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DENSITY OF ANT-LION LARVAE *(NEUROPTERA: MYRMELEONTIDAE)* IN SANDY GRASSLANDS

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Abstract

The heteromorph character of Bugacpuszta (Kiskunság National Park, Hungary) is well reflected by the dispersion of the *Euroleon nostras* and the *Myrmeleon inconspicuus* larvae from the 6 species of ant-lion populations demonstrated at the area within 5 years.

The greatest density is found in the *Festucetum vaginatae* typicum association, where the dispersion does not show significant aggregation. In the more closed *Potentillo-Festucetum pseudovinae* association the majority of the *Myrmeleontidae* larvae are localized on mole-hill sides; here the pattern analysis refers to cluster dispersion. The migration activity peak of the quasi sessile predator larvae is in June. The greatest imago density at the area is measurable in July. At the time of oviposition the imagos keep away from the large free sandy areas, because of the rapid decrease in density of their prey and the catch-funnel destructive effect of the wind.

Key words: ant-lion larva, density, season-dynamism

Introduction

One part of the larvae of the ant-lion species *(Myrmeleontidae)* continues sessile predator strategy, catching the prey with their catch-funnel. The space pattern of the larvae living in loose soils greatly depends on the degree of the vegetation coverage, their settlement is connected to smaller-larger free sandy areas.

Their space-pattern has been analysed on several occasions at semi-arid areas (WILSON, 1974; SIMBERLOFF et al. 1978; BOAKE et al. 1983), mostly in respect to the determination of the dispersion type, the probable changes in the prey strategies, as well as regarding studies on group-selective advantage. The majority of these analyses have been performed at places where aggregates are formed by the ant-lion larvae. The season-dynamism and plant-association-dependent density of the *Myrmeleontidae* living at sandy grasslands have not been studied up to this time in Central European relations.

The aims of the present studies were as follows:

1. Determination of larval density depending on vegetation coverage
2. Studies on the space structure of the populations by means of pattern analysis
3. Effect of the number of potential preys on the density of the larvae.

Material and method

The density of the catch-funnel building ant-lion larvae was estimated in 1x1 m squares at the study area at Bugacpuszta of the Department of Zoology of the Attila József University (Szeged, Hungary). With the help of 4x4 sized square net, the pattern analysis of the data can also be performed (following the method of PRÉCSÉNYI, 1981) in case of appropriate funnel number. Two plant-associations were used for the pattern analysis (*Festucetum vaginatae* typicum and *Potentillo-Festucetum pseudovinae*), where the density of the ant-lion larvae is the greatest. During the course of the analysis, the dispersion index ($I = s^2(\bar{x})$ was studied in the function of block size increasing from 625 cm^2 to 1 m^2. The significance was studied at 5% and 10% levels.

The complex synbotanical analysis of the study area was carried out by KÖRMÖCZI et al. (1981; 1982; 1983).

Studies on the season-dynamism of the ant-lion were performed by means of determining the material collected in the years 1983 and 1984 with various trapping methods (Barber-traps, platter- and window-traps, resp.) (GALLÉ et al. 1985). In certain cases the larvae change their catch-funnels, when — though in small number — they can be collected by soil traps.

The density of the potential preys of the *Myrmeleontidae* was studied at the continuous free sandy areas with cylindrical (diameters of 23 and 32 mm) ethylene-glycol traps digged into the ground. 50 — 50 traps were placed at two 1,5x20 m sized sand-zones, in parallel rows (distances of 25 cm) to their edges covered with vegetation. The trapped animals were defined after 3 days. The groups which cannot be caught by the *Myrmeleontidae* larvae (*Acrididae*, large *Carabidae*, *Cicindelidae*) were left unconsidered.

Results

DENSITY OF VEGETATION COVERAGE-DEPENDENT ANT-LION LARVAE

During the course of 5 years' collection 6 ant-lion species were found at the study area: *Acanthaclisis occitanica* VILL., *Distoleon tetragrammicus* FABR. *Creoleon plumbeus* OLIV., *Myrmecaelurus trigrammus* PALL., *Myrmeleon inconspicuus* RAMB., *Euroleon nostras* FOURC. The first two species are rather rare at the area.

The density studies were performed on the populations of the two most frequent catch-funnel-building species, the *Euroleon nostras* and the *Myrmeleon inconspicuus*. The average funnel-density related to the whole study area was $0{,}52/m^2$. The largeness of the plant-associations at the enclosed 2,3 ha sized sandy grassland (on the basis of a botanical record from 1983), as well as the density values per association of the catch-funnel-building ant-lions are demonstrated on Table 1.

The sample area withdrawn from grazing 10 years ago does not completely represent the vegetation coverage relations of the several thousand ha sized Bugac-puszta. On the effect of intensive grazing — as considerable degradation — the expansion of the open grasses of importance from the viewpoint of the ant-lion larvae (*Festucetum vaginatae* typicum) greatly decreased at the largest part of the puszta; shrinking to 1 — 200 m^2 sized continuous stands according to KÖRMÖCZI (1982). Their places are generally occupied by the closed *Cynodon dactylon* facies, where no funnel-building *Myrmeleontidae* larvae live.

Table 1. Density-dependence of funnel-building ant-lions on plant-associations (combined data of the surveys of 29—30 August, 1984 and 15 September, 1984)

Plant-association	Plant coverage		Larval density ind/m²	Total number of ant-lions
	%	total m²		
Festucetum vag. typicum	12.56	2888.8	2.1	6066
Molinio-Salicetum rosmarinifoliae	22.47	5168.1	0	0
Potentillo-Fest. pseudovinae	56.53	13001.9	0.44	5721
its facies:				
Cynodon dactylon	1.67	384.1	0	0
Euphorbia seguieriana	0.13	29.9	0.35	10
Stipa capillata	2.39	549.7	0	0
Bromus squarrosus	0.23	52.9	0.25	13
Carex liparicarpos	3.57	821.1	0.1	82
Holoschoenus vulgaris	0.2	46.0	0	0
Salix rosmarinifolia	0.28	64.4	0	0
				Σ: 11892

Table 2. Season-dynamism of the ant-lions collected by various trapping methods (l = larva, i = imago individual number)

1983	individual number in the different months													
	4.		5.		6.		7.		8.		9.		10.	
	l.	i.	l.	i.	l.	i.	l.	i.	l.	i.	l.	i.	l.	i.
Barber-trap	5		7	—	32	—	7	—	1	—	5	—	—	—
Platter-trap	1	—	10	—	27	—	5	2	—	1	—	3	—	—
Window-trap	—	—	—	—	1	1	—	13	—	6	—	—	—	—
1984 Barber-trap	1		1		4	—	1	—	—	—	—	—	1	—

Sampling was performed following oviposition (29—30 August and 15 September, 1983, resp.), at the time when the number of hatched juveniles is high.

As the consequence of considerable juvenile mortality, there is a striking decrease in incidence with the growth of larval size (SIMBERLOFF et al. 1978). Therefore, the estimation of density at the beginning of Summer would give a much lower value.

Owing to their occasional change of place, the larvae are collectable — though in small number — with soil traps. It is apparent from the analysis of the distribution of the ant-lions caught with various trap types in the years 1983 and 1984 (Table 2, Figs. 1, 2) that the "locomotive peak" of the larvae is in June, the period prior to pupation. This is caused by the acceleration of the metabolism due to the heat and the enchanced need of food owing to the increase of body size, which is manifested in the longer migration distances as well. In July, because of maturation, there is a strong decrease in larval number. In case of fine weather, another larval locomotion (but of slighter degree) is observable around September—October, however, the participants of this are mostly the hatched juveniles. The first imagos appear in June, the peak is in July, then there is a gradual decrease in their number till September.

PATTERN ANALYSIS

According to the results of the recording methods used for the estimation of the pattern analysis (based on 122 catch-funnels) significant clustering was not at all observable in the *Festucetum vaginatae* typicum association (Fig. 3). This may be due to the more or less even dispersion of the *Festuca vaginata* roots; in their typical association the bare sandy areas betwixt — which are the potential habitats for the ant-lion larvae — can quasi be regarded as uniform. This result would presumedly not be considerably modified neither by higher sampling quadrate number, nor by the even more dense quadratic division.

In the *Potentillo-Festucetum pseudovinae* association, the density of the *Myrmeleontidae* larvae is much lower — almost the fifth — as compared to the density values measured for the *Festucetum vaginatae* typicum. Therefore, not every recording by 1x1 m sized quadrates divided into 16 equal parts, used for the density-estimation sampling, was suitable for estimation from the viewpoint of pattern analysis. According to the calculations (Fig. 4), significant aggregation of the ant-lion larvae could be experienced in the *Potentillo-Festucetum pseudovinae* association in case of block size 4 (50 x 50 cm). This is a good verification of the observation performed in nature that at the study area of Bugacpuszta, at several places the mole living there (*Talpa europea* L.) breaks up with its digging the coverage of mainly the *Potentillo-Festucetum* association, growing on sandy-hill ridges and on the whole regarded as closed. At the cc. quarter m^2 sized free sandy areas developing in such manner, 20—30 small ant-lion funnels are often detectable at the end of Summer.

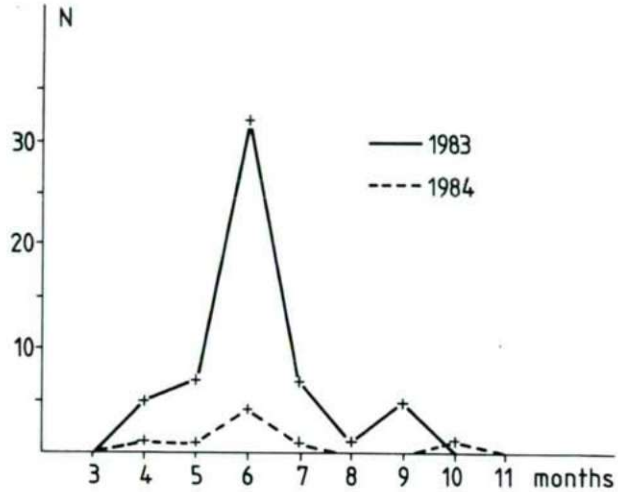

Fig. 1. Season-dynamism of ant-lion larvae collected with Barber-traps.

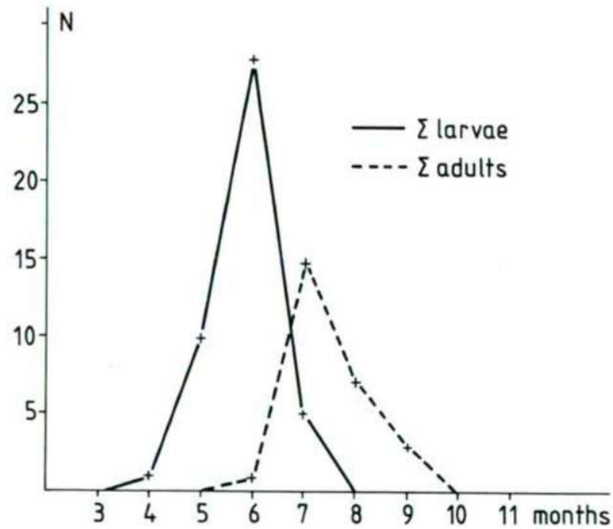

Fig. 2. Season-dynamism of ant-lions based on the global material of the platter- and window-traps.

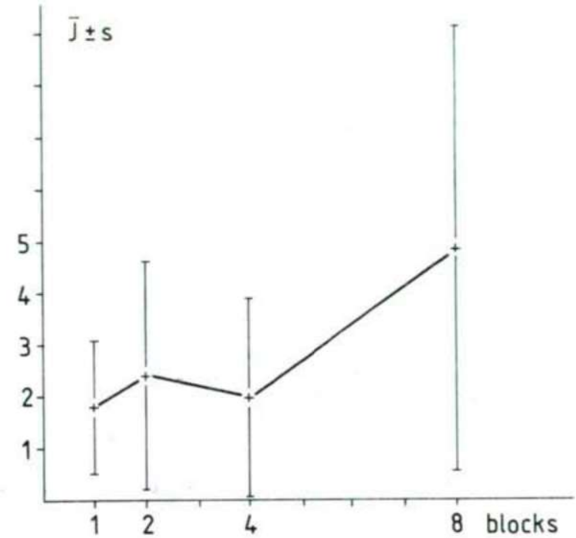

Fig. 3. Results of the pattern-analysis regarding the *Festucetum vaginatae* typicum association.

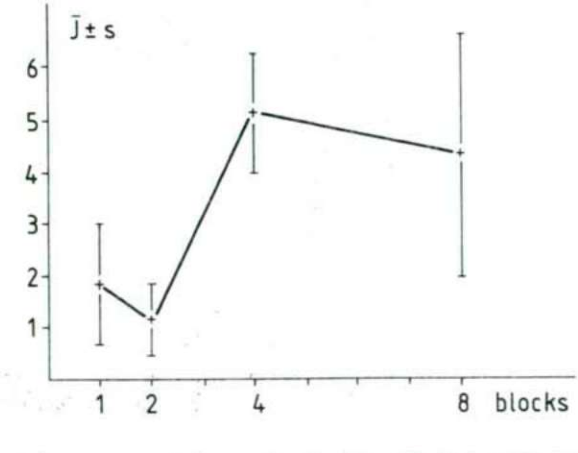

Fig. 4. Results of the pattern-analysis regarding the *Potentillo-Festucetum pseudovinae* association.

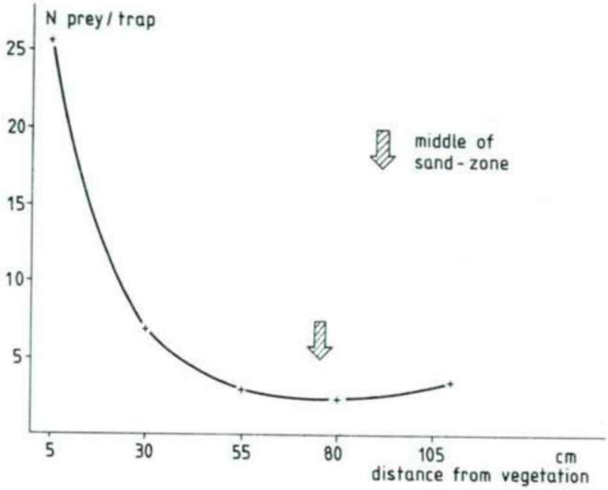

Fig. 5. Potential prey relations of the large free sandy areas in the function of distance from vegetation, based on Tables 1. and 3.

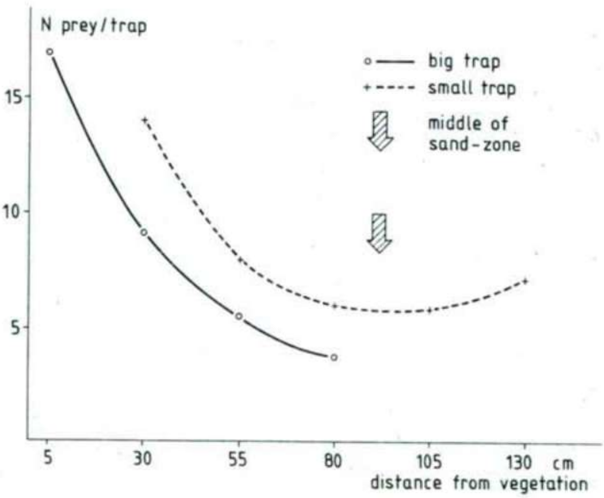

Fig. 6. Potential prey relations of the large free sandy areas in the function of distance from vegetation, based on Tables 2. and 4.

Table 3. Relationship between the incidence of prey experienced at the continuous free sandy areas and the distance from the edge of the sandy surface I.
25—28 June, 1985. forest-zone
(The 1. row is beside the vegetation).

Prey taxon	Dominance % in the different rows				
	1	2	3	4	5
Formicoidea	82.0	23.9	11.1	9.1	29.0
other *Hymenoptera*	—	—	3.7	4.5	—
Collembola	9.8	44.7	22.2	27.2	19.4
Coleoptera	1.0	10.4	29.6	22.7	19.4
Diptera	2.4	4.5	11.1	13.6	9.7
Homoptera	2.0	3.0	3.7	—	3.2
Heteroptera	0.4	1.5	—	—	—
Araneidea	0.4	3.0	—	9.1	3.2
Aphidina	—	4.5	3.7	9.1	16.1
Acariformes	—	5.5	3.7	—	—
Staphylinidae	—	—	11.1	4.5	—
Number of preys referring to 1 trap	25.5	6.7	3.0	2.4	3.4

EFFECT OF THE NUMBER OF POTENTIAL PREYS ON THE DENSITY OF THE LARVAE

The qualitative and quantitative estimation of the potential ant-lion larval preys collected from trappings performed at Bugacpuszta and the sand-zone of a clearing (Tables 3, 4., Figs. 5, 6) indicates why there is no increase in the number of *Myrmeleontidae* larvae at large free sandy areas.

At the time of the first study sèries (25—28 June, 1985) the majority of the traps at the puszta were covered with sand by the wind, thus this recording could not be evalueted. Nevertheless, it also follows from this that the continuous, large free sandy areas are not advantageous for the ant-lion larvae even for energetic point of view either, as to restore the catch-funnels at these sites plenty of time and energy would be required. The repetitions of the study were appreciable. As observable in Fig. 5 and 6, the number of preys is the lowest at the middle of the 1,5 m wide sand-zone.

According to the results, the number of potentially reckoned prey for the ant-lion larvae shows rapid decrease moving away from the vegetation-covered edges of the sand-zone. Therefore it is firstly due to this and the strongly destructive effect of the wind that at the time of oviposition the *Myrmeleontidae* avoid the open free sandy areas.

Table 4. Relationship between the incidence of prey experienced at the continuous free sandy areas and the distance from the edge of the sandy surface II.
23—26 July, 1985. Puszta
(k = small, n = large trap diameter)

Prey taxon	Dominance % in the different rows									
	1		2		3		4		5	6
	n.	k.	n.	k.	n.	k.	n.	k.	k.	k.
Formicoidea	70.5	6.4	40.5	62.5	22.7	22.6	20.0	12.5	12.7	15.8
Mutillidae	—	—	2.7	—	—	—	—	8.3	—	3.5
Sphecoidea	—	—	—	—	—	—	—	—	—	3.5
other *Hymenoptera*	2.9	3.2	2.7	5.7	9.1	12.9	13.3	—	6.4	15.7
Staphylinidae	—	—	—	—	—	—	—	—	2.1	—
other *Coleoptera*	8.8	25.8	5.4	5.4	13.6	12.9	13.3	20.8	27.6	26.3
Diptera	2.9		2.7	5.4	13.6	3.2	26.6	12.5	12.7	19.3
Heteroptera	4.4	6.4	5.4	5.4	27.2	6.4	6.7	29.2	14.9	7.0
Acariformes	7.3	35.5	8.1	14.3	13.6	22.5	13.3	12.5	12.8	8.8
Blattidea	1.5	—	—	—	—	3.2	—	—	—	—
Araneidea	1.5	3.2	2.7	—	—	3.2	—	—	2.1	—
Collembola	—	9.7	30.0	—	—	9.7	—	4.2	—	—
Acrididae juv. larvae	—	6.4	—	—	—	—	6.7	—	2.1	—
Myrmeleontidae larvae	—	3.2	—	—	—	—	—	—	—	—
Homoptera	—	—	—	1.8	—	3.2	—	—	—	—
Isopoda	—	—	—	—	—	—	—	—	2.1	—
Aphidina	—	—	—	—	—	—	—	—	2.1	—
Microlepidoptera	—	—	—	—	—	—	—	—	2.1	—
Average number of preys referring to 1 trap	17	7.75	9.27	14	5.5	7.75	3.75	6.0	5.87	7.1

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