constant		
				Min.T.	R.H.	W V	R.H.	W.V.	Max.T.	W.V.	Max.T.	Min.T.	Max.T.	Min.T.	R.H.
A	2007-2008	**Spring**	24	**0.5115****	0.1508	**0.3882***	**0.4132***	0.2679	-0.0521	0.2894	**0.4439****	**0.7039****	**0.5640****	**0.6695****	-0.3235
		Summer	24	0.2465	-0.3622	-0.1968	-0.3220	-0.0960	-0.2494	-0.2433	-0.1832	0.0374	-0.2007	0.0962	**-0.3945***
		Autumn	23	0.1705	**0.4303***	0.1761	0.2362	0.1501	0.0887	0.3901	**0.6109****	**0.5378****	**0.3565****	0.3718	0.0840
		All months	99	**0.2718***	0.0368	0.1893	0.0325	0.1069	0.0077	0.1650	**0.5018****	**0.5539****	**0.5990****	**0.6254****	**-0.3696****
A	2008-2009	**Spring**	24	-0.1640	-0.0477	-0.2395	-0.1154	-0.2367	0.1610	-0.2457	-0.0104	-0.1104	0.0495	0.0452	-0.0882
		Summer	25	-0.2299	-0.1053	0.1454	-0.1280	0.1920	0.2615	0.1363	0.1439	-0.0985	0.1735	-0.1725	-0.1342
		Autumn	22	0.0825	0.0557	-0.2020	0.0380	-0.2603	0.0537	-0.2190	0.0920	0.1035	-0.0289	0.1810	-0.0541
		All months	99	-0.0756	-0.0669	0.0442	-0.1431	0.0175	0.1936	0.0582	0.1920	0.1452	**0.3079****	**0.2517***	**-0.2563***
B	2008-2009	**Spring**	24	-0.1822	0.2441	-0.2469	0.1154	-0.2333	0.1639	-0.2361	0.2016	0.0012	0.0248	0.0150	0.1222
		Summer	25	-0.2223	-0.2553	0.2220	-0.2898	0.2532	0.3127	0.2080	0.1811	-0.0381	0.2434	-0.1558	-0.2915
		Autumn	22	0.2137	-0.1118	0.2239	-0.1032	0.0783	0.0526	0.1080	0.0456	0.2078	0.1993	0.1961	-0.1062
		All months	99	-0.1004	-0.0241	-0.0186	-0.0821	-0.0217	0.1557	-0.0087	0.1034	0.0501	0.1738	0.1275	-0.1416
C	2008-2009	**Spring**	24	-0.1416	-0.2376	-0.2805	-0.2737	-0.2849	0.1771	-0.3045	-0.1484	-0.1984	0.0698	0.0758	-0.2336
		Summer	25	-0.2831	-0.0232	-0.4081	0.0037	-0.3591	0.1565	-0.4103	0.0100	-0.2381	0.0148	-0.1216	-0.0529
		Autumn	22	0.1582	0.0912	0.0466	0.0925	-0.0458	0.0227	0.0307	0.0957	0.1836	0.0764	0.1736	0.0614
		All months	99	-0.0588	-0.0884	-0.1916	-0.1743	**-0.2494***	**0.2131***	-0.1703	**0.2444***	0.2019	**0.4648****	**0.4508****	**-0.4076****
D	2008-2009	**Spring**	24	0.0703	-0.0978	-0.0888	-0.1062	-0.1672	0.0294	-0.1035	0.0303	0.0820	0.1671	0.2269	-0.1977
		Summer	25	-0.2600	-0.2789	0.2387	-0.2924	0.3025	0.2692	0.2295	0.0986	-0.1132	0.1677	-0.2423	-0.3013
		All months	99	-0.0346	-0.0391	0.1229	-0.0874	0.1087	0.1166	0.1344	0.1352	0.1096	0.1803	0.1306	-0.1377

Df = Degree of freedom Max. T. = Maximum temperature, Min.T. = Minimum temperature, R.H. = Humidity, W. V. = Wind velocity.
* Significant at 5% level. ** Significant at 1% level.

all months at constant minimum temperature, respectively. Mohamed (1997) reported that wind velocity had a positive significant effect on the activity of *Paederus alfierii* at station "Agriculture B" during summer 1994 with constant temperature or humidity.

On other hand, For *Atheta gregaria* , *Philonthus quisquiliarius* and *Philonthus turbidus,* the partial correlation coefficient values on wind velocity had positive and highly significant effect at 1%, this result suggests that, the population of this species rise in windy days, at traps (A of the two years, B

and C) during all months at constant relative humidity, at traps (A of the first year, B and D) during all months at constant minimum temperature and relative humidity, at traps (A of the first year and C) during all months at constant relative humidity.

For *Atheta gregaria*, *Paederus alfierii* and *Philonthus turbidus,* the partial correlation coefficient values on wind velocity had negative and significant effect at 5% ; at trap (D) during all months at constant relative humidity, at trap (B) during all months at constant relative humidity, at trap (A of the two years) during summer and all months at constant relative humidity, respectively.

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