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Pit building ant-lion larvae effect to the distribution of the substrate particles in their microhabitats

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ÁBRAHÁM, L: *Pit building ant-lion larvae effect to the distribution of the substrate particles in their microhabitats.*
Abstract: The distribution of the size of the substrate particles in and around the pits of the pit-building ant-lion larvae was examined at two different types of microhabitats (open and protected). Samples of substrate were taken from the side of the pits, from the edges of the pits and from 3 cm and 10 cm away from the edges of the pit. The size of the substrate particles taken 10 cm away from the edge is considered to be characteristic for the microhabitat. The samplings consisted of different quality of substrates such as sand, loess, clay and they were taken at all three larvae stages. The samples were divided into fractions by a sieve series and the distribution of the weight percentage of the granulation was analyzed. In order to compare the samples the cluster analysis and statistical tests were used. The preference calculations were performed with Ivlev's index of preference (Ei minimum -1; Ei maximum +1). In this respect the distribution of sandy area in the Carpathian Basin is in correspondence with the distribution of the pit-building ant-lion larvae living in open habitats. The preference of the ant-lion larvae living in protected habitat does not depend on the bedrock. The investigation proved that the substrate has particular spatial distribution in the pits and their environment (microhabitat). While building and repairing the pit, the larvae gather the fine particles in the pit and throw the bigger particles further out from the pit. The spatial distribution of the particle size of the substrate can be actively influenced by the chitin bristles and teeth of the mandibles and head of the larvae. Statistical analysis has proved that the particle size preference does not depend on the development stage of the larvae, it is not species dependent and it does not depend on the quality of the substrate as well. The preferred particle size of the pit-building ant-lion larvae was determined by the physical characteristics (particle size, to what extent they were cemented) of the substrate (sand, loess, clay) which is typical of the habitat. The present and the earlier studies suggest that *Euroleon nostras*, and very likely other pit-building species living in protected microhabitat, chose their habitats providing less food besides optimal particle size and thermal conditions. On the other hand, the species occurring in open habitats such as *Myrmeleon bore,* live in habitats with bigger food supply but with extreme thermal conditions and coarser particle size.

Keywords: ant-lion larva, substrate preference

Introduction

The pit-building ant-lion larvae are sit-and-wait predators that dwell in loose soil. At the base of their pit they are sitting with open mandible motionlessly waiting for their prey (REDTENBACHER 1883, 1884, BÍRÓ 1885a, 1885b). Studying the life of the ant-lion larvae the researchers realized as early as the 18th century that these larvae live in two different types of habitats: open (unsheltered) and protected (sheltered) (WHEELER 1930).

In Central Europe the species occurring in open habitats have strong correlation with the size of the sandy stretches (STEINMANN 1969, ASPÖCK et al. 1980). In open habitats

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where sunrays, the rain and wind have a direct influence, the area with vegetation and with the open sandy surfaces alternate giving a mosaic-like patterns.

The geographical distribution of the species dwelling in protected habitats cannot be related to the quality of the bedrock (sand, loess, clay, adobe etc.), the larvae only occur in dry warm microhabitats (WHEELER 1930, GEPP and HÖLZEL 1989). The common features of this type of habitats that they are small and protected from the wind, from the rain and in most cases from direct sunrays as well. The protected microhabitats distributed in a mosaic-like pattern in the habitat and their vegetation coverage is close to 0%. These kinds of microhabitats form on scarps, drop-offs, at the foot of artificial building sides and under cliff ledges. In order to understand the habitat preference and the distribution pattern of the ant-lion larvae, the geographical distribution of the substrate needs to be compared to the substrate of the two characteristic habitats.

The experiments with different types of substrates suggested that the particle sizes are significantly influencing the habitat preferences of the larvae, and therefore effecting on the predator activity and on the interactions (SIMBERLOFF et al. 1978, GATTI and FARJI-BRENNER 2002). On the other hand, direct observations revealed that the larvae also have an effect on the particle size distribution in their pit's environment (GEPP and HÖLZEL 1989).

The particle size preference of the ant-lion larvae observed in laboratories has been the subject of several publications. During their experiments, YOUTHED and MORAN 1969 came to the conclusion that *Myrmeleon obscurus* which lives in open habitats in South Africa prefers the size of sand fraction between 0.211-0.295 mm. KITCHING (1984) during his experiments with the larvae of *Myrmeleon pictifrons* which occurs in protected habitats in Australia found the particle size preferences of this larvae between 0.125-0.5 mm. ALLEN and CROFT's (1985) experiments carried out also in Australia gave more specific information on the ant-lion larvae. They divided the sand particles into three fractions (fine 0.3 mm, medium 0.3-0.6 mm, coarse 0.6-1.2 mm) and they realized that *Myrmeleon diminutus* living in open habitats and *Myrmeleon pictifrons* occurring in protected habitats prefer the finest substrate fraction.

In the United States LUCAS (1982, 1986, 1989a) has carried out laboratory experiments to examine the influencing factors on the behavior of the ant-lion larvae. He tested pit-building ant-lion larvae living in open (*Myrmeleon carolinus*) and in protected habitats (*Myrmeleon crudelis*) and he divided the substrate into seven fractions. He pointed out that the larvae both from protected and open habitats chose the fine (fine 0.125-0.250 mm) fraction from the substrate. According to his studies (LUCAS 1989b) no significant differences can be found between the particle size preferences of the larvae living in open or protected habitats.

In Hungary SIPOS (1986) has studied the particle size preferences of *Euroleon nostras* occurring in protected microhabitats in experiments with seven fraction sizes as well. As a result he stated that during the experiment most third instar (L3) larvae (80%) built their pits in sand of 0.2-0.4 mm fraction size. During the laboratory experiments in Slovenia with ant-lion larvae of Euroleon nostras DEVETAK et al. (2005) got similar results.

Those laboratory experiments which used flour, iron-filings or glass-dust as substrate cannot be evaluated from behavioral ecology point of view since they do not reflect nature like circumstances.

From earlier experiments it is known that there is an overlap between the particle size preferences of the larvae living in the two different kinds of habitat. The quality of the substrate is different in the two characteristic habitats of the ant-lion larvae. The environmental factors are different in the open and the protected habitats (ÁBRAHÁM 2003).

The aim of the present study is to investigate the particle size preferences of the pit-building ant-lion larvae living in open or protected microhabitats.

Methods and material

In order to study the particles of substrate in different types of habitat the fieldworks were carried out in open and protected habitats of the South Transdanubian region in Hungary.

The sampling site in open habitats on sandy bedrock were Kerek hill at Bélavár (BO), Csárda at Tótújfalu (TO), Nagyhomok at Nagybajom (NO) Kolláti grazing field at Látrány (LO). Samplings of protected habitats on sandy bedrock were carried out Tótújfalu: Csárda (TP), Bélavár: Kerek hill (BP), on clay bedrock: Zselickisfalud (ZP), Kaposvár: Gyertyános (KP), Ropoly (RP) and on loess bedrock Nagyharsány: Szársomlyó (NP).

In order to study the particle size preferences of substrate (Figure 1) samples were taken with a plastic spoon only from the surface layer (as deep as 2-3 mm) of the pit's side (ps), from the edge of the pit (pe) and from 3 cm from the edge (pe3). Beside these a reference point (rp) was also located at every sampling location 10 cm from the edge of the pit which represented the general substrate distribution of the microhabitat.

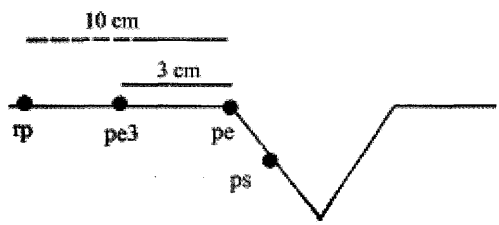

Figure 1: Sampling points in and around the pit

Abbreviations: rp-reference point, pe3-3 cm from the edge, pe-edge of the pit, ps-side of the pit

The samplings were carried out in all three larvae stages (L1, L2, L3) in a 10 x10 series by pits. Afterwards the small amount of particle samples added together type by type (sampling site, habitat, quality of substrate larvae stages) in order to obtain enough quantity of samples for the measurements.

The dried substrate samples were sifted through sieves of different sizes (0.1, 0.2, 0.315, 0.4, 0.5, 0.8, 1, 2 mm). The fractions obtained by this method were weighed and the particle size distribution was calculated in percentage so that the substrate types of different specific weight could be compared.

To analyze statistically the distances between the samplings cluster analysis (complete linkage, Eucledian distances) were chosen.

Earlier studies (YOUTHED and MORAN 1969, KITCHING 1984, ALLEN and CROFT 1985, SIPOS 1986, LUCAS 1989b DEVETAK et al. 2005) in laboratory circumstances defined the particle size preferences of the pit-building ant-lion larvae. In order to define the larvae's preferences in natural environment the particle distribution of the pits (ps) and the reference point (rp) was compared.

For the calculation of the preferences the Ivlev's electivity index (KREBS 1989) was used:

$$Ei = (ri-ni)/(ri+ni)$$

where

ri = percentage frequency of the given fraction of substrate type in reference point (rp)

ni = percentage frequency of the given fraction of substrate type in pit side (ps)

The index varies from -1.0 to +1.0, with values between 0 and +1 indicating preference and values between 0 and -1 indicating avoidance.

The comparison of the different specific weight of the substrate at the reference points was carried out with the Spearman rank correlation. The substrates of same quality but of different types of habitats (TO-TP and BO-BP) were compared by paired samples t-test. The normality examination was carried out by Kolmogorov-Smirnov test. STATISTICA 5.0 and SSPS 11.5 for Windows were used for the statistical analysis.

Results

In order to examine the size of the substrate particle preference of the ant-lion larvae samples in two different types of habitats were taken. In open habitats, the samples were collected at four sampling sites on sandy bedrock. In protected habitat two of the samples were from sandy bedrock, three from clay bedrock and one from loess bedrock. In open habitats on sandy bedrock the larvae of *Myrmeleon bore* (Bélavár: Kerek hill (BO); Tótújfalu: Csárda (TO)) were examined. The larvae from protected habitats occur in hilly and mountainous areas as well, where loose and dry scarps, drop-offs, artificial building sides and cliff ledges offer shelter suitable for their development. In these kinds of habitats the larvae of *Euroleon nostras* on sandy bedrock (Tótújfalu: Csárda (TP); Bélavár: Kerek hill (BP)), on clay bedrock (Zselickisfalud (ZP) and on loess bedrock

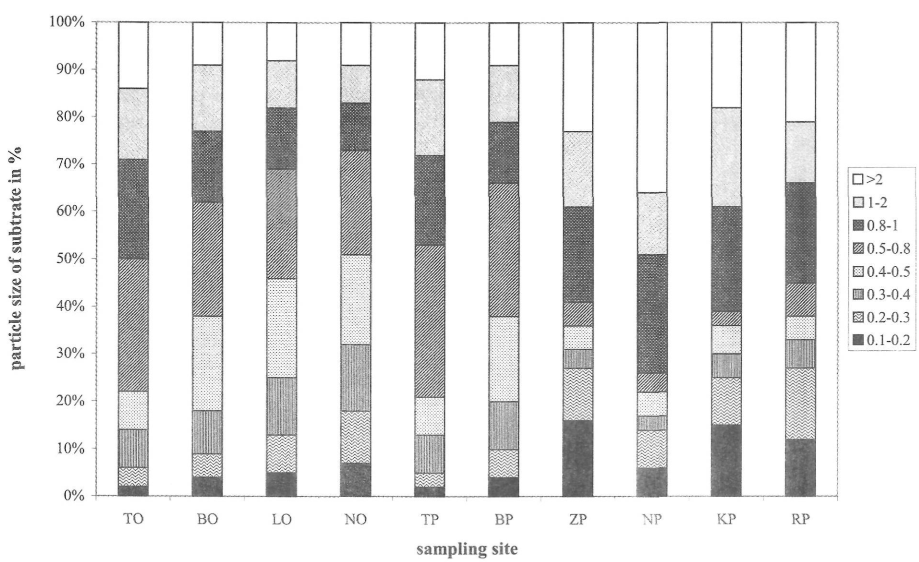

Figure 2: The percentage of the particle size distribution by sampling site

(The first letter is the initial of the settlement, sand: T-Tótújfalu, B-Bélavár, L-Látrány, N-Nagybajom; loess: N- Nagyharsány, Z-Zselickisfalud; clay: K-Kaposvár, R-Ropolypuszta, the second letter refers to the type of the habitat P-protected O-open)

(Nagyharsány: Szársomlyó (NP) were examined. The pits of *Myrmeleon formicarius* larvae were studied on clay bedrock (Kaposvár: Gyertyános (KP); Ropoly (RP)).

The samples taken 10 cm from the edge of the pit (reference point) show the percentage of the general particle size distribution (Figure 2).

The particles of loess or clay are finer than the particles of sand (>0.2 mm) but both kinds of substrate tend to granulate (become cemented) therefore their particle size is a characteristic of a certain sampling site. From figure 2, it is clear that clay proved to have bigger particle size even if it is a finer substrate than sand (Figure 2: ZP, KP, and RP). In loess and clay samples, finer particles were found in bigger portion than in sand. In the sand samples of recent running water (Drava) at Tótújfalu, the proportion of the rounded so-called coarse sand of bigger particle size (>0.8 mm) (Figure 2: TP, TO) can be as much as 50%. In Inner Somogy, on the other hand, the surface is covered with angular fine sand (Figure 2: BO, BP, NO) which originates from the ancient Danube and the wind redeposited it in dunes over and over. Fine particle sand covers the sandy stretches of Látrány (Figure 2: LO) where the proportion of 0.5-0.8 mm particles is maximum 30%.

The above statements are clearly demonstrated in the dendogram of figure 3, which also reflects on the fact that the shortest distance (Euclidean distance) is between samples coming from the protected (BP - Bélavár protected; TP Tótújfalu protected) and the open (BO-Bélavár open; TO-Tótújfalu open) habitats of the same sampling sites.

The result shown by the dendrogram was given more details after a statistical analysis. According to the Spearmann rank correlation evaluation (Table 1), the difference between the sand samples from the same sampling site but from different types of habitat (TO-TP and BO-BP) and the difference between the samples collected from clay sampling sites (ZP, KP, RP) is not significant.

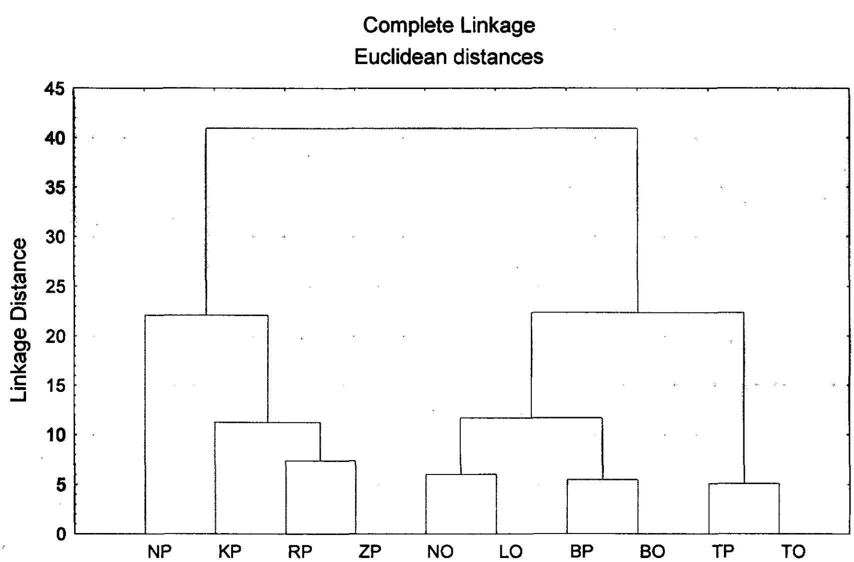

Figure 3: The distance of substrate samples in different habitats

The first letter refers to the sampling site the second letter to the type of the habitat (P-protected, O-open)

Table 1: The Spearmann rank correlation values of the substrate samples representing the sampling sites (rp) compared by pairs

	TO	BO	LO	NO	TP	BP	ZP	NP	KP
TO									
BO	0.801								
LO	0.687	0.946							
NO	0.323	0.659	0.814						
TP	1.000	0.801	0.687	0.323					
BP	0.778	0.994	0.970	0.690	0.778				
ZP	0.139	-0.242	-0.485	-0.723	0.139	-0.325			
NP	0.168	-0.180	-0.419	-0.619	0.168	-0.262	0.952		
KP	0.108	-0.216	-0.407	-0.762	0.108	-0.262	0.868	0.881	
RP	0.205	-0.283	-0.440	-0.539	0.205	-0.347	0.873	0.898	0.766

p=0,05 R=0.738; gray cells-ns

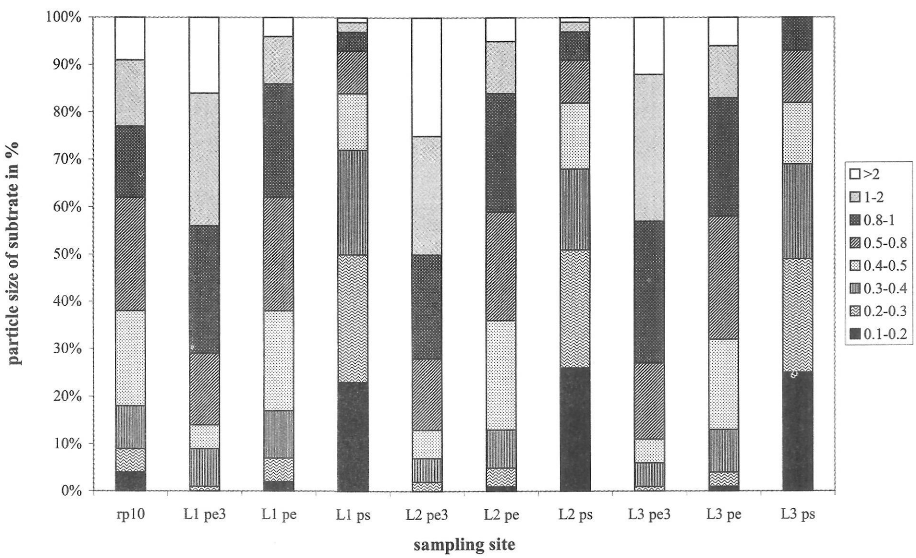

Figure 4: Particle size distribution in open habitat (sand) at Bélavár, plotted against the distance from the pit and the larvae stages

Sand samples 3 cm from the pit (pe3), from the edge of the pit (pe) and also from the pit side (ps) were taken. After sifting through the samples diagrams of the particle size distribution was made for each sampling site representing the different microhabitats (open, protected) the different substrate qualities (sand, loess, clay) and the three larvae stages. One of each type is presented below (Figures 4-7).

From the percentage distribution of the substrate particle size, it can be concluded that there are significant differences between the particle size of the sample taken 3 cm away from the pit (pe3) from the edge of the pit (pe), from the pit's side (ps) and between the reference point (rp) (Figures 4-7).

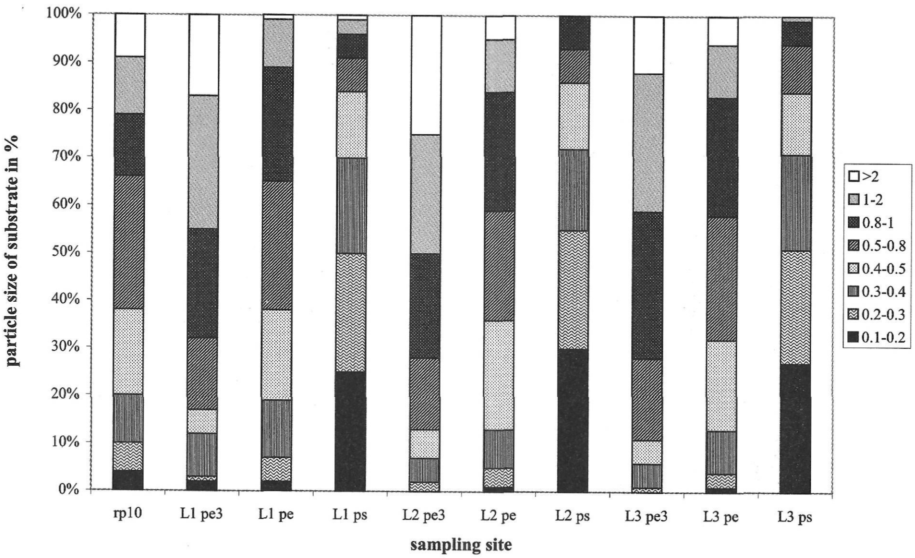

Figure 5: Particle size distribution in protected habitat (sand) at Bélavár, plotted against the distance from the pit and the larvae stages

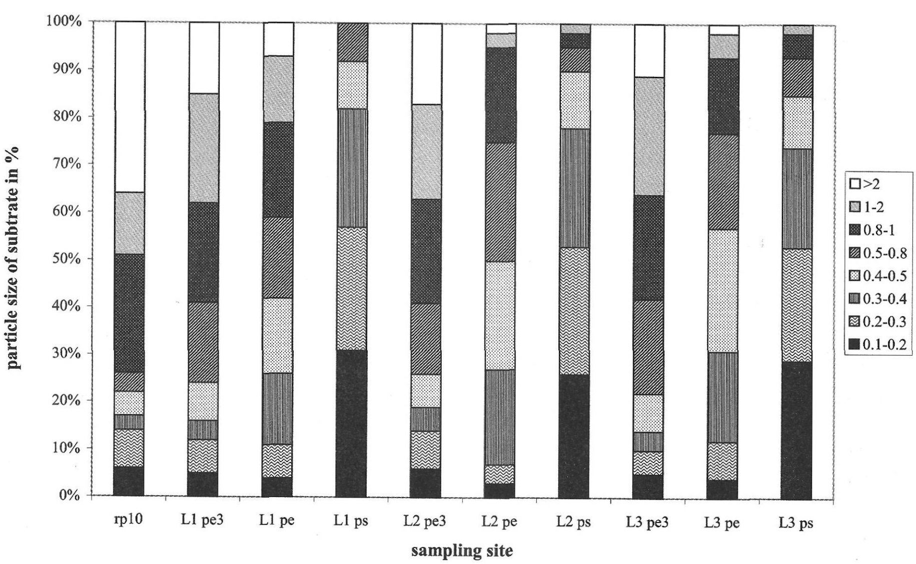

Figure 6: Particle size distribution in protected habitat (loess) at Nagyharsány, plotted against the distance from the pit and the larvae stages

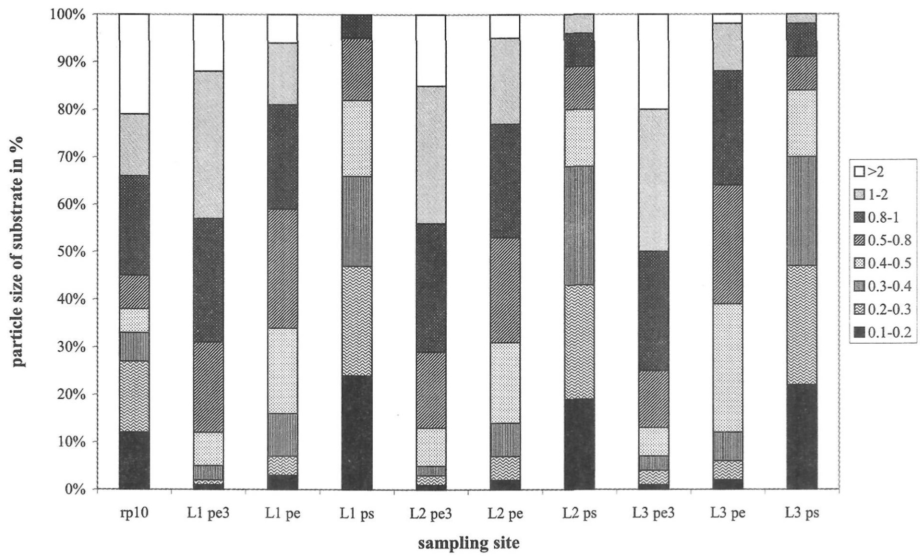

Figure 7: Particle size distribution in protected habitat (clay) at Ropoly, plotted against the distance from the pit and the larvae stages

The dendrogram in figure 8 shows the particle size distribution of the substrate caused by the sand throwing activity of the ant-lion larvae.

The three typical node of cluster clearly apparent on the dendrogram correspond with the locations of the sampling (ps-the pit's side, pe-edge of the pit, pe3-3cm from the edge of the pit) irrespective of the type of the habitat (open or protected) and of the quality of the bedrock (sand, loess or clay).

The analysis of the particle size preference of the larvae at different development stages was based on the comparison of the samples taken from the pit's side (ps) and from the reference point (rp) which is typical of the whole habitat. For this comparison the Ivlev's electivity index (preference index) was used.

Figures 9-18 show the different substrate fraction preferences (+) and the avoidances (-) at certain larvae stages.

It is clear from these figures that difference between the particle size preferences of larvae at different development stages is negligible. The minor differences in the cases of the different larvae stages are neither characteristic of the habitats (open and protected) nor of the type of substrate they are from.

In open sandy habitats (Figures 9-12: TO, BO, NO, LO) the larvae prefer finer substrate fractions (0.1-0.2, 0.2-0.3, and 0.3-0.4 mm) (Ei>= +0.25). They reject the coarser substrates to a great extent (>0.5-0.8 mm Ei>= -0.35).

On the sandy bedrock of Bélavár and Tótújfalu both types of habitats can be found. The difference between the particle size and the homogeneity of the substrate collected in the two types of habitats was not significant (TO-TP R=1 BO-BP R=0.994 p=5.29E-07). The particle size distribution is outstandingly similar in the case of the larvae of *Myrmeleon bore* living in open habitat (TO, BO) on sandy bedrock and in the case of *Euroleon nostras* of the same location (TP, BP) but of protected habitat (Figures 9-10. and 11-12.). Significant difference at these locations (TO-TP and BO-BP) could not be

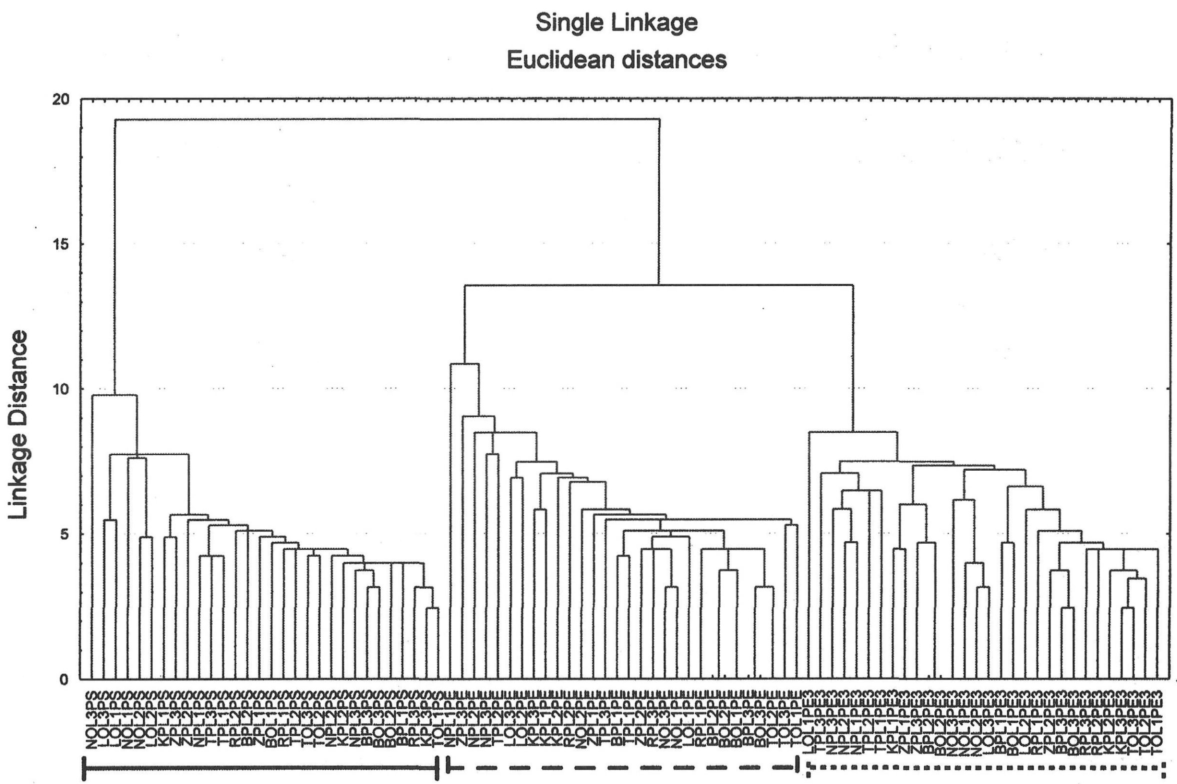

Figure 8: The relative distance of the substrate samples caused by throwing activity of ant-lion larvae

The first letter refers to the sampling site; the second letter to the type of habitat (P-protected, O-open); the third letter to the larvae stages (L1, L2, L3); the fourth letter refers to the distance of the samples from the edge of the pit (pe3 3cm from the edge of the pit (broken line), pe- on the edge of the pit (doted line), ps-the pit's side (solid line)

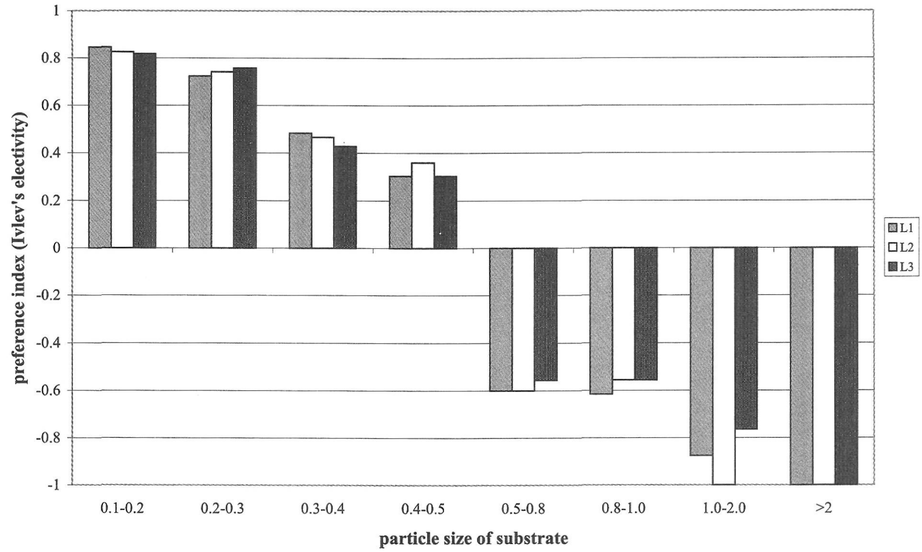

Figure 9: Tótújfalu open habitat

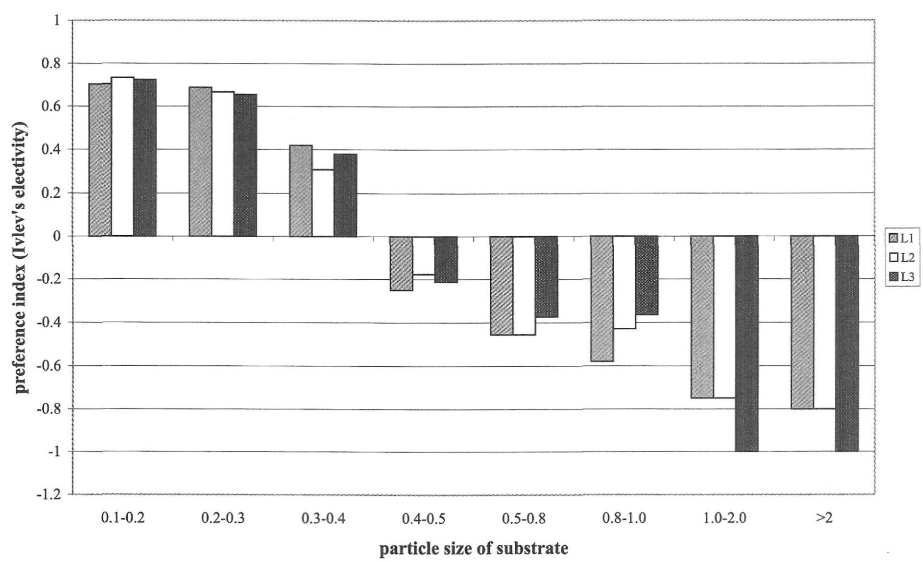

Figure 10: Bélavár open habitat

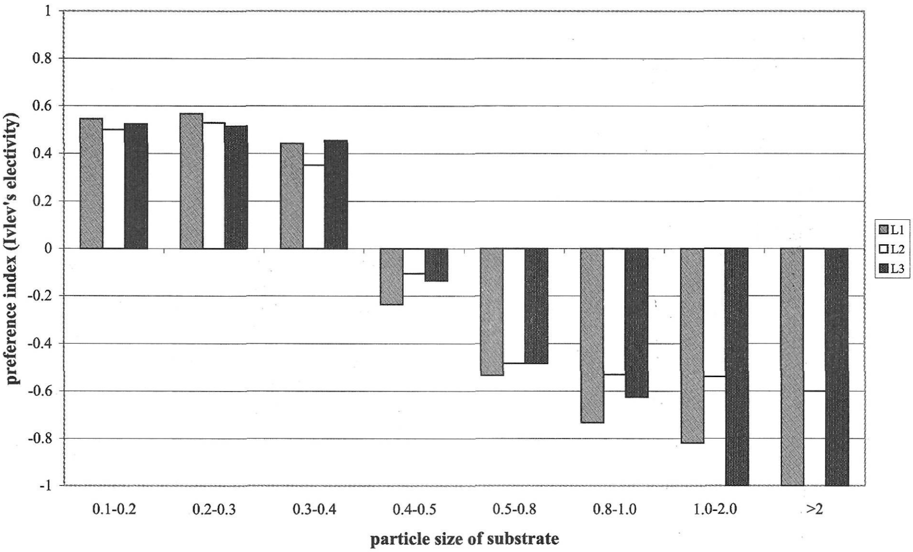

Figure 11: Látrány open habitat

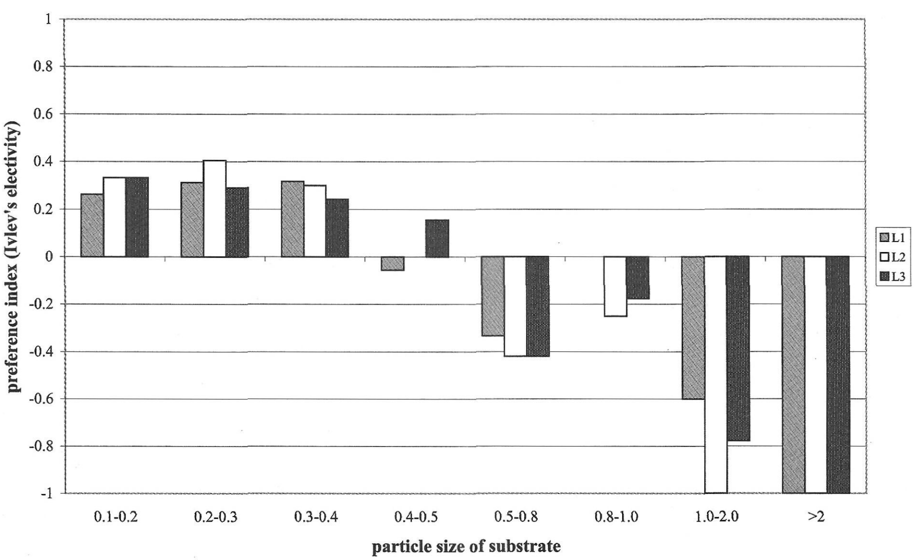

Figure 12: Nagybajom open habitat

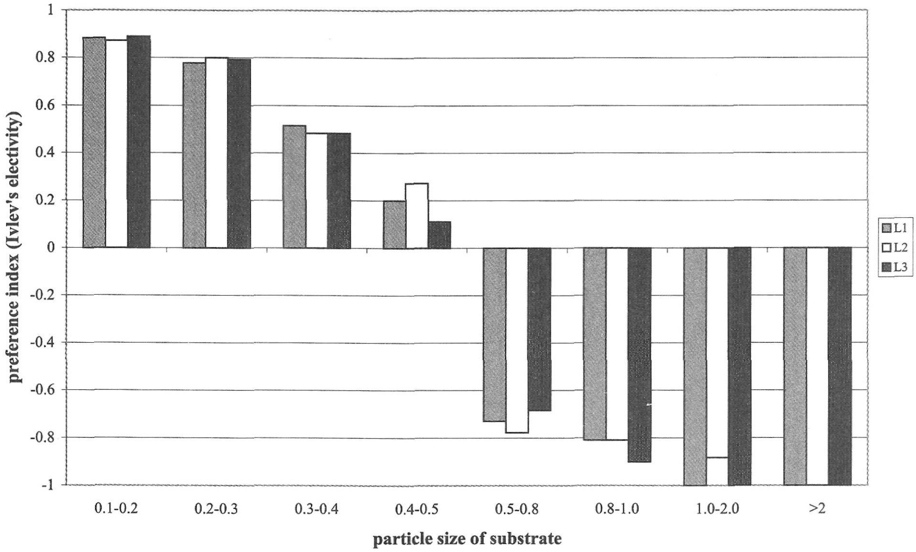

Figure 13: Tótújfalu protected habitat

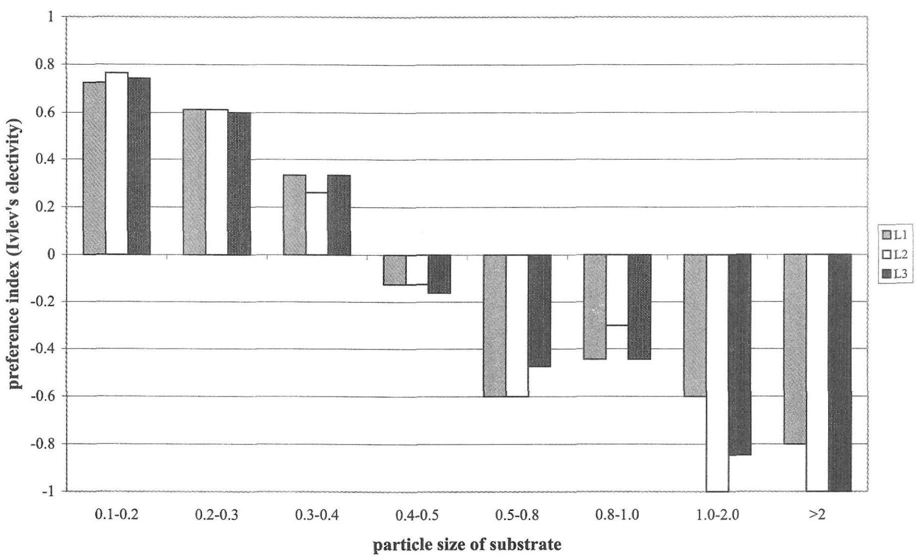

Figure 14: Bélavár protected habitat

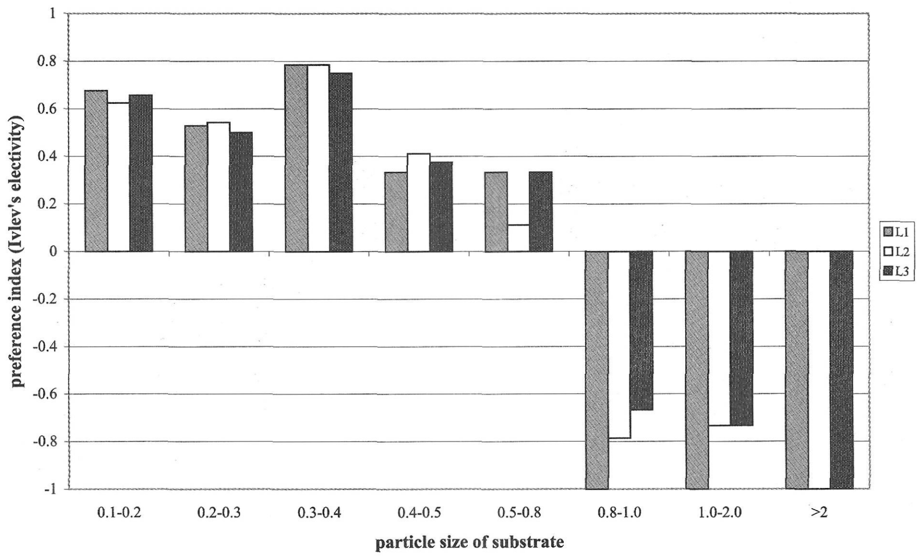

Figure 15: Nagyharsány protected habitat

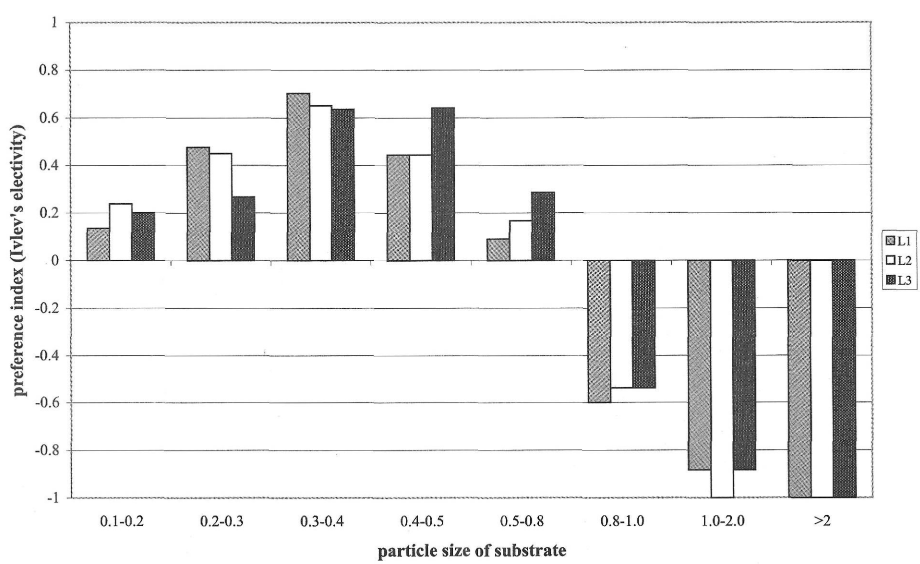

Figure 16: Zselickisfalud protected habitat

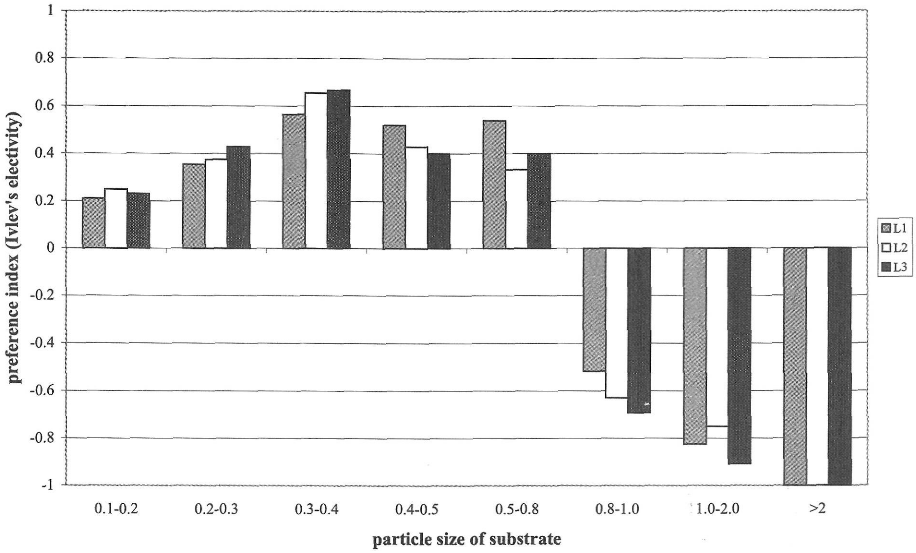

Figure 17: Kaposvár protected habitat

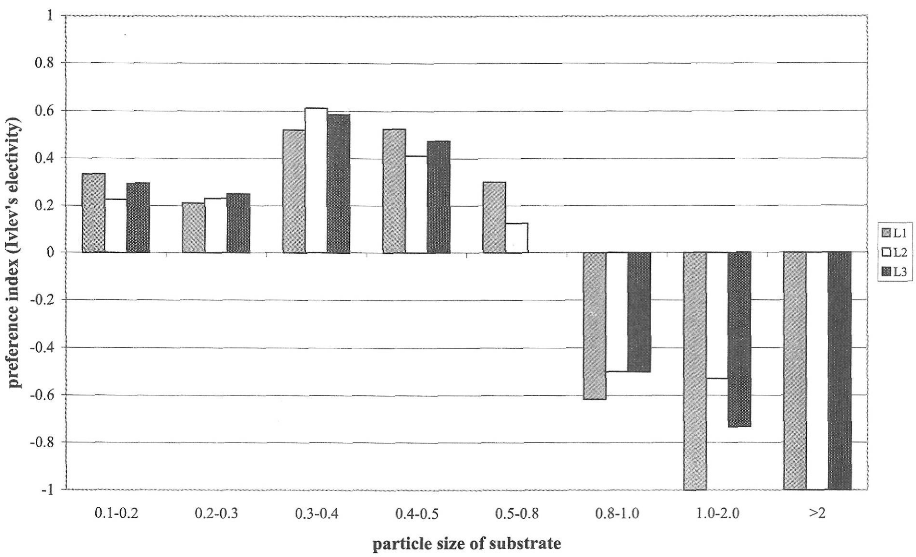

Figure 18: Ropolypuszta protected habitat

Table 2: Comparison of the distribution of particle sizes taken from the pit's side (ps) at the same sampling sites on sandy bedrock

Samples	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
TO-TP	0.061	0.11386	0.04026	-0.035	0.156	1.5	7	0.176
BO-BP	0.018	0.07248	0.02563	-0.043	0.078	0.69	7	0.513

detected even with the paired samples t-test (Table 2). Therefore it can be stated that there was no detectable difference between the preference of the particle size of the ant-lion larvae of *Myrmeleon bore* in open habitat and of *Euroleon nostras* in protected habitat.

In spite of this, the proportion of the finer particles among the substrate particles was smaller in protected habitat than in open habitat.

Comparing figures 9-10. and 11-12., a small difference can be seen between the substrate preferences of *Mymeleon bore* (TO and BO) and *Mymeleon inconspicuus* (NO and LO) in open habitat but this difference might derive from the characteristics of the habitats.

In protected habitats on loess bedrock (NP) the larvae also gather finer substrates in their pits. The preference of the particle size fractions of 0.1-0.2 and 0.3-0.4 mm is high (Ei>= +0.6). It's probable that it is a characteristic of the habitat to what extent the loess particles granulate therefore in the cases of bigger particle sizes (0.4-0.5 and 0.5-0.8 mm) the same preference was observable. The transition is clearly noticeable in the case of the particle sizes of 0.5-0.8 and 0.8-1.0 mm. The particle sizes of >0.8 mm are rejected by the larvae of all three stages to a great extent (Ei>= +0.66).

In protected habitat on clay bedrock the particle size preference of 0.3-0.4 mm particles proved to be stronger (Ei>= +0.52) than the preference of finer or coarser particles, irrespective of the type of species. In this type of habitat the particle size of >0.8 mm is avoided by the larvae; that is they throw out these particle from their pits. The sampling sites of clay substrate were a couple of kilometers away from each other within one region. No significant difference was shown between certain sampling sites (Table 1). At these sampling sites (KP, ZP, RP) no significant differences between the particle size preferences of the larvae of *Myrmeleon formicarius* and *Euroleon nostras* (Table 3) were found.

Table 3: The analysis of the substrate preference according to the sample taken from the pit's side (ps) in protected habitats on clay bedrock

Samples	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
ZP- KP	-0.027	0.10107	0.03573	-0.111	0.058	-0.75	7	0.479
ZP - RP	0.0072	0.10432	0.03688	-0.08	0.094	0.194	7	0.852
KP - RP	0.0339	0.12664	0.04477	-0.072	0.14	0.757	7	0.474

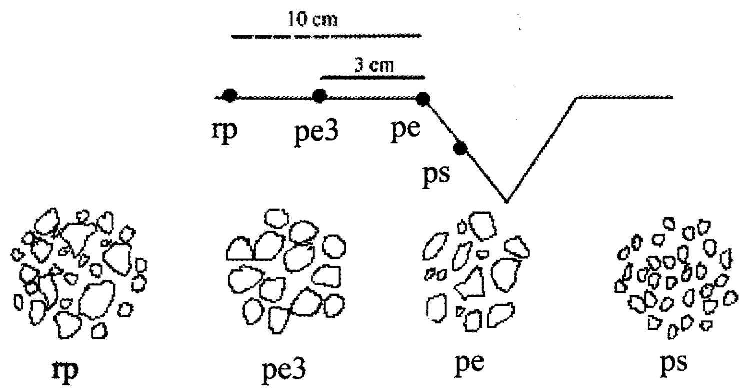

Figure 19: The distribution of the substrate particles in and around the pit

Figure 19 gives a graphic illustration of spatial general distribution given by proportion of the different sizes of particles. It is clear that the particles found 3 cm away from the edge of the pit (pe3) is the coarsest in comparison with the reference point (rp). The substrate particle is the finest inside the pit (ps). The sizes of the particles taken from the edge of the pits (pe) are bigger than the ones taken from the pit side but smaller than pe3.

Their homogeneity is smaller than the samples from the pit side (ps) or the samples taken 3 cm from the edge (pe3).

Discussion

In arboreal areas - except the Mediterranean regions - the pit-building ant-lion larvae have two characteristic habitats: open (unsheltered), protected (sheltered). Open habitats can only form on contiguous sandy stretches (WHEELER 1930, GEPP and HÖLZEl 1989). In this respect the distribution of sandy area in the Carpathian Basin (PÉCSI 1989) is in correspondence with the distribution of the pit-building ant-lion larvae living in open habitats (STEINMANN 1969, ASPÖCK et al. 1980, ÁBRAHÁM 1998). The preference of the ant-lion larvae living in protected habitat does not depend on the bedrock (BÍRÓ 1885a, 1885b). During the present investigation both types of habitats and the species characteristic of these habitats were found (ÁBRAHÁM 1998) therefore the quality of the substrate cannot be considered species dependent factor. On clay and loess bedrock open habitats cannot be formed in Central-Europe due to climatic reasons. The species typical of open and protected habitats are clearly distinguished.

During the present research the particle size preferences of the pit-building ant-lion larvae occurring in open and protected habitat on sand, loess and clay substrate was studied. The common feature of the experiments of earlier studies (YOUTHED és MORAN 1969, KITCHING 1984, ALLEN és CROFT 1985, LUCAS 1982, 1986, 1989a, SIPOS 1986) is that these were manipulated under laboratory circumstances. As a result of these experiments it can be stated that there is an overlap in the preferences of the particle size of the ant-lion larvae, but this depended on the particle sizes used in a certain experiment.

The analysis of the samples taken from the natural habitats of the ant-lion larvae has proved that the particle size of the substrate is converted by the larvae during their pit building and sand throwing activity (Figure 8) and this result corresponds with the earlier experimental observations of the pit building activity (BÍRÓ 1885a, 1885b REDTENBACHER 1883, 1884). The spatial distribution of the particle size of the substrate can be influenced by the chitin bristles and teeth of the mandibles and head of the larvae. The larvae gather the finer fraction particles inside the pit and they throw out the coarser particles in the neighborhood of the pit (GEPP and HÖLZEL 1989). This pattern is suitable for the effective predator activity which comes from the physical characteristic of the substrate (LUCAS 1982, FARJI-BRENER 2003). In protected habitat the larvae live in populations of higher density than in open habitats therefore they sift through the substrate of their microhabitats several times for many years. In the process of arranging the larger size particles towards the edge, the substrate is getting finer (Figures 12, 14).

In open habitats the larvae being under unfavorable conditions (e.g. lack of food, high temperature) leave their pits and rebuild them somewhere else consequently the particle size of the substrate is not as differentiated as in the cases of the species living in protected habitat (Figures 9, 10). Because of the prevailing exogenic processes, such as wind, rain and other disturbing effects in open habitats, a more homogenous mixture of particles is formed on the spatial scale of the microhabitats.

In their case study, LOIREITON and MAGRATH (1996) emphasize the important role the particle size plays in the predator activity. In the case of finer particle size, the pray has less chance to escape, which was proved by a measurement series as well. Therefore it can be stated that in both types of habitats the ant-lion larvae try to gather the finer particles in their pits by their sand throwing activity.

There are more significant differences in the particle size distribution between the habitats which are geographically are far from each other than between the different types of microhabitats (Figure 3).

In the microhabitats of the ant-lion larvae, the particle distribution of the substrate is the result of the activity of the larvae. The larvae gather the particle size which they prefer the most. The particle size of 0.2-0.3 mm seems to be the most typical in the case of the *Myrmeleon* species regardless of the type of the habitat and the quality of the substrate. In three cases out of two, the highest figure of preference of the larvae of *Euroleon nostras* was 0.1-0.2 mm under natural circumstances.

In general it can be established that the quality of the substrate is reflected in the particle size preferences of the larvae dwelling in different habitats rather than in the difference of the species and the ages of the larvae.

The present and the earlier studies (ÁBRAHÁM 2003) suggest that *Euroleon nostras*, and very likely other pit-building species living in protected microhabitat, chose their habitats providing less food besides optimal particle size and thermal conditions. On the other hand, the species occurring in open habitats such as *Myrmeleon bore*, live in habitats with bigger food supply but with extreme thermal conditions and coarser particle size.

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Tölcsérépítő hangyaleső lárvák hatása a szubsztrát szemcsék eloszlására élőhelyeiken

ÁBRAHÁM LEVENTE

Tölcsérépítő hangyaleső lárvák szempontjából két különböző típusú élőhelyen (nyílt és védett) vizsgáltam a szubsztrát szemcsék eloszlását a hangyaleső lárvák tölcséreiben és azok környezetében. Szubsztrát mintákat vettem a tölcsérek oldalából, a tölcsérek pereméről, a tölcsér szélétől 3 cm-re és az egész élőhelyet jellemző helyről, a tölcsértől 10 cm-es távolságból. A mintavételt különböző szubsztrát minőségű anyagok: homok, lösz, agyag esetében mind a három lárvastádiumoknál elvégeztem. A mintákat egy szita sorozattal frakcionált részekre választottam szét és a szemcsenagyság súlyszázalék eloszlását elemeztem. A minták összehasonlításához clusteranalízist és statisztikai próbákat használtam. A lárvák által előnyben részesített szemcsenagyságot az Ivlev féle preferencia indexxel számoltam ki, ahol az Ei minimum = -1; az Ei maximum = +1.

A terepi felmérések megerősítették azt, hogy Közép-Európában a nyílt élőhelyeken előforduló hangyaleső lárvák a homokvidékek elterjedésével mutatnak korrelációt, míg a védett élőhelyen előforduló fajok elterjedése ettől független.

A vizsgálat kimutatta, hogy a hangyaleső lárvák tölcséreiben és azok környezetében (microhabitat) a szubsztrát jellegzetes térbeli eloszlást mutat. A lárvák a tölcsérekben mindig finomabb szemcséket halmoznak fel, míg a durvább szemcséket a tölcsérek szélétől távolabb szórják ki a tölcsérépítés és a javítgatások közben (Figure 8, Figure 19). A szubsztrát szemcseméret térbeli eloszlását a lárvák fején és rágóján található kitin tüskék és fogak segítségével képesek aktívan befolyásolni.

A statisztikai elemzés rávilágított arra, hogy a szemcseméret preferencia nem függ a lárvák fejlettségétől, nem mutat faj függőséget és nem függ a szubsztrát anyag minőségétől sem. A tölcsérépítő hangyaleső lárvák által preferált szemcsenagyság méretét mindig az adott élőhelyre jellemző szubszrát (homok, lösz, agyag) fizikai tulajdonságai (szemcsék nagysága, összecementáltságuk, stb.) határozták meg.

A jelenlegi és a korábbi vizsgálatok alapján úgy tűnik, hogy az *Euroleon nostras*, és valószínűleg a többi, védett helyen tölcsért építő faj is, viselkedés-biológiailag az optimálisabb szemcsenagyság és hőmérsékleti tényezők melletti, kisebb táplálék-ellátottsággal bíró habitatban él, míg a nyílt élőhelyeken előforduló fajok, köztük pl. a *Myrmeleon bore*, a szélsőséges hőmérsékleti körülmények között, durvább szemcseméret eloszlású, nagyobb táplálék kínálattal bíró élőhelyeken fordulnak elő.