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The Larvae of European Myrmeleontidae and Ascalaphidae (Neuroptera)

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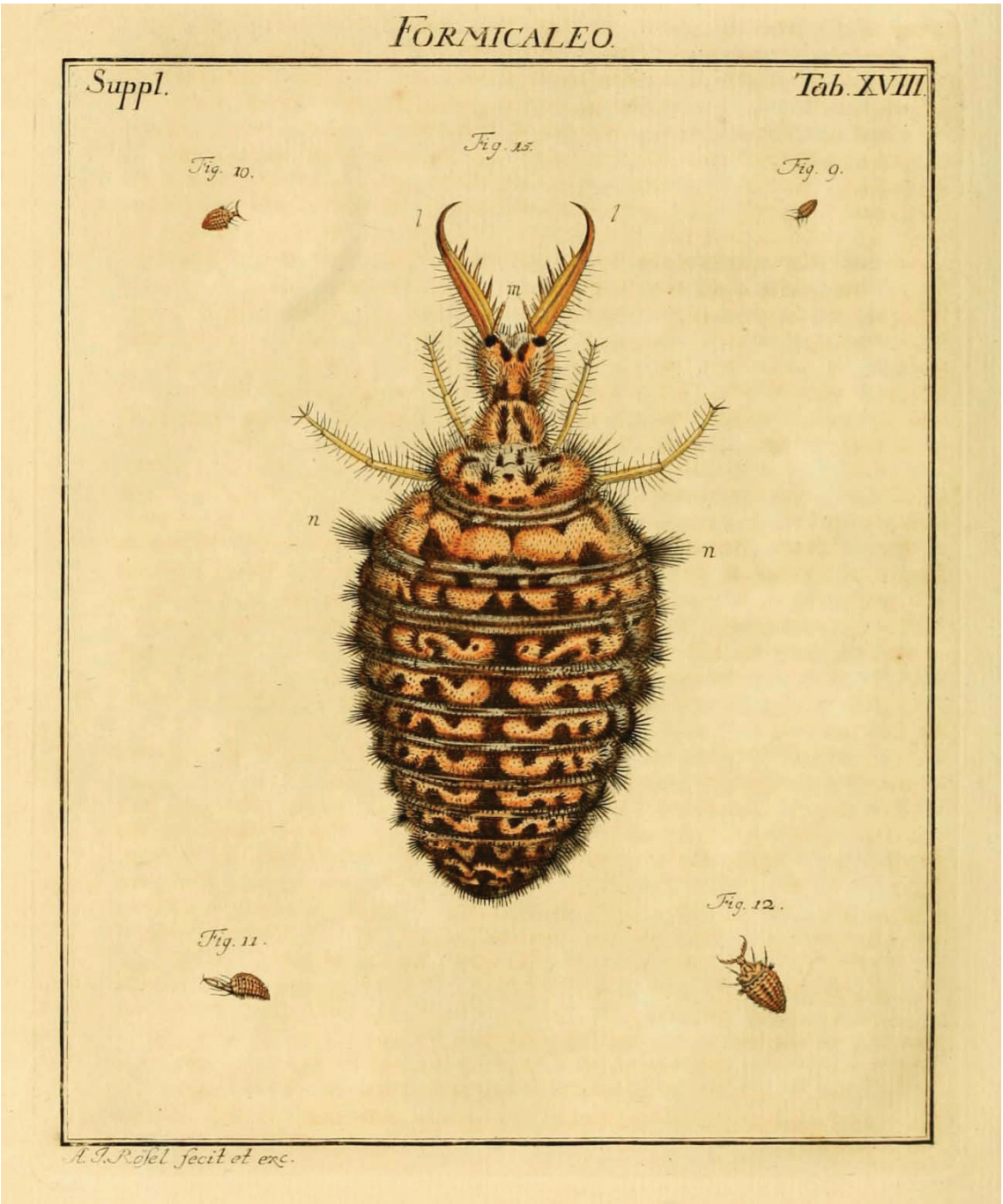
Der listige und geschickte Ameis-Raüber welcher sich in eine Land und Nacht Libelle, oder in eine Land und nacht Nymphe verwandelt, nebst seinen wunderbahren Eigenschafften.

Rösel von Rosenhof

"Die Monatlich-herausgegeben Insekten-Belustigung " (1755)



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Introduction

Antlions (Neuroptera Myrmeleontidae) are probably the only insects whose larvae are popularly best known than the adults, surely for their ability to build conical pit traps to catch preys; in fact the name itself was firstly attributed to the preimaginal stages and not to the imago. The term "antlion" originally referred to a mythological beast during the Classical antiquity but already in the Middle Ages it was clearly used to define these larvae by *Albertus Magnus* in one of the first zoological books, *De Animalibus Libri* XXVI (first printed in 1478). The ancient accounts on this insects and on the surrounding mythology are deeply treated by Druce (1923), Wheeler (1930), McKevan (1992) and Nicoli Aldini (2005a). The remarkable and noticeable pit-building activity of the larvae inevitably attracted the attention of the naturalists of the 18th century, such as Vallisneri (1717, 1733), Réaumur (1742) and Rösel von Rosenhof (1755); the last two authors, in particular, described and illustrated with a keen attention the metamorphosis and the life cycle of *Euroleon nostras* (Geoffroy *in* Fourcroy, 1785), one of the commonest European species. Systematic and precise morphological studies on the larvae began mainly by the efforts of Brauer, who published numerous works on the larvae of these insects (1854, 1855a, 1855b, 1867) – firstly understanding the importance of the preimaginal stages in the systematic of Neuroptera – and by Hagen (1873b). The conical pit traps built the larvae and the correlated behaviors continues to be a subject of research even now, whereby a surprisingly vast literature exists. Nevertheless the numerous ecological and ethological studies are to counterbalance by the extremely poor state of knowledge of the larvae of the various species and it is often difficult to discriminate between them. Moreover, bio-ecological data are lacking for most members of the family. In reference of the Europen fauna, only an handful of original comprehensive comparative work followed the above mentioned authors, such as Redtenbacher (1884), Steffan (1968, 1975) and Willmann (1977) and it is also noteworthy that they can be all considered occasional papers. Notably, the French entomologist Steffan, who was undoubtedly the major contributor to the identification and the ecology of the larvae of the European species (Steffan 1965, 1968, 1971, 1975a, 1975b) was an hymenopterist that originally studied Hymenoptera Chalcididae parasitoids of antlions (Steffan 1958, 1959a, 1959b, 1961a, 1961b, 1966). Generalizing, the ambush-hunter species of antlions are far less known than the pit-building ones. The knowledge of the larvae of the family Ascalaphidae, very closely related to Myrmeleontidae, is even poorer surely due to their secretive habits. The only works regarding the distinction of the larvae of the European taxa are exclusively the outdated account by Hagen (1873a), followed by the more recent Rousset (1972) and Pieper & Willmann (1980) that comprise only a few species. Important studies not focused on the

European fauna are, among the others Stange & Miller (1985, 1990), Stange (1994) for Myrmeleontidae and Henry (1976, 1977, 1978), Tjeder (1992) for Ascalaphidae.

The aim of the present study is to realized a modern, update and comprehensive as far as possible instrument to allow the identification of the preimaginal stages of the European Myrmeleontidae and Ascalaphidae. The identification of the larvae appears even more important considering the narrow habitat requirements of some species allowing to attribute them a potential role as bio-indicators (Gepp, 2010).

Materials and methods

Collection of the larvae in nature

The examined larvae of Myrmeleontidae and Ascalaphidae were obtained through two different ways of sampling: direct research in the field or alternatively by eggs laid by adult females. The larvae of Myrmeleontidae can be found wherever dry and sand-like substratum is present, despite only an handful of species is present in relatively fresh and humid environments such as mountains. Most of the species prefers protected microhabitat such as rock overhangs, cave mouths, at the entrance of animal burrows, at the base of trees, under bushes and in proximity of rocks and roots where loose detritus, suitable to dig, often accumulates itself. The larvae of the species dwelling in open environments, such as sand dunes or grasslands, are normally found in exposed conditions or near small shelters such as tufts of herbs. Finally, a peculiar microhabitat colonized by few species is represented by dry tree holes full of sawdust in large trees. The main requirement of the larvae is the presence of a dry and fine substratum such as sand, loose soil and radical detritus; moreover its density often plays an important role on habitat choice of most species of antlions, with an important effect on pit building species (Devetak et al., 2012). However observations in the field shows that some species, especially among non pit-builders, are noticeably plastic in the characteristics of the substratum and of the habitat choice in general. The larvae are usually hidden under a narrow layer of sand, waiting for the passage of a possible prey, despite they are able to bury themselves to a considerable deep to avoid excessive heat or other adverse conditions. Due to their fossorial habits the larvae are normally difficult to locate, with the exception of pit-builder species, despite the traces and small depressions that they leave in the sand can betray their presence. Sieving is probably the best way to collect larvae on Myrmeleontidae in environments with a considerable deep loose substratum, such as sand dunes, allowing to easily collect not only pit-building species but also the hardly noticeable ambush hunters. However, this collecting method has its limits where the sand is mixed with large quantities of vegetal matters: in this condition the sieve

rapidly obstruct itself and small larvae are easily overlooked. Pit-building species are best collected noticing their conical traps by spot and gently digging to find the larvae; a small sieve or a strainer can be extremely useful in this respect. Another method successfully applied to collect pit-builders is to quickly insert a vial in the center of pit, pushing it until it is full of sand and then to examine the contain on the palm of the hand, to notice if the larva have been captured. The capture of ambush-hunter species is, on the contrary, quite difficult and only some large species leave tracks useful to locate them. Moreover the sieve cannot be employed in environments where the loose substratum is very narrow or limited to small pockets; in this conditions the best way to find the larvae is to remove it with a fine brush or to blow off it with an entomological aspirator. The larvae of Ascalaphidae are probably even more difficult to find in the field than those of Myrmeleontidae, despite they do not dig. They live in the same sites frequented by the adults, hidden among herbaceous vegetation or rocks and they are commonly present in low densities. Moreover these larvae are completely immobile and usually well camouflaged, covering themselves with debris. For this reason they are very difficult to locate when they lay on the soil surface. Owlflies' larvae are often hidden under rocks and they can be easily spotted when they adhere to their inferior surface. As above mentioned, the larvae can be also obtained from the eggs laid by mature females and this method appears quite proficient for Ascalaphidae, due to the difficulty to directly find the larvae in nature. The adults are mainly collected using an entomological net or at light, being most of the species crepuscular or nocturnal, with the exception of some diurnal Ascalaphids such as the genera *Libelloides* and *Deleproctophylla*. The oviposition of Myrmeleontidae is obtained by keeping the females in containers, superiorly closed with paper or a net, partly filled with sand and with some sticks as support; if the condition are optimal the female lays the eggs in the sand. For the oviposition of Ascalaphidae it is necessary to follow the same procedure, with the notable exception that the presence of sand is not necessary because the eggs are directly laid on the sticks. The two methods, the direct research of the larvae in the field and the rearing from eggs, are complementary and they are both successfully applied during the present research. The field research provides the necessary information on the ecological requirements and habitat choices of the studied species, besides to be useful to obtain any parasitoids while rearing from eggs allows to have an immediate and sure determination of the specimens (being the female known) and a considerable higher number of larvae. The direct research in the field has been applied especially for the larvae of antlions while in the case of ascalaphids the second methods has been successfully used for three genera (*Ascalaphus*, *Deleproctophylla* and *Libelloides*). Finally, the larvae of both families can be collected in pit-fall traps but the low-densities and the micro-habitat requirements of most species make this collecting method unsuitable for dedicated research.

Rearing

The larvae, both those obtained from eggs than from field samplings, were reared in the laboratory in order to check the identification or to obtain the 3rd instar, being the previous ones not suitable for identification purposes. Rearing was carried out in a dedicated room with a mean temperature of 25°C and 60% humidity. During the winter the larvae were moved into an unconditioned room to simulate natural conditions. The larvae of Myrmeleontidae were reared in small cylindrical containers of plastic a third filled with sand; for some species with a different substratum preference, loose soil or vegetal detritus were used instead. The larvae of Ascalaphidae were reared in the same type of containers placing a stripe of paper on the bottom, on which they securely adhere. The preys were constituted by Yellow Mealworm larvae, *Tenebrio molitor* Linnaeus, 1758 (Coleoptera Tenebrionidae) and by cockroaches (Blattaria Blaberidae gen. sp.) of adequate size; the larvae of Ascalaphidae were fed almost exclusively with cockroaches. Newly hatched specimens and small first instar larvae were nourished with Bean Aphids, *Aphis fabae* Scopoli, 1763 (Hemiptera Aphididae) until reaching a suitable size to larger and more combative preys. After spinning the cocoon, the specimens were placed in larger and high containers with a stick to allow the eclosion of the imago.

Study

Morphological observations were mainly conducted by means of a Leica® MZ9.5 stereomicroscope while measurements and photographs were taken using a Leica® MZ16 stereomicroscope with apochromatic lens, equipped with a Leica® DFC320 digital camera. The specimens were measured following the protocol applied by Cesaroni et al. (2010): the body length of larvae was measured from the head (excluding mandibles) to the tip of abdomen; the length of the head capsule was measured ventrally from the clypeo-labrum to the proximal margin (insertion of the head capsule with the thorax), the width was taken just below the eye tubercles, at the point of maximum width; the length of the mandibles was measured from the apex to the base. The photographs were realized placing the specimens in Petri dishes filled with alcohol and taken by means of the above mentioned camera, afterwards they were elaborated using LAS (Leica® Application Suite) applied software Version 2.5.0 R1. Finally, the obtained images were processed and retouched using the software Adobe Photoshop® CS5 Extended Version 12.0. The larvae were preserved in 95° ethanol and preserved in the collection of the author and of R. A. Pantaleoni.

Larval morphology

The main apomorphic characters of the order Neuroptera are shown by the preimaginal stages and the most striking, immediately evident in them is represented by the extreme specializations of the head and mouthparts due to the predaceous and suctorial habits of the larvae, as recognized the first time by Brauer & Löw (1857). In Neuroptera, in contrast with Megaloptera and Raphidioptera, the mouth cavity is not functional and the aliment is acquired by means to extra-oral digestion and suction through the jaws, modified in sucking tubes by the elongated and grooved mandibles and maxillae. Within Neuroptera the suborder Myrmeleontiformia, comprising the extant families Psychopsidae, Nemopteridae, Nymphidae, Myrmeleontidae and Ascalaphidae, is well supported in all recent analyses (Aspöck U. et al., 2001; Haring & Aspöck U., 2004; Aspöck U. & Aspöck H., 2008; Beutel et al., 2010; Winterton, 2003; Winterton et al., 2010) albeit it was recognized for the first time by Withycombe (1925) on larval features. Myrmeleontiformia are characterized by a strongly sclerotized head modified in an head capsule - in opposition with the "maxillary head" *sensu* Aspöck U. (1992) - very large and robust mandibles and the presence of dolichasters, a specialized type of setae. Myrmeleontidae and Ascalaphidae are two very closely related families and their larvae are distinguished by the presence of 7 stemmata and fusion of tibia and tarsus in the metathoracic pair of legs. They share with Nymphidae the presence of thoracic and abdominal protuberances, named scoli (Henry, 1978; Stange, 1994). The reciprocal relationship between these families and Nemopteridae is still not well understood (Aspöck U. et al., 2001; Haring & Aspöck U., 2004; Aspöck U. & Aspöck H., 2008; Beutel et al., 2010; Winterton, 2010). Myrmeleontidae and Ascalaphidae share most apomorphies and some apparently striking larval differences are in reality of no phylogenetic value considering the families as a whole and the ecology of some taxa (Stange, 1994). Generalizing, Ascalaphidae preserve a more conservative type of larva in comparison with the Nymphidae, while Myrmelontidae show a considerable diversified way of life and peculiar specializations. Most of Myrmeleontidae, including all the European species whose preimaginal stages are known, manifest adaptations to a fossorial habits absent in Ascalaphidae therefore making them easily recognizable.

Head

The head is comparatively large, heavily sclerified and sub-rectangular in shape (fig. 1). The composing sclerites are strongly chitinized and mostly fused in a robust head capsule. The anterior margin of the labrum is straight or concave according to the taxon, and it is often a valuable diagnostic feature. The dorsal tentorial pits are very evident in most of taxa, they are oblique and convergent from the base of the antennae toward the middle. The anterior portion of the head is separated from the epicranial area by a pair

of oblique frontal sutures converging in median straight epicranial one running along the dorsal side of the head from the middle toward the posterior part of the head. The occipital foramen is dorsally placed, consequently the insertion with the prothorax is vertical. In Ascalaphidae a dorsal emargination in the occipital area is normally very evident and the head is distinctly cordate. This is often considered a diagnostic character of this family (fig. 7) (Henry, 1976), however it occurs also in Myrmeleontidae (Miller & Stange, 1985). The antennae are dorso-lateral in position between the jaws and ocular area (fig.1). They are small and filiform, borne on a slight protrusion and composed by a short scapus, a comparatively long pedicel and a slender flagellum. The stemmata are borne on an ocular tubercle whose size, position and prominence is often of diagnostic value; they are 7 in number of which 6 dorsally placed and 1 ventral (fig. 1). The labium is sclerified, disposed in the ventro-anterior portion of the head and encased by the lateral sclerites of the head capsule (genae). The basal portion of the palpi, at their insertion on the mentum, is very distinct being large and characteristically swollen. This structure is controversial and it has considered the basal article of the palpi (Frieheden, 1973; Principi, 1943, 1947; Nicoli Aldini, 2005b) or a prelabial lobe (MacLeod, 1964; Rousset, 1973; Henry, 1976; Tjeder, 1992). Depending on the chosen option the number of articles of the labial palpi conceptually varies. It is here considered as an integral part of the labial palpus as a basal article due to the weakly supported alternative of considering it a prelabium. The labial palpus is normally 4-segmented, in rare instances among Myrmeleontidae there are only 3 recognizable articles (fig. 34D) (Devetak et al., 2010b; Frieheden, 1973; Nicoli Aldini, 2005b), the distal segment bears a sensorial pit. The gula is present and recognizable in the posterior portion of the labium and prosecute as a straight line running all along the ventral portion of the head, often reaching its posterior margin. The small ventral tentorial pits are disposed along the side of the labium. The jaws are large and are the most striking feature of the group. They are composed by very large, sclerified and dorsally disposed mandibles and narrow, ventrally-placed maxillae; both elements are elongated and form sucking tubes by mean of the median furrow (fig. 1). The mandibles are curved apically and are equipped with teeth and setae along the internal margin. They represent a very important diagnostic features: their relative dimensions, shape and thickness, the disposition and dimension of their teeth and setae allow to discriminate numerous taxa. The conspicuous mandibular teeth are a sinapomorphy of Nymphidae, Myrmeleontidae and Ascalaphidae, and true teeth are lacking in the other two families of Myrmeleontiformia. This structures derive from the setigere tubercles (Stange, 1970) and intermediate condition is relatively common. In most Myrmeleontidae and Ascalaphidae (including all European species) they are 3 in number, however members of both families show addional teeth (Tjeder, 1992; Stange, 2004) while a reduction of their number is much rarer and reported for few genera of Myrmleontidae (Stange, 2004). The middle tooth is the largest in Ascalaphidae and some tribes of Myrmeleontidae. The mandibles are articulated through a condyle and

inserted at the apex of the genae. The maxillae are elongated, curved and considerably narrower than the mandibles along which they are disposed; the respective cardo and stipes are visible ventrally between the base of the palpi and the sclerified head capsule.

Thorax

The prothorax is narrower and smaller than the other two thoracic segments which in turn are not visually abrupt separated from the abdomen (fig. 1). The cervix, the anterior portion of the prothorax, is short and annular in shape and it is articulated with the head, allowing its mobility in respect of the rest of the body. This subsegment is more or less developed according to the considered taxa and their relative habits, conditioning the movement of the head and consequently influencing the predatory capabilities. The following subsegment is mostly covered by the large and sclerified pronotum and bears the first pair of legs. The pronotum is large and cuneiform and the posterior portion of the head can be partly retracted within it (fig. 1, 3). The disposition of the setae on its dorsal surface can be useful in identification purpose (fig. 5). The mesothorax is broader than the prothorax but shorter. The anterior mesothoracic subsegment bears the only pair of thoracic spiracles which are often discriminating, especially in Myrmeleontidae, according to their sclerification, shape and prominence (fig. 2). The mesonotum is equipped with a pair of protuberances on the sides, termed scoli (fig. 2). In Ascalaphidae they are conspicuous and sometimes very developed (fig. 37) while in Myrmeleontidae they are present and distinct, albeit often reduced, in some tribes (fig. 9) and completely lost in others (fig. 21). The scoli can be more or less flattened or cylindrical. The metathorax is not particulary differentiated from the previous segment with the notable exception of the absence of the spiracles. It is equipped with a pair of scoli in most Ascalaphidae and in few Myrmeleontidae. This segment is very short on the dorsal side but wide and well developed ventrally, therefore it is dorsally partly covered by the first abdominal tergite.

Legs

The legs pairs are characterized by a similar conformation and there are not considerably differences between the prothoracic and mesothoracic pairs except the larger dimensions of the latter (fig. 1). They are composed by a large and robust coxa, trochanter, femur, tibia and a tarsus composed of one segment and a reduced, claws-bearing pretarsus. The metathoracic pair of legs is similar in shape with the previous ones but is notably characterized by the fusion of the tibia and the tarsus, an exclusive character of both families. Moreover solely in Myrmeleontidae the claws of the last pair of legs are enlarged probably due to digging purposes; only one exception is known (Stange, 1994). In the antlion tribe Myrmeleontini the metathoracic legs are stouter than the others and subject to a torsion, conditioning the whole movement of the larva, a modification probably due to their pit-building habits (see Myrmeleontini).

Abdomen

The abdomen is not clearly visually separated from the thorax and its shape and relative size change according the stage of the larva and the nutrition (fig. 1). The 1st segment is as broad as the thorax, the maximal width is progressively reached at the middle of the abdomen until it declines gradually toward the posterior end. It is composed by 10 segments but only the first nine are normally visible. The 10th segment is, in fact, telescopical and retracted inside the 9th and 8th segments (fig. 4F); it is specialized to spin the silk secreted by the Malpighian tubules during the construction of the cocoon. The tergites are not always recognizable due to the soft and elastic pleural area with they gradually merge, while the sternites are normally discernible. Each of the first eight segments are equipped with a pair of lateral spiracles (fig. 2). In Ascalaphidae subfamily Ascalaphinae, it is observed a tendency to locate the first pair of spiracles dorsally, while in Haplogleniinae the first two pair of spiracles are present on the dorsum (Hagen, 1873; Henry, 1978). In the Myrmeleontidae the first pair of abdominal spiracles is normally dorsal-placed. One of most distinct characteristic of the abdomen are represented by the scoli, similar in shape with those present on the thorax and normally well developed in the family Ascalaphidae (fig. 2). These abdominal protuberances are lost in most members of Myrmeleontidae, including all the European species, due to their fossorial habits with the notable exception of those species whose larvae live permanently on hard surfaces (Stange, 1994, 2004). The plesiomorphic condition is represented by two well developed series of scoli: a dorsal one and a ventral one in respect to the abdominal spiracles, as observed in Nymphidae and certain Ascalaphidae (Henry, 1978). The dorsal series is termed here "supra-spiracular" scoli while the ventral one "sub-spiracular" scoli according to their position. In numerous genera of Ascalaphidae the sub-spiracular series of scoli is atrophied or absent, however some larvae with a reduced supra-spiracular series are known (Tjeder, 1992). As already mentioned for the spiracles, between some lineages it is also observable a trend toward the migration of the first two pair of abdominal scoli dorsally (Henry, 1978). Moreover the scoli can be cylindrical or flattened in shape according to the genus, thus showing a diagnostic value. The 8th and especially the 9th segments are ventrally equipped with modified macrochetae used by the larvae to anchor their self or to dig in the substratum according to their habits (fig. 2). As a result of this conspicuous modifications the IX sternite, and in some case even the 8th, represents one of the most important features for identification purposes, especially in Myrmeleontidae (fig. 4, 35). In both families, the 8th sclerite is normally equipped with a pair of tooth-like structures, termed odontoid processes, along its posterior margin. In some antlion genera, specialized digging setae are also present on its surface (fig. 4). The 9th segment is conical, longer than wide in Ascalaphidae and in some Myrmeleontidae that maintain a propensity to climb (fig. 4B). Nevertheless in most exponents of Myrmeleontidae this segment is short and wider than long for digging purposes. The IX sternite is equipped at its posterior margin with

short and robust macrochetae, the digging setae; they are usually disposed on an enlarged, sclerified support, that is termed here "rastra", from the Latin "rastrum", rake. The number, shape and relative disposition of the digging setae are of taxonomic interest, especially in Myrmeleontidae in which they often attain a larger size than in Ascalaphidae. In antlions, in some cases, other digging setae are disposed on the ventral side of the IX sternite in a more proximal position. Despite the obvious adaption of this portion of the abdomen of most of Myrmeleontidae to dig, it should be noted that at least some taxa belonging to this family with an "ascalaphid-type" 9th segment dig with ease as well. Among the modifications of the IX abdominal sternite in Myrmeleontids, it is particularly noteworthy that shown by the 2nd and 3rd instars larvae of the tribe Palparini in which is present a very large, heavily sclerified, triangular digging structure named "fossoria" (fig. 4A).

Chaetotaxy

The larvae of Myrmeleontidae and Ascalaphidae are equipped with a considerable diversified array of setae, often useful for identification purposes. The whole body is thickly covered of macrotrichia and among them stands a characteristic type of setae, termed dolichasters. Dolichasters represent a larval apomorphy of the whole clade Myrmeleontiformia (fig. 6). The simpler type of dolichasters, defined by Tillyard (1918) in the Psychopsidae, is represented by a robust, hollow macrocheta set on an enlarged base and with a star-shaped distal end; the cross section of this kind of setae is often geometrical. The dolichasters can be disposed on all the tagmata, including mouthparts such as the mandibles and the labial palps; they are typically present on the scoli. These setae show a considerable diversification in shape and structure among different taxa, often acquiring a identification value; Henry (1976) recognized and termed various types of this setae according to their structure: "stellate", "goblet-shaped" (fig. 6B), "clavate", "scale-like", "stellate-tipped" and "plumose". The diagnostic value of dolichasters is particularly important in Ascalaphidae, where they are often useful to distinguish the different genera. The different types of dolichasters probably reflect the habitat and life strategies of the larva, being effective to retain the debris with which it is often camouflaged. Dolichasters are the most widespread and characteristic type of macrochetae in the larvae of Ascalaphidae while in Myrmeleontidae bristles and hairs are predominant, often giving to the latters an hairy appearance. In fact, in Myrmeleontidae the whole body - including the head, mouthparts and legs - is thickly covered by bristle-like setae while the dolichasters have a secondary importance and in some lineages they are completely absent. In antlions the thickness and length of bristles varies according to the taxa but they are normally shorter on the dorsum and venter while very long on the sides. The chaetotaxy of the mandibles in important in the identification of both families, being the number, the type and the

thickness of the setae disposed between the mandibular teeth, the margins and the surface of great diagnostic importance. The internal margin of the mandibles are equipped with numerous setae disposed between the teeth. In some taxa a part of them is modified and transformed in “pseudo-teeth”; it should keep in mind that the “true” characteristic teeth of the larvae of Nymphidae, Myrmeleontidae and Ascalaphidae derived from setae-bearing jaws processes. In the family Ascalaphidae, stout setae with an enlarged spiniform base are particularly common. The ventral and dorsal surface of the jaws is often covered by short setae and in some taxa by dolichastes. The external margin of the mandible is normally equipped with setae, longer toward the base. In pit-building antlions, the setae of the external margin of the mandible are very long, creating a some sort of basket useful to throw grain of sands. As mentioned above, another part of the body of characterized by the presence of specialized setae useful for identification purposes is represented by the last abdominal segments. The macrochetae of this portion of the abdomen acquire a digging function and they are robust and stout, peg-like in some taxa.

Key to the European preimaginal stages of Myrmeleontidae and Ascalaphidae

The following identification key is based on the known larvae of European genera of Myrmeleontidae and Ascalaphidae and it is valid only for this area. The key allows identification of 2nd and 3rd instar larvae. Nemopteridae are only included for comparison.

1. Jaws without teeth

Nemopteridae

- Jaws with three pairs of teeth

2

2. Abdomen without prominent scoli (fig. 1); claws of the metathoracic leg larger than those of the other legs

Myrmeleontidae 3

- Abdomen provided with prominent scoli (fig. 2, 37); claws of the metathoracic leg not different from those of the others legs

Ascalaphidae 17

3. Mesothoracic scoli pronounced, at least the first pair (fig. 9,10)

4

- Mesothoracic scoli not distinct (fig. 21,23)

11

4. Middle mandibular tooth longer than the apical one (fig. 3A), IX abdominal sternite of 2nd and 3rd instar with a pair of very large triangular digging structures (fossoria) (fig. 4A)

Palpares (p. 21)

- Middle mandibular tooth shorter or equal to the apical one (fig. 3H,3I), IX abdominal sternite without a pair of large triangular digging structures

5

5. Mandibles curved upward, mesothorax with a median tuft of long hair-like setae (fig. 3H, 9), IX sternite conical, longer than wide (fig. 4B) , mesothoracic spiracle not raised on tubercle

Dendroleon (p. 24)

- Mandible not curved, mesothorax without a median tuft of setae, IX sternite wider than long, mesothoracic spiracle raised on tubercle

6

6. VIII abdominal sternite with a pair of well developed and evident odontoid processes on its distal margin (fig. 4F)

7

- VIII abdominal sternite with odontoid processes very reduced or completely absent on its distal margin (fig. 4H)

10

7. IX sternite with a group of digging setae on the middle of the ventral surface (fig. 4D), mandibles very robust with the two proximal teeth slightly nearer to each other than to the distal one (fig. 3J)

Creoleon (p. 28)

- IX sternite without a group of digging setae on the middle of the ventral surface (4C), mandibles comparatively slender, teeth equidistant

8

8. Pronotum with 4 dorsal thick parallel series of large setae with no other ones between them except some dolichasters (fig. 5D)

Macronemurus (p. 26)

- Pronotum without distinct dorsal series of setae and covered by a thickest setation (fig. 5C)

9

9. Pronotum covered by long setae interspersed by short spiniform ones (fig. 5A), rastra of IX sternite with digging setae of similar size (fig. 4C)

Distoleon (p. 29)

- Pronotum covered by long setae interspersed by dolichasters (fig. 5C), rastra of IX sternite with inner digging seta long half of the longest pair (fig. 4E)

Neuroleon
(key p. 32)

10. Distance between the base of the mandible and the basal tooth longer to that between the basal tooth and the apical one, middle and distal teeth equal sized (fig. 3N), rastra of IX sternite with inner digging seta long half of the others (fig. 4H)

Gymnocnemia (p. 43)

- Distance between the base of the mandible and the basal tooth shorter to that between the basal tooth and the apical one, apical tooth larger than middle one (fig. 3M), rastra of IX sternite with inner digging seta long less than one third of the others (fig. 4G)

Megistopus
(key p. 39)

11. External margin of the mandible with a fringe of long setae reaching the apical tooth, basal setae longer than the width of the mandible (fig. 3D, 3F)

12

- External margin of the mandible with a small basal group of setae not reaching the apical tooth and shorter than the width of the mandible (fig. 3B, 3C)

16

12. Apical tooth longer than the others (fig. 3D), IX sternite with sessile rastra (fig. 35)

13

- Middle tooth longer than the others (fig. 3D), IX sternite equipped with protruding rastra (fig. 4I)

15

14. Posterior margin of the VIII abdominal sternite covered by spiniform or stout setae (fig. 35 A-H)

Myrmeleon
(key p. 54)

- Posterior margin of the VIII abdominal sternite exclusively covered by long, hair-like, setae (fig. 35I)

Euroleon (p. 67)

15. Apical and middle teeth spaced by 1-2 setae (fig. 3E)

Cueta (p.47), *Myrmecaelurus* (*Nohoveus*)[1]

- Apical and middle teeth in contact, without setae between them (fig. 3D)

Myrmecaelurus (p. 45)

16. Anterior margin of the labrum with a pronounced rounded lobe, mandible swollen at the base (fig. 3B), VIII sternite with digging setae (fig. 4K)

Acanthaclisis (p. 48)

- Anterior margin of the labrum without a lobe, mandible not swollen (fig. 3C), VIII sternite without digging setae (fig. 4L)

Synclisis (p. 50)

17. Head over one and half times wider than long, ocular tubercles flattened (fig. 7C), 11 pairs of developed scoli (3 thoracic pair and 8 supra-spiracular abdominal ones), sub-spiracular scoli absent (fig. 37)

Puer (p. 101)

- Head as wide as long (fig. 3A), ocular tubercles cylindrical, 12 pairs of developed scoli (4 thoracic and 8 supra-spiracular abdominal ones), sub-spiracular abdominal series of scoli present, albeit reduced (fig. 2)

18

18. Base of the mandible covered by white dolichasters, teeth small, distance between the base of the mandible and the basal tooth noticeably longer to that between the basal and distal teeth, ocular tubercles with a distinct apical bump (fig. 7B)

Bubopsis (p.102)

[1] *Nohoveus* Navás 1919, has been normally considered a synonym of *Myrmecaelurus* Costa, 1855 (Stange, 2004) or its subgenus (Aspöck et al., 1980) but is retained as a good genus by other authors (Krivokhatskji, 2011). Here it is only considered for identification purposes. The genera *Cueta* and *Myrmecaelurus (Nohoveus)* are not sympatric in Europe.

- Base of the mandible without white dolichasters, teeth large, distance between the base of the mandible and the basal tooth equal to that between the basal and the distal teeth, ocular tubercles without a distinct apical bump (fig. 7C)

19

19. Dorsoposterior emargination of head capsule very deep, reaching middle length of the head capsule, slighty behind eye tubercles, eye tubercles large, wider than long (fig. 7C)

Ascalaphus (p. 99)

- Dorsoposterior emargination of head capsule shallow, not reaching middle length of the head capsule, eye tubercles longer than wide or as long as wide (fig. 7E)

20

20. Head dilated posteriorly (fig. 7E), body covered by short goblet-shaped dolichasters besides longer stick-shaped ones (fig. 6B)

Libelloides
(key p. 108)

- Head not dilated posteriorly (fig. 7D), body covered exclusively by elongated, stick-shaped dolichasters (fig. 6A)

Deleproctophylla (p. 104)

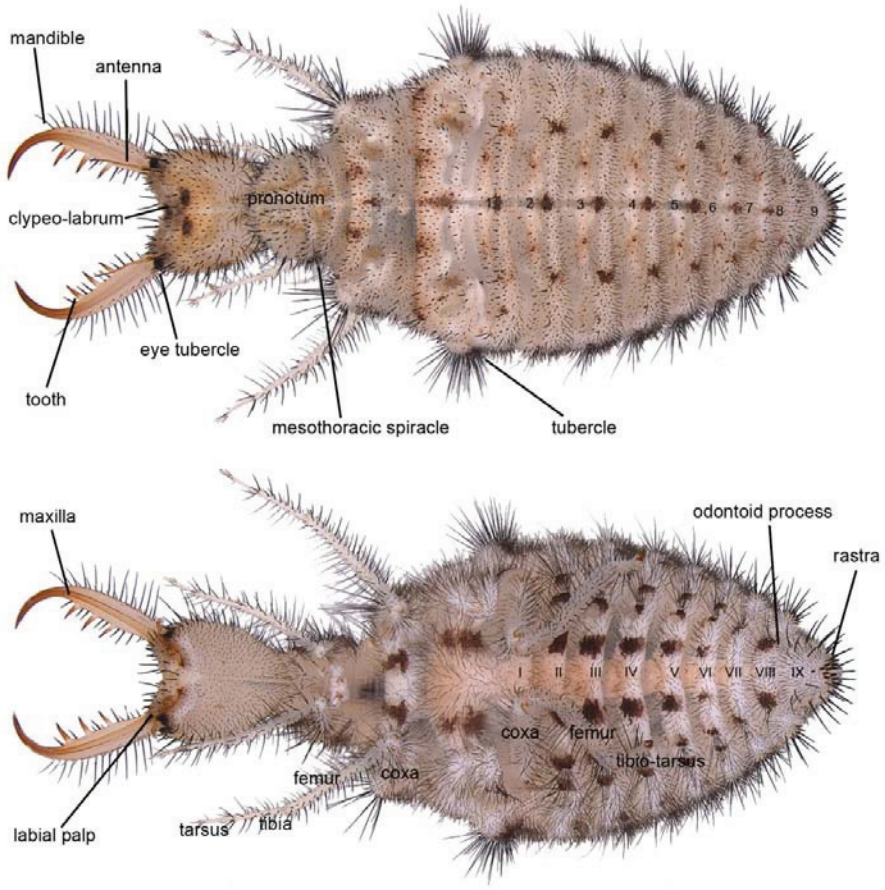

Figure 1. *Myrmeleon mariaemathildae* (Myrmeleontidae): 3rd instar larva, dorsal (above) and ventral (middle) view; position of diagnostic characters.

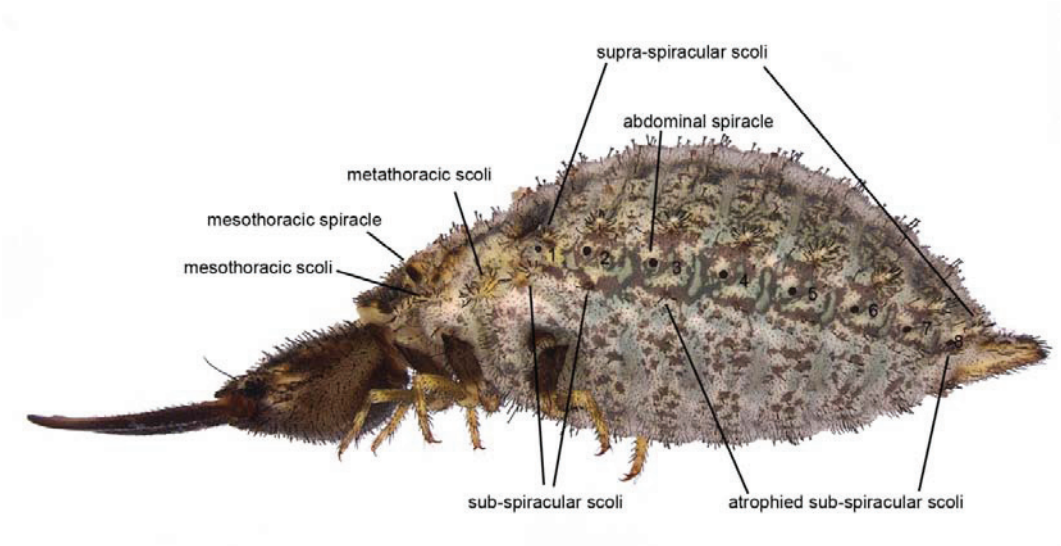

Figure 2. *Libelloides siculus* (Ascalaphidae): 3rd instar larva, lateral view; position of spiracles and scoli.

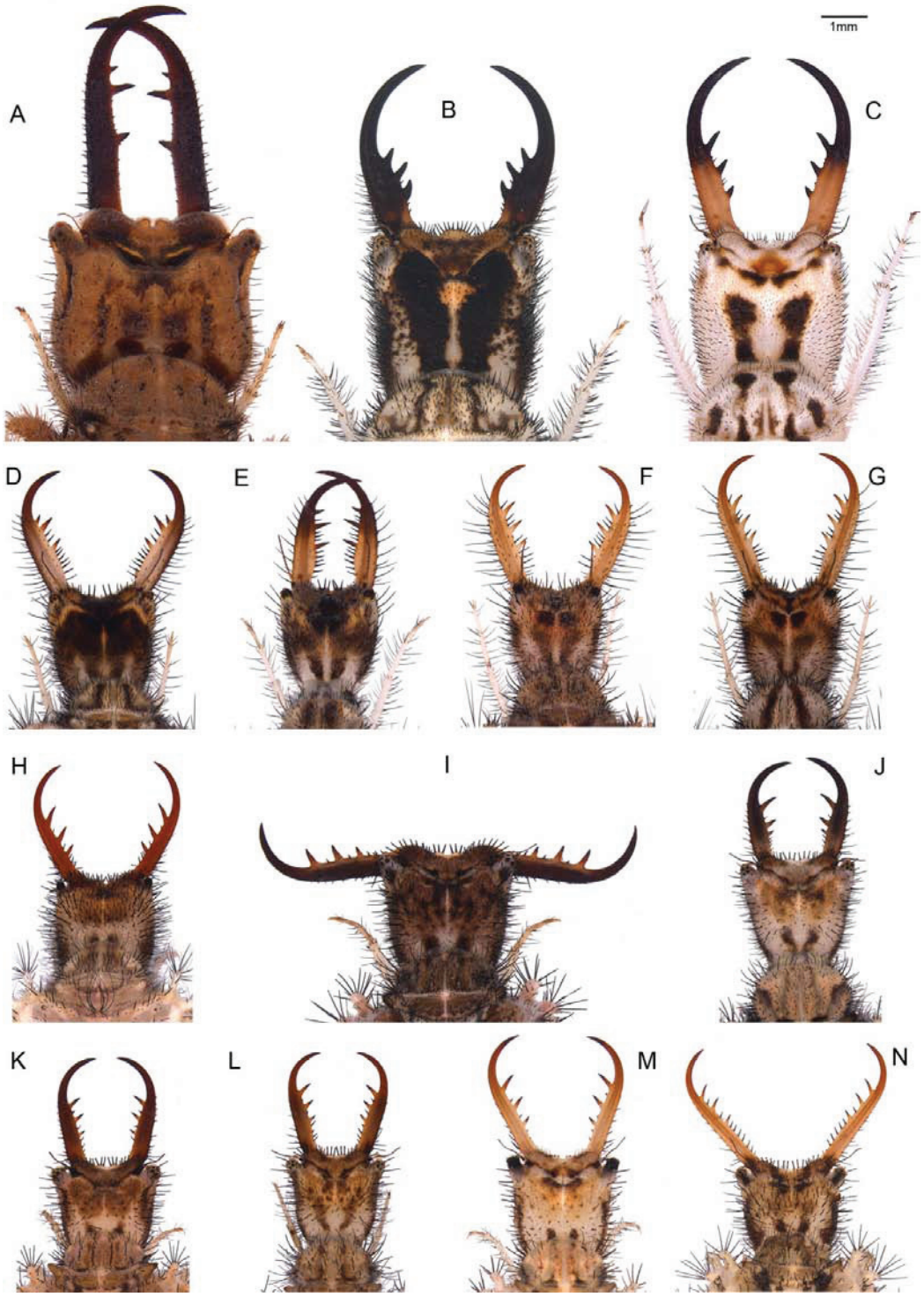

Figure 3. European genera of Myrmeleontidae, head of 3rd instar larva; A, *Palpares* (*P. libelluloides*), fossoria; B, *Acanthaclisis* (*A. occitanica*); C, *Synclisis* (*S. baetica*); D, *Myrmecaelurus* (*M. trigrammus*); E, *Cueta* (*C. beieri*); F, *Myrmeleon* (*M. gerlindae*); G, *Euroleon* (*E. nostras*); H, *Dendroleon* (*D. pantherinus*); I, *Distoleon* (*D. tetragrammicus*); J, *Creoleon* (*C. lugdunensis*); K, *Macronemurus* (*M. appendiculatus*); L. *Neuroleon* (*N. arenarius*); M, *Megistopus* (*M. lucasi*); N, *Gymnocnemia* (*G. variegata*)..

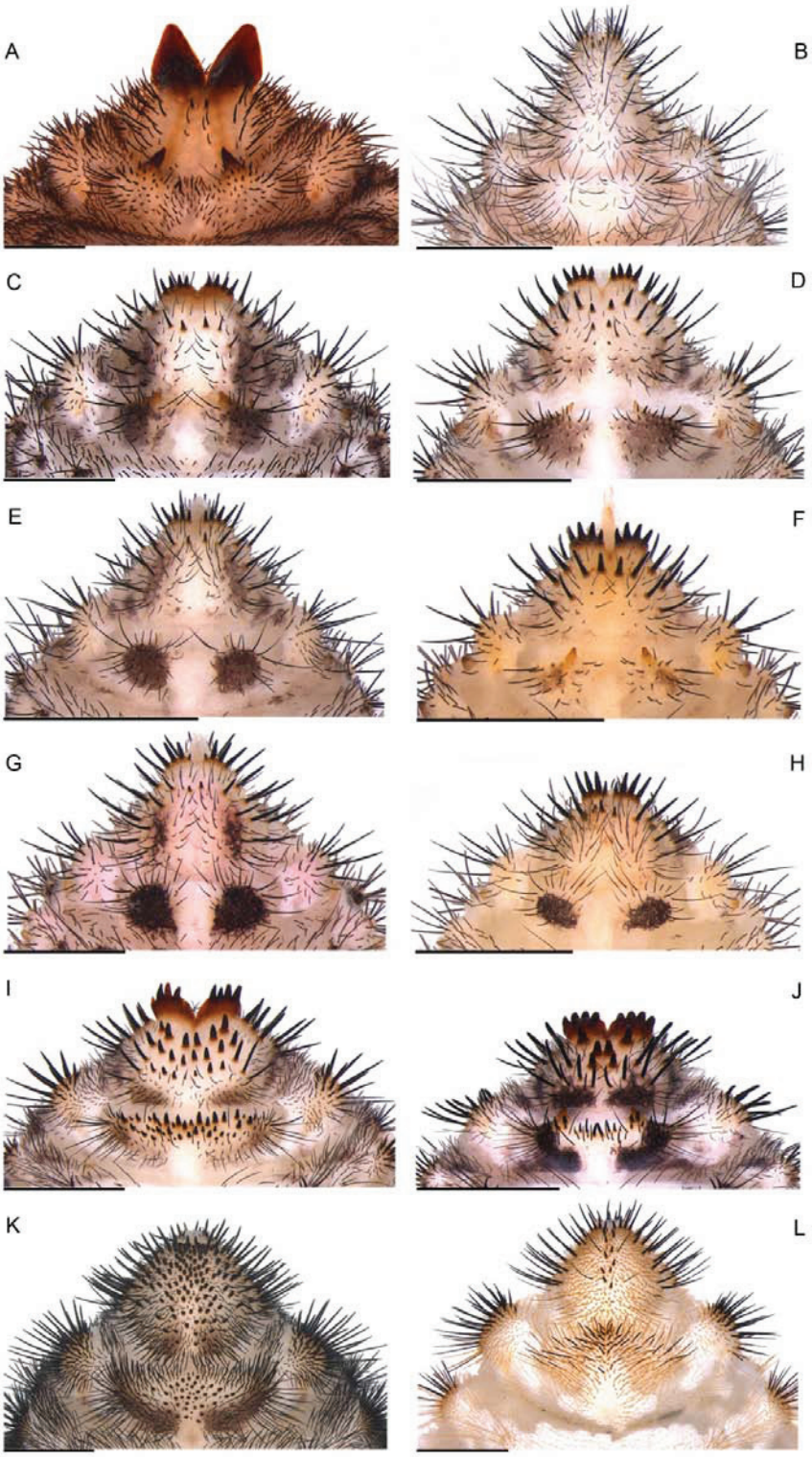

Figure 4. Genera of Myrmeleontidae, IX and VIII abdominal sternite of 3rd instar larva; A, *Palpares* (*P. libelluloides*); B, *Dendroleon* (*D. pantherinus*); C, *Distoleon* (*D. tetragrammicus*); D, *Creoleon* (*C. lugdunensis*)); E, *Neuroleon* (*N. assimilis*); F, *Macronemurus* (*M. appendiculatus*); G, *Megistopus* (*M. lucasi*); H, *Gymnocnemia* (*G. variegata*); I, *Myrmecaelurus* (*M. trigrammus*); J, *Cueta (C. beieri)*; K. *Acanthaclisis* (*A. occitanica*); L, *Synclisis* (*S. baetica*). Scale: 1mm.

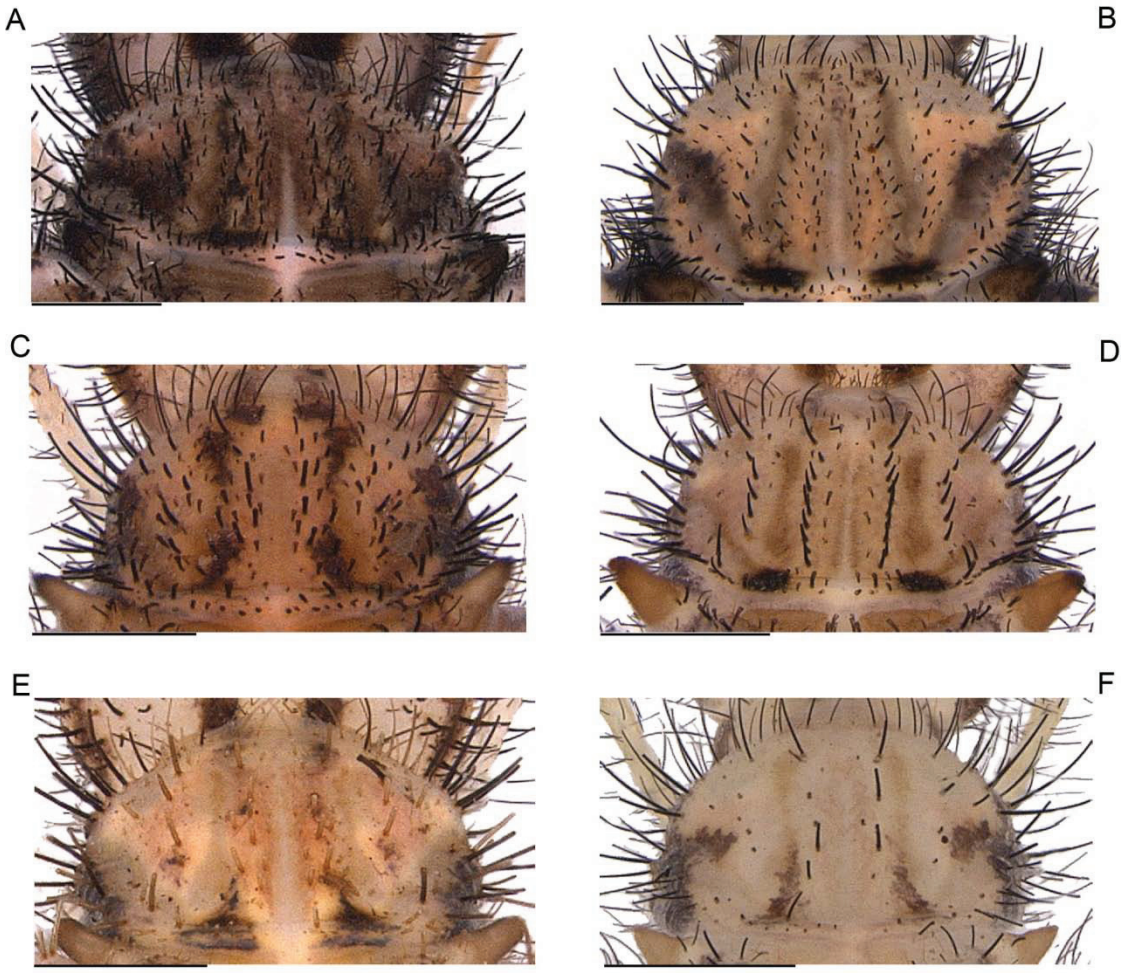

Figure 5. Genera of Myrmeleontidae Nemoleontini, pronotum of 3rd instar larvae; A, *Distoleon* (*D. tetragrammicus*); B, *Creoleon* (*C. lugdunensis*); C, *Neuroleon* (*N. nemausiensis*); D, *Macronemurus* (*M. appendiculatus*); E, *Megistopus* (*M. lucasi*); F, *Gymnocnemia* (*G. variegata*). Scale: 1 mm.

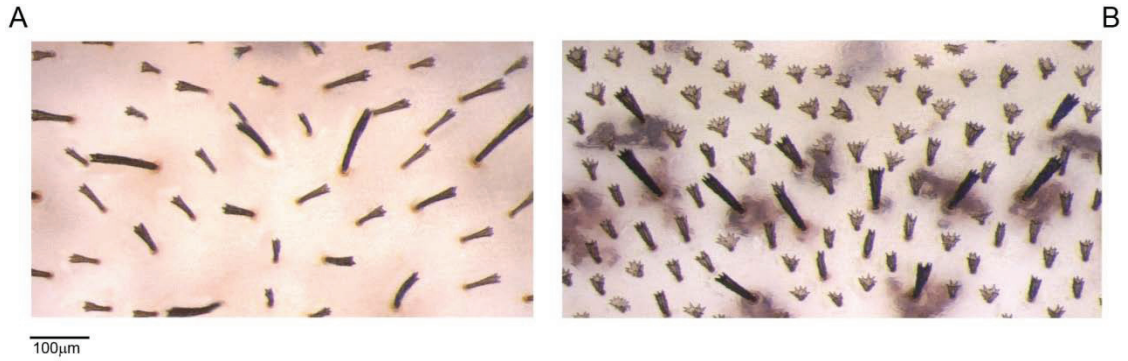

Figure 6. Ascalaphidae, dolichasters on the VII abdominal sternite of 3rd instar larvae; A, *Deleproctophylla australis*, "typical" dolichasters; B, *Libelloides longicornis*,, "goblet-shaped" dolichasters and "typical" ones.

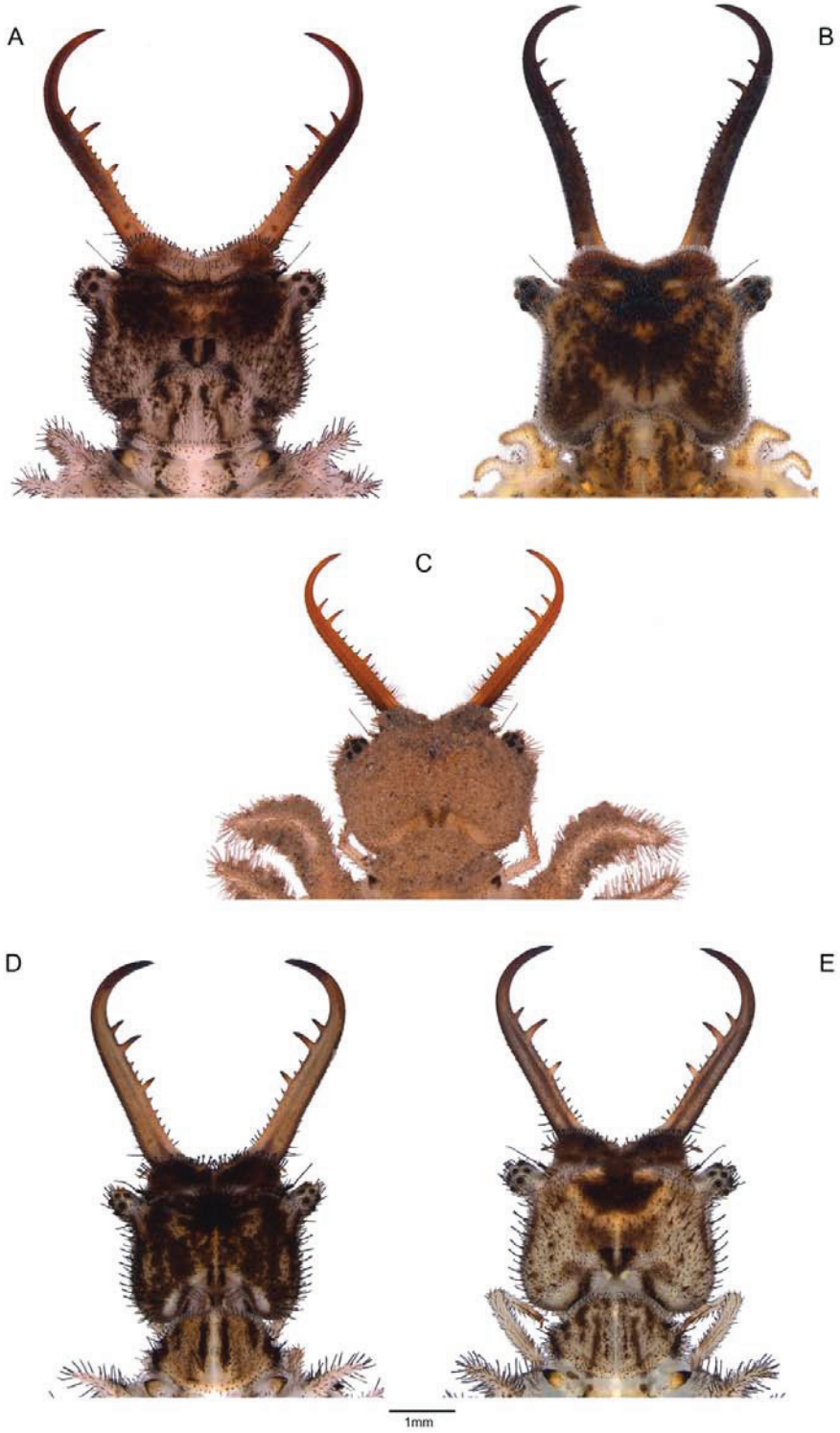

Figure 7. European genera of Ascalaphidae, head of 3rd instar larva; A, *Ascalaphus* (*A. festivus*); B, *Bubopsis* (*B. agrionoides*); C, *Puer* (*P. maculatus*); D, *Deleproctophylla* (*D. australis*); E, *Libelloides* (*L. latinus*).

Family Myrmeleontidae Latreille, 1803

In his catalogue on the Myrmeleontidae of the world, Stange (2004) lists 1522 species, accordingly the number of described species is presently superior to 1550 taxa making this family the largest one in the order Neuroptera. However, the taxonomic value of some taxa is still uncertain, making difficult to state the correct number of valid species. The family is of worldwide distribution, completely lacking only in cold climates and reaching is maximum diversity in arid areas such as deserts, semi-deserts or steppe-like environments. However they are not exclusively limited to this biotopes, being some species also present in forest habitats. The key of the success of antlions is undoubtedly due to the niche of fossorial ambush-predators occupied by the larvae and their ability to colonize difficult and sometimes extreme environments. Nevertheless the life strategies of the members of the family are far more diverse and the larvae of some species are adapted to live exposed on hard surfaces (Stange 1994, 2004). The modern classification of the family is based on the the study of Markl (1954), who established 23 tribes. Presently 3 subfamilies and 14 tribes are recognized thanks to the effort of Hölzel (1969), New (1985a, 1985b, 1985c) and Stange (1970, 1994, 2004). The strictly European fauna comprises 49 valid species belonging to the subfamilies and tribes Palparinae (Palparini) and Myrmeleontinae (Dendroleontini, Nemoleontini, Myrmecaelurini, Nemoleontini, Acanthaclisini and Myrmeleontini).

Tribe Palparini Navás, 1912

The preimmaginal stages of the members of this tribe are characterized by the presence of large triangular digging structures, or fossoria, on IX abdominal sternite in the 2nd and 3rd instars larvae. This peculiarity represents one of its main apomorphic characters (Mansell, 2002, Stange, 2004).

Palpares Rambur, 1842

Diagnosis: head comparatively large and robust; eye tubercle prominent; mandibles strong and straight with three to five teeth (Stange, 1994); metathoracic spiracle not raised on tubercle; metathoracic scoli present but small; VIII abdominal sternite equipped with large odontoid processes; IX abdominal sternite with fossoria.

Examined species: *P. libelluloides* (Linnaeus, 1764)

The genus *Palpares* comprises over 67 species widely distributed in the Old World, across the Afrotropical (the main center of distribution), Palearctic and Oriental regions;

only two species are reported for Europe, in addition to be diffused in North Africa and Middle East: *P.libelluloides*, widespread in southern Europe and *P. hispanus* Hagen 1860, limited to the southern Iberian peninsula. The genus *Palpares* appears to be polyphyletic (Mansell 1992, 2002) and the few known larvae are of uncertain specific attribution making difficult to discriminate between them and the closely related genera.

Palpares libelluloides (Linnaeus, 1764) (figs. 3A, 4A, 8)

The larvae of this species has been described and illustrated for the first time by Brauer (1854) and subsequently by Hagen (1873b) and Redtenbcher (1884) who both compared it with other Palparini. A drawing of the larva is present in Doflein (1921). The species has been inserted in the keys of Steffan (1975), Willmann (1977), Hölzel & Gepp (1989), Gepp (2010) and Krivokhatsky (2011). Moreover a photo of a larva of this species appears in Séméria & Berland (1988). It is interesting to note that in the past the larva of this species has been sometimes confused with the equally unmistakable larvae of Acanthaclisini simply for their large dimensions (e.g. Navás confused it with *Synclis baetica*: 1923). Despite the wide distribution of the species in Mediterranean countries the reports of the larval stages are particularly rare.

Specimens measured

Italy, Genova, terrapieni or., V.1908, G. Mantero leg. (MSNG), 1 (3rd instar).

France, Aniane 44, Les Bernayves, IX.1985, J. M. Maldes leg. (coll. B. Michel) , 2 (3rd instar).

Italy, Liguria, Perinaldo (IM), VI.2012, D. Badano leg., 1 (1st instar reared until the 2nd).

Italy, Liguria, Cipressa (IM), ex ova, VII.2010, D. Badano leg., 5 (1st instar).

Description of 3rd instar larva. Average body length 20.18 mm; head capsule length 5.61 mm (min-max 5.44-5.85), head capsule width 5.46 mm (5.36-5.57), mandible length 5.61 mm (5.33-5.95), ratio head capsule width/length 0.97, ratio mandible length/head capsule length 1.00. General colouring pale brown with darker marks, abdomen ventrally very pale almost whitish; inferior side of the head capsule pale brown, clearer than the dorsal side, with black margins; jaws black; setae black. Head: almost quadrate in shape, as long as wide; dorso-posterior portion of head capsule with a deep emargination; margin of the labrum with a median recess; eyes tubercles cylindrical, small in comparison with the head capsule, forward directed; antennae thin, a little longer than the eye tubercle; mandibles as long as the head capsule, robust and straight with three teeth; the middle tooth longer than the others, the first two teeth are closer to each other than the third one; mandibles equipped with small

spiniform setae along the internal margin; a series of stout setae is distributed on the external margin, reaching the apical incurvation of the mandible; labial palps robust, article 2-4 as long as the mandible width; head surface covered by pale dolichasters. Body: elongate oval, covered by short and relatively sparse setae. Thorax: pronotum large, covered by sparse and thin setae with four parallel series of stout, spiniform, black setae, the central pair shorter than the external one; spiracles of the mesothorax not borne on tubercle, surrounded by black hairs; metathorax with two pair of short scoli, the first one shows a forward directed tuft of black setae at its base. Legs: short and stout covered by dark spiniform setae. Abdomen: covered by black setae, longer toward the margins; spiracles large and dark; the first pair is situated dorsally; VIII sternite with two large sclerified odontoid processes; IX sternite with fossoria.

Remarks. The 1st instar larva of *Palpares* shows remarkable differences from the later stages in the last abdominal segments: the odontoid processes of the VIII sternite are smaller and less sclerified and the IX sternite bears rastra with a rastrum composed of four digging setae, not so dissimilar from other members of the family, instead of the large fossoria of the older larvae. Despite lacking the specialized digging setae of the Palparini, the ascalaphid-like head makes the first instar larva of this genus clearly recognizable from all other larvae of the European Myrmeleontidae.

The larvae of this species can been confused exclusively with those of *P. hispanus* Hagen, 1860, the only other European member of the Palparini, distributed in the southern Iberian peninsula and still insufficiently known.

Bio-ecology: the larvae live in the same environment of the adults: Mediterranean arid grasslands, garrigues and open shrublands on a rocky substratum. They normally avoid sand dunes. They hide in radical detritus and leaves and there are some reports of larvae moving freely during the night (Séméria & Berland, 1988). The large and robust larva is also able to dig into gravel with ease. One specimen has been collected in an exposed dark patch of arid terrain, composed by conspicuous quantity of vegetal debris, among herbs at the margin of an olive grove.

Tribe Dendroleontini Banks, 1899

The larvae of this widespread tribe are quite variable according to the different species and in some case show peculiar specializations. A exclusive character of some genera is represented by the presence of a tuft of setae on the mesonotum (Stange, 2004).

Dendroleon Brauer, 1866

Diagnosis: Mandibles curved upward, equipped with 3 pairs of teeth; eye tubercles very small; mesothoracic spiracles not prominent; mesothorax equipped with a median tuft of setae; thoracic scoli pronounced; VIII abdominal sternite without odontoid processes; IX abdominal sternite noticeably longer than wide, lacking prominent rastra.

Examined species: *D. pantherinus* (Fabricius, 1787)

Dendroleon represents one of the most widely distributed genera of Myrmeleontidae, being present in North America, Eurasia and Australia, despite comprising only ca. 20 species (Stange, 2004). The bio-ecology of the genus is poorly known, the larvae have been described only for *D. pantherinus* (Fabricius, 1787), the N-American *D. obsoletus* (Say, 1839) and *D. speciosus* Banks, 1905 and finally the Taiwanese *D. esbenpeterseni* Miller & Stange, 2000 (Stange, 2004, 2008; Stange et al. 2003). [The larva assigned to *D. porteri* Stange, 2008 (Stange, 2008) apparently does not show the set of characters representative of the genus.]. The larvae of *Dendroleon* dwell in cavities such as tree holes, rock overhangs and mouth of caves moreover such habitat requirements allow them to colonize human infrastructures making this genus one of the few synantrophic antlions (Stange 2008; Gepp, 2010).

Dendroleon pantherinus (Fabricius, 1787) (figs. 3H, 4B, 9)

The first known larva of this species was discovered in a hole of a white poplar fallen in the Prater in Vienna and it came to the attention of Brauer, who carefully described and illustrated the specimen over to rear it obtaining the imago (Brauer, 1867). The original description of Brauer was later the base for the accounts of Hagen (1873) and Redtenbacher (1884) that apparently did not known further specimens. Afterwards there are only sparse records of the larva of this species, usually collected in tree holes especially on chestnut (Roubal, 1936; Kelner, 1967). In the light of new findings, the habits of the preimaginal stages were discussed by Gepp & Hölzel (1989) who also reported their occasional synanthropy having been collected in buildings, confirm an older account by Steinmann (1967). The species is inserted in the key of the larvae of antlions of Gepp & Hölzel (1989) and Gepp (2010).

Examined specimen

Italy, Emilia Romagna, Castel d'Aiano (Bologna), III.2012, L. Colacurcio leg., 1 (3rd instar).

Description of 3rd instar larva. Body length 10.6 mm; head capsule length 2.49 mm, head capsule width 2.01 mm, mandible length 1.79 mm, ratio head capsule width/length 0.80, ratio mandible length/head capsule length 0.72. General colouring very pale, whitish pink without darker markings; head capsule reddish brown with darker lateral margins, eye tubercles black, mandibles reddish brown. Head: longer than wide, sub-rectangular in shape; anterior margin of the labrum slightly concave; antennae very long and thin, half the length of the mandible; eye tubercles very small, forward directed; mandible bent upward, shorter than the head capsule, armed with 3 equidistant pairs of long teeth; 1 seta between each pair of teeth, 4 setae between the basal tooth and the mandible base; few short setae are disposed on the external margin of the mandible; labial palps elongated, segment 2-4 noticeably longer than the base of the mandible. Body: elongated, subconical, covered by black setae, very short and sparse on the dorsal side, longer setae on the sides, some of which extremely thin. Thorax: pronotum cuneiform dorsally covered by large black setae; mesothoracic spiracles not prominent, without basal tubercle; mesothorax with a conspicuous median tuft of hair-like black setae; mesothoracic scoli developed and prominent. Legs: relatively short, covered by black setae. Abdomen: abdominal spiracle very small, not prominent; 9th segment sub-conical in shape; IX abdominal sternite longer than wide, its posterior margin without prominent rastra and equipped with very long setae, medially there are few irregularly disposed very short digging setae.

Bio-ecology: This species has been usually recorded in temperate woods of broadleaves or in their proximity, apparently avoiding arid Mediterranean environments. The few known larvae have been collected in tree-holes filled with dry detritus, especially on chestnut or in human buildings in proximity of woods where they hide in sheltered corners (Brauer, 1867; Gepp & Hölzel, 1989; Gepp 2010). Brauer (1867) implied that the larvae could be also found in the soil of pine woods but it is probably a speculation not supported by actual findings. However the presence of specimens in artificial structures suggests that is, at least potentially, able to colonize different kinds of cavities in forested habitats or in their proximity. The examined specimen was collected in a dry tree hole of a chestnut in a wood at 900 m on the Apennine. At the beginning of March it was still a 1st instar larva, attaining the last instar in June. Moreover, the occasional synanthropy of this antlion is also confirmed during the present research by the finding of a 2nd instar exuvia in the old ashes of a fireplace of an abandoned house, always in the Apennine. It is an extremely motionless ambush predator, normally staying completely burrowed, not even the eyes emerge from the substratum as it is usually observed in other no-pit building antlions during the hunt. The potential prey is detected by means of tactile setae, probably the peculiar thoracic tuft of long bristles performs an important role in this respect. The extremely small eyes imply that the vision it is not necessary for this species living in dark cavities. The setae of the body retain the particles of the substratum contributing to hide the larvae, despite the holding is quite

weak. A clot of detritus is tightly attached to the tip of the thoracic tuft of setae probably playing a tactile role.

Tribe Nemoleontini Banks, 1911

This tribe is the largest and more diverse in the whole family Myrmeleontidae, despite being poorly defined and lackomg precise apomorphic characters (Stange, 2004). The larvae of only an handful of genera are exhaustively described and the diagnostic characters are not well defined.

Macronemurus A. Costa, 1855

Diagnosis: Mandibles equipped with 3 pairs of teeth; pronotum with 4 distinct parallel rows of setae; mesothoracic spiracle borne on tubercle and cone-shaped; digging setae of the rostrum subequal in length, only the internal pair is shorter than the others.

Examined species: *M. appendiculatus* (Latreille, 1807)

This genus comprise at least 34 species mainly distributed in Africa, in addition to these, few others are present in the Palearctic region (Stange, 2004). The preimaginal stages of this genus are undescribed, except an illustration and a concise description of the 1st instar larva by Insom et al. (1985) and the statement of Stange (2004) on the habits of the larvae.

Macronemurus appendiculatus (Latreille, 1807) (figs. 3K, 4F, 5D, 10)

The 1st instar larva of this species has been synthetically described and illustrated by Insom et al. (1985).

Measured specimens

Italy, Liguria, Pompeiana (IM), VII.2010, ex ovo, D. Badano leg., 1 (3rd instar).

Italy, Sardinia, Sassari (SS), Li Punti, VII.2010, D. Badano leg., 1 (3rd instar).

Italy, Sardinia, Alghero (SS), VIII.2010, D. Badano leg., 1 (3rd instar).

Italy, Sardinia, Alghero (SS), Capocaccia, IX.2011, D. Badano leg., 1 (3rd instar).

Italy, Sardinia, Alghero (SS), Capocaccia, IV.2011, D. Badano leg., 1 (3rd instar).

Italy, Sardinia, Alghero (SS), Capocaccia, V.2012, D. Badano leg., 4 (3rd instar).

France, Gard, Pompignan, VII.2011, B. Michel & D. Badano leg., 1 (3rd instar).

Italy, Sardinia, by rearing, Pantaleoni, 3 (3rd instar).

Further examined specimens

Italy, Sardinia, Alghero (SS), VIII.2010, D. Badano leg., 1 (3rd instar); reared.

Italy, Sardinia, Alghero (SS), Capocaccia, V.2012, D. Badano leg., 2 (3rd instar); reared.

Description of 3rd instar larva. Average body length 8.06 mm; head capsule length 1.93 mm (min-max 1.79-2.11), head capsule width 1.72 mm (1.60-1.94), mandible length 1.67 mm (1.43-2.00), ratio head capsule width/length 0.89, ratio mandible length/head capsule length 0.86. General colouring pale brown with darker marks, ventrally very pale, yellowish or whitish; head capsule darker than the body with dark markings on the sides; jaws dark brown. Head: a little longer than wide; anterior margin of the labrum with a slight median incision; antennae thin, longer than the eye tubercle, completely black in colour including the scape; eye tubercles prominent; mandibles shorter than the head capsule and relatively robust, equipped with three pairs of teeth; the apical tooth is the longest; 1 seta between the apical and middle teeth and again between the latter and the basal one; few setae between the basal tooth and the base of the mandible; short setae are disposed on the external margin of the mandible; labial palps segment 2-4 longer the base of the mandibles. Body: elongate elliptical, covered by dark setae; thorax equipped with scoli. Thorax: surface of the pronotum characterized by 4 parallel rows of setae with only very small setae between them; metathoracic spiracles, prominent, cone-shaped; mesothorax with two pairs of scoli; mesothoracic scoli reduced to small bumps. Legs: comparatively robust, pale and equipped with dark setae. Abdomen: abdominal spiracles slightly raised; VIII sternite equipped with odontoid processes, IX sternite covered by long digging setae; rastra prominent with 4 subequal digging setae only the internal one is slightly shorter than the others.

Remarks: The larvae of *M. appendiculatus* are similar with those of the genus *Neuroleon*, especially with those characterized by a pale colouration, with which they often share the same habitat. *M. appendiculatus* can been distinguished by the proportionally stouter mandibles, the chaetotaxy of the pronotum and the digging setae of the IX sternite.

Bio-ecology: As the adults, the larvae of this species live in open arid grasslands; they are usually found at the base of tuft of herbs, under or in proximity of stones and in stone crevices filled with sand-like substratum. Moreover they were seldom collected at

the base of trees and near exposed roots but always in open environments. Cocoons containing prepupae have been found in nature since the end of May.

Creoleon Tillyard, 1918

Diagnosis: Mandibles relatively short and stout, equipped with 3 pairs of teeth, the distance between the basal and middle teeth is inferior to that between the latter and apical one; mesothoracic spiracle raised on a short tubercle; 8th stenite provided with odontoid processes; IX sternite equipped with digging setae on the ventral surface.

Examined species: *C. lugdunensis* (Villers, 1789)

The genus *Creoleon*, with 58 known species, is one of the largest in the tribe Nemoleontini and it is widely distributed in Eurasia and Africa (Stange, 2004). Nevertheless the biology is almost unknown and the larvae are exclusively known for the two commonest and widely distributed European species: *C. lugdunensis* (Villers, 1789) (Steffan, 1964, 1975) and *C. plumbeus* (Olivier, 1811) (Willmann, 1977; Gepp & Hölzel, 1989; Gepp, 2010; Krivokhatsky, 2011). The larva described by Redtenbacher (1883, 1884) under "*Creagris plumbeus*" does not belong to this genus and clearly corresponds that of *Myrmecaelurus* Costa.

Creoleon lugdunensis (Villers, 1789) (figs. 3 J, 4D, 5B, 11)

The preimaginal stages of this species and their ecology were described and illustrated by Steffan (1964; 1975), who also compared them with other European species of antlions.

Measured specimens

Italy, Campania, Boscotrecase (NA), VI.2010, ex ovo, C. Labriola leg., 9 (3rd instar).

Italy, Campania, Boscotrecase (NA), VI.2011, ex ovo, C. Labriola leg., 5 (3rd instar).

Italy, Sicily, Gorghi Tondi (TP), IX.2010, ex ovo, R. A. Pantaleoni leg., 2 (3rd instar).

Further examined specimens

Italy, Sardinia, Alghero (SS), XI.2009, D. Badano leg. 1 (3rd instar); reared.

Description of 3rd instar larva. Average body length 9.85 mm; head capsule length 2.58 mm (min-max 2.39-2.73), head capsule width 2.17 mm (2.28-2.39), mandible length 1.90 mm (1.76-2.05), ratio head capsule width/length 0.84, ratio

mandible length/head capsule length 0.73. General colouring brown with darker markings, ventrally paler with darker markings; head capsule brown with darker areas along the sides, ventrally with darker areas at middle length; mandibles dark brown with blackish apex. Head: comparatively large, longer than wide; anterior margin of the labrum equipped with two smooth protrusions; antennae very thin, longer than the eye tubercle; eye tubercles prominent but comparatively small; mandibles noticeably shorter than the head capsule, and very robust, equipped with 3 pairs of teeth; basal tooth closer to the middle one and half of its size, the apical tooth is the longest; 1 seta between the apical and the middle teeth, 1 or no seta between the middle and the basal ones, few very short setae at the base of the mandible, short setae are disposed on the external margin of the mandible; labial palps black; segment 2-4 longer than the mandible base. Body: elliptical provided of black setae; scoli not particularly prominent. Thorax: pronotum dorsally covered by very short, sparse setae; mesothoracic spiracles raised on a short tubercle; first pair of thoracic scoli short but distinct, second pair reduced to a small bump. Legs: comparatively robust, covered by black setae. Abdomen: abdominal spiracles slightly raised, brown; VIII sternite provided with odontoid processes: IX sternite ventrally equipped with few digging setae in the middle, rastra prominent, bearing 4 pairs of digging setae slightly longer toward the exterior.

Bio-ecology: The larvae of this species inhabit open arid habitats with low herbaceous vegetation and characterized by a sandy or sand-like substratum. It is normally observed in arid grasslands and meadows or retro-dunal environments. One larva was collected in a pine wood on retrodunal environment (Sardinia: Alghero). According to Steffan (1975), they prefer exposed patch of sand far from the base of trees.

Remarks: In Sardinia *C. lugdunensis* is sympatric with the congeneric *C. corsicus* (Hagen, 1860), a thyrrenian endemism. The presence of individuals characterized by an intermediate phenotype between the two species suggests the possibility of an hybridization between them. The necessity of further studies to clarify the taxonomic situation prevents to compare their larvae.

Distoleon, Banks 1910

Diagnosis: Mandible equipped with 3 pairs of teeth; pronotum with a thick covering of large setae interspersed by short, spiniform ones; mesothoracic spiracle protruding on tubercle; VIII sternite armed with odontoid processes; IX sternite provided with short but prominent rastra bearing 4 pairs of sub-equal digging setae.

Examined species: *D. tetragrammicus* (Fabricius, 1798)

The genus *Distoleon* comprises ca. 120 species distributed all across the Old World in tropical and temperate areas. Nevertheless the biology and larval stages are known only for the European *D. tetragrammicus* (Fabricius, 1798) and for few Far Eastern species (Stange et al. 2003; Stange, 2004).

Distoleon tetragrammicus (Fabricius, 1798) (figs. 3I, 4C, 5A, 12)

The larva of this widespread European species probably represents the first example of non pit-building antlion known, being the observations of Bonnet referable to this taxon (Bonnet, 1780). His specimen was also studied and illustrated by Réaumur (1742). However the first accurate description was realized much later by Brauer (1854) who also provided diagnostic illustrations. This species was also included in the works of Hagen (1873b) and Redtenbacher (1884). Steffan (1975) not only included this species in his identification key but also detailed for the first time its ecological requirements. Finally the species was included in the keys of Gepp & Hölzel (1989) and Gepp (2010).

Measured specimens

Italy, Veneto, Bovolone (VR), V.2010, F. Sanna leg., 1 (3rd instar).

Italy, Liguria, Pompeiana (IM), VII.2010, D. Badano leg., 1 (3rd instar).

Italy, Sardinia, Berchidda (OT),VII.2010, M. Verdinelli & S. Cossu leg., pitfall, 1 (3rd instar).

Italy, Sardinia, Alghero (SS), Capocaccia, IX.2010, D. Badano leg., 1 (3rd instar).

Italy, Tuscany, Elba, Portoferraio (LI), IX.2010, L. Forbicioni leg., 1 (3rd instar).

Italy, Liguria, Perinaldo (IM), VII.2011, D. Badano leg., 3 (3rd instar).

Italy, Val d'Aosta, Aymavilles (Ao), Pont d'Ael, VIII.2011, D. Badano leg., 1 (3rd instar).

France, Gard, Générac, VIII.2011, D. Badano leg., 10 (3rd instar).

Italy, Lazio, Rocca Priora (RM), X.2011, M. Gigli leg. 1 (3rd instar).

Italy, Liguria, Cipressa (IM), I.2012, D. Badano leg., 4 (3rd instar).

Greece, Corfù, Kato Pauliana, V.2012, D. Badano leg., 1 (3rd instar).

Description of 3rd instar larva. Average body length 10.60 mm; head capsule length 3.00 mm (min-max 2.41-3.33), head capsule width 2.45 mm (2.22-2.72), mandible length 2.54 mm (2.24-2.76), ratio head capsule width/length 0.82, ratio

mandible length/head capsule length 0.85. General colouring brown with darker line and markings, ventral side paler with dark brown patch, head dark brown, lateral and ventral sides with conspicuous darker area; mandibles dark brown. Head: longer than wide; external margin of the labrum with a small median emargination; antennae longer than the eye tubercle; eye tubercles large and prominent; mandibles comparatively strong, shorter than the head capsule, provided with 3 pairs of equidistant teeth of which the first one is the strongest; 1 seta between each pair of teeth, few (3-4) setae between the basal tooth and the insertion of the mandible; labial palps dark in colour, distal segment longer than the others. Body: elliptical in shape, covered by black setae and provided with scoli. Thorax: pronotum dorsally covered by numerous short setae; mesothoracic spiracle borne on tubercle, subcylindrical; thoracic scoli prominent, especially the anterior pair. Legs: pale in colour, yellowish in some specimens, covered by dark setae. Abdomen: with a dorsal median series of dark markings surrounding a central pale area, creating an annulated pattern; abdominal spiracles slightly pronounced, brown; VIII sternite equipped with odontoid processes; IX sternite with a ventral-posterior pair of spiniform setae and a distal pair of small but protruding rastra equipped with 4 pairs of sub-equal digging setae.

Bio-ecology: A common species in Mediterranean Europe, *D. tetragrammicus* shows a considerable ecological plasticity and its larvae could be potentially found wherever a dry and fine substratum, suitable to dig, is present. Steffan (1975) reported the presence of this species in sandy soils with a rich component of humus in pine woods with a thick undergrowth but also in alluvial deposits and in the sediments bordering a path. This species is not normally found in open sand dunes despite being common in retro-dunal environments with rich shrublands and pine woods, confirming the observation of the above mentioned author. The larvae were collected in Mediterranean woods at the base of trees, in low shrublands under stones or under isolated trees (often Aleppo Pine); finally they are relatively common on rock escarpments and under rock overhangs. The larvae also colonize artificial structures, having been observed not only on stone walls but even in concrete buildings where there were deposits of detritus. During the inspection of an arenaceous escarpement (France, Générac), 15 1st instar larvae were detected buried together and in close contact in a very small recess, surely representing the oviposition site of a female specimen. These larvae did not show any sign of cannibalism or aggressiveness among them suggesting the presence of a behaviour not dissimilar from that observed in ascalaphids, whose newly-hatched larvae rest together on the stem where the oviposition occurred for a short period, before disperse themselves.

Remarks: *D. tetragrammicus* is one of the most widespread and common not pit-builder species in Europe. The pigmentation of the abdomen in an unmistakable character allowing an easy identification of all larval stages.

Neuroleon Navás, 1909

Diagnosis: Mandible equipped with 3 pairs of teeth; pronotum covered by long setae and by dolicasters; mesothoracic spiracle conical, borne on a short tubercle; IX sternite equipped with short rastra bearing 4 pairs of digging setae of which the internal pair is noticeably shorter than the others, less tha half the size the following pair.

Examined species: *N. arenarius* Navás, 1904; *N. egenus* (Navás, 1914); *N. nemausiensis* (Borkhausen, 1791); *N. assimilis* (Navás, 1914); *Neuroleon microstenus* (McLachlan, 1898).

A large and taxonomically complex genus, *Neuroleon* includes over 120 species distributed in Africa, Europe, Middle East, Central Asia and India with other doubtful extralimital species (Stange, 2004). The larval stages are very poorly known and they have been described only for few European species (Auber, 1956; Steffan, 1964, 1971, 1975; Devetak et al., 2010), despite the original accounts of the first two authors should be considered with caution (see *N. egenus* and *N. nemausiensis*)

Remarks: The larvae of this genus are very homogeneous in overall morphology and they lack striking differences useful to discriminate them from other genera of Nemoleontini. At the present state of knownledge, the shape of the digging setae of the IX sternite combined with the whole habitus allow to discriminate them from similar taxa. The larvae of the different species of *Neuroleon* can be distinguished between them thanks to overall colouration and the disposition of markings.

Preliminary key to the examined larvae of the species of *Neuroleon*

1. Anterior portion of the dorsal side of the head capsule sparsely covered by very short setae, head mostly stained by extended dorsal and lateral dark markings, ventral side infuscated (fig. 16)

N. microstenus

- Anterior portion of the dorsal side of the head capsule thickly covered by relatively long setae; head with delimited dorsal and lateral markings, ventral side not infuscated

2

2. Ventral portion of the head capsule with a pair of median markings besides those surrounding the gular area, general colour of the body brown

3

- Ventral portion of the head capsule without a pair of median markings besides those surrounding the gular area, general colour of the body yellowish or ochre

4

3. Mandibles relatively thin, distance between the basal and apical teeth equal to that between the basal tooth and the base of the mandible, ventral side of the head capsule with a pair of median well separated spots, labial palps dark (fig. 14)

N. assimilis

- Mandibles relatively robust, distance between the basal and apical teeth inferior to that between the basal tooth and the base of the mandible, ventral side of the head capsule with a pair of median contiguous parallel stripes, labial palps pale (fig. 15)

N. egenus

4. Dorsal side of the head with a pair of dark markings disposed from the antennal pit to the posterior "V"-shaped ones (fig. 13)

N. arenarius

- Dorsal side of the head without a pair of dark markings between the antennal pit and the posterior "V"-shaped ones (fig. 17)

N. nemausiensis

Neuroleon arenarius Navás, 1904 (figs. 3L, 13)

The larva of this species is described here for the first time.

Measured specimens

Italy, Lazio, Roma, Monte Mario, VII.2010, A. Alfonsi & C. Cesaroni leg., 3 (3rd instar).

Italy, Lazio, Roma, Monte Mario, IX.2010, A. Alfonsi & C. Cesaroni leg., 1 (3rd instar).

Italy, Sardinia, Alghero, Spiaggia del Lazzaretto, IX.2010, D. Badano leg., 2 (3rd instar).

Italy, Sardinia, Cagliari, Stagno di Molentargius, IX.2010, D. Badano leg., 2 (3rd instar).

Further examined specimens

Italy, Lazio, Roma, Monte Mario, VII.2010, A. Alfonsi & C. Cesaroni leg., 1 (3rd instar); reared.

Greece, Corfù, dunes of Korission lake, V.2012, D. Badano leg., 1 (3rd instar); reared.

Description of 3rd instar larva. Average body length 8.20 mm; head capsule length 1.80 mm (min-max 1.68-1.86), head capsule width 1.44 mm (1.35-1.52), mandible length 1.57 mm (1.37-1.72), ratio head capsule width/length 0.80, ratio mandible length/head capsule length 0.86. General colouring ochre, sand-like, with brown markings and spots; head capsule with dorsal distinctive brown markings: 2 anterior convergent stripes running from the antennal pits toward the middle dorsal portion of the head where they are bordered by 2 posterior markings creating a "V"-shaped pattern, margins of the head with brown stripes, head ventrally pale, without spots except a darker area in the anterior portion, bordering the gula; labial palps dark brown; mandibles brown; setae mostly black. Head: longer than wide; anterior margin of the labrum slightly concave with a median incision; dorsal side of the head capsule covered by relatively thick pale dolichasters antennae long and thin, over twice the length of the eye tubercles; eye tubercle prominent; mandible shorter than the head capsule and comparatively strong, armed with 3 pairs of teeth of which the first one is the longest; 1 seta between the apical and middle teeth, 1 seta between the middle and basal ones, ca. 4 setae between the basal teeth and the base of the mandible; few setae on the external margin of the mandible, longer at the base. Body: elongate elliptical, covered by dark setae longer toward the exterior. Thorax: pronotum covered by sparse and long setae; mesothoracic spiracle raised on tubercle, conical; thoracic scoli pronounced and evident. Legs: comparatively long, pale in colour and covered by dark setae. Abdomen: abdominal spiracle slightly raised and protruding; VIII sternite provided with reduced odontoid processes; IX sternite with short rastra equipped with 4 digging setae each one, the internal pair of setae is less than half the size of the others.

Bio-ecology: The larvae of this species have been collected under rock overhangs and on escarpments of friable rocks or compacted sand in crevices and recesses, including burrows of bee-eaters (*Merops apiaster* Linnaeus, 1758). The surrounding vegetation in the inspected sites was mainly composed by Mediterranean shrublands and open woods, but also grasslands. Moreover one specimen (Greece, Corfù, near Korission Lake) was collect on a dune, under a thick bush.

Neuroleon assimilis (Navás, 1914) (figs. 4E, 14)

Previously un-described larva.

Measured specimens

Greece, Corfù, Kato Pauliana, V.2012, D. Badano leg., 1 (3rd instar).

Greece, Corfù, Kato Garouna, V.2012, D. Badano leg., 1 (3rd instar).

Greece, Corfù, Acharavi, VI.2012, D. Badano leg., 2 (3rd instar).

Greece, Corfù, Lafki, VI.2012, D. Badano leg., 2 (3rd instar).

Description of 3rd instar larva. Average body length 8.52 mm; head capsule length 2.21 mm (min-max 1.96-2.33), head capsule width 1.75 mm (1.70-1.87), mandible length 1.74 mm (1.9-2.08), ratio head capsule width/length 0.79, ratio mandible length/head capsule length 0.90. General colouring pale brown mottled dark brown, ventrally very pale with conspicuous dark brown patches; head capsule dorsally dark brown with a darker "V"-shaped marking on the occipital area, sides marked dark brown, ventral side of the head paler with conspicuous paired dark brown markings: the first pair is composed by two elongated patches surrounding the gular area, the second one by two isolated spots at middle length (sometimes slightly tainted in some individuals); labial palps dark brown, mandibles brown with a dark brown marking at the base. Head: longer than wide; anterior margin of the labrum with a slight median recess; dorsal side of the head capsule with a thick covering of short dolichasters antennae over twice the length of the eye tubercles; eye tubercles prominent; mandibles slightly shorter than the head capsule, comparatively thin, equipped with 3 pairs of teeth; distance between the basal and apical teeth comparable to that between the basal tooth and the base of the mandible; 1 seta between each pair of teeth, at least 5 setae between the basal tooth and the base of the mandible. Thorax: pronotum covered by short setae; mesothoracic spiracle sub-conical, raised on a short tubercle; thoracic scoli pronounced. Legs: comparatively long, covered by dark setae. Abdomen: VIII sternite provided with short odontoid processes; IX sternite with short rastra equipped with 4 pairs of digging setae of which the internal pair is the shortest.

Bio-ecology: The larvae of *N. assimilis* have been collected in Mediterranean environments under rock overhangs, hidden in crevices filled with sand-like detritus. One specimen was found at the base of a clay escarpment. The surrounding vegetation was composed both by Mediterranean evergreen shrublands (macchia) and by garrigue or herbaceous vegetation, according to the locality.

Neuroleon egenus (Navás, 1914) (fig. 15)

The larva of this species was illustrated for the first time by Steffan (1965) as *N. nemausiensis*, a species with which he initially confused, as it was later confirmed and admitted by the same author (1971). Afterwards, Steffan compared the preimmaginal stages of this species with the congeneric ones known to him, detailing their ecology.

Measured specimens

Italy, Sardinia, Dolianova (CA), V.2010, D. Badano leg., 2 (3rd instar).

Italy, Sardinia, Platamona (SS), XII.2010, D. Badano leg., 4 (3rd instar).

Italy, Sardinia, Sassari (SS), XI.2011, D. Badano leg., 1 (3rd instar).

Italy, Liguria, Cipressa (IM), IX.2010, D. Badano leg., 1 (3rd instar).

Italy, Lazio, Roma, Insugherata, IX.2010, A. Alfonsi & C. Cesaroni leg., 3 (3rd instar).

France, Gard, Beauvoisin, VIII.2011, D. Badano leg., 4 (3rd instar).

France, Gard, Générac, VIII.2011, D. Badano leg., 2 (3rd instar).

Greece, Corfù, Acharavi, V.2012, D. Badano leg., 1 (3rd instar).

Description of 3rd instar larva. Average body length 8.20 mm; head capsule length 1.96 mm (min-max 1.68-2.22), head capsule width 1.58 mm (1.38-1.99), mandible length 1.74 mm (1.41-1.99), ratio head capsule width/length 0.80, ratio mandible length/head capsule length 0.88. General colouring brown with darker brown markings, ventrally paler with darker patches and spots; head capsule with limited markings on the dorsal side: the antennal pits are bordered of dark brown and a "V"-shaped marking is recognizable in the occipital area, side of the head with conspicuous dark markings, ventral side of the head capsule with dark spots bordering the gula and two parallel short stripes in median position (slight stained in some individuals); labial palps pale brown; mandibles brown with a dark brown spot at the base. Head: longer than wide; dorsal side of the head capsule covered by short and relatively sparse dolichasters anterior margin of the labrum almost straight with a small median recess; antennae at least twice the length of eye tubercles; eye tubercles prominent; mandibles slightly shorter than the head capsule, equipped with three pairs of teeth; 1 (rarely 2) seta between the apical and middle teeth, 1 seta between the middle and basal ones, over 4 setae between the basal teeth and the insertion of the mandible. Thorax: pronotum covered by relatively short, sparse setae; mesothoracic spiracle borne on tubercle, sub-conical; thoracic scoli pronounced. Legs: comparatively long, covered by dark setae. Abdomen: VIII sternite provided with short odontoid processes; IX sternite with short rastra equipped with 4 pairs of digging setae of which the internal one is shorter than the others.

Bio-ecology: A very common species in Mediterranean environments which larvae are often found at the base of trees and among roots, in shaded conditions. *N. egenus* appears to be a quite euryoecious in respect of the vegetation and substratum: it has been collected in retrodunal environments at the base of pines, in woods on internal relict dunes, in pine woods on rocky substratum surrounded by low shrublands and in woods of holm-oak and cork-oak. Moreover the larvae are also often found on rock escarpments and overhangs in woods or at their borders. Despite the apparent predilection to live in the presence of arboreal vegetation, larvae of this species have

been also collected in open habitats without trees such as dunes with shattered bushes (Italy, Sardinia, Scivu) and grasslands (Italy, Sardinia, Cagliari, Molentargius), but always in presence of shelters. Due to its habitat, it is usually burrowed in radical detritus, in which it is well hidden thanks to its dark colouration. The larvae of this species are often found in small groups, in many cases composed by coetaneous specimens, apparently they don't disperse far from the original site of oviposition.

Neuroleon microstenus (McLachlan, 1898) (fig. 16)

The 1st instar larva of this species was illustrated by Gepp (1974), despite the first exhaustive description of all the preimaginal stages has appeared only recently (Devetak et al., 2010a) .

Measured specimens

Italy, Liguria, Bordighera (IM), Monte Nero, VIII.2010, D. Badano leg., 2 (3rd instar).

Italy, Liguria, Bordighera (IM), Monte Nero, VIII.2012, D. Badano leg., 2 (3rd instar).

Description of 3rd instar larva. Average body length 8.00 mm; head capsule length 2.24 mm (min-max 1.81-2.51), head capsule width 1.72 mm (1.57-1.82), mandible length 1.96 mm (1.90-2.10), ratio head capsule width/length 0.77, ratio mandible length/head capsule length 0.87. General colouring light ochre with contrasting dark brown markings, ventrally paler with darker patches; head with extensive dark markings, dorsal surface with a pair of median large dark markings creating a "V"-shaped pattern, sides completely dark in colour, ventral side dark brown with darker markings surrounding the gula (in one specimen the patches of the side prosecute ventrally); labial palps black; mandibles dark brown. Head: longer than wide; anterior margin of the labrum with a very small median incision; dorsal side of the head capsule covered by very short and sparse dolichasters; antennae longer than eye tubercles; eye tubercles prominent; mandibles almost long as the head capsule, equipped with 3 pairs of teeth; distance between the basal and apical teeth slightly inferior to that between the basal tooth and the base of the mandible 1 seta between each pair of teeth, few setae (3-4) between the basal tooth and the insertion of the mandible. Thorax: pronotum covered by very short setae; mesothoracic spiracle sub-conical, on a small tubercle; thoracic scoli pronounced. Legs: comparatively long, covered by dark setae. Abdomen: VIII sternite provided with short odontoid processes; IX sternite with short rastra equipped with 4 pairs of digging setae of which the internal pair is shorter than the others.

Bio-ecology: Devetak et al. (2010) reported the finding of the larvae of this species in a grassland with sporadic bushes on a loose soil. The studied larvae were collected in a

high macchia on arenaceous substrate, buried in small rock pockets filled with sand and cohabiting with those of *N. nemausiensis*.

Neuroleon nemausiensis (Borkhausen, 1791) (figs. 5C. 17)

A considerable confusion surrounds the preimaginal stages of this widespread Euro-Mediterranean species. Auber (1956) illustrated and treated the ecology of some larvae that he assigned to *N.nemausiensis*, characterized by the presence of extensive dark markings on the dorsal surface of the head. However the association with this species is not reliable because he considered the presence of only 3 species of this genus in France, notably *N. nemausiensis*, *N. arenarius* and *N. ochreatus* (Auber, 1956). Steffan (1965) originally confused *N. egenus* with this species and he described the larvae of the latter as those of *N. nemausiensis*. Afterwards he corrected himself (1971) assigning the larvae previously described by him to the proper species, moreover he matched the larvae of *N. nemausiensis* with those described by Auber (1956). The present observations of the larvae of *N. nemausiensis* does not agree with the original description of Auber (1956) and the identity of his larvae cannot be clarified because of his original error in the number of possible species and the lack of details in the account. In order to the above mentioned reason, this is the first reliable description of the larva of *N. nemausiensis*, albeit it is interesting to underline that a larva illustrated by Steffan (1975) as *N. microstenus* shows a similar head pattern to those observed in this species.

Measured specimens

Italy, Sardinia, Alghero (SS), Capocaccia, V.2010, D. Badano leg., 1 (3rd instar).

Italy, Sardinia, Alghero (SS), Capocaccia, IX.2010, D. Badano leg. 3 (3rd instar).

Italy, Sardinia, Alghero (SS), Capocaccia, IX.2011, D. Badano leg. 3 (3rd instar).

Italy, Sardinia, Alghero (SS), Capocaccia, V.2012, D. Badano leg. 4 (3rd instar).

Italy, Liguria, Bordighera (IM), Monte Nero, VIII.2010, D. Badano leg. 5 (3rd instar).

Description of 3rd instar larva. Average body length 8.11 mm; head capsule length 1.94 mm (min-max 1.8-2.23), head capsule width 1.53 mm (1.37-1.65), mandible length 1.61 mm (1.46-1.80), ratio head capsule width/length 0.82, ratio mandible length/head capsule length 0.78. General colouring yellowish brown with dark brown markings (the contrast of the darker areas varies according to the individuals), ventrally very pale without evident markings; dorsal side of the head capsule with large conspicuous "V"-shaped dark markings, antennal pits shrouded dark brown, margin of the head with a long darker markings, ventral side of the head completely pale except

the anterior portion (labial area) marked dark brown, a pair of dark markings borders the gular area; labial palps dark brown; mandibles dark brown with a paler median area and a basal dark brown patch. Head: longer than wide; anterior margin of the labrum with a slightly concave; dorsal side of the head capsule thickly covered by dolichasters antennae over twice the length of the eye tubercles; eye tubercles prominent; mandibles slightly shorter than the head capsule, comparatively thin, equipped with 3 pairs of teeth; distance between the basal and apical teeth slightly inferior to that between the basal tooth and the base of the mandible; 1 seta between the apical and middle pair of teeth, 1 (2) setae between the middle and basal teeth; over 4 setae between the basal tooth and the base of the mandible. Thorax: pronotum covered by short setae; mesothoracic spiracle sub-conical, prominent; thoracic scoli pronounced. Legs: comparatively long, covered by dark setae. Abdomen: VIII sternite equipped with slightly developed odontoid processes; IX sternite provided with short rastra bearing 4 pairs of digging setae of which the internal pair is the shortest.

Bio-ecology: The larvae of this species were collected in macchia-type biotopes, specifically in a coastal juniper thicket, characterized by deposit of dry loose red soil, and in a more diverse sclerophyllous shrubland growing on arenaceous substrate. The larvae were collected under rock-overhangs, in proximity of obstacles, such as stones or roots of bushes, and at the base of tuft of herbs; apparently they show a preference to burrow themselves in small rock pockets filled with fine detritus. However the ecological requirements are probably more diverse, being the adults commonly found in Mediterranean woodlands and garrigue.

Megistopus Rambur, 1842

Diagnosis: Mandibles comparatively long equipped with 3 pairs of teeth; mesothoracic spiracle raised on tubercle; thoracic scoli well developed; odontoid processes of the VIII sternite atrophied or completely absent; IX sternite provided with very few, short digging setae; rastra short with the internal pair of digging setae reduced, not over a quarter the others in length.

Examined species: *M. flavicornis* (Rossi, 1790), *M. lucasi* (Navás, 1912).

An exclusively western Palearctic genus, *Megistopus* comprises 3 species: *M. flavicornis* (Rossi, 1790) widespread in the Mediterranean basin and reaching Central Europe in the north and Iran in the east (Aspöck et al., 2001), *M. mirabilis* (Hölzel, 1980), known from a single specimen from Sinai (Hölzel, 1980) and finally *M. lucasi* (Navás, 1912) reported from Algeria and Tunisia (Navás, 1912a; Güsten, 2003). The latter species was overlooked being originally described as a member of the genus *Nelees* Navás, 1912 (now synonym of *Neuroleon* Navás, 1909) despite the correct

genus placement was already recognized by Banks (1913). This interesting species is also present in Italy (Letardi & Pantaleoni, 1998; Letardi & Maltzeff, 2001) however the specimens belonging to this population were previously assigned to the overall similar congeneric *M. mirabilis* due to the inaccessibility of the type specimens.

Remarks: the larva of *M. flavicornis* is distinguished by extremely developed spiracles, an unusual and rare character in the whole family Myrmeleontidae, thus considered worth of generic value by Stange (2004). Nevertheless the discovery of the larva of *M. lucasi*, in which this structures are normally developed, allows to consider this character as simply species-specific and approaching the larvae of this genus with those of the closely related *Gymnocnemia* from which it differs essentially only in details of the mandibles and of the abdominal IX sternite.

1. Spiracles pedunculated, of which the thoracic pair longer than the first pair of scoli, dolichasters covering the clypeo-labrum and labial palps black, IX abdominal sternite without markings (fig. 18)

M. flavicornis

- Spiracles not pedunculated, of which the thoracic pair shorter than the first pair of scoli, dolichasters covering the clypeo-labrum and labial palps whitish, IX abdominal sternite with markings (fig. 19)

M. lucasi

Megistopus flavicornis (Rossi, 1790) (fig. 18)

The account by Redtenbacher (1884) on a larva assigned to this species in reality clearly refers to a larva of *Cueta* and it will be necessary to wait the work of Steffan (1964) to have the first accurate description of this antlion, that he studied it in depth clarifying its ecological requirements and habits and comparing it with other members of the family (Steffan, 1968; 1975). Afterwards the larva of this species was inserted in the identification key to the Centro-European larvae of Gepp & Hölzel (1989) and Gepp (2010) and it was finally compared with the closely related *Gymnocnemia variegata* (Cesaroni et al., 2010).

Measured specimens

Italy, Sardinia, Alghero (SS), IV.2008, C. Cesaroni leg. 4 (3rd instar).

Italy, Sardinia, Alghero (SS), XI.2008, C. Cesaroni leg. 2 (3rd instar).

Greece, Chalkidiki, Athos, Aj. Pavlo, VIII.2008, L. Fancello leg. 1 (3rd instar).

Further examined specimens

France, Gard, Pompignan, VIII.2011, D. Badano leg. 2 (2nd instar), 2 (3rd instar); reared..

France, Gard, Beauvoisin, VIII.2011, D. Badano leg. 1 (2nd instar), 2 (3rd instar); reared..

Description of 3rd instar larva. Average body length 10.25 mm; head capsule length 2.35 mm (min-max 2.07-2.41), head capsule width 1.75 mm (1.60-2.05), mandible length 2.16 mm (2.07-2.28), ratio head capsule width/length 0.82, ratio mandible length/head capsule length 0.87. General colouring light brown, mottled dark brown, ventral side pale with dark markings and spots; head with extensive dorsal dark marking, eye tubercles black, ventral side of the head pale with the exception of dark markings surrounding the gula. Head: longer than wide; anterior margin of the labrum with a small median recess and covered by black dolichasters; antenna thin, longer than the eye tubercles; eye tubercles prominent, black in colour; mandibles as long as the head capsule and provided with 3 pair of teeth of which the apical is the longest one; 1 seta between each pair of teeth, few setae (3-4) between the basal tooth and the insertion of the mandible, external margin of the mandible with few and short setae; labial palps comparatively slender, covered by black dolichasters, the last segment is the longest. Body: elongated, covered by black setae and characterized by protruding thoracic scoli and spiracles. Thorax: pronotum thickly covered by setae; mesothoracic tubercles cylindrical and over-developed, considerably longer than the thoracic scoli; thoracic scoli developed. Legs: relatively long, covered by dark setae. Abdomen: abdominal spiracles large, pedunculated and protruding, visible from above; VIII sternite provided with very reduced odontoid processes; IX sternite pale in colour, without conspicuous lateral markings, rastra with the internal pair of setae less than a quarter of the others in size.

Bio-ecology: The ecology and behaviour of this species have been exhaustively treated by Steffan (1968). This species is relatively euryecious and it can been found in various environments of Mediterranean influence and with the presence of sand-like substratum, such as coastal dunes, internal sandy deposit and river banks. The larvae are usually found in shaded conditions, at the base of trees and in proximity of other shelters. They are often assembled in groups thus they apparently not disperse far from the site of oviposition (Steffan, 1968). The present observations clearly agrees with the original observation of the above mentioned author: larvae of this species were collected in retrodunal environments (Italy, Sardinia, Alghero and Platamona) with pine trees, in pine woods on relict internal sand dunes (France, Gard, Générac) and in the sandy deposits of a dry stream, among pebbles (France, Gard, Pompignan).

Megistopus lucasi (Navás, 1912) (figs. 3M, 4G, 5E, 19)

The larva of this rare species is described here for the first time.

Measured specimens

Italy, Sardinia, Arbus (VS), Torre dei Corsari, V.2010, D. Badano leg., 2 (3rd instar).

Italy, Sardinia, Arbus (VS), Torre dei Corsari, IV.2011, D. Badano leg., 4 (3rd instar).

Italy, Sardinia, Chia (CA), XI.2011, D. Badano leg., 2 (3rd instar).

Further examined specimens

Italy, Sardinia, Arbus (VS), Torre dei Corsari, V.2010, D. Badano leg., 1 (3rd instar); reared.

Italy, Sardinia, Arbus (VS), Torre dei Corsari, IV.2011, D. Badano leg., 1 (3rd instar); reared.

Italy, Sardinia, Chia (CA), XI.2011, D. Badano leg., 1 (3rd instar); reared.

Description of 3rd instar larva. Average body length 9.48 mm; head capsule length 2.27 mm (min-max 2.15-2.49), head capsule width 1.86 mm (1.71-1.96), mandible length 1.98 mm (1.90-2.22), ratio head capsule width/length 0.82, ratio mandible length/head capsule length 0.87. General colouring ochre with pink shades and mottled dark brown, ventrally very pale with dark markings; head with dark occipital markings and dark lines along the margins, ocular tubercles black, ventral side of the head pale except the gular area; mandibles orange; setae mostly black. Head: longer than wide; anterior margin of the labrum slightly concave, dolichasters of the labrum whitish; antennae at least twice the length of the eye tubercle; eye tubercle prominent, black; mandibles slender, slightly shorter than the head capsule and armed with 3 pairs of teeth of which the apical one is the longest, distance between the apical and basal teeth superior to that between the basal tooth and the insertion of the mandible; 1 seta between each pair of teeth, 2 setae between the basal tooth and the base of the mandible; labial palps comparatively slender, covered by whitish dolichasters, last segment longer than the others. Body: elongated, covered by black setae. Thorax: pronotum covered by few sparse and long setae, not interspersed by short ones, the anterior setae pale in colour; mesothoracic spiracles cylindrical, raised on tubercle but comparatively stout, shorter than the first pair of scoli; thoracic scoli pronounced. Legs: comparatively long, covered by dark setae. Abdomen: abdominal spiracles slightly protruding; VIII sternite without odontoid processes; IX sternite tainted with a pair of dark markings on the side; rastra short and equipped with 4 pairs of digging setae of

which the internal one extremely reduced; very few short digging setae are disposed ventrally just before the rastra.

Bio-ecology: *M. lucasi* is a rare and little known species reported from few Italian localities in Latium (Letardi & Pantaleoni, 1998; Letardi & Maltzeff, 2001) and Sardinia, all of them represented by coastal sand dunes. The larvae were collected in proximity of the first isolated junipers on open dunes and they were not observed in retro-dunal environments with a more thick vegetation. The larvae dwell at the base of junipers or under their roots, often buried at a depth of few decimetres. The substratum where they have been found was always composed by clean sand without conspicuous quantities of organic debris except junipers' needles.

Gymnocnemia Schneider, 1845

Diagnosis: Mandibles long and slender with middle and apical teeth subequal in size; mesothoracic spiracle borne on tubercle; thoracic scoli well developed; odontoid processes of the VIII sternite atrophied; rastra with the internal pair of digging setae reduced .

Examined species: *G. variegata* (Schneider, 1845)

This is a monospecific genus but closely related to *Megistopus* Rambur, 1842, restricted to the Western Palearctic region from the Mediterranean basin to Central Asia (Aspöck et al., 2001; Stange, 2004).

Gymnocnemia variegata (Schneider, 1845) (figs. 3N, 4H, 5F, 20)

The larva of this relatively rare species has been unequivocally described for the first time by Willmann (1977) under "? *Distoleon annulatus*" since the older account by Hagen (1873b) clearly refers to another species. Afterwards, the 1st instar larva was synthetically described by Insom *et al.* (1985) and a photo of a Tunisian specimen was published by Stange & Miller (1990) but without an exhaustive description. Finally, Cesaroni et al. (2010) comprehensively described and illustrated the preimmaginal stages of this species, comparing them with those of *Megistopus flavicornis* Rambur, 1842, despite the ecological informations were still restricted to the few information by Willmann (1977), Stange & Miller (1990) and Stange (2004). Monserrat & Acevedo (2011) reported the finding of larvae in rock cavities in Spain.

Measured specimens

Italy, Lazio, Roma, Monte Mario, VII.2010, A. Alfonsi & C. Cesaroni leg., 4 (3rd instar).

Italy, Lazio, Roma, Monte Mario, X.2011, A. Alfonsi & C. Cesaroni leg., 4 (3rd instar).

Greece, Corfù, Panagias, V.2012, D. Badano leg., 2 (3rd instar).

Greece, Corfù, Agios Markianos, VI.2012, D. Badano leg., 1 (3rd instar).

Description of 3rd instar larva. Average body length 7.41 mm; head capsule length 2.07 mm (min-max 1.82-2.27), head capsule width 1.71 mm (1.61-1.90), mandible length 2.20 mm (2.00-2.46), ratio head capsule width/length 0.85, ratio mandible length/head capsule length 1.08. General colouring pale yellowish brown with darker areas and markings, ventrally paler; head capsule darker than the body, with large dark markings on the dorsal side; mandibles pale brown. Head: longer than wide; anterior margin of the labrum concave; antennae very long and thin, over twice the length of the eye tubercle; eye tubercle prominent, with dark markings; mandibles considerably longer than the head capsule and very thin; distance between the basal tooth and the base of the mandible greater than that between the basal and the apical teeth; apical and middle teeth almost subequal in size; 1-0 setae between the apical and middle teeth, 1-0 setae between the middle and basal teeth, 6-7 setae between the basal teeth and the base of the mandible; few sparse setae are disposed on the external margin of the mandible; labial palps comparatively long and narrow, segments 2-4 longer than the width of the mandible. Body: elongate oval, covered by dark setae, longer toward the margin. Thorax: pronotum cuneiform, covered by sparse dolichasters; mesothoracic spiracle raised on tubercle, conical in shape; thoracic scoli prominent. Legs: slender and comparatively long, provided with black setae. Abdomen: spiracles of the abdomen slightly raised; VIII sternite with two well distinct dark spots; odontoid processes atrophied or completely absent; IX sternite with short rastra equipped with long and thin digging setae of which the internal pair is half the others in size.

Bio-ecology: The larvae of this species live on rocky escarpments, especially on erodible rocks or where there is a considerable deposition of dry and fine substratum. During the present research, the larvae have been found under rock overhangs, in cavities and in crevices, including abandoned burrows of bee-eaters (*Merops apiaster*, Linnaeus, 1758). The vegetation surrounding the rocky cliffs does not to appear to influence the presence of the species, in fact the larvae have been found not only in open environments with shrubs or Mediterranean maquis where the rocks are directly exposed but also in small escarpments surrounded and covered by arboreal vegetation, such as holm-oak forests and thick olive groves. They are typical ambush predators.

Tribe Myrmecaelurini Esben-Petersen 1918

This poorly defined tribe is characteristic of the steppes and deserts of the Palearctic region, few species are reported for the Afrotropical region. The larvae are characterized by the presence of a middle mandibular tooth longer than the others, mesothoracic tubercle not raised on tubercle. The last abdominal tergites show considerable differences between the different genera. Some genera of the tribe are pit-builders.

Myrmecaelurus A. Costa, 1855

Diagnosis. Mandibles equipped with 3 pairs of teeth, the middle one is the largest and considerably nearer to the apical tooth than to the basal one, in *M. s.str.* they are directly in contact without setae between them; long setae are present along the external margin of the mandible; eye tubercle not prominent; VIII abdominal sternite without odontoid processes and with numerous digging setae; IX abdominal sternite ventrally covered by digging setae and very large rastra.

Examined species: *M. trigrammus* (Pallas, 1771)

The genus *Myrmecaelurus* comprises over 70 species (Stange, 2004) mainly diffused in the Palearctic region; however there is not a strict consensus in its delimitation and it is often subdivided in different subgenera (Aspöck et al., 1980) or even genera (Krivokhatsky, 2011). It is interesting to note the presence of morphological differences between the larvae belonging to these taxa (Krivokhatsky, 2011). The only species reported for south-western Europe is *M. trigrammus* (Pallas, 1771) the type genus, for this reason the present description especially refers to *Myrmecalurus s.str.*.

Myrmecaelurus trigrammus (Pallas, 1771) (figs. 3D, 4I, 21)

The first reliable description and illustration of the larva of this species was redacted by Redtenbacher (1884), being the previous accounts of Brauer (1867) and Hagen (1873b) not diagnostic or referable to other taxa, however he erroneously assigned the larvae of this species also to *?Creagris plumbeus*, *?Macronemurus appendiculatus* and *?Macronemurus bilineatus*. Doflein (1921) illustrated some larvae of this species, wrongly attributing them to *Macronemurus appendiculatus* and *Megistopus flavicornis* following the previous erroneous descriptions of Redtenbacher. Much later, Willmann (1977) gave an excellent re-description of this species from the Dodecanese Islands, while Steffan (1975) simply inserted it in his identification keys. Curiously Hölzel (1974) described the larva of this species as *Myrmeleon gerlindae* Hölzel, 1974. More

recent descriptions of the larva of this species are treated in Gepp & Hölzel (1989), Gepp (2010) and Krivokhatsky (2011).

Specimens measured

Italy, Sicily, Gurne dell'Alcantara (ME), VII.2010, A. Corso leg., 3 (3rd instar).

Italy, Calabria, Strogoli (KR), VIII.2010, C. Labriola leg., 1 (3rd instar).

Romania, Badabag, VIII.2010, C. Manci leg., 2 (3rd instar).

Turkey, Cappadocia, Göreme, V.2010, A. Letardi leg., 3 (3rd instar).

Description of 3rd instar larva. Average body length 9.83 mm; head capsule length 2.42 mm (min-max 2.29-2.59), head capsule width 2.05 mm (1.97-2.18), mandible length 2.14 mm (1.78-2.32), ratio head capsule width/length 0.85, ratio mandible length/head capsule length 0.88. General colouring ochre with dark brown markings; head capsule dorsally dark brown, ventrally covered by extensive dark markings; jaws pale brown with a darker apex; setae dark brown. Head: a little longer than wide; antennae long, at least as half of the length of the mandible, thin; ocular tubercles small and sessile; mandibles shorter than the head capsule and comparatively robust; the middle tooth is longer than the other and it is directly in contact with apical tooth, distance between the proximal tooth and the base of the mandible slightly superior to that between the proximal and the apical teeth; no setae between the apical and middle teeth, at least a pair between the middle and the proximal teeth, numerous between the basal tooth (at least 7) and the base of the mandible; labial palpi with segments 2-4 together longer than the width of the mandible. Body: oval, without scoli or other protrusion, setae black. Thorax: pronotum cuneiform, covered by relatively sparse and robust dark setae; mesothoracic tubercle not raised, dark in colour. Legs comparatively long and robust. Abdomen covered by dark setae longer toward the margins; VIII sternite without odontoid processes and equipped with numerous spiniform digging setae toward its posterior margin; IX sternite provided ventrally with very large spiniform digging setae and laterally with long and stout setae, posterior margin with very large and protruding rastra with 4 subequal digging setae.

Bio-ecology: *M. trigrammus* is an inhabitant of steppe-like biotopes such as arid meadows and grasslands. The larvae are pit-builders, as it is also clear by their external morphology, able to move backward and forward; however they retain a considerable ability to hunt simply by ambush and they are often defined as "facultative pit-builders" and the pit-building habits have been reported to be limited to the first stages (Aspöck, 1964; Popov, 1984). During the present researches all the stages have been observed to build pit traps both in the field than in the laboratory, probably the expression of this behaviour is due to rearing conditions, the characteristics of the site or the abundance of

prey. The pit are often build in open condition, not rarely near tuft of grass, but they are also observed near shelters as stones, logs or under rock escarpments.

Tribe Nesoleontini Markl, 1954

This tribe comprises only 3 genera of which 2 are limited to the Afrotropical region, while the third one, *Cueta*, is widespread in the Old World (Stange, 2004). The larvae are pit-builders and share the overall habitus with the Myrmecaelurini.

Cueta Navás, 1911

Diagnosis: Mandibles armed with 3 pairs of teeth, of which the middle one is the longest and strongest; at least 1 seta is always present between the apical and the middle teeth; external margin of the mandible provided with long setae; ocular tubercles not prominent; mesothoracic spiracle not raised on tubercle; VIII abdominal sternite provided with odontoid process and digging setae; IX sternite equipped with large and prominent rastra and ventral large digging setae.

Examined species: *C. beieri* (Hölzel, 1972)

This is a speciose genus, with at least 80 species distributed in the arid areas of Eurasia and Africa (Stange, 2004). The larvae are pit-builder and they are poorly known and only for an handful of species they exhaustively described (Krivokhatsky, 2011; Stange et al., 2003; Willmann, 1977).

Cueta beieri (Hölzel, 1972) (figs. 3E, 4J, 22)

The preimaginal stages of this species have been described by Willmann (1977).

Measured specimens

Greece, Rhodes, Kamiros, VII.2009, D. Badano leg., 1 (3rd instar).

Greece, Rhodes, Kamiros, XI.2010, R. A. Pantaleoni leg., 4 (3rd instar).

Greece, Rhodes, Kiotari, XI.2010, R. A. Pantaleoni leg., 2 (3rd instar).

Description of 3rd instar larva. Average body length 8.67 mm; head capsule length 2.10 mm (min-max 1.81-2.25), head capsule width 1.71 mm (1.56-1.81), mandible length 1.92 mm (1.67-2.09), ratio head capsule width/length 0.82, ratio mandible length/head capsule length 0.92. General colouring pale brown with darker

areas and markings, ventral side with a whitish median area bordere by very dark markings; head capsule brown with a darker area in proximity of the clypeo-labrum, ventral side pale with dark borders; mandibles brown with a dark apex; chaetotaxy of the body black. Head: longer than wide, anterior margin of the labrum straight with a little pronounced median incision; antennae brown, comparatively long; ocular tubercle small and not prominent; mandibles slightly shorter than the head capsule and comparatively stout, equipped with 3 pairs of teeth, of which the middle one is the longest; 1-2 setae between the apical and middle teeth, 3 setae between the middle and the basal teeth, at least 5, thickly disposed setae between the basal tooth and the base of the mandible; external margin of the mandible provided with very long setae; labial palps comparatively long, 4-articulated, segment 2-4, longer than the width of the mandible. Body: elliptical but comparatively rounded and flattened, covered by dark setae. Thorax: pronotum dorsally covered by short setae; mesothoracic spiracle sessile, black in colour; mesothorax with a pair of large lateral tuft of setae. Legs: all pairs of legs completely pale and covered by dark setae Abdomen: abdominal spiracles small and pale, hardly noticeable; VIII sternite equipped with large odontoid processed and with the posterior margin covered by spiniform digging setae; IX sternite with a median anterior group of 2 pairs of large and stout digging setae, rastra very large and prominent bearing 4 pairs of digging setae, one large digging seta is ventrally disposed at the base of each one.

Bio-ecology: This species has been observed in open arid and hot environments such as grassland and scrublands. The larvae dig their pit traps in exposed conditions in loose and dry soil, often near obstacles such as rocks and roots. Observations in laboratory suggest that the pit-building behaviour is the main strategy to catch preys and it appears not particularly well suited for simply ambush-hunting.

Tribe Acanthaclisini Navás, 1912

The larvae of this tribe are characterized by the lack of scoli, head dolichasters, odontoid processes and rastra on the last two abdominal sternites, the mesothoracic spiracle is not borne on tubercle. Typical ambush predators.

Acanthaclisis Rambur, 1842

Diagnosis: Anterior margin of the labrum with a median cuneiform processes; mandibles robust, swollen basally, equipped with three pairs teeth of which the middle one is slightly longer than the others; ventral portion of the head capsule with sparse

setae; VIII sternite with ventral robust digging setae; IX sternite ventrally covered by robust digging setae.

Examined species: *A. occitanica* (Villers, 1789)

This genus includes 7 species of Palearctic distribution of which only *A. occitanica* is present in Western Europe. The similar *A. pallida* (McLachlan, 1887) is reported for European Russia (Stange, 2004; Krivokathsky, 2011).

Acanthaclisis occitanica (Villers, 1789) (figs. 3B, 4K, 23)

The larva of this species was described and illustrated for the first time in the pioneering work of Percheron (1833) as "*Myrmeleon libelluloides*". A much more rigorous account was redacted by Brauer (1855b), on the basis of some specimens discovered by Bachmann in the Vistula split. Bachmann carefully described the site where the larvae were found and their biology (Bachmann in Brauer, 1855b). The species was later re-described by Hagen (1859; 1873b) and by Redtenbacher (1884) mainly following the previous study of Brauer. It is interesting to underline that in the XIX° century the larva of this species was confused multiple times with that of *Synclisis baetica* - that is much more easier to find in the field - (Dufour, 1854; Perris, 1857; Ferrari, 1864; Girard, 1875; Dubois, 1899). Steffan (1975) studied carefully the larva of this species, detailing its ecological requirements in southern France and comparing it with the other species of antlion. This unmistakable species was later treated mainly for identification purposes in Willmann (1977), Gepp & Hölzel (1989), Gepp (2010) and finally Krivokhatsky (2011). Stange & Miller (1985) reviewed the larvae of the tribe Acanthaclisini comparing the larva of this genus with closely related species.

Measured specimens

Italy, Sardegna, Alghero (SS), pineta di Maria Pia, IV.2008, C. Cesaroni leg., 1 (3rd instar).
Italy, Sardegna, Spiaggia del Liscia (OT), IX.2009, L. Lenzini leg., 3 (3rd instar).
Portugal, Estremadura, San Martinino, VII.1996, A. Molinu leg., 2 (3rd instar).

Further examined specimens
Italy, Sardegna, Alghero (SS), pineta di Maria Pia, XI.2009, D. Badano leg., 1 (2nd instar).
Italy, Sardegna, Sa Tiria Posada (NU), V.2006, R. A. Pantaleoni leg. , 1 (2nd instar).
Italy, Sardegna, Scivu, Arbus (VT), V.2010, D. Badano leg., 1 (2nd instar).

Description of 3rd instar larva. Average body length 23.37 mm; head capsule length 4.58 mm (min-max 4.43-4.89), head capsule width 3.75 mm (3.69-3.92), mandible length 3.55 mm (3.42-3.72), ratio head capsule width/length 0.82, ratio mandible length/head capsule length 0.77. General colouring grey with numerous dark spots and marks, head with a dorsal large brown marks, mandibles black. Head: rectangular a little longer than wide; anterior margin of the labrum with a cuneiform process bearing setae on the external margin; antennae a little longer than the mandible at its insertion; ocular tubercles small, not prominent; mandibles very strong, shorter than the head capsule, noticeably broader in correspondence of basal tooth, progressively narrower and curved at mid-length; the apical tooth is a little bent to the inside, middle tooth a little longer than the others two; no or very few setae between the teeth; few short and sparse setae between the insertion of the mandible and the basal tooth; external edge of the basal half of the mandible covered by setae at least long as half of the widest portion of the mandible. Body: oval, without scoli or protuberances covered by dark and robust setae especially along the margin. Thorax: pronotum as large as the posterior margin of the head capsule, covered by numerous stout dark setae; mesothoracic spiracles dark, hidden by robust setae. Legs: relatively long and robust covered by dark setae. Abdomen: spiracles darker than the surrounding cuticle; VIII sternite ventrally covered by with many long and black setae, especially at the margin, middle ventral portion characterized by the presence of short and particularly robust peg-like digging setae; IX sternite rounded in shape, with many dark setae progressively longer and thicker toward the lateral posterior edge, ventral side equipped with numerous short and robust peg-like digging setae almost identical to those on the previous sternite.

Bio-ecology: The larvae of *A. occitanica* are typical inhabitants of retro-dunal environments with a relatively complex vegetation, characterized by the presence of bushes or trees and where the sand is rich in organic debris and humus giving it a darker color. They are also found in internal sandy habitats such as fluvial deposits, steppes and relict dunes (Steffan, 1975). The larvae are often found among roots, near tree bases or under shrubs; the first stages are less mobile than the 3rd one (Steffan, 1975). They are relatively fast burrowers able to move forward and backward. The larvae of *A. occitanica* are strictly ambush predators usually not pursuing the prey if it escapes from the first attack. These antlions are able to grab large preys, sometimes even heavily sclerified insects like Coleoptera Geotrupidae and Tenebrionidae.

Synclisis Navás, 1919

Diagnosis. Mandible long and robust with 3 teeth, the apical one is the longest; no setae between the basal tooth and the mandible base; VIII abdominal sternite without

digging setae; IX abdominal sternite subtriangular in shape with a median series of digging setae.

Examined species: *S. baetica* (Rambur, 1842)

The genus *Synclisis* comprises 3 Palearctic species of which only the following one belongs to the European fauna; a fourth species from Madagascar is considered of doubtful taxonomic placement (Stange, 2004).

Synclisis baetica (Rambur, 1842) (figs. 3C, 4L, 24)

This species is surely the most well known antlion species between those with no-pit building habits, probably due to its large dimensions and its abundance in relatively well preserved sand dunes. Nevertheless, the first accounts on the larva of *S. baetica* were almost all misidentification with other large antlions, especially with *A. occitanica*. The first description was compiled by Dufour (1853) despite he incorrectly attributed the larvae to *A. occitanica*; this error was prosecuted by other authors who reported its presence in sand dunes (Perris, 1847; Ferrari, 1864; Girard, 1875; Dubois, 1899). McLachlan (1873b), again re-described the larva of this species but he wrongly assigned it to *Palpares hispanus*. For the above mentioned reason, the first correct description of the larva of this species is the work of Redtenbacher (1884) who also gave the first illustration of it. Furthermore, Meinert (1889) detailed the anatomy of the larvae that he attributed to "*Myrmeleon pallidipennis* Rambur?". The best study on the biology of this species is, without any doubts, the excellent paper of Principi (1947) who accurately treated the life cycle of this species particularizing the larval morphology and anatomy, its ecology and behavior. The ecology of the species was also treated few years later by Richard (1951) and Richard & Pons (1952), studying the species in southern France. Moreover the characteristic of the tentorium of this species were investigated in the same period by Saffre (1957). Steffan (1975) inserted the species in his valuable key and discussed the ecological requirements of the species in different biotopes in southern France. This antlion was finally included in all the recent major works on the larvae of Myrmeleontidae: Willmann (1977), Gepp & Hölzel (1989), Gepp (2010) and Krivokhatsky (2011), besides the systematic review of the larvae of acanthaclisine antlions by Stange & Miller (1985).

Specimens measured

Italy, Latium, Sabaudia (LT), V.2006, R. A. Pantaleoni leg., 1 (3rd instar).

Italy, Sardinia, Alghero (SS), Maria Pia, V.1992, R. A. Pantaleoni leg., 1 (3rd instar).

Italy, Sardinia, Sassari (SS), Porto Ferro, V.1999, R. A. Pantaleoni leg., 1 (3rd instar).

Italy, Sardinia, Sassari (SS), Porto Ferro, V.1999, R. A. Pantaleoni leg., 1 (3rd instar).

Italy, Sardinia, Sorso (SS), Platamona, IV.1999, C. Cesaroni leg., 1 (3rd instar).

Italy, Sardinia, Alghero (SS), Maria Pia, IX.2007, C. Cesaroni leg., 1 (3rd instar).

Italy, Sardinia, Sorso (SS), Platamona, IX.2010 C. Cesaroni leg., 1 (3rd instar).

Italy, Sardinia, Alghero (SS), Maria Pia, XI.2009, D. Badano leg., 2 (3rd instar).

Italy, Sardinia, Arbus (VS), Torre dei Corsari, IV.2011, D. Badano leg., 1 (3rd instar).

Italy, Sardinia, Sorso (SS), Platamona, VIII.2012, D. Badano leg., 1 (3rd instar).

Tunisia, Zoiraâ beach, VI.2006, R. A. Pantaleoni leg., 1 (3rd instar).

Tunisia, Tunis, Plage Rafraf VI.2006, R. A. Pantaleoni leg., 1 (3rd instar).

Further examined specimens

Italy, Sardinia, Sorso (SS), Platamona, IV.1994, R. A. Pantaleoni leg., 1 (1st instar), 4 (2nd instar).

Italy, Sardinia, Sassari (SS), Porto Ferro, VII.1999, R. A. Pantaleoni leg., 2 (2nd instar).

Tunisia, Zoiraâ beach, VI.2006, R. A. Pantaleoni leg., 1 (2nd instar).

Description of 3rd instar larva. Average body length 19.60 mm; head capsule length 4.55 mm (min-max 4.09-5.00), head capsule width 3.62 mm (3.10-4.27), mandible length 3.55 mm (3.51-4.42), ratio head capsule width/length 0.88, ratio mandible length/head capsule length 0.85. General colouring pale sand-like ochre with conflicting dark marks regularly disposed on the dorsum, ventral side whitish. Head: rectangular, longer than wide, large in comparison with the body; anterior margin of the labrum with a small median recess; antennae thin and a little longer than the mandibular base; ocular tubercles small, not prominent; mandibles quite strong, a little shorter than the head capsule and provided of three equidistant teeth; apical tooth longer than the others that are progressively shorter; few short setae on the internal side of the forceps, none between the basal tooth and the insertion of the mandibles; many short setae on the external margin of the mandible from its base to the apical tooth. Body: elongated and oval, covered by black setae dorsally and numerous long thin and pale setae toward the margins. Thorax: pronotum cuneiform, covered by short black setae, mesothoracic spiracles dark. Legs: comparatively very long and slender, covered by black setae. Abdomen covered by many long fine and clear setae especially at the margin, long black setae protruding from sternites VII, VIII and IX; spiracular tubercles black; VIII sternite simply covered by large sclerotized setae, some thicker setae near the distal

margin at middle length; IX sternite triangular in shape, covered by many clear and fine setae, some short almost spiniform black digging setae are disposed in series along the median section, external margin with many stout setae.

Bio-ecology: *S. baetica* is a typical inhabitant of open sand-dunes with a limited vegetal cover, especially herbaceous plants and isolated bushes. It is a particularly common species in relatively undisturbed coastal sand-dunes on the Mediterranean. This antlion is also found in internal sandy environments with a considerably deep and loose arenaceous deposits (Steffan, 1975). The larvae of *S.baetica* are often located at the base of psammophilus plants or tuft of Graminaceae, where they are probably protected from atmospheric agents. In coastal sand-dunes this species is usually found in open dunes with low vegetal cover (*Ammophiletum*) sometimes reaching the littoral area. They are active fast burrowing predators, able to move both forward and backward with a remarkable speed, not rarely they pursue the escaped prey for a little distance. During the day the larvae are hidden under the sand surface, acting as ambush predators while during the night they roam freely on the dunes (Principi, 1947). The larvae has been to observed to feed on Acrididae and Coleoptera; between the identified prey in Sardinia: *Sphingonotus* cf. *candidus* (A. Costa, 1888) (Orthoptera Acrididae), *Leptolepurus meridionalis* (Jaquelin du Val, 1854) (Coleoptera Curculionidae), *Lagria hirta* (Linnaeus, 1758) and *Omophlus lepturoides* (Fabricius, 1787) (Coleoptera Tenebrionidae).

Tribe Myrmeleontini Latreille, 1802

This large, widespread, tribe comprises the typical pit-builder species. The larvae are obligate pit-builders, able to move only backwards. They are characterized by the presence of long setae on the external edge of the mandible, mesothoracic tubercle not raised and specialized digging setae on the last sternite.

Myrmeleon Linnaeus, 1767

Diagnosis: Mandibles equipped with 3 equidistant pairs of teeth of which the apical one is the longest and the strongest despite an abrupt differentiation in the size of teeth is not particularly evident, 1 seta is present after the apical tooth, external margin of the mandible provided with long setae; ocular tubercles short and small, not prominent; mesothoracic spiracle not raised on tubercle; thoracic scoli absent; VIII abdominal sternite with odontoid processes (often short) and covered by spiniform or stout setae along the median-posterior margin; IX abdominal sternite equipped with an anterior group of digging setae and a posterior one situated on the rastra, in some

species isolated digging setae are disposed on the ventral side of the sternite as well; larvae able to move only backwards.

Examined species: *M. formicarius* Linnaeus, 1767, *M. gerlindae* Hölzel, 1974, *M. punicanus* Pantaleoni & Badano, 2012, *M. bore* (Tjeder, 1941), *M. inconspicuus* Rambur, 1842, *M. mariaemathildae* Pantaleoni, Cesaroni & Nicoli Aldini, 2010, *M. hyalinus* Olivier, 1811, *M. fasciatus* (Navás, 1914).

This cosmopolite genus is the most speciose in the family, comprising over 180 species (Stange, 2004), despite the reciprocal relationships between species and closely related genera are unclear. The larvae are obligate pit-builders and they have been observed since the XVIII° century due to their pit-building habits, a kind of research that still continues today. Nevertheless the state of knowledge regarding the ecological requirements and even the external morphology of most species is very inadequate, especially for tropical species.

Key to the examined species of *Myrmeleon*

1. Labial palps 3-articulated (fig. 34D)

M. bore

- Labial palps 4-articulated (fig. 34A)

2

2. IX abdominal sternite with anterior row of digging setae composed by 4 setae (fig. 4A)

3

- IX abdominal sternite with anterior row of digging setae composed by at least 6 (exceptionally 5) setae (fig. 4E)

8

3. Coxae of the hind pair of legs with large dark markings (fig. 25)

4

- Coxae of the hind pair of legs without markings (fig. 31)

7

4. Ventral side of the mandible with a covering of setae external to the maxilla reaching the basal tooth (fig. 34B); femora of the hind pair of legs spotless (fig. 26)

M. gerlindae

- Ventral side of the mandible with a covering of setae external to the maxilla reaching the middle tooth (fig. 34A, 34C); femora of the hind pair of legs spotted (fig. 25, 27)

5

5. Small larva, head capsule length not superior to 2 mm, tibiae and tarsi of pro- and mesothoracic legs with dark proximal soffusions (fig. 27)

M. punicanus

- Large larva, head capsule length superior to 2 mm, tibiae and tarsi of pro- and mesothoracic legs without dark proximal soffusions (fig. 25)

M. formicarius

7. Ventral side of the head with a pair of dark elongated markings, ventral side of the mandible with a very sparse covering of setae external to the maxilla (fig. 3G), body with a recognizable dark pattern (fig. 31)

M.hyalinus

- Ventral side of the head without markings, ventral side of the mandible with a thick covering of setae external to the maxilla (fig. 3H), body without contrasted dark areas (fig. 32)

M. fasciatus

8. Dark habitus (fig. 29), IX abdominal sternite with the anterior row of digging setae composed by equal-sized setae (fig. 35E)

M.inconspicuus

- Pale habitus (fig. 2, 30), IX abdominal sternite with the anterior row of digging setae composed by large setae disorderly interspersed with shorter ones (fig. 35 F)

M. mariaemathildae

Myrmeleon formicarius Linnaeus, 1767 (figs. 25, 34A, 35C)

The preimaginal stages of this species are among the most described and well known in the family, despite it was often confused with other species in the older accounts. For a complete list of the numerous studies regarding the larva of this common and widespread Palearctic species, see Stange (2004). Linnaeus (1746) itself attributed to this species some larvae that he observed in the dunes of Oland. Brauer (1853) was the first to prepare a diagnostic description to differentiate the larva of this species, that he named *M. formicalynx* from that of *E. nostras*, to which he referred terming it *M. formicarium* instead. The larva of this species was later included in the monographic works on antlions by Hagen (1873b) and Redtenbacher (1884). Doflein (1916) deeply treated the life history and behavior of this species, besides re-describing it. Moreover, Eglin (1940) studied in detail the species in thereabouts Basel. *M. formicarius* was included in most of the modern keys for the identification of antlions: Friheden (1973), Steffan (1975), Matsura (1987), Gepp & Hölzel (1989), Gepp (2010) and Krivokhatsky (2011). Eisenbeis & Wichard (1987) illustrate this species by means of electronic microscope.

Measured specimens

Italy, Piedmont, Torino (TO), VII.2010, A. Alma leg., 4 (3^{rd} instar).

Italy, Tuscany, Follonica (GR), VII.2010, M. Bastianini leg., 2 (3^{rd} instar).

Italy, Tuscany, Montieri (GR), VII.2010, M. Bastianini leg., 2 (3^{rd} instar).

Italy, Tuscany, Casale Marittimo (PI), VII.2010, M. Bastianini leg., 4 (3^{rd} instar).

Italy, Latium, Roma (RM), Prataglia di Cervara, VI.2010, M. Gigli leg., 2 (3^{rd} instar).

Italy, Val d'Aosta, Aymavilles (AO), Pont d'Ael, VIII.2012, D. Badano leg., 4 (3^{rd} instar).

Italy, Sicily, Mt. Etna, VII.2010, F. Camino leg., 1 (3^{rd} instar).

Portugal, Parque Nacional da Penada, VII.2011 B. Michel leg., 2 (3^{rd} instar).

Romania, Dobrogea, Badabag, VIII.2010, C. Manci leg., 1 (3^{rd} instar).

Description of 3^{rd} instar larva. Average body length 9.11 mm; head capsule length 2.28 mm (min-max 2.11-2.55), head capsule width 2.04 mm (1.80-2.42), mandible length 2.41 mm (2.14-2.70), ratio head capsule width/length 0.89, ratio mandible length/head capsule length 1.05. General colouring brown with darker markings and patches, ventral side pale with conspicuous dark markings; head capsule dorsally with large paired markings, ventrally mottled dark brown, at a least a pair of

large spots is normally recognizable, mandibles pale brown; metathoracic pair of legs with dark spots; chaetotaxy of the body black. Head: a little longer than wide, anterior margin of the labrum slightly concave; antennae brown, comparatively stout; ocular tubercle not pronounced and very small; mandibles as long as the head capsule and relatively robust, equipped with 3 pairs of teeth; 1 seta after the apical tooth, 2-3 setae between each pair of teeth, at least 6 setae between the basal tooth and the base of the mandible; external margin of the mandible equipped with very long setae, dorsal side of the mandible covered by sparse, short setae, ventral side with a thick covering of short setae external to the maxilla, reaching the middle tooth and very few setae disposed internal to the maxilla; labial palps short, 4-articulated, segment 2-4, shorter than the width of the mandible. Body: elliptical but comparatively rounded and flattened, covered by dark setae. Thorax: pronotum dorsally covered by spiniform setae; mesothoracic spiracle sessile, dark brown in colour; mesothorax with a pair of large lateral tuft of setae. Legs: pro- and mesothoracic pair of legs completely pale and covered by dark setae, metathoracic pair of legs characterized by coxae mottled by dark spots, femora spotted and with the ventral side equipped with spiniform setae. Abdomen: abdominal spiracles brown, not prominent; VIII sternite provided with odontoid processed and with the posterior margin covered by spiniform setae; IX sternite with an anterior group of 2 pairs of digging setae and a posterior one of 4 pair of subequal digging setae disposed on a sessile rastra.

Bio-ecology: *M. formicarius* is one of the most widespread European members of the family (Aspöck et al. 2001). This antlion is one of the commonest species in Central Europe while in Southern Europe it is limited to mountainous habitats or to suitable fresh lowland micro-environments (Navás, 1924; Steffan, 1975; Pantaleoni & Badano, 2012). *M. formicarius* avoids strictly Mediterranean environments where it is ecologically replaced by closely related taxa (notably *M. gerlindae*, *M. punicanus* and *M. noacki* Ohm, 1965). This species can be found in various habitats especially with arboreal vegetation and with presence of loose dry substratum. The larvae build their pits both in exposed than sheltered conditions, often under tuft of plants or under rock overhangs or in proximity of small escarpments.

Myrmeleon gerlindae Hölzel, 1974 (figs. 3F, 26, 34B, 35A)

The larva of this antlion is described here for the first time, being the account on the preimaginal stages in the original description of the species (Hölzel, 1974) actually clearly referable to *Myrmecaelurus trigrammus*.

Measured specimens

Italy, Sardinia, Alghero (SS), Capocaccia, VI.2010, D. Badano leg., 1 (3rd instar).

Italy, Sardinia, Alghero (SS), Capocaccia, V.2012, D. Badano leg., 9 (3rd instar).

Italy, Sardinia, Alghero (SS), Capocaccia, V.2012, D. Badano leg., 2 (3rd instar).

Italy, Liguria, Bordighera (IM), Monte Nero, VIII.2010, D. Badano leg. 3 (3rd instar).

Description of 3rd instar larva. Average body length 7.68 mm; head capsule length 1.85 mm (min-max 1.58-2.00), head capsule width 1.60 mm (1.62-1.92), mandible length 1.77 mm (1.62-1.92), ratio head capsule width/length 0.86, ratio mandible length/head capsule length 0.96. General colouring brown with dark brown markings, ventrally pale with large dark areas; head capsule with dorsal paired dark markings markings, ventral side of the head with a pair of dark markings surrounding the gula and a pair of median dark spots; mandibles pale brown; metathoracic pair of legs spotted; chaetotaxy of the body black. Head: a little longer then wide, anterior margin of the labrum lightly concave; antennae brown; ocular tubercle not prominent; mandibles almost long as the head capsule and comparatively robust, armed with 3 pairs of teeth; 1 seta after the apical tooth, 2 setae between the apical and middle teeth, 2-3 setae between the middle and the basal teeth, at least 6 setae between the basal tooth and the insertion of the mandible; external margin of the mandible provided with long setae, dorsal side of the mandible covered by sparse, short setae, ventral side with a sparse covering of short setae external to the maxilla, reaching the basal tooth and few isolated setae (or no one) disposed internal to the maxilla; labial palps short, 4-articulated, segment 2-4, shorter than the width of the mandible. Thorax: pronotum thickly covered by short setae, mesothoracic spiracles sessile, brown. Legs: pro- and mesothoracic pair of legs completely pale, hind pair of legs characterized by spotted coxae and unmarked, pale femora. Abdomen: VIII sternite equipped with odontoid process and with posterior margin covered by spiniform setae; IX sternite with an anterior group of 2 pairs of digging setae and a posterior one composed by 4 pair of subequal digging setae borne by sessile rastra.

Bio-ecology: This antlion is a typical W-Mediterranean faunal element, being present in Morocco, Iberian Peninsula, Southern France, Sardinia and a very limited portion of North-West Italy (Pantaleoni & Badano, 2012). Preliminary surveys conducted in Italy suggest that this little-known species is an ecological vicariant of the closely related *M. formicarius* in relatively hot and arid Mediterranean environments. This species has been collected in Mediterranean woods (with pines or sclerophyllous oaks) and high, thick shrublands (macchia). The larvae build their pits in sheltered sites such as at the base of trees, under bushes or under rock overhangs; they are often found in dry dark radical detritus but they have been also observed buried in sand and in chalky substratum (in some occasions cohabiting with the larvae of Diptera Vermileonidae).

Myrmelon punicanus Pantaleoni & Badano, 2012 (figs. 27, 34C, 35B)

The larva of this species was recently treated in the original description of the species (Pantaleoni & Badano, 2012) but it was not compared with other members of the genus.

Measured specimens

Italy, Sicily, Pantelleria island (TP), Bugeber, V.2010, A. Corso leg., 3 (3rd instar).

Italy, Sicily, Mazara del Vallo (TP), Gorghi Tondi, IX.2011, M. Romano leg., 3 (3rd instar).

Description of 3rd instar larva. Average body length 8.57 mm; head capsule length 1.93 mm (min-max 1.84-2.03), head capsule width 1.64 mm (1.56-1.75), mandible length 1.90 mm (1.86-1.93), ratio head capsule width/length 0.84, ratio mandible length/head capsule length 0.97. General colouring dark brown with numerous darker marks and areas, ventral side pale with large dark markings; head capsule dorsally brown with not well defined darker markings, ventrally paler with an anterior pair of dark markings surrounding the gula and a pair of posterior dark spots; mandibles pale brown; setae covering the body black. Head: longer than wide; anterior margin of the head capsule slightly concave; antennae brown; ocular tubercles not prominent; mandibles substantially long as the head capsule, relatively robust, equipped with 3 pairs of teeth; 1 seta after the apical tooth, 2 setae between each pair of teeth, between the basal tooth and the insertion of the mandible there are few (from 2 to 4) long setae followed by very short ones; external margin of the mandibles covered by long setae; dorsal side of the mandibles covered by sparse and short setae, ventral side with a thick covering of short setae external to the maxilla, reaching the middle tooth and few setae disposed internal to the maxilla, reaching the basal tooth; labial palpi 4-articulated. Thorax: pronotum covered by short spiniform setae, mesothoracic spiracle not prominent. Legs: pro- and mesothoracic pair of legs pale with darker suffusions at the proximal section of the tibiae and of the tarsi, metathoracic pair of legs pale with conspicuous dark spots on the coxae and on the femora. Abdomen: VIII sternite equipped with a pair of odontoid processes, its posterior margin covered by spiniform setae; IX sternite equipped with an anterior group of 2 pair of digging setae disposed on a row and a posterior one composed of 4 pair of digging setae borne by sessile rastra.

Bio-ecology: As the above mentioned species, *M. punicanus* is a pit-builder species of Mediterranean forested environments. This species is at present known exclusively for Sicily and Pantelleria (Pantaleoni & Badano, 2012). The larvae were collected in shrublands on small patches of loose soil, under the shelter of rock overhangs and vegetation.

Myrmeleon bore (Tjeder, 1941) (figs. 28, 34D, 35D)

The first observations of the larva of this species probably predate its description being the report of Schenck (1877) and the morphological study of Dewitz (1883) possibly referable to this species. Friheden (1973) clearly described this species for the first time, comparing it with other north-european species, moreover Matsura (1987) treated it in his work on Japanese pit-building antlions. Nicoli Aldini (2005b) provided an excellent description of this taxon, correlated with ecological notes in Northern Italy. Finally the larva was treated in the monographic works of Gepp & Hölzel (1989), Gepp (2010) and Krivokhatsky (2011)

Measured specimens

Italy, Lombardy, Pieve Albignola (PV), Cascinotto Mensa, IX.1979, R. Nicoli Aldini leg., 2 (3^{rd} instar).

Italy, Lombardy, Casterno (MI), Ticino River, V.2012, D. Piccolino leg., 1 (3^{rd} instar).

Germany, Meckleburg Vorpommen, Graal Müritz, VI.2011, C. Kehlmaier leg., 3 (3^{rd} instar).

Description of 3^{rd} instar larva. Average body length 8.31 mm; head capsule length 2.06 mm (min-max 1.90-2.20), head capsule width 1.74 mm (1.61-1.84), mandible length 2.25 mm (2.13-2.34), ratio head capsule width/length 0.84, ratio mandible length/head capsule length 1.09. General colouring pale brown mottled dark brown, ventrally very pale with dark brown patches; dorsal side of the head capsule covered by large markings: an anterior one on the clypeolabrum and a posterior pair of "V"-shaped one, ventral side pale with a pair of median dark spots; mandibles pale brown; chaetotaxy of the body black. Head: longer than wide; anterior margin of the labrum slightly concave with a shallow median incision; antennae dark brown; ocular tubercles not prominent; mandibles slightly longer than the head capsule, equipped with 3 pairs of teeth; 1 seta after the apical tooth, 2-3 setae between each pair of teeth, over 5 setae between the basal tooth and the base of the mandible; external margin of the mandible equipped with very long setae, ventral side of the mandible with few setae at the base; labial palps 3-articulated, last two segments noticeably shorter than the width of the mandible. Thorax: pronotum covered by short, stout setae; mesothoracic spiracles not prominent, of the same colour of the body. Legs: all pair of legs completely pale, provided with black setae. Abdomen: 8^{th} abdominal tergite equipped with odontoid processes, its posterior margin covered by stout spiniform setae; IX abdominal sternite equipped with isolated, irregularly disposed, ventral digging setae followed by an anterior group composed by 2 pair of digging setae and finally a posterior one composed by 4 pair of setae borne on little pronounced rastra.

Bio-ecology: *M. bore* is one of the few antlion species to reach Northern Europe while it is completely absent from areas characterized by a Mediterranean climate. In Fennoscandia it is a typical inhabitant of coastal sand dunes (Meinander, 1962), as it is also observed in the Baltic coast of Germany (Kehlmaier, comm. pers.). In Central Europe it is found in inland sandy deposits (Aspöck et al., 1980). In Northern Italythis species dwells in the sand banks of lowland rivers. The pit are built on exposed places, the first stages often in proximity of vegetation, thus separating it for habitat requirements from *M. formicarius* and *E. nostras* while in Northern Italy, it becomes syntopic with *M. inconspicuus* that shows the same preferences (Nicoli Aldini, 2005b).

Myrmeleon inconspicuus Rambur, 1842 (figs. 29, 34E, 35E)

The preimaginal stages were described and illustrated firstly by Redtenbacher (1883, 1884), under the synonym *Myrmeleon erberi* Brauer. The better description of this antlion is undoubtedly the study of Principi (1943), who gave a complete, detailed account of the morphology, ecology, behaviour and life-history of this species. Description of the larvae for identification purposes were later included in the monographic works of Steffan (1975), Hölzel & Gepp (1979), Gepp (2010) and Krivokhatsky (2011). Nicoli Aldini (2007) compared the larva of this species with that of *M. bore*.

Measured specimens

Italy, Campania, Castelcivita (SA), Fiume Calore, VII.2010, C. Labriola leg., 2 (3^{rd} instar).

Italy, Veneto, Venezia (VE), Punta Sabbioni, III.2012, E. Ruzzier leg., 7 (3^{rd} instar).

Italy, Sardinia, Alghero (SS), Porticciolo, III.2010, D. Badano leg., 1 (3^{rd} instar).

Italy, Sardinia, Alghero (SS), Lazzaretto, X.2010, D. Badano leg., 1 (3^{rd} instar).

Italy, Sicily, Gurne dell'Alcantara (ME), VII.2010, A. Corso leg., 5 (3^{rd} instar).

Italy, Sardinia, Alghero (SS), Lazzaretto, III.2011, D. Badano leg., 5 (3^{rd} instar).

Italy, Sardinia, Sorso (SS), Platamona, VIII.2012, D. Badano leg., 3 (3^{rd} instar).

Romania, Dobrogea, Agigea, VIII.2010, C. Manci leg., 1 (3^{rd} instar).

Romania, Dobrogea, Badabag, VIII.2010, C. Manci leg., 1 (3^{rd} instar).

Greece, Corfù, Korission lake, V.2012, D. Badano leg., 1 (3^{rd} instar).

Tunisia, Gammarth, VII.2010, local collector, 5 (3rd instar).

Description of 3rd instar larva. Average body length 8.08 mm; head capsule length 1.70 mm (min-max 1.52-1.92), head capsule width 1.48 mm (1.38-1.65), mandible length 1.67 mm (1.33-1.85), ratio head capsule width/length 0.80, ratio mandible length/head capsule length 1.0. General colouring ochre with conspicuous dark brown markings, ventrally paler with dark brown areas; head capsule with conspicuous dark stains on the clypeo-labrum and smaller ones on the occipital area, ventral side pale with two diagnostic markings; mandibles pale brown; setae of body black. Head: longer than wide; anterior margin of the labrum slightly concave; antennae brown; ocular tubercles not prominent; mandibles as long as the head capsule, equipped with 3 pairs of teeth; 1 seta after the apical tooth, 2-3 setae between each pair of teeth, at least 5 setae between the basal tooth and the insertion of the mandible; external margin of the mandible equipped with very long setae, dorsal side of the mandible covered by very few short setae disposed near the margins, ventral side exclusively with few isolated setae at the base; labial palps 4-articulated, segment 2-4, shorter than the width of the mandible. Thorax: pronotum sparsely covered by short, stout setae; mesothoracic spiracle not raised. Legs: completely pale, not stained, covered by black setae. Abdomen: VIII abdominal sternite provided with odontoid processes, posterior margin covered by spiniform setae; IX abdominal sternite characterized by a complex pattern of digging setae: the first ones irregulary disposed on the ventral side, posteriorly it is present an anterior group composed by at least 5 equal-sized digging setae disposed on a row, finally followed by a posterior group of 4 pairs of digging setae raised on a little pronounced rastra, of which the external pair is long as leas two times the others.

Bio-ecology: This pit-building antlion is a common species in sandy environments such as coastal dunes, internal sand deposits and banks of rivers and torrents. The larvae build their pits in exposed conditions, often in proximity of herbs. They can be commonly found at the base of trees growing in retro-dunal environments. *M. inconspicuus* is often the dominant pit-building species on coastal sand dunes, especially in the northern shores of the Mediterranean sea and in the coasts of the Atlantic with a suitable climate, colonizing both open dunes than retrodunal environments with complex vegetation (Badano & Pantaleoni, pers. oss.; Principi, 1943; Steffan, 1975). In the southern coasts of the Mediterranean, wherever it is syntopic with *M. hyalinus* and *M. mariaemathildae*, this species abandons the open dunes to the latter two antlions and it inhabits retrodunal environments with arboreal vegetation, with the notable exception of few sites with a notable anthropic disturbation (Badano & Pantaleoni, pers. oss.; Pantaleoni et al., 2010). Along the river banks this species is again found in open conditions, thus spatially separated from *M. formicarius* and *E. nostras* that prefer more sheltered corners, but often cohabiting with *M. bore* (Badano & Pantaleoni, pers. oss.; Nicoli Aldini, 2005b). Moreover, in Southern Europe it often

share its habitats with other pit-builder species, such as *Myrmecaelurus trigrammus*. As noted by Steffan (1975), the larvae can survive in submerged sediments for a considerable time thus allowing them to overcome seasonal floods of Mediterranean watercourses. Finally this species is able to colonize other hot microhabitat with the presence of loose substratum as open pine woods (Badano pers. oss.). In North Africa this plastic species also inhabits sub-desert environments.

Myrmeleon mariaemathildae Pantaleoni, Cesaroni & Nicoli Aldini, 2010 (figs. 1, 30, 34F, 35F)

The larval stages of this species were synthetically treated in the original description of the species (Pantaleoni et al., 2010).

Measured specimens

Italy, Sardinia, Cabras (OR), Tharros, III.2011, D. Badano leg. 1 (3rd instar).

Italy, Sardinia, Sorso (SS), Platamona, VIII.2012, D. Badano leg. 3 (3rd instar).

Tunisia, Tabarka, VII.2006, R. A. Pantaleoni leg. 5 (3rd instar).

Tunisia, Gammarth, VII.2010, local collector, 1 (3rd instar).

Description of 3rd instar larva. Average body length 9.28 mm; head capsule length 1.70 mm (min-max 1.60-1.81), head capsule width 1.48 mm (1.42-1.57), mandible length 1.64 mm (1.54-1.80), ratio head capsule width/length 0.87, ratio mandible length/head capsule length 0.96. General colouring pale ochre with dark stains, ventrally paler with dark areas; dorsal side of the head capsule covered by a dark marking on the clypeo-labrum and a pair of contiguous spots in the middle, ventral side pale with two median spots, whose intensity varies according to the individual, completely absent in some specimens; mandibles pale brown; chaetotaxy of the body black. Head: longer than wide; anterior margin of the labrum slightly concave; antennae ochre; ocular tubercles not raised; mandibles as long as the head capsule, armed with 3 pairs of teeth; 1 seta after the apical tooth, 1-2 setae between each pair of teeth, 4-5 setae between the basal tooth and the base of the mandible; external margin of the mandible equipped with very long setae, dorsal side of the mandible with a sparse covering of short setae along the margins, ventral side with few isolated setae at the base; labial palps 4-articulated; segment 2-4 shorter than the width of the mandible. Thorax: pronotum covered by short, stout setae; mesothoracic spiracle sessile, of the same colouring of the body. Legs: all pairs of legs unmarked, covered by black setae. Abdomen: VIII abdominal sternite provided with short odontoid process, its posterior margin covered by stout, spiniform setae; IX abdominal sternite equipped with isolated,

irregularly disposed, ventral digging setae followed by an anterior group disposed on an irregular row and composed by large setae irregularly interspersed with smaller ones, giving a characteristic "disorderly" appearance; rastra not prominent, bearing the posterior group of 4 pair of digging setae, of which the external one is long at least two times the others.

Bio-ecology: The larvae of this recently described species usually dwell in sea-faced coastal sand dunes with vegetation covering limited to pioneer arenophile plants. The pits are normally built in exposed conditions, often at the base of tufts of herbs. In Sardinia, where extensive surveys have been conducted, this species and *M. hyalinus*, that occupies the same niche, normally displace each other thus only one of the two is present in the same site. On the contrary, the closely related *M. inconspicuus* colonizes retro-dunal environments with arboreal covering. Exclusively in peculiar situations, such as moderate anthropic disturbance, these 3 species can be completely syntopic.

Myrmeleon hyalinus Olivier, 1811 (figs. 31, 34G, 35G)

The larva of this species was described firstly by Auber (1956) and subsequently in the monograph of Willmann (1977).

Measured specimens

Italy, Sardinia, Alghero (SS), VIII.2010, D. Badano & R. A. Pantaleoni leg., 6 (3rd instar).

Italy, Sardinia, Alghero (SS), IX.2010, D. Badano,1 (3rd instar).

Italy, Sardinia, Cagliari (CA), Molentargius, XI.2011, D. Badano, 3 (3rd instar).

Italy, Sardinia, Chia (CA), XI.2011, D. Badano leg., 5 (3rd instar).

Italy, Sicily, Mazara del Vallo (TP), Gorghi Tondi, IX.2010, M. Romano leg., 5 (3rd instar).

Italy, Sicily, Mazara del Vallo (TP), Gorghi Tondi, IX.2011, M. Romano leg., 7 (3rd instar).

Italy, Sicily, Mazara del Vallo (TP), Capo Feto, IX.2010, R. A. Pantaleoni leg., 2 (3rd instar).

Italy, Sicily, Linosa Island (AG), IX.2010, A. Corso leg., 3 (3rd instar).

Greece, Rhodes, Tsambika, XI.2010, R. A. Pantaleoni leg., 1 (3rd instar).

Morocco, Tissint, III.2011, A. Corso leg., 4 (3rd instar).

Tunisia, Ras Remel, V.2010, A. Corso leg., 3 (3rd instar).

Egypt, Sharm el Sheik, IX.2010, A. Corso leg., 1 (3rd instar).

Egypt, Feiran Oasis, IX.2010, A. Corso leg., 1 (3rd instar).

Description of 3rd instar larva. Average body length 8.08 mm; head capsule length 1.74 mm (min-max 1.44-2.00), head capsule width 1.30 mm (1.06-1.49), mandible length 1.64 mm (1.38-1.91), ratio head capsule width/length 0.75, ratio mandible length/head capsule length 0.94. General colouring pale, sand-like with dark markings, ventrally whitish with contrasting dark markings; head capsule pale with an anterior marking on the clypeo-labrum followed by a pair of spots (more or less contiguous according to the individual) , ventrally completely pale except a distinctive pair of elongated markings in the middle (very rarely only slightly stained); mandibles pale; setae of the body black. Head: noticeably longer than wide, rectangular in shape; anterior margin of the labrum with a median incision; antennae pale; eye tubercle sessile, not prominent; mandibles almost as long as the head capsule, equipped with 3 pairs of teeth; 1 seta after the apical tooth, 2-3 setae between each pair of teeth, numerous (at least 7) setae between the basal tooth and the base of the mandible; external margin of the mandible equipped with very long setae, dorsal side of the mandible covered by few short setae, ventral side covered with sparse, short setae external to the maxilla and few setae disposed internally to it; labial palps 4-articulated, segment 2-4, shorter than the width of the mandible. Thorax: pronotum covered by short setae; mesothoracic spiracle sessile, of the same colour of the body. Legs: all pairs of legs completely pale, covered by dark setae. Abdomen: VIII abdominal sternite provided with very short odontoid processes, with the posterior margin covered by stout setae and spiniform ones; IX abdominal sternite equipped with an anterior group of 2 pairs of digging setae followed by posterior one composed by 4 pair setae disposed on a poorly developed rastra, of which the external pair is long at least two times the others.

Bio-ecology: *M. hyalinus* is a characteristic species of coastal sand dunes of the southern shores of the Mediterranean sea. This antlion builds the pits in the exposed condition of open dunes, often at the base of tufts of arenophile plants or bushes, avoiding retrodunal environments with a closer vegetation. In Sardinia *M. hyalinus* cohabits with *M. mariaemathildae*, with which it shares a similar habitat preference, only in exceptional conditions (Badano & Pantaleoni, pers. oss). This species can also colonize extended internal sand deposits. In one occasion, larvae of this species were found in an escarpment of arenaceous rocks surrounded by Mediterranean shrublands, in recesses and overhangs. The habitat requirements of this species in North Africa and

Middle East remain poorly known but it probably dwells in subdesert besides coastal dunes.

Myrmeleon fasciatus (Navás, 1914) (figs. 32, 34H, 35H)

This species is a typical inhabitant of the desert-like biotopes of North Africa and Middle East whose presence in Europe is limited to the Greek Island of Rhodes (Aspöck et al., 2001, Willmann, 1977). Its larva was treated by the first and only time by Willmann (1977).

Measured specimens.

Greece, Rhodes, Kiotari, VII.2009, D. Badano leg., 1 (3rd instar).

Greece, Rhodes, Kiotari, XI.2010, R. A. Pantaleoni leg., 19 (3rd instar).

Greece, Rhodes, Kamiros, XI.2010, R. A. Pantaleoni leg., 8 (3rd instar).

Greece, Rhodes, Kallitea, XI.2010, R. A. Pantaleoni leg., 3 (3rd instar).

Description of 3rd instar larva. Average body length 9.34 mm; head capsule length 1.95 mm (min-max 1.70-2.20), head capsule width 1.58 mm (1.37-1.77), mandible length 2.00 mm (1.76-2.10), ratio head capsule width/length 0.80, ratio mandible length/head capsule length 1.0. General colouring very pale ochre with few and very suffused darker markings, ventrally whitish with not contrasting darker markings; head capsule with a reduced dark pattern, limited to a dark area on the clypeo-labrum and a pair of suffused markings in the occipital area, ventrally spotless; mandibles pale; chaetotaxy of the body black. Head: longer than wide; anterior margin of the labrum lightly concave; antennae pale; ocular tubercles sessile; mandibles as long as the head capsule, armed with 3 pairs of teeth; 1 seta after the apical tooth, 2 setae between the apical and middle teeth, 2-3 setae between the middle and basal teeth, over 6 setae between the basal teeth and the base of the mandible; external margin of the mandible equipped with very long setae, dorsal side of the mandible covered by sparse short setae, ventral side with a thick covering of short setae external to the maxilla reaching the middle tooth and normally arriving in proximity of the apical one and few setae disposed internally to it; labial palps 4-articulated, segment 2-4 shorter than the width of the mandible. Thorax: cuneiform. covered by short black setae; mesothoracic spiracle sessile. Legs: all pairs of legs completely pale, without markings and covered by dark setae. Abdomen: VIII abdominal sternite provided with very short odontoid processe, its posterior margin covered by sparse stout setae; IX abdominal sternite equipped with an anterior group of 4 digging setae and a posterior one borne on slightly

pronounced rastra composed by 4 pair of digging setae of which the external pair is long two times the others.

Bio-ecology: This species colonizes very arid and hot environments, including true deserts. The larvae lives in very fine and dusty detritus accumulated in easily erodible sedimentary rocks in sheltered corners, such as under rock overhangs, small caves and recesses. This kind of micro-habitat is normally avoided by most species of pit-building Myrmeleontidae while it is typical for the larvae of Diptera Vermileonidae, thus appearing an interesting specialisation of this species. In desert environments, *M. fasciatus* is also found in very fine sand eroded by wind.

Euroleon Esben-Petersen, 1918

Diagnosis: Mandibles armed with 3 equidistant pairs of teeth of which the apical one is larger then the others, albeit only slightly noticeable; 1 seta is present after the apical tooth, external margin of the mandible bearing long setae; ocular tubercles sessile; mesothoracic spiracle not borne on tubercle; thoracic scoli absent; VIII abdominal sternite provided with odontoid processes, its posterior margin covered by long and thin setae; IX abdominal sternite equipped with an anterior group of digging setae and a posterior one borne by the rastra; larvae able to move only backwards.

Examined species: *E. nostras* (Geoffroy *in* Fourcroy, 1785)

Euroleon is a small genus, very closely related to *Myrmeleon*, comprising only 6 described species of exclusively Palearctic distribution. The larval stages of the widespread European *E. nostras* (Geoffroy *in* Fourcroy, 1785) attracted the attention of the naturalists since the XVIII° century, while those of Eastern species, *E. parvus* Hölzel, 1972, *E. polyspilus* (Gerstaecker, 1885) and *E. coreanus* Okamoto, 1926 were described only recently (Krivokhatsky, 1994; 2011).

Remarks: The morphological characters of this genus fall in the range of variability shown by the various species included in the closely related genus *Myrmeleon*. In particular, the larvae of *Euroleon* appear very similar to those of *M. formicarius*-group of species, notably for the overall habitus and the disposition of digging setae of the 9th abdominal tergite. The larvae of *Euroleon* are characterized by the shape of the setae covering the VIII abdominal sternite, that are long and thin, hair-like, while at least in the European species of *Myrmeleon* are relatively short and stout or spiniform. Nevertheless, the larvae of *Euroleon* can be immediately separated but most of the European *Myrmeleon* species thanks to the different coloration of the body and the configuration of digging setae of 9th abdominal tergite; moreover they can be

recognized at a glance from the similar *formicarius*-group of species for the absence of spots on the hind pair of legs.

Euroleon nostras (Geoffroy *in* Fourcroy, 1785) (figs. 3G, 33, 34I, 35I)

The larva of *E. nostras* is undoubtedly one of the best known in the family, rivaling with that of *M. formicarius* in number of descriptions and studies; for a complete list of the literature regarding this species, see Stange (2004). The first account on the life history of this insect is reported by Réaumur (1742), in his series of book on entomology. Few years later, Rösel von Rosenhof (1755) described similar observation, enriching them with illustrations of exquisite workmanship. The first comparative description of this species was realized by Brauer (1857), who compared it (under the name *Myrmeleon formicarium*) with *M. formicarius* (called *M. formicalynx*). Hagen (1873b) and subsequently Redtenbacher (1884) considered this species in their respective monographs. Eglin (1939, 1940) discussed its ecology and life history. The better description regarding the morphology of this species, is the exhaustive research of Principi (1943). *E. nostras* is included in all the main works on the identification of European antlion larvae: Friheden (1973), Steffan (1975), Gepp & Hölzel (1989), Gepp (2010) and Krivokhatsky (2011). Worth of note is the comparative description of the various species of the genus *Euroleon* (Krivokhatsky, 1994).

Measured specimens:

Italy, Liguria, Mt. Toraggio (IM), VII.2010, D. Badano leg., 2 (3rd instar).

Italy, Lombardy, Zelo Buon Persico (LO), VII.2010, D. Scaccini leg., 7 (3rd instar).

Italy, Lombardy, Zelo Buon Persico (LO), X.2011, D. Scaccini leg., 1 (3rd instar).

Italy, Latium, Roma (RM), Mt. Mario, IX.2010, A. Alfonsi & C. Cesaroni leg., 1 (3rd instar).

Italy, Val d'Aosta, Aymavilles (AO), Pont d'Ael, VIII.2012, D. Badano leg., 2 (3rd instar).

Germany, Saxony, Dresden, VIII.2010, C. Kehlmaier leg., 4 (3rd instar).

France, Gard, Beauvoisin, VIII.2011, D. Badano leg., 4 (3rd instar).

Greece, Corfù, Nissaki, V.2012, D. Badano leg., 1 (3rd instar).

Turkey, Cappadocia, 2 km from Gorëme, V.2010, A. Letardi leg., 1 (3rd instar).

Georgia, Tbilisi (surroundings), VIII.2011, C. Deiaco leg., 25 (3rd instar).

Description of 3rd instar larva. Average body length 9.32 mm; head capsule length 2.24 mm (min-max 1.91-2.55), head capsule width 1.84 mm (1.57-2.13), mandible length 2.26 mm (2.00-2.60), ratio head capsule width/length 0.82, ratio mandible length/head capsule length 1.0. General colouring brown with darker pattern, ventrally paler, whitish with large dark markings; dorsal side of the head capsule with an anterior pair of spots after the ocular tubercles and a pair of large "V-shaped" stains in the occipital region, ventral side pale mottled brown, with a median pair of markings surrounding the gular area and a posterior pair of spots; mandibles pale brown. Head: longer than wide; anterior margin of the labrum slightly concave with a little pronounced median incision; antennae thin, brown; ocular tubercles not prominent; mandibles as long as the head capsule, armed with 3 pairs of teeth, of which the apical pair is the longest; 1 seta after the apical tooth, 2 setae between each pair of teeth, at least 4 long setae between the basal tooth and the base of the mandible, together with smaller ones; external margin of the mandible equipped with very long setae, dorsal side of the mandible covered by short setae both on the external and internal margin, ventral side with a thick covering of short setae external to the maxilla, reaching the basal tooth and very few setae disposed internal to the maxilla; labial palps short, 4-articulated, segment 2-4, shorter than the width of the mandible. Body: elliptical in shape, without scoli; setation black. Thorax: pronotum cuneiform, covered by short and sparse setae; mesothoracic pair of scoli sessile. Legs: all pairs of legs pale, without dark markings and covered by black setae. Abdomen: abdominal spiracles not prominent; VIII abdominal sternite provided with odontoid process, posterior margin covered by hair-like setae; IX abdominal sternite with an anterior group of 4 pair of digging setae equal in size, followed by the posterior one borne by short rastra and composed by 4 pairs of subequal digging setae.

Bio-ecology: *E. nostras* is undoubtedly one of the most widespread and euryoecious European antlions and probably the most well known pit-building species. In Southern Europe this species can be found from the sea-level to above the tree line on mountains, despite it clearly avoids open and arid strictly Mediterranean environments. The pits are built in shelter conditions wherever a suitable loose substratum can be found, thus they are normally found under rock overhangs, near escarpments, at the entrance of caves and at the base of trees. Its needs for corners protected from atmospheric agents make this species one of the few synanthropic Myrmeleontids, being often found near human infrastructures such as buildings, rock walls and bridges. Generalizing, this species prefers woody environments, in more open habitat such as river banks and dunes it is found in covered sites. In Central and Northern Europe, *E. nostras* is also found in coastal sand dunes (near shelters) but in Southern Europe it abandons this environment to more termophilous species. As already noted by previous authors (Eglin, 1940; Rabaud, 1927) the female often ovideposit in site unreacheable from the larvae themselves, so they can be found inaccessible sites such as corner of buildings and tree-

holes, in particular the presence of the larvae of this species inside old decayed trees in not unusual and relatively frequent.

Figure 8. *Palpares libelluloides* (Linnaeus, 1764): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [France: Hérault, Aniane].

Figure 9. *Dendroleon pantherinus* (Fabricius, 1787): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Emilia Romagna, Castel d'Aiano].

Figure 10. *Macronemurus appendiculatus* (Latreille, 1807): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Alghero, Capo Caccia].

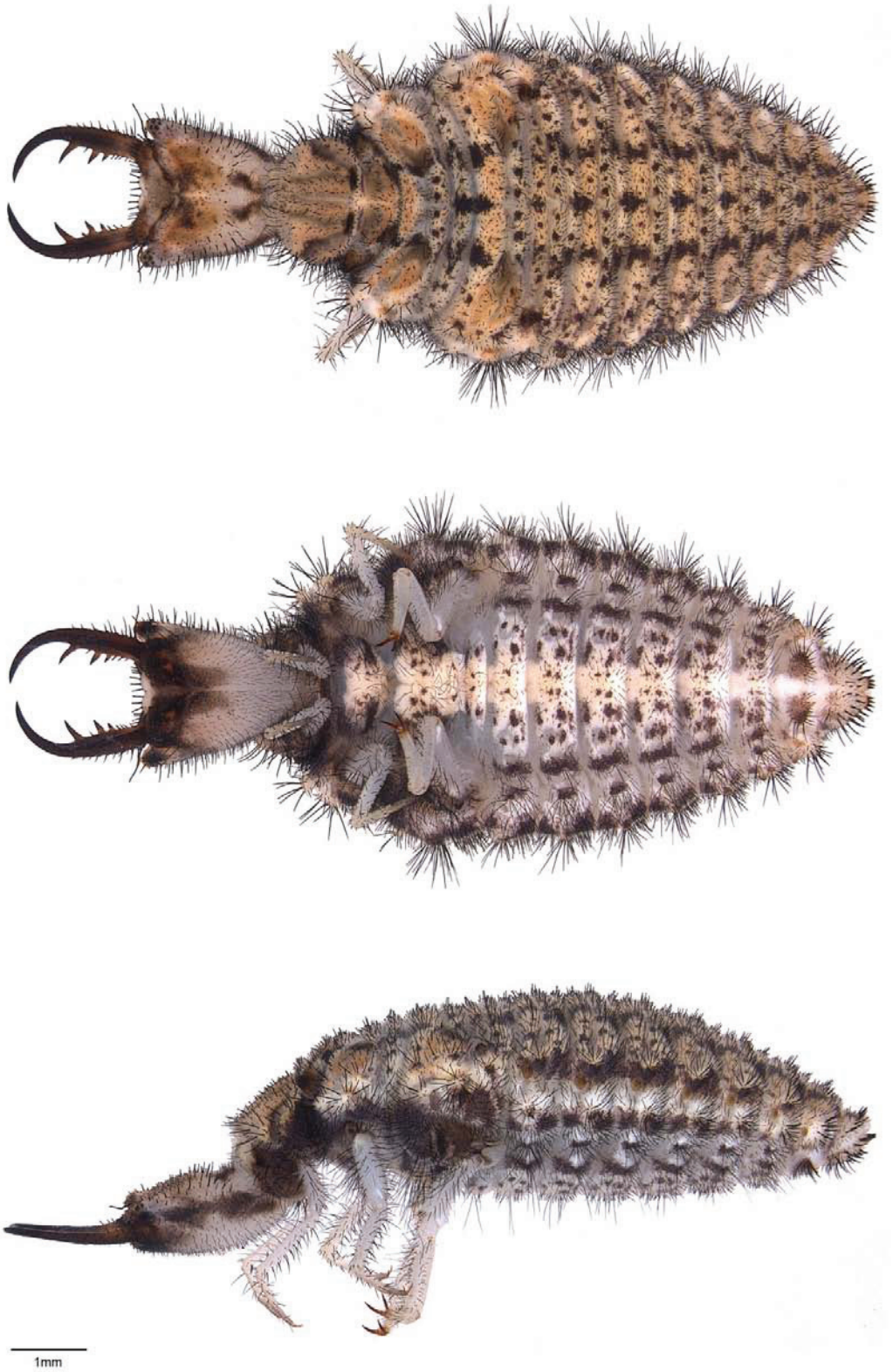

Figure 11. *Creoleon lugdunensis* (Villers, 1789): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Campania, Boscotrecase].

Figure 12. *Distoleon tetragrammicus* (Fabricius, 1798): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [France: Gard, Générac].

Figure 13. *Neuroleon arenarius* (Navás, 1904): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Alghero, Lazzaretto].

Figure 14. *Neuroleon assimilis* (Navás, 1915): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Greece: Corfù, Kato Pauliana].

Figure 15. *Neuroleon egenus* (Navás, 1915): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Liguria, Cipressa].

Figure 16. *Neuroleon microstenus* (McLachlan, 1898): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Liguria, Bordighera, Mt. Nero].

Figure 17. *Neuroleon nemausiensis* (Borkhausen, 1791): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Alghero, Capo Caccia].

Figure 18. *Megistopus flavicornis* (Rossi, 1790): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Alghero].

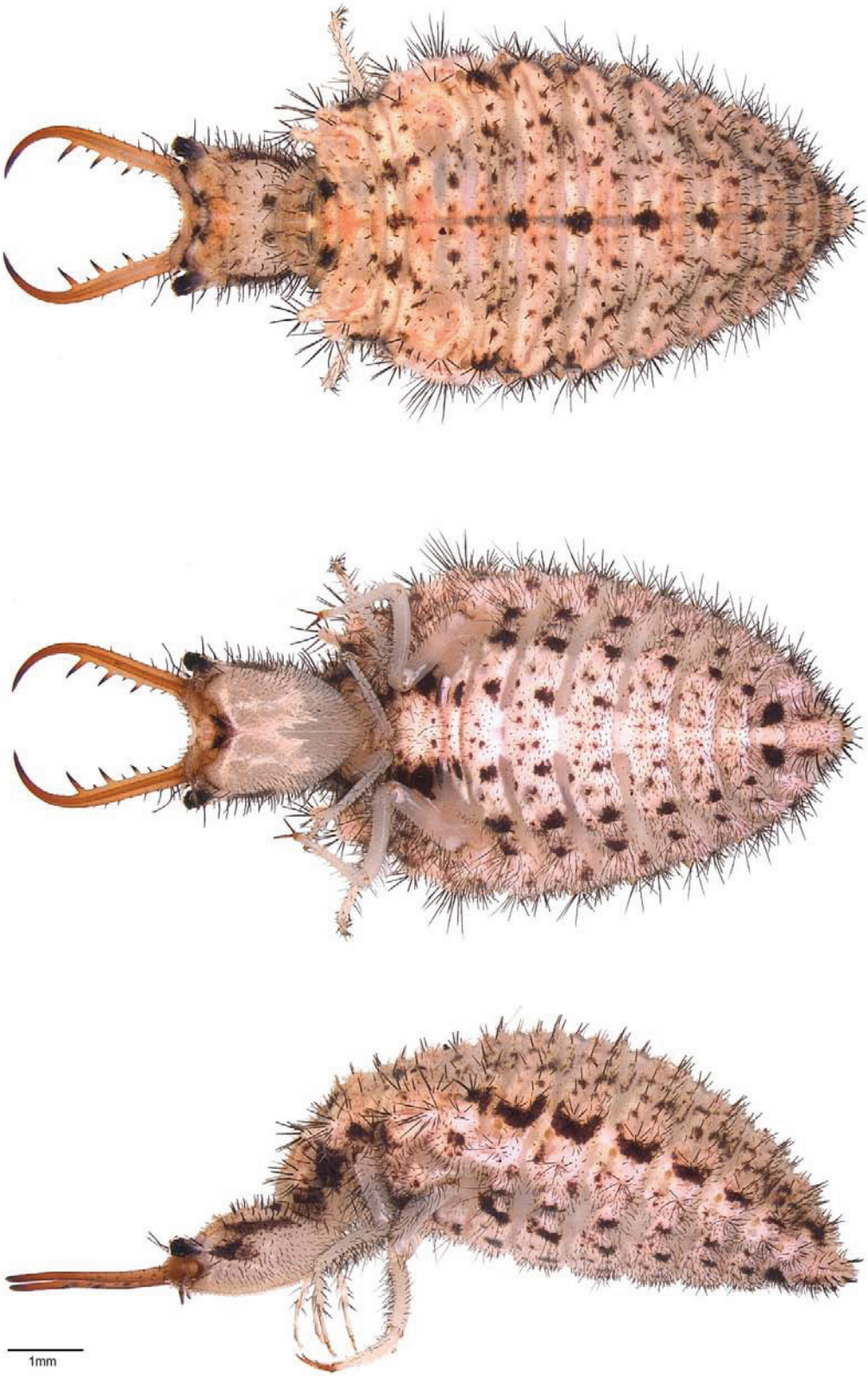

Figure 19. *Megistopus lucasi* (Navás, 1912): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Chia].

Figure 20. *Gymnocnemia variegata* (Schneider, 1845): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Greece: Corfù, Panagias].

Figure 21. *Myrmecaelurus trigrammus* (Pallas, 1771): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Calabria, Strogoli].

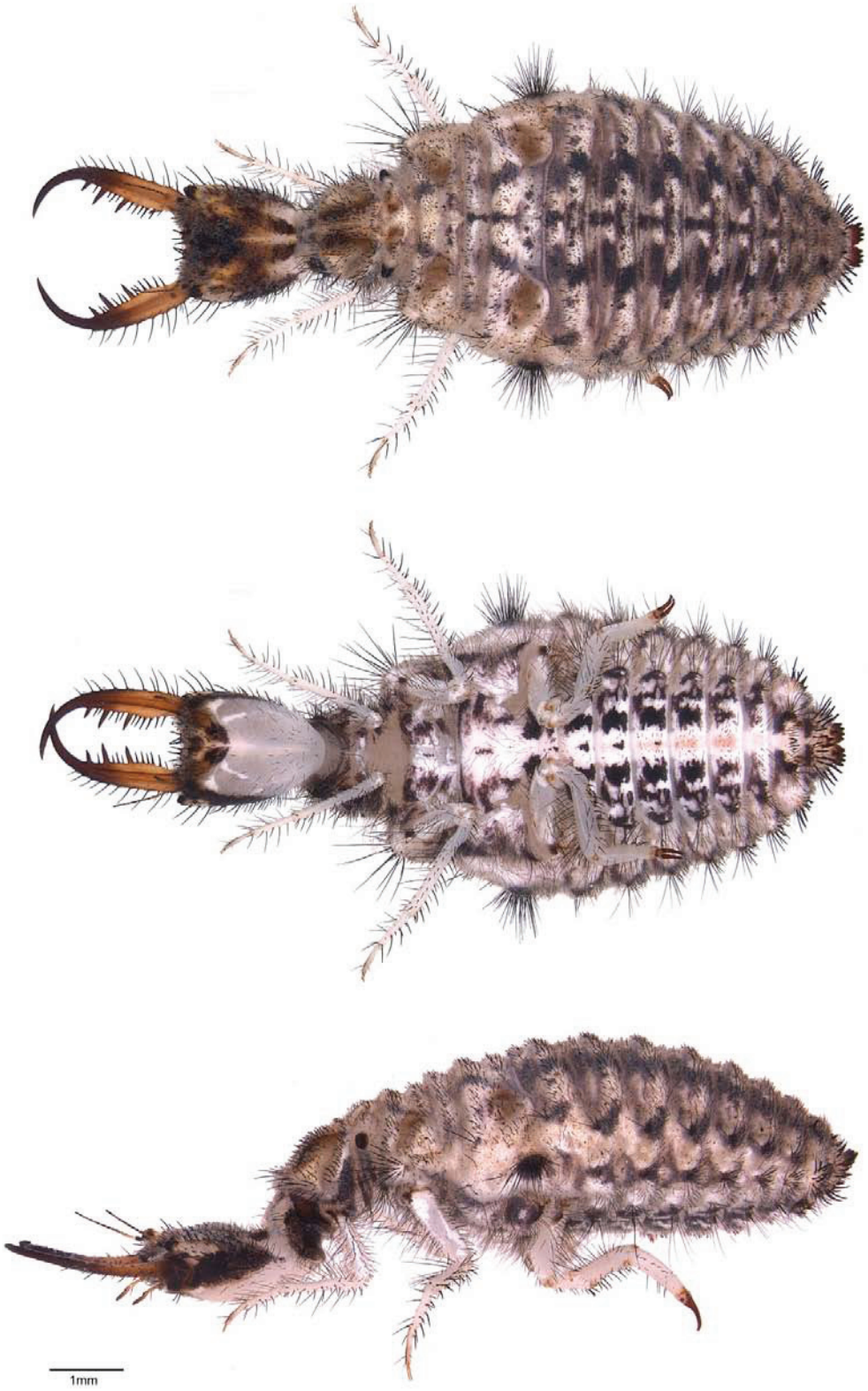

Figure 22. *Cueta beieri* Hölzel, 1968: 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Greece: Rhodos, Kiotari].

Figure 23. *Acanthaclisis occitanica* (Villers, 1789): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Spiaggia del Liscia].

Figure 24. *Synclisis baetica* Rambur, 1842: 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Sorso, Platamona].

Figure 25. *Myrmeleon formicarius* Linnaeus, 1767: 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Latium, Roma, Prataglia di Cervara].

Figure 26. *Myrmeleon gerlindae* Hölzel, 1974: 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Alghero, Capo Caccia].

Figure 27. *Myrmeleon punicanus* Pantaleoni & Badano, 2012: 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Pantelleria, Bugeber].

Figure 28. *Myrmeleon bore* (Tjeder, 1941): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Germany: Meckleburg Vorpommen, Graal Müritz].

Figure 29. *Myrmeleon inconspicuus* Rambur, 1842: 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy:Veneto, Venezia, Punta Sabbioni].

Figure 30. *Myrmeleon mariaemathildae* Pantaleoni, Cesaroni & Nicoli Aldini, 2010: 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Sassari, Platamona].

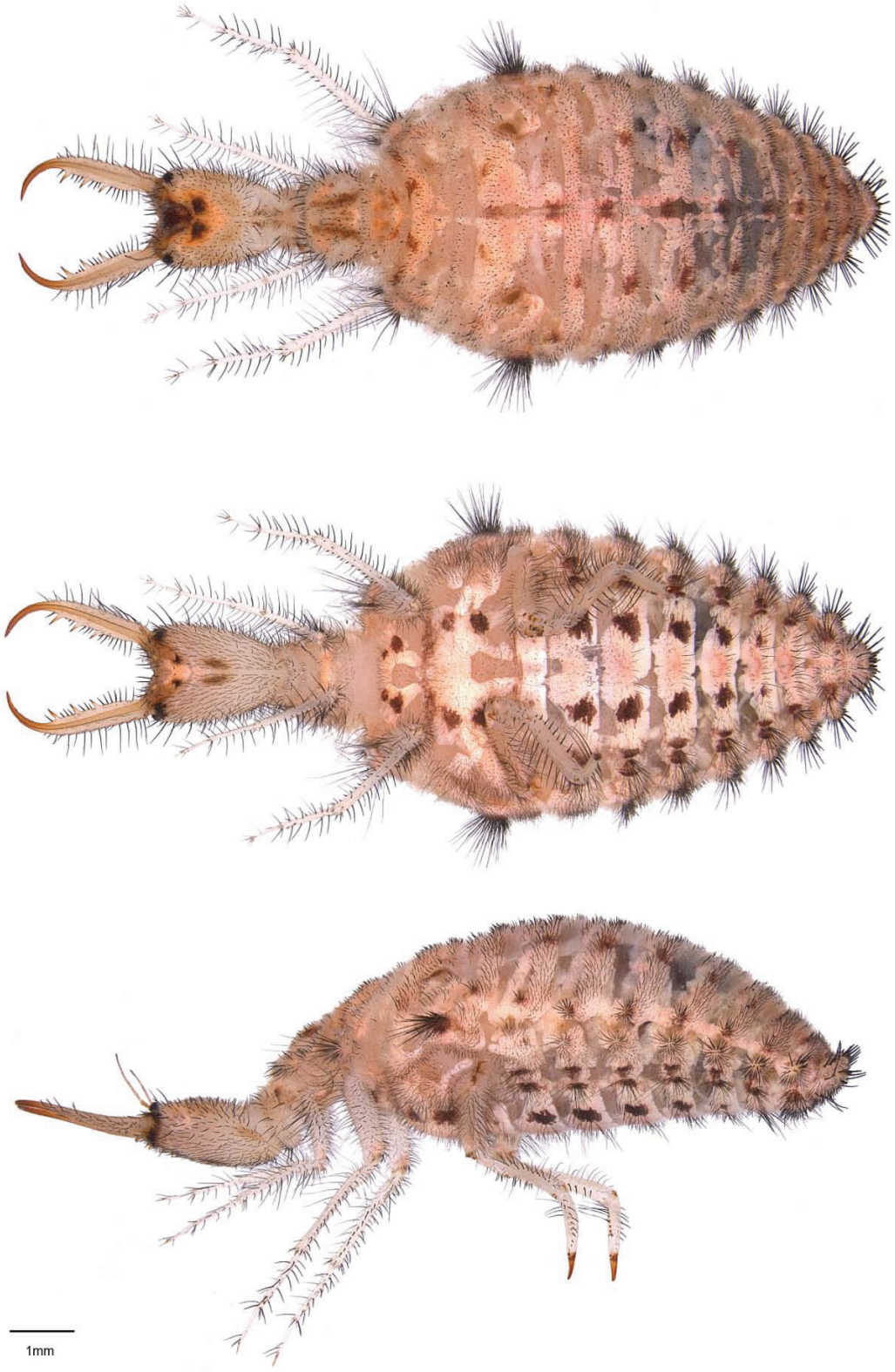

Figure 31. *Myrmeleon hyalinus* Olivier, 1811: 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Lampedusa, Spiaggia dei Conigli].

Figure 32. *Myrmeleon fasciatus* (Navás, 1912): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Greece: Rhodos, Kiotari].

Figure 33. *Euroleon nostras* (Geoffroy in Fourcroy, 1785): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Latium, Roma, Prataglia di Cervara].

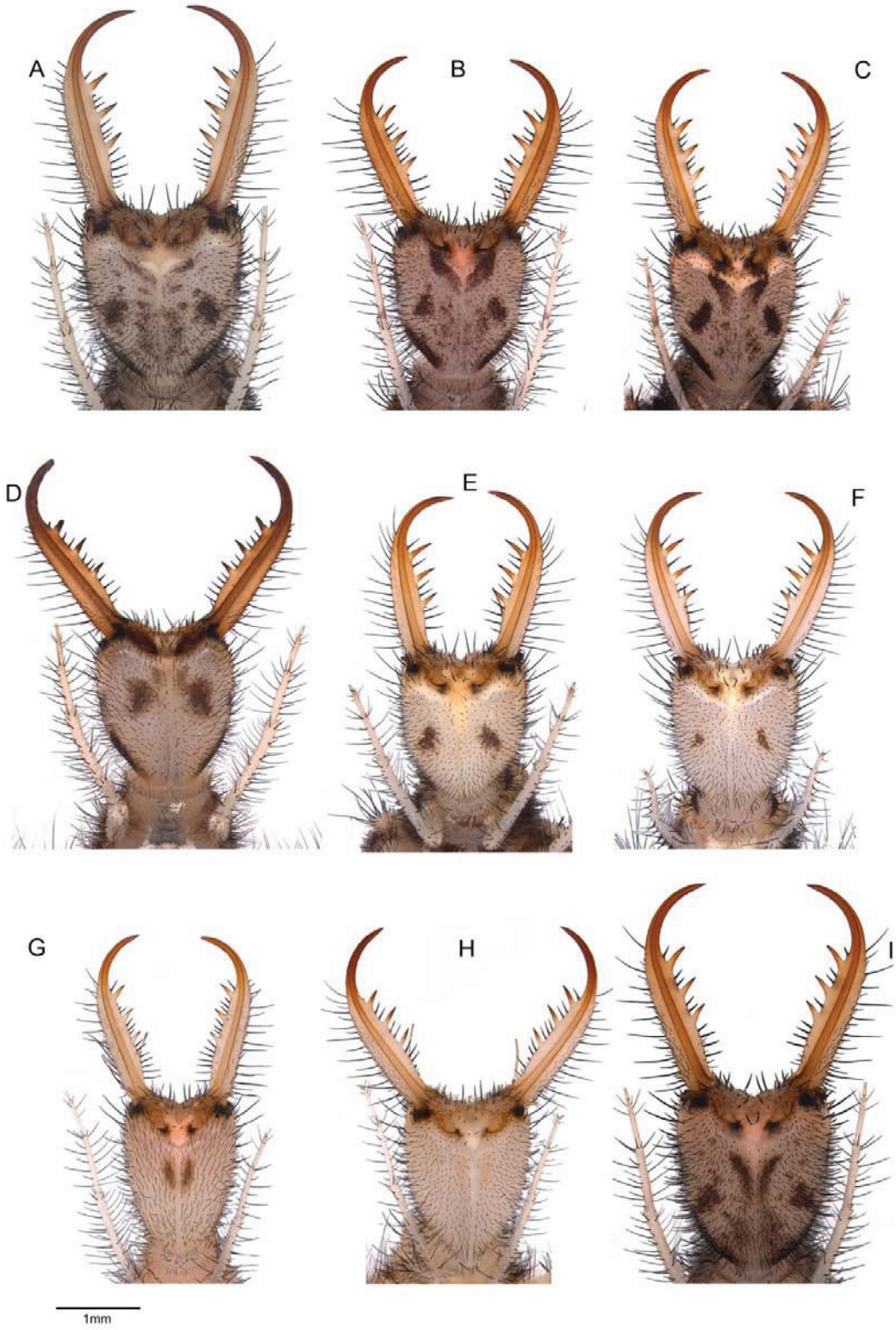

Figure 34. Myrmeleontidae Myrmeleontini, head of 3rd instar larvae, ventral view; A, *Myrmeleon formicarius*; B, *Myrmeleon gerlindae*; C, *Myrmeleon punicanus*; D, *Myrmeleon bore*; E, *Myrmeleon inconspicuus* F, *Myrmeleon mariaemathildae*; G, *Myrmeleon hyalinus*; H, *Myrmeleon fasciatus*; I, *Euroleon nostras*.

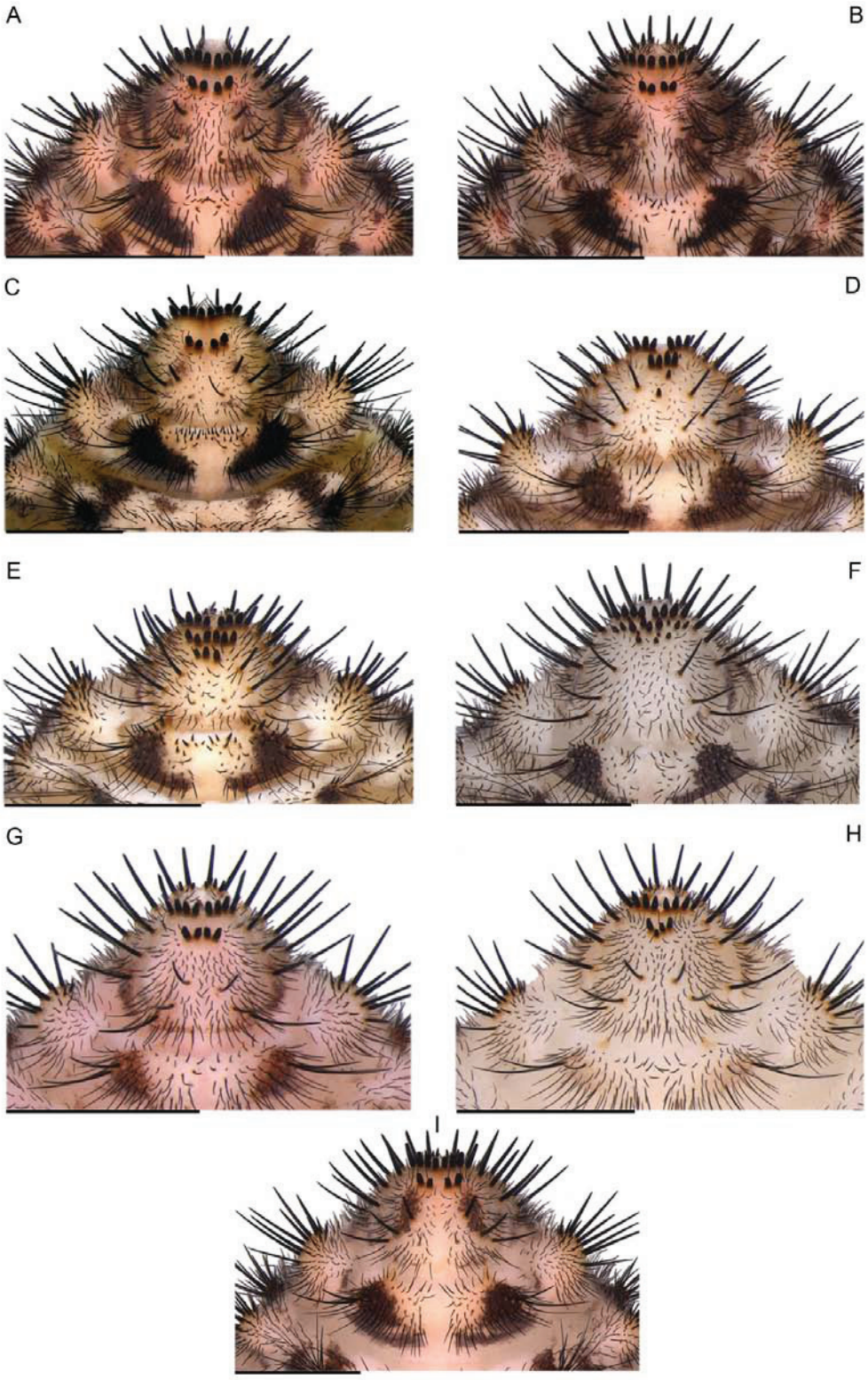

Figure 35. Myrmeleontidae Myrmeleontini, IX abdominal sternite of 3rd instar larvae, ventral view; A, *Myrmeleon gerlindae*; B, *Myrmeleon punicanus*; C, *Myrmeleon formicarius*; D, *Myrmeleon bore*; E, *Myrmeleon inconspicuus* F, *Myrmeleon mariaemathildae*; G, *Myrmeleon hyalinus*; H, *Myrmeleon fasciatus*; I, *Euroleon nostras*.

Family Ascalaphidae Rambur, 1842

This family still verses in a state of taxonomical confusion and it is in great need of revision; Aspöck U. & Aspöck H. (2007) list ca. 430 species. Ascalaphidae have a worldwide distribution in temperate and tropical areas. The larvae are little known and only in few cases they have been attributed to the genus or species of membership. They are normally ambush predators living on the surface of the substratum, sometimes completely exposed, counting on mimicry to hide themselves. The last world monographs of the families are van der Weele (1909) and Navás (1912b), while New (1984), Penny (1981), Tjeder (1992), Tjeder & Hansson (1992) treat specific faunas. The European fauna comprises at least 19 species, allo belonging to the subfamily Ascalaphinae.

Ascalaphus Fabricius, 1775

Diagnosis. Head with a strong dorsoposterior incision, reaching middle length of the head; mandibles equipped with 3 pairs of teeth of which the middle one is the largest; eye tubercles large, wider than long; 4 pairs of thoracic scoli; 8 pairs of supra-spiracular abdominal scoli, 8 pairs of sub-spiracular scoli, only the first two pairs clearly distinct, the others atrophied.

Examined species: *A. festivus* Rambur, 1842

A complex genus, *Ascalaphus* comprises in the present sense around twenty species distributed in the Afrotropical, Western Palearctic and Oriental regions; however there is incertitude if the Oriental species actually belong to this taxon. *A. festivus* Rambur, 1842, a widespread species in Africa and Middle East, is the only European exponent of this genus and it has been only recently collected in southern Sardinia. The preimaginal stages of this genus appear de facto unknown; the only description refers to an Indian species that probably does not belong to this genus *s.s.* (Ghosh, 1913). Michel (2001) discussed the eggs of an African species.

Ascalaphus festivus Rambur, 1842 (figs. 7A, 36)

Excluding a photo of freshly hatched 1st instars larvae in Aspöck U. & Aspöck H. (1999), the larvae of this species are undescribed.

Measured specimens

Italy, Sardinia, Sant'Anna Arresi, Porto Pino, VII.2005, *ex ovo*, 2 (3rd instar).

Italy, Sardinia, Sant'Anna Arresi, Porto Pino, VIII.2008, R. A. Pantaleoni, D. Badano & A. Letardi legit, *ex ovo*, 2 (3rd instars).

Description of 3rd instar larva. Average body length 14.98 mm; head capsule length 3.07 mm (min-max 2.88-3.18), head capsule width 3.69 mm (3.51-3.79), mandible length 3.73 mm (3.47-3.97), ratio head capsule width/length 1.20, ratio mandible length/head capsule length 1.21. A characteristically bicoloured larva with the anterior part of the body pale, whitish and the posterior one dark brown, ventrally pale and mottled brown, head capsule mainly dark brown with dorsal paler areas, mandibles brown, darker apically. Head: almost quadrate in shape and a little dilated posteriorly, wider than long, strongly emarginated with the dorsoposterior incision reaching middle length of the capsule, slightly after the ocular tubercles; eyes tubercles large and protruding, cylindrical in shape and wider than long; antennae thin longer than the eye tubercles; mandibles straight and thin, longer than the head capsule; middle tooth longer the others, apical tooth bent to a different angle in comparison with other teeth; spine-like setae between the median and basal teeth and between the latter and mandibular base; external margin of the mandible with short setae. Body: ovol, equipped with cylindrical scoli and covered by black stick-shaped dolichasters. Thorax: pronotum large, narrower than the posterior portion of the head but corresponding to the emargination of the head; mesothoracic tubercles slightly raised, pale with a darker apex; 4 pairs of thoracic scoli (2 mesothoracic and 2 metathoracic). Legs: comparatively thin and long; tarsal claws not dilated. Abdomen: equipped with 8 pairs of supra-spiracular scoli, the 1st pair shows a trend to migrate on the dorsum and it is black in colour in contrast with the following pairs that are completely pale; sub-spiracular series of scoli composed by 8 pairs of which only the first 2 pairs are well developed, the other are reduced to small bumps equipped with dolichasters and they are hardly discernible from the normal chaetotaxy of the abdomen; abdominal spiracles dark, the first pair shows a migration toward the dorsum; VIII sternite equipped with very small odontoid processes bearing dolichasters; 9th urite longer than wide, cylindrical, IX sternite with small posterior rastra.

Bio-ecology: The larvae have been exclusively obtained by rearing and their habitat is unknown. Nevertheless the adults were collected in a coastal salt marshes with *Juncus* sp. vegetation on a sandy substratum, so it is possible to assume that the preimaginal stages live on the ground, among the impenetrable tuft of these plants.

Puer Lefèbvre, 1842

Diagnosis. Head at least one and half times wider than long; eye tubercles hemispherical, forward placed and flattened; jaws narrow with 3 pair of teeth, the middle one longer, and with numerous pseudo-teeth; body elliptical, extremely flattened; pronotum as wide as the posterior portion of the head; scoli very large and flat, 3 main thoracic scoli, 8 abdominal supra-spiracular scoli; sub-spiracular absent; first pair of abdominal spiracles dorsally placed, the following ones disposed on the ventral side; tarsal claws not dilated.

Examined species: *P. maculatus* (Olivier, 1789)

The genus *Puer* is exclusive of Western Palearctic, and comprises two rarely reported species known for South-Western Europe, North Africa (Morocco and Algeria) and Middle East (Israel); *P. maculatus* is present in the Iberian Peninsula and Southern France (Aspöck U. & Aspöck H., 1978; Aspöck et al., 2001; Badano & Pantaleoni, 2011). Its larva, uncertainly described by Hagen (1873), is the most unmistakable between those of European Myrmeleontiformia due to its peculiar habitus.

Puer maculatus (Oliver, 1789) (figs. 7C, 37)

The larva of this species was described by Hagen (1873), however his description was based on a dead specimen and the taxonomic assignment was founded on geographical assumptions and relative differences with other larvae known to him. Therefore his account was considered doubtful (Aspöck et al., 1980). The present description, confirmed by rearing, agrees with the original description of Hagen.

Measured specimens

France, Hérault, Argelliers, Les Hauts de Boscorre, VI.2011, D.Badano & B. Michel legit 2 (3^{rd} instar).

Description of 3^{rd} instar larva. Average body length 10.435 mm; head capsule length 2.21 mm (min-max 2.12-2.30), head capsule width 3.24 mm (3.25-3.23), mandible length 2.60 mm (2.59-2.62), ratio head capsule length/width 0.68, ratio head capsule length/mandible length 0.84. General colouring ochre with darker symmentrical areas, ventral side noticeably paler, mottled with dark spots; jaws brown; setae dark. Head: over one and half wider than long, reaching is maximum width immediately after eye tubercles and narrowing between eye tubercles and the insertion of the mandibles; head capsule smoothly emarginated dorsoposteriorly; eye tubercles very short, hemispherical, flat, placed forward; long and stout setae are present between the eye tubercles and their head insertion; antennae longer than eye tubercles; mandibles

straight, narrow, equipped with three teeth, the middle tooth longer the others, basal tooth equidistant between the middle tooth and the base of the mandibles, pseudo-teeth are present between the teeth and thin and hair-like setae are distributed after the third tooth, near the base of the mandible; robust setae along the external margin of mandible, longer toward the base; last article of labial palpi swollen. Body: extremely flattened, oniscoid; scoli very large, flattened, apparently 11 pairs in number and covered by very long, hair like dolichasters; the body is covered by flat and scale-like dolichasters Thorax: pronotum wider than long, its width comparable to the posterior portion of the head capsule; metathoracic pair of spiracles a little raised, dark in colour; 3 main pairs of thoracic scoli, longer than those of the abdomen, the first pair bent at 90°; an atrophied fourth pair of scoli is present immediately after the third pair, albeit reduced to a little setae-bearing tubercle. Legs: thin and comparatively small, covered by dark setae. Abdomen: fist pair of abdominal spiracles small and dorsally disposed; the other pairs from the 2nd to 8th segments lateral (apparently ventral due to the flattened shape of the body); abdomen equipped with 8 pairs of supra-spiracular scoli progressively smaller toward the 8th segment; tsub-spiracular scoli absent except the pair of the 1st abdominal segment that is reduced to small, almost indistinguishable, tubercles; 9th segment large, longer than wide, posterior margin equipped with small and thin digging setae arranged in two groups of three setae each one, the middle setae in the group are the longest.

Bio-ecology. The larvae have been collected in a Mediterranean maquis on calcareous substrate with a prevalence of holm oak, *Quercus ilex*. In the investigated site the trees are interspersed with extensive barren rocky areas of cracked and broken whitish limestone with numerous crevices and holes; the herbaceous covering is very limited and sparse. The larvae and pupae have been found adhering to the inferior surface of flat stones, often in turn disposed below larger rocks. The larva of *P. maculatus* appears specialized to live on rock surfaces as shown by the overall flattened body shape and the very large scoli equipped with long dolichasters helping to retain the position in its upside down habitat. The cocoon is spun and fixed in the same location. The larva is extremely motionless and is camouflaged by the fine rock dust that is retained by the dolichasters. The larval and pupal stages have been both collected during the first decade of June, just before the known flight period in the area (Michel & Kral, 2008).

Bubopsis McLachlan, 1898

Diagnosis: Mandibles long and thin with the apical half bent outward; mandible base covered by white dolichasters; 3 pairs of mandibular teeth, comparatively small, the middle pair is the largest; ocular tubercles with a distinct apical protuberance; 4 pairs of thoracic scoli (the last one reduced); 8 pairs of supra-spiracular abdominal scoli

(the last one very reduced), 7 pairs of sub-spiracular abdominal scoli, gradually reducing in size.

Examined species: *B. agrionoides* (Rambur, 1838)

This genus comprises at least 8 species distributed in the Mediterranean Basin, Middle East and India. The first description of the larva belonging to this genus is reported in Hagen (1873) under "*Theleproctophylla variegata*" as he associated the larvae to the corresponding adults only on a geographic basis. Escribano (1921), describing the larva of *Deleproctophylla dusmeti*, noticed the considerable differences between his larva and Hagen's description and correctly supposed that the latter account actually referred to this genus. The assumption of Escribano is indeed correct, in fact the description of Hagen is accurate enough to associate it with the genus *Bubopsis*, however only over a century later the larva of this genus will be described and illustrated (Pieper & Willmann, 1981).

Bubopsis agrionoides (Rambur, 1838) (fig. 7B, 38)

As the above mentioned earlier descriptions refer to Eastern species, the larva of this taxon is described here for the first time.

Specimens examined

France, Hérault, Argelliers, Les Hauts de Boscorre, VI.2011, D.Badano & B. Michel legit 5 (3rd instar).

France, Hérault, Argelliers, Les Hauts de Boscorre, VII.2011, D.Badano legit 2 (3rd instar).

Description of 3rd instar larva. Average body length 13.86 mm; head capsule length 3.09 mm (min-max 2.90-3.34), head capsule width 3.59 mm (3.32-3.82), mandible length 4.07 mm (3.89-4.25), ratio head capsule width/length 1.32, ratio mandible length/head capsule length 1.16. General colouring pale gray with yellowish areas, head capsule dark brown above and grey below; all the body is covered by white dolichasters that give to this species a pruinose appearance; mandibles black. Head: wider than long, only slightly dilated posteriorly, its dorso posterior emargination swollen, limited to the posterior margin of the head capsule; anterior margin of the labrum concave; antennae thin, as long as the eye tubercles; eye tubercles large and prominent, cylindrical in shape; with a distinct apical bump; mandibles noticeably longer than the head capsule, their distal portion bent outward (bend more or less pronounced according to the individual); teeth small, the middle tooth is larger than the others and closer to the apical one; distance between the base of the mandible and the

basal tooth superior to that between the teeth; short and spiniform setae are disposed between the teeth and the base; very short setae are disposed on the external margin; base of the mandible covered by white dolichasters; labial palps with segment 2-4 as long as the width of the mandible. Body: ovol, equipped with bent scoli; coverd by white clavate dolichasters. Thorax: pronotum cuneiform, coverd by white dolichasters; mesothoracic spiracle small, yellowish; 2 pairs of mesothoracic scoli bent backward; 2 pairs of metathoracic scoli, the 1st pair is large and "T-shaped" with a forward and a backward protrusions, the 2nd pair is very reduced, cylindrical in shape. Legs: comparatively short and slender, dark brown and coverd by black setae and white dolichasters. Abdomen: equipped with 8 pairs of supra-spiracular scoli, cone-like and "t-shaped" with an anterior and posterior protrusion, gradually reducing toward the IX segment, 7 pairs of sub-spiracular scoli gradually reducing toward caudal direction, the first 4 pairs well developed and recognizable, the other in a gradual sequence of progressive atrophization, the original 8th pair disappeared; abdominal spiracles lateral, the first pair a little above the others; VIII sternite equipped with short apical odontoid processes covered by white clavate dolichaster and few black larger ones: 9th abdominal segment cone-shaped, longer than wide; IX sternite covered by white dolichasters, rastra very small and surrounded by dark and robust setae.

Bio-ecology: this species was collected in a Mediterranean maquis of holm oak on a rocky calcareous substrate almost without herbaceous vegetation (see also *P. maculatus*; Michel & Kral, 2008). The larvae were observed to live under large, normally flat, stones and sharing the same habitat with those of *P. maculatus*. The observations are few but apparently while the latter is specialized to live on the inferior surface of rocks, the larvae of *B. agrionoides* simply live under them, on the covered substratum. They are exclusively ambush predators and they are camouflaged by the rock dust retained by the numerous dolichasters widely distributed on the whole body surface.

Deleproctophylla Lefèbvre, 1842

Diagnosis: Head capsule quadrate, not dilated posteriorly; mandibles equipped with 3 pairs of teeth, of which the middle one is the largest; 4 pairs of thoracic scoli, 8 pairs of supra-spiracular abdominal scoli, sub-spiracular series atrophied except the first two pairs; dolichasters of the body elongated, stick-shaped.

Examined species: *D. australis* (Fabricius, 1787); *D. dusmeti* Navás, 1914.

The 5 species included in this genus are distributed in the Mediterranean basin, reaching Central Asia in the East (Aspöck, 2001). The only reliable report on the preimaginal stages of this genus regards the larva of *D. dusmeti* by Escribano (1921). The detailed description of the larva of "*Theleproctophylla barbara*" from Anatolia by Hagen (1873)

in reality perfectly match that of the genus *Bubopsis* McLachlan, as also supposed by the same Escribano (1921).

Remarks: As it is observed in the adults, that show a considerable overlapping in characters normally considered useful for identification purposes (Badano, pers. oss.), the larvae of *D. australis* and *D. dusmeti* don't display any valuable diagnostic character. They can be identified only by their disjunct distribution: *D. australis* is present in the Apennine and Balkan Peninsulas and in the islands of the Tyrrhenian sea while *D. dusmeti* is diffused in the Iberian Peninsula and Southern France. [Despite the close resemblance the two species are genetically well distinct (Badano pers. obs.) and their specific status is supported.]

Deleproctophylla australis (Fabricius, 1787) (figs. 6A, 7D, 39)

The larva of this species is described here for the first time.

Specimens examined

Italy, Sardinia, Monti, VII.2010, D. Badano leg., *ex ovo,* 6 (3rd instar).

Description of 3rd instar larva. Average body length 10.66 mm; head capsule length 2.50 mm (min-max 2.24-2.72), head capsule width 2.69 mm (2.42-2.92), mandible length 2.98 mm (2.77-3.22), ratio head capsule width/length 1.07, ratio mandible length/head capsule length 1.19. General colouring whitish with pale brown markings; head capsule dark brown; mandibles brown. Head: quadrate, as wide as long, without a pronounced posterior dilatation, dorso-posterior emargination of the head capsule relatively deep; anterior margin of the labrum slightly concave; antennae thin, a little longer than the head tubercle; eye tubercle cylindrical with a small, little pronounced apical bump; mandibles longer than the head capsule, equipped with 3 pairs of teeth of which the middle one is the longest; 1-0 very short setae between the middle and the apical teeth, 2-3 setae w with an enlarged, tooth-like, base base between the middle and basal teeth, more than 4 setae with dilated base between the base of the mandible and middle tooth; few very short setae on the external margin of the mandible, few longer ones are disposed at its base; labial palps 4-articulated, articles 2-4 longer than the base of the mandible. Body: oval, equipped with scoli and covered by black setae and dolichasters, most of the dolichasters are elongated and stick-shaped. Thorax: pronotum cuneiform, brown with a distinct middle pale stripe bordered by dark brown areas; mesothoracic spiracles short and pale brown; 4 pair of thoracic scoli, cylindrical in shape; 1st pair of scoli with a ventral dark marking at the base. Legs short, covered by dark setae; tarsal claws slightly dilated at the base. Abdomen: equipped with 8 pairs of supra-spiracular scoli, cylindrical in shape; sub-spiracular series of scoli mostly reduced

to small bumps bearing a pair of setae, only the first two anterior pairs are well developed and recognizable; abdominal spiracles dark brown; VIII sternite equipped with short odontoid processes, bearing black setae, a pair of distinct brown spots is present on the side, exactly below the last pair of scoli; IX sternite longer than wide, with short rastra equipped with 4 pair of short, triangular digging setae.

Bio-ecology: *D. australis* dwells in arid and hot grasslands in Mediterranean environments. The habits of the larvae are still little known but they are strictly ambush predators, probably living on the soil surface among stones and the tuft of plants.

Deleproctophylla dusmeti Navás, 1914 (fig. 40)

Navás (1915) doubtfully attributed a freshly hatched larva, a not diagnostic instar, to this species. Few years later, the larva, the pupa and the development of this species have been correctly described and illustrated by Escribano (1921) who found a larva near Madrid, the only previously existing account on the larva of this genus.

The larva of *D. dusmeti* is not recognizable from that of *D. australis*, with which it shares not only the same morphological features and proportions but even the most minute details like the markings at the base of the first pair of thoracic scoli and on the ventral surface of the 8th abdominal segment.

Specimens examined

France, Hérault, Saint Paul et Valmalle, VII.2011, D. Badano leg., *ex ovo,* 1 (3rd instar).

France, Alpes Maritimes, Villeneuve Loubet, VII.2011, D. Badano leg., *ex ovo,* 3 (3rd instar).

Description of 3rd instar larva. Average body length 10.42 mm; head capsule length 2.52 mm (min-max 2.44-2.68), head capsule width 2.83 mm (2.44-2.94), mandible length 3.16 mm (2.96-3.34), ratio head capsule width/length 1.12, ratio mandible length/head capsule length 1.25. General colouring whitish with pale brown markings, head capsule dark brown, mandible brown. Head: quadrate, without a posterior dilatation; eye tubercle prominent, cylindrical with a small apical bumps; mandible longer than the head capsule and provided with 3 pairs of teeth of which the middle one is the longest. Body: oval, equipped with scoli and covered by black dolichasters. Thorax: with 4 pair of scoli. Abdomen: 8 pairs of supra-spiracular scoli, sub-spiracular series atrophied except the first two pairs; VIII sternite with short setae-bearing odontoid processes; IX sternite with short, apical rastra.

Bio-ecology: This species, like the congener, lives in open arid Mediterranean environments with herbaceous vegetation.

Libelloides Schäffer, 1763

Diagnosis: Head capsule noticeably dilated posteriorly, mandibles equipped with 3 pair of teeth of which the middle one is the largest; thorax equipped with 4 pairs of scoli, abdomen provided with 8 pairs of supra-spiracular scoli and with the sub-spiracular series atrophied with the exception of 2 anterior pairs; body covered by short goblet-shaped dolichasters besides the longer, normal shaped ones.

Examined species: *L. coccajus* (Denis et Schiffermüller, 1775), *L. macaronius* (Scopoli, 1763), *L. longicornis* (Linnaeus, 1764), *L. ictericus* (Charpentier, 1825), *L. siculus* (Angelini, 1827), *L. corsicus* (Rambur, 1842), *L. latinus* (Lefèbvre, 1842) .

The genus *Libelloides* comprises the most characteristic ascalaphids of the Palearctic region, due to their colourful appearance, and its distribution well match the biogeographic region itself. Despite the taxonomic value of some subspecies needs to be evaluated, *Libelloides* includes at least 19 species of which about 12 are present in Europe, where they are concentrated in the south-western portion of the continent (Aspöck et al., 2001). The morphology and ecology of the preimmaginal stages of this genus are poorly known; the first accurate study on this subject was realized by Brauer (1854) and the general characteristics of the larvae were defined in Hagen (1873). Only two recent comparative works exist (Rousset, 1973; Pieper & Willmann, 1980).

Remarks: As underlined by Rousset (1973), the larvae of the different species belonging to the genus *Libelloides* show between them a noticeable overlapping in the macroscopic characters normally used for identification purposes, such as chaetotaxy, morphometry and the general pigmentation. Moreover the difficulty to find a considerable number of specimens in the field, makes this light differences even more unsuitable. In nature the larvae of this genus cover themselves with debris (Pantaleoni, 1991), that are firmly retained by their dolichasters, making them not only perfectly camouflaged but also very difficult to recognize if alive and not artificially cleaned, being the pigmentation completely not visible. The following key is based on character that have been observed constant in the examined specimens, however it should be considered a try.

Preliminary key to the examined species of *Libelloides*

1. Ventral side of the head capsule with longitudinal pale stripes (fig. 43)

2

- Ventral side of the head capsule without pale stripes (fig. 42)

3

2. Dorsal side of the head with yellow markings, thorax and its scoli yellowish, all pairs of legs with femora and tibiae yellowish, IX abdominal sternite completely pale, yellowish (fig. 46)

L. siculus

- Dorsal side of the head brown without yellow markings, thorax and its scoli grey like the rest of the body, all pairs of legs with femora and tibiae brown, IX abdominal sternite with contrasting dark markings (fig. 43)

L. longicornis

3. IX abdominal sternite with contrasting dark markings (fig. 41)

4

- IX abdominal sternite without contrasting dark markings, monochrome (fig. 44)

6

4. Dorsal side of the head capsule pale brown with a contrasting anterior median trapezoidal dark marking surrounded by yellowish borders, anterior portion of IX abdominal sternite with a pair of dark spots, ventral side of the abdominal scoli dark (fig. 47)

L. latinus

- Dorsal side of the head capsule dark brown without a distinct median trapezoidal marking, anterior portion of IX abdominal sternite without a pair of dark spots, abdominal scoli monochrome

5

5. Odontoid processes of VIII abdominal sternite tainted dark brown, mandibles with not over 3 setae with dilated base between the apical and middle teeth (fig. 41)

L. coccajus

- Odontoid processes of VIII abdominal sternite not tainted, one of the mandibles with at least 4 setae with dilated base between the apical and middle teeth (fig. 42)

L. macaronius

6. Dorsal side of the head capsule with distinct dark spots at the base of the major dorsal setae, general colouring of the body dark, including the ventral side (fig. 45)

L. corsicus

- Dorsal side of the head capsule without distinct dark spots at the base of the major dorsal setae, general colouring of the body pale (fig. 44)

L. ictericus

Libelloides coccajus (Denis et Schiffermüller, 1775) (fig. 41)

First instars larvae of this species were mentioned by Hagen (1873). Other old accounts on its larvae (Xambeu, 1903; Lacroix, 1923) are incomplete or totally unreliable. Eglin (1940) related and illustrated the hatching behaviour of the first instar larvae. However, the first exhaustive description of the larva of this so common European species was surprisingly realized relatively recently by Rousset (1973), who also compared it to congeneric species. Finally a photo of a larva of *L. coccajus* appears in Aspöck U. & Aspöck H. (1999).

Measured specimens

Italy, Liguria, Mt. Toraggio (IM), VII.2010, D. Badano leg., *ex ovo,* 4 (3rd instar).

France, Alpes Maritimes, Venanson, VI.2011, D. Badano leg., *ex ovo,* 15 (3rd instar).

Description of 3rd instar larva. Average body length 10.53 mm; head capsule length 2.66 mm (min-max 2.51-2.91), head capsule width 3.10 mm (2.89-3.30), mandible length 3.09 mm (2.87-3.29), ratio head capsule width/length 1.16, ratio mandible length/head capsule length 1.16. General colouring brown with darker markings and areas, ventral side paler mottled brown; head capsule brown with a darker anterior area, ventral side completely brown, mandibles brown. Head: wider than long, noticeably dilated posteriorly; anterior margin of the labrum with a small median incision, antennae thin, longer than the eye tubercle; eye tubercle prominent, cylindrical in shape; mandibles longer than the head capsule, armed with 3 pairs of teeth of which the middle one is the longest; 0-1 setae between the apical and the middle teeth, 1-3 setae with a dilated, tooth-like, base between the middle and the basal teeth, 3-4 setae with dilated base between the basal teeth and the base of the mandible; external margin

of the mandible provided with very short setae distributed until the height of the apical teeth, longer setae are present at the base of the mandible; dorsal and ventral side of the mandible covered by short and sparsely disposed setae; labial palps composed of 4 articles of which the articles 2-4 are long as the width of the mandible. Body: elliptical in shape, provided with prominent scoli and covered by black dolichasters of two main types: longer, stick-shaped ones and shorter goblet-shaped ones, the second type covers most of the body surface, especially the ventral side. Thorax: equipped with 4 pairs of cylindrical scoli; pronotum cuneiform, covered by short setae, brown in colour with a pair of darker stripes; mesothoracic spiracles slightly raised, ochre with a dark apex. Legs: comparatively short and thin, covered by dark setae; coxae of all legs dark brown, femora, tibiae and tarsi pale brown with darker markings. Abdomen: provided with 8 pairs of supra-spiracular scoli, cylindrical in shape; sub-spiracular series of scoli mostly atrophied with exception of the first two anterior pairs; abdominal spiracles dark brown; VIII sternite equipped with short odontoid setae-bearing processes, a pair of diagnostic brown spots is present on both side, taining the processes; IX sternite longer than wide, pale with a dark posterior end, provided with short rastra equipped with 4 pair of short, triangular digging setae.

Bio-ecology: *L. coccajus* is a common, euryoecious species that can be found in open environments with herbaceous vegetation from the lowlands to ridge of the mountains. This ascalaphid inhabits grasslands, meadows, glades, low-shrublands and sparse woods and it is absent only in sites with excessive grazing. The larvae are ambush hunters living on the soil surface, between the rocks and the tufts of herbaceous plants; they are perfectly camouflaged covering themselves with debris.

Libelloides macaronius (Scopoli, 1763) (fig. 42)

The preimaginal stages of this species are the first of the genus to have been scientifically described, in fact Brauer (1854) treated and illustrated its larvae, discussing the hatching behavior. An year later (1855a) he also described the pupa, completing the whole life history of this ascalaphid. Hagen (1873) treated this larva as well, following the previous study of Brauer. More than a century later, Pieper & Willmann (1980), illustrated and synthetically described the larvae of this species, comparing the Ascalaphid species of the Balkan Peninsula. Aspöck U. & Aspöck H. (1999) show a photo of a larval specimen.

Measured specimens

Italy, Friuli Venezia Giulia, Trieste, VI.2010, L. Morin leg., *ex ovo,* 3 (3rd instar).

Description of 3rd instar larva. Average body length 11.81 mm; head capsule length 2.43 mm (min-max 2.38-2.49), head capsule width 2.81 mm (2.77-2.86), mandible length 2.77 mm (2.63-2.90), ratio head capsule width/length 1.15, ratio mandible length/head capsule length 1.14. General colouring pale brown with darker areas and markings, ventral side pale with an indistinct mottled pattern; head capsule dark brown with a darker anterior portion, ventral side dark brown, mandibles dark brown. Head: wider than long, slightly dilated posteriorly; anterior margin of the labrum with a a little pronounced median incision; antennae thin, longer than the eye tubercles; eye tubercles protruding; mandibles longer than the head capsule, armed with 3 pairs of teeth of which the middle one is the largest; 0-1 setae between the apical and middle teeth, 3-4 setae with dilated base between the middle and basal teeth, 4-5 setae with dilated base between the basal teeth and the base of the mandible; labial palps 4-articulated. Thorax: provided with 4 pairs of cylindrical scoli; pronotum brown with darker stripes and covered by short setae; mesothoracic spiracle brownish with black apex. Legs: all pairs of legs characterized by the same colouring: coxae dark brown, femora, tibiae and tarsi brown with darker suffused markings. Abdomen: provided with 8 pairs of supra-spiracular scoli, sub-spiracular series mostly atrophied except the first two anterior pairs; VIII sternite brown spots covering the short setae-bearing odontoid processes; IX sternite with longitudinal brown markings and a dark posterior end, equipped with short rastra.

Remarks: *L. macaronius* is an Eastern species, whose areal of distribution is allopatric in respect of *L. coccajus* and *L. longicornis*, with which it comes in contact in few areas of Central Europe and Northern Italy. Besides the pigmentation pattern, the larva of *L. macaronius* disposes on average a greater number of setae with dilated base (3-4) between the middle and basal mandibular teeth.

Bio-ecology: *L. macaronius* is an euryoecious species occurring from the sea level to the mountains in open habitats with herbaceous vegetation, such as grasslands, glades and shrublands. L. macaronius is a typical species of steppes and similar biotopes. Its ecological preferences explain its large distribution in Central Asia. The larvae live in the soil in the same open environments inhabited by the adults, as the other congeneric species.

Libelloides longicornis (Linnaeus, 1764) (figs. 6B, 43)

Excluding older report on the discovery of the eggs and 1st instar larvae of this specie (McLachlan, 1878; Ragonot, 1878), the first description is imputable to Navás (1915), who schematically described and illustrated for larvae, that he obtained from eggs. Moreover, he shortly discussed his observations on their development. Shortly later

studies on its larva (Lacroix, 1923; Rabaud, 1927) did not add further relevant information on this species. Rousset (1973) re-described it, comparing the larvae with those of other member of the genus.

Measured specimens

France, Var, Mt. Aurelien, VI.2011, D. Badano leg., *ex ovo,* 17 (3rd instar).

Description of 3rd instar larva. Average body length 11.18 mm; head capsule length 2.63 mm (min-max 2.49-2.77), head capsule width 3.17 mm (2.91-3.42), mandible length 3.06 mm (2.77-3.34), ratio head capsule width/length 1.20, ratio mandible length/head capsule length 1.16.General colouring pale brown with a darker pattern, ventral side paler mottled dark; head capsule brown with a darker anterior portion, ventral side brown with a darker area near the mouthpart and diagnostic longitudinal pale stripes running from the eye tubercle to posterior margin of the head; mandibles dark brown. Head: wider than long, noticeably dilated posteriorly; anterior margin of the labrum with a slight median incision; antennae thin, longer than eye tubercle; eye tubercles, prominent; mandibles longer than the head capsule and equipped with 3 pairs of teeth of which the middle one is the largest; 0-1 setae between the apical and middle teeth, 1-3 setae with dilated base between the middle and the basal teeth, 3-4 setae with dilated base between the basal teeth and the base of the mandible; labial palps 4-articulated. Thorax: equipped with 4 pairs of scoli; pronotum pale brown with indistinct brown stripes; mesothoracic spiracles ochre with a black apex. Legs: coxae of all pairs of legs dark brown; femora, tibiae and tarsi brown with a suffused darker area. Abdomen: equipped with 8 pairs of supra-spiracular scoli and 8 pairs of sub-spiracular scoli, most of them atrophied with the exception of the first two anterior pairs; 8th abdominal s provided with short setae-bearing odontoid processes, pale in colour with the except of the dark sclerified parts; IX sternite pale with dark posterior end, equipped with short rastra.

Remarks: The preimaginal stages of *L. longicornis* are easily recognized from all the other examined species, with the notable exception of *L. siculus,* for the presence of longitudinal pale stripes on the ventral side of the head. However, this two species are set apart for the different body colouring. Moreover, the presence of *L. longicornis* in Sicily, where the other species is endemic, is unproven and unlikely ([Bernardi] Iori *et al*., 1995).

Bio-ecology: *L. longicornis*, as the previous two species, is a common and euryoecious species occurring in open environments such as grassland, pastures, glades and low shrublands. In Italy this is an owlfly typical of mountainous environments, often inhabiting alpine grassland and its presence in lowlands and Mediterranean environments is rare and in most case attributable to stranded individuals (Pantaleoni,

1990; Badano, pers. obs.). On the contrary, in southern France this species shows a remarkable wider altitudinal range, being found from the sea-level to the mountains and being common in strictly Mediterranean environments (Puisségur, 1967; Badano, pers. obs.). The larvae are ambush predators living in the soil of grasslands.

Libelloides ictericus (Charpentier, 1825) (fig. 44)

Larvae attributed to this species were firstly described by Xambeu (1903), however his account should be considered doubtful, lacking any useful identification character. Lacroix (1923) also mentioned the larvae of this species. Nevertheless, the first exhaustive and comparative description of the larvae of this species was detailed by Rousset (1973).

Measured specimens

France, Hérault, Saint Paul et Valmalle, VI.2011, D. Badano leg., *ex ovo,* 28 (3rd instar).

Description of 3rd instar larva. Average body length 10.60 mm; head capsule length 2.36 mm (min-max 2.15-2.56), head capsule width 2.67 mm (2.38-2.95), mandible length 2.61 mm (2.42-2.94), ratio head capsule width/length 1.13, ratio mandible length/head capsule length 1.10. General colouring pale ochre mottled brown, ventral side paler; dorsal side of the head brown, clypeo-labrum and anterior portion of the head with dark markings, ventral side brown with a darker anterior area with a pale marking surrounding the labium; mandibles brown. Head: wider than long and dilated posteriorly; anterior margin of the labium with a median incision; antennae thin, longer than the eye tubercle; eye tubercle prominent; mandible longer than the head capsule and equipped of 3 pairs of teeth of which the middle one is the longest; 1 seta between the apical and middle teeth (rarely absent), 2-3 setae with dilated base between the middle and basal teeth, 4-5 setae with dilated base between the basal teeth and the base of the mandibles; labial palps 4-articulated. Thorax: provided with 4 pairs of scoli; pronotum brown with darker stripes; mesothoracic spiracle ochre with a dark apex. Legs: all pair of legs with dark brown coxae, femora and tibiae pale with a darker median area. Abdomen: equipped with 8 pairs of supra-spiracular scoli, sub-spiracular series atrophied with the exception of the two anterior pairs; VIII sternite with the short setae-bearing odontoid processes; IX sternite completely pale equipped with short, apical rastra.

Remarks: The larvae of *L. ictericus* can be distinguished from the other *Libelloides* species for the completely pale, monochrome IX abdominal sternite.It is set apart from the closely related *L. corsicus* and *L. siculus* thanks to general pigmentation and habitat.

Moreover most of the specimens of this species present 1 setae between the apical and middle teeth in both mandibles while the rate of presence of this character in other species in both mandibles is significantly lower.

Bio-ecology: *L. ictericus* occurs in open arid environments with herbaceous vegetation such as Mediterranean grasslands and low shrublands (garrigue). In southern France is a typical lowland species while in North Africa it can attain mountainous altitudes (Aspöck *et al.*, 1980). The larvae are ambush hunters, living on the soil surface and hidden between grasses and rocks.

Libelloides corsicus (Rambur, 1842) (fig. 45)

The larvae of this Tyrrhenian endemic species are described here for the first time.

Measured specimens

Italy, Sardinia, Alghero (SS), Mt. Doglia, VI.2010, D. Badano leg., *ex ovo,* 6 (3rd instar).

Italy, Sardinia, Berchidda (OT), VI.2010, D. Badano leg., *ex ovo,* 2 (3rd instar).

Description of 3rd instar larva. Average body length 8.86 mm; head capsule length 1.92 mm (min-max 1.81-2.06), head capsule width 2.30 mm (2.13-2.41), mandible length 2.10 mm (2.00-2.28), ratio head capsule width/length 1.20, ratio mandible length/head capsule length 1.09. General colouring dark brown with darker areas and markings, ventral side of the body brown; head capsule brown, dorsal side with dark markings on clypeo-labrum prosecuting posteriorlu on the sides, a darker marking is present at the insertion of the larger dorsal dolichasters, ventral side completely brown; mandibles dark brown. Head: wider than long, slightly dilated posteriorly; anterior margin of the labrum with a small median recess; antennae thin, dark, longer than the eye tubercles; eye tubercles prominent, large in comparison with the head capsule; mandibles slightly longer than the head capsule, armed with 3 pairs of teeth of which the middle one is the longest; 0-1 setae between the apical and middle teeth, 2-3 setae with dilated base between the middle and basal teeth, numerous (at least 5) setae with dilated base closely disposed between the basal tooth and the base of the mandible; labial palps 4-articulated. Thorax: provided with 4 pairs of scoli; pronotum brown with dark brown stripes; mesothoracic spiracles ochre with a dark apex. Legs: all pairs of legs with dark brown coxae and brown femora, tibiae and tarsi. Abdomen: equipped with 8 pairs of supra-spiracular scoli and 8 pairs of sub-spiracular scoli of which only the first two anterior pairs are developed, the others reduced; VIII abdominal sternite provided with short setae-bearing odontoid processes; IX sternite of the same general colouring of the ventral side, provided with short posterior rastra.

Remarks: *L. corsicus* is the only species of *Libelloides* in the Tyrrhenian islands of Corse, Sardinia, Capraia and nearby islets, making its identification unequivocal. The pigmentation of the larvae clearly set apart this species from the closely related and allopatric *L. ictericus* and *L. siculus*. Finally, larvae of this species are on average smaller then the congeneric ones.

Bio-ecology: *L. corsicus* is a relatively euryoecious species that lives in open habitats such as grasslands, meadows, shrublands, glades and open woods from the sea level to the mountains; it is a very common species wherever the anthropic disturbance is not excessive. The larvae live in the soil, camouflaged between stones and tuft of grass, as indicated by some findings in pit-fall traps (Italy, Sardinia, Berchidda).

Libelloides siculus (Angelini, 1827) (figs. 2, 46)

The larvae of this Sicilian endemism are described here for the first time.

Measured specimens

Italy, Sicily, Madonie (PA), VI.2010, M. Romano leg., *ex ovo,* 19 (3rd instar).

Description of 3rd instar larva. Average body length 9.72 mm; head capsule length 2.06 mm (min-max 1.87-2.22), head capsule width 2.50 mm (2.25-2.70), mandible length 2.37 mm (2.19-2.58), ratio head capsule width/length 1.21, ratio mandible length/head capsule length 1.15. General colouring pale greyish thickly mottled darker grey, ventral side paler; dorsal side of the head capsule dark dark brown with conspicuous variegated yellow markings, ventral side dark brown with two paler longitudinal markings, mandibles dark brown; thorax and legs yellowish. Head: wider than long, slightly dilated posteriorly; anterior margin of the labrum with a median incision; antennae thin, longer than the eye tubercles; eye tubercles cylindrical and pronounced; mandibles longer than the head capsule, equipped with 3 pairs of teeth of which the middle one is the longest; 0-1 setae between the apical and middle teeth, at least 2 setae with dilated base between the middle and basal teeth, at least 4 setae with dilated base between the basal teeth and the base of the mandible; labial palps 4-articulated. Thorax: provided with 4 pairs of scoli and characterized by a dorsal yellowish coloration, making it visually distinct from the greyish abdomen, thoracic scoli yellow; pronotum dark brown with yellow stripes and covered by short setae; mesothoracic spiracle yellow with black apex. Legs: all pairs of legs with dark brown coxae, femora, tibiae and tarsi yellowish with median suffused brown markings. Abdomen: provided with 8 pairs of supra-spiracular scoli yellowish in colour, sub-spiracular series atrophied except the first two pairs; VIII sternite with brown spots in

proximity of the short setae-bearing odontoid processes; IX sternite yellowish with a brown base and equipped with short, apical rastra.

Remarks: *L. siculus* is an endemism of Sicily and nearby islands, and it shares its distribution only with one congeneric species: *L. coccajus*. The two species can be clearly set apart thanks to the pale markings on the ventral side of the head, the yellowish colour of the head markings, of the thorax and of the legs of the first one. The above mentioned characters also clearly distinguish *L. siculus* from the closely related but allopatric *L. ictericus* and *L. corsicus*.

Bio-ecology: This species inhabits open, grassy habitats from the sea-level to the mountains (Madonie, Peloritani, Etna); the larvae are soil dweller ambush hunters, not differently from other members of the genus.

Libelloides latinus (Lefèbvre, 1842) (figs. 7E, 47)

The larvae of this Italian endemism are un-described; the only existing account is a short note by Pantaleoni (1991) discussing their camouflaging behavior.

Measured specimens

Italy, Liguria, Pompeiana (IM), VII.2010, D. Badano leg., *ex ovo,* 22 (3rd instar).

Description of 3rd instar larva. Average body length 12.08 mm; head capsule length 2.58 mm (min-max 2.37-2.73), head capsule width 2.95 mm (2.77-3.11), mandible length 2.77 mm (2.55-3.03), ratio head capsule width/length 1.14, ratio mandible length/head capsule length 1.07. General colouring pale ochre with a dark mottled pattern, ventral side paler; head capsule dorsally pale brown with a dark clypeo-labrum and a median trapezoidal dark marking with a yellowish border disposed at the height of the eye tubercle, a darker area is present at the insertion of larger dolichasters on the surface of the head, ventral side brown with a darker anterior portion; mandibles brown. Head: wider than long, slightly dilated posteriorly; anterior margin of the labrum with a small median incision; antennae thin, black and longer than eye tubercle; eye tubercles, prominent, relatively large; mandibles slightly longer than the head capsule and equipped with 3 pairs of teeth of which the middle one is the largest; 0-1 setae between the apical and middle teeth, 1-3 setae with dilated base between the middle and the basal teeth, 3-4 setae with dilated base between the basal teeth and the base of the mandible; labial palps 4-articulated. Thorax: provided with 4 pairs of scoli; pronotum pale brown with dark brown stripes; mesothoracic spiracles ochre with a dark apex. Legs: all pairs of legs with dark brown coxae while femora, tibiae and tarsi are pale with a central darker area. Abdomen: equipped with 8 pairs of supra-spiracular scoli and 8 pairs of sub-spiracular scoli of which only the first two anterior pairs are

developed, the others atrophied; VIII abdominal sternite provided with short setae-bearing odontoid processes; IX sternite pale with dark markings both on the anterior an posterior ends, posteriorly provided with short rastra.

Remarks: This species is an endemism of the Apennine Peninula, not crossing the Po river and absent from most of northern Italy. The pigmentation pattern allows to discriminate it from the examined sympatric species.

Bio-ecology: *L. latinus* is a lowland species of open environment, rarely found over 700 m of altitude (Pantaleoni, 1990). As the other members of the genus, it is an inhabitant of grassland, meadows, glades and open shrublands; it is common in Mediterranean environments. The larvae are ambush predators living on the soil surface, camouflanging themselves with detritus.

Figure 36. *Ascalaphus festivus* Rambur, 1842: 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Sant'Anna Arresi, Porto Pino].

Figure 37. *Puer maculatus* (Olivier, 1789): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [France: Hérault, Argelliers].

Figure 38. *Bubopsis agrionoides* (Rambur, 1838): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [France: Hérault, Argelliers].

Figure 39. *Deleproctophylla australis* (Fabricius, 1787): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Monti].

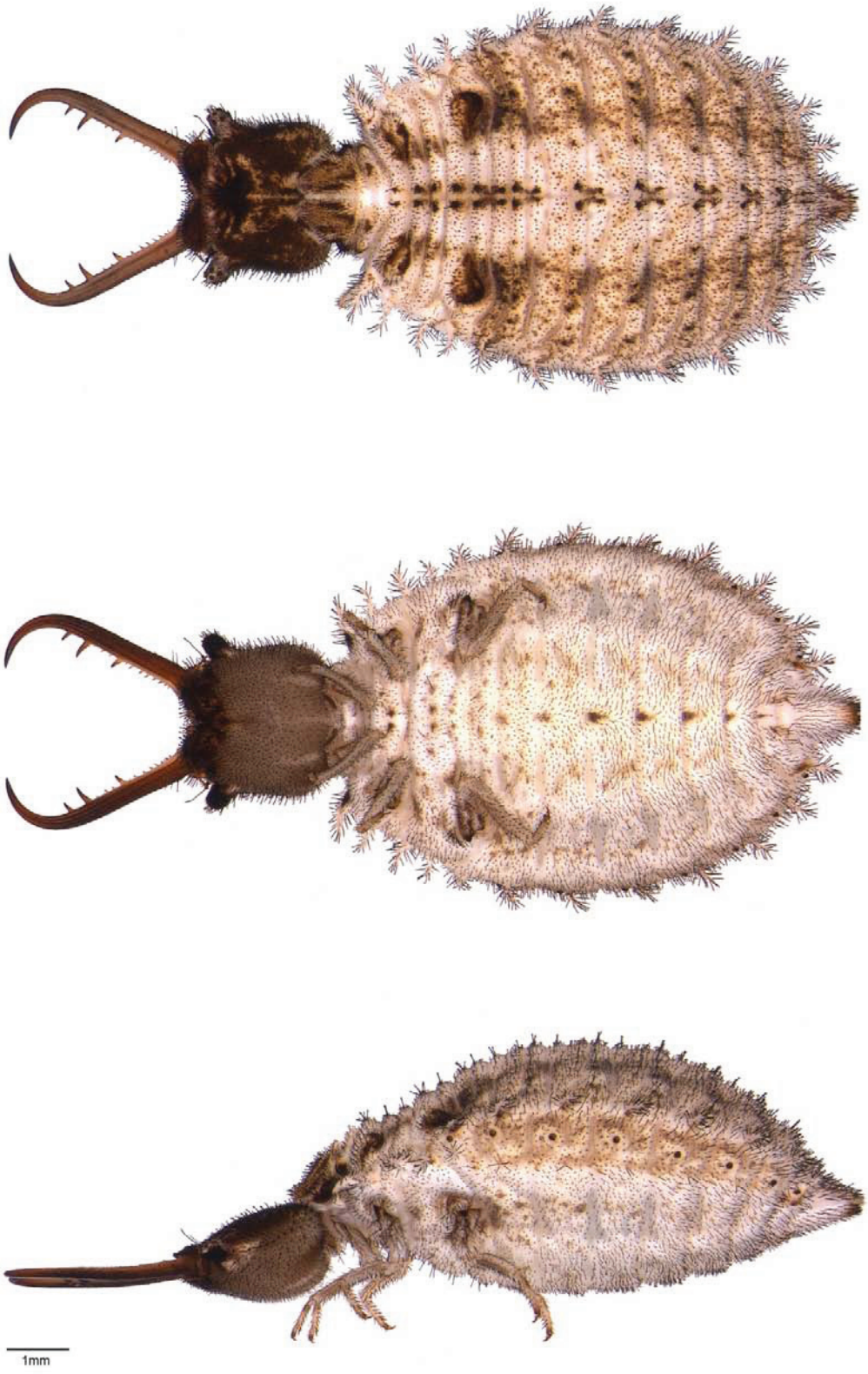

Figure 40. *Deleproctophylla dusmeti* Navás, 1914: 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [France: Alpes Maritimes, Villeneuve-Loubet].

Figure 41. *Libelloides coccajus* (Denis et Schiffermüller, 1775): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Liguria, Mt. Toraggio].

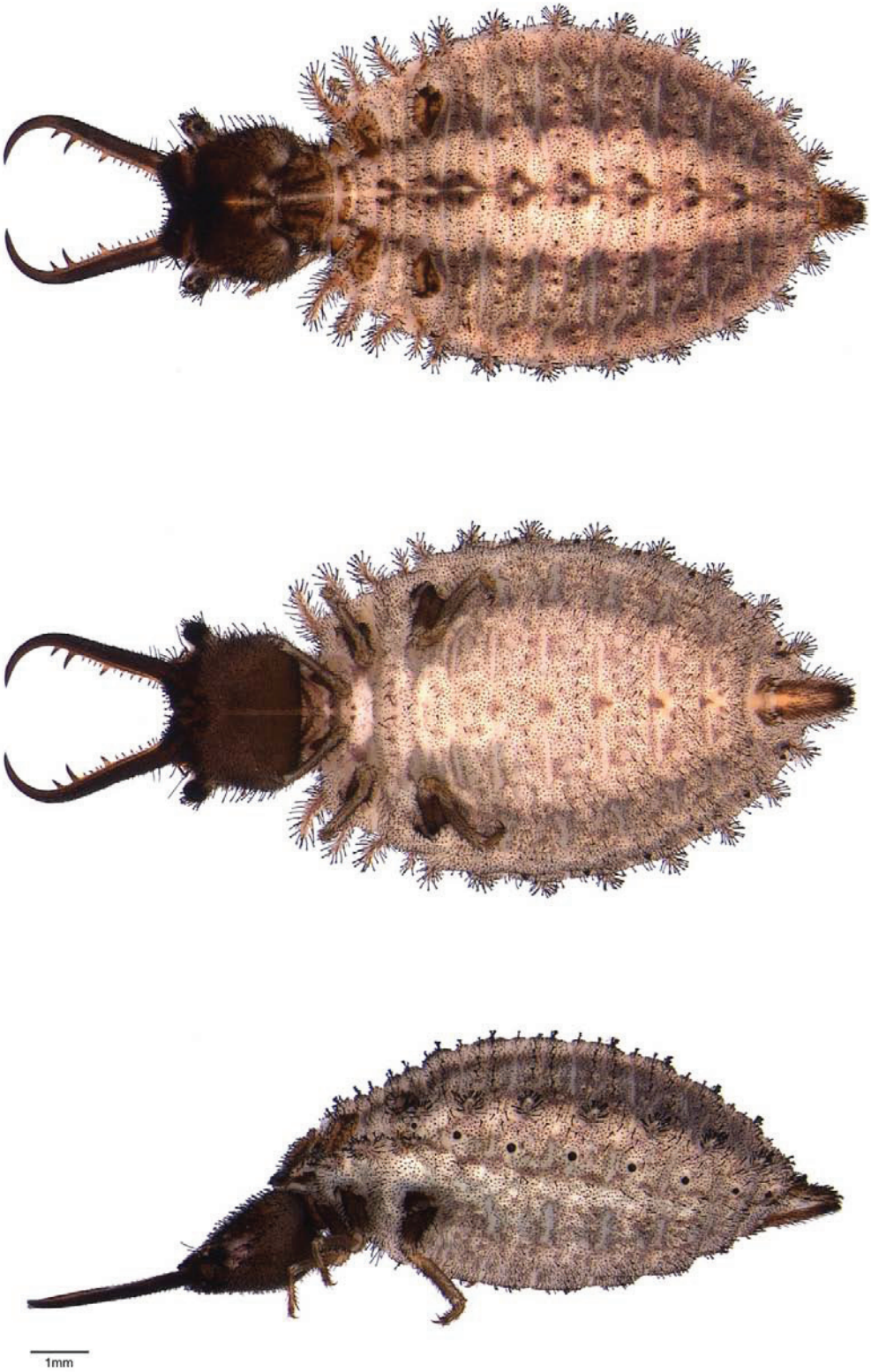

Figure 42. *Libelloides macaronius* (Scopoli, 1763): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Friuli-Venezia Giulia, Trieste].

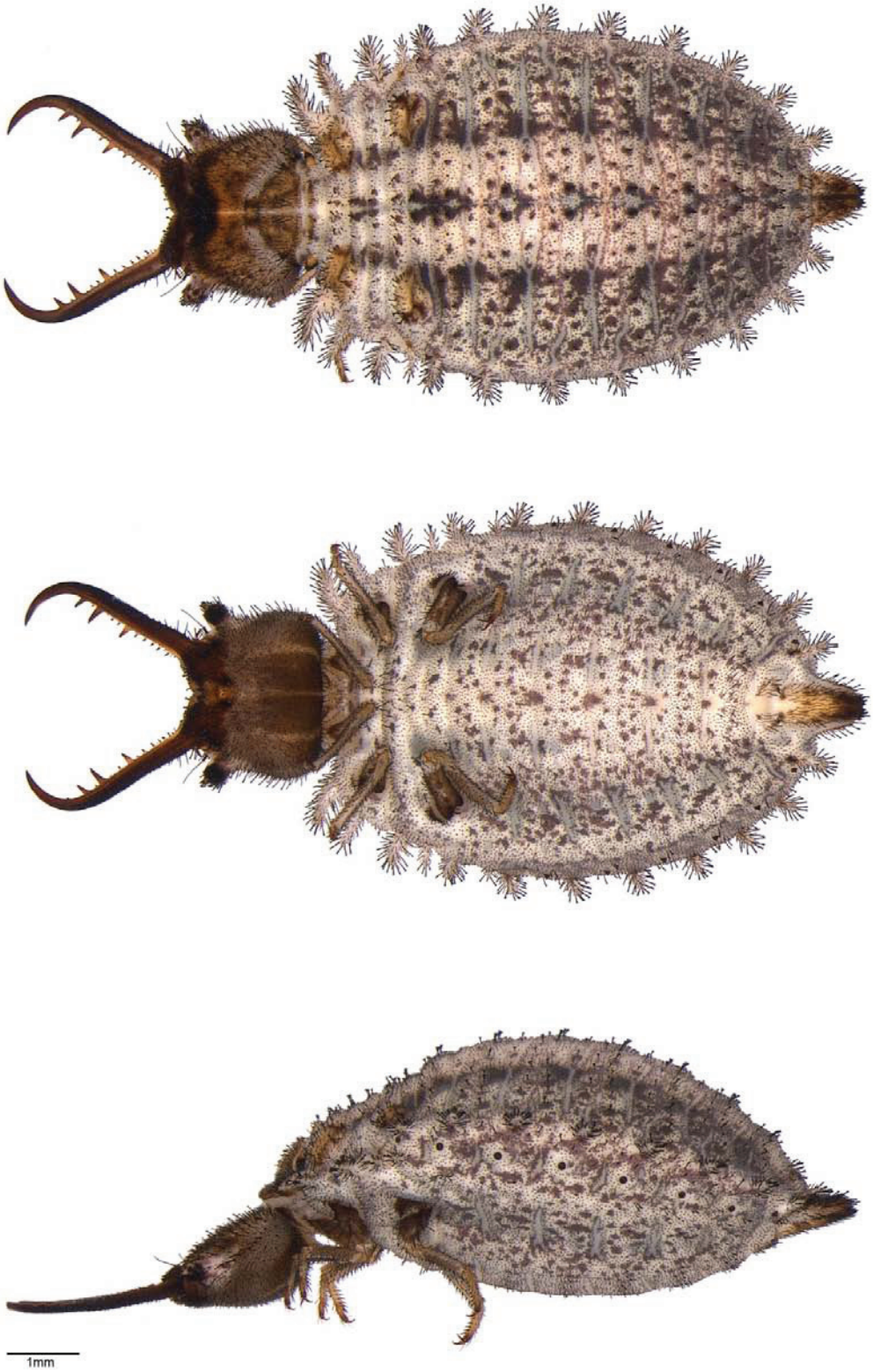

Figure 43. *Libelloides longicornis* (Linnaeus, 1764): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [France: Var, Mt. Aurelien].

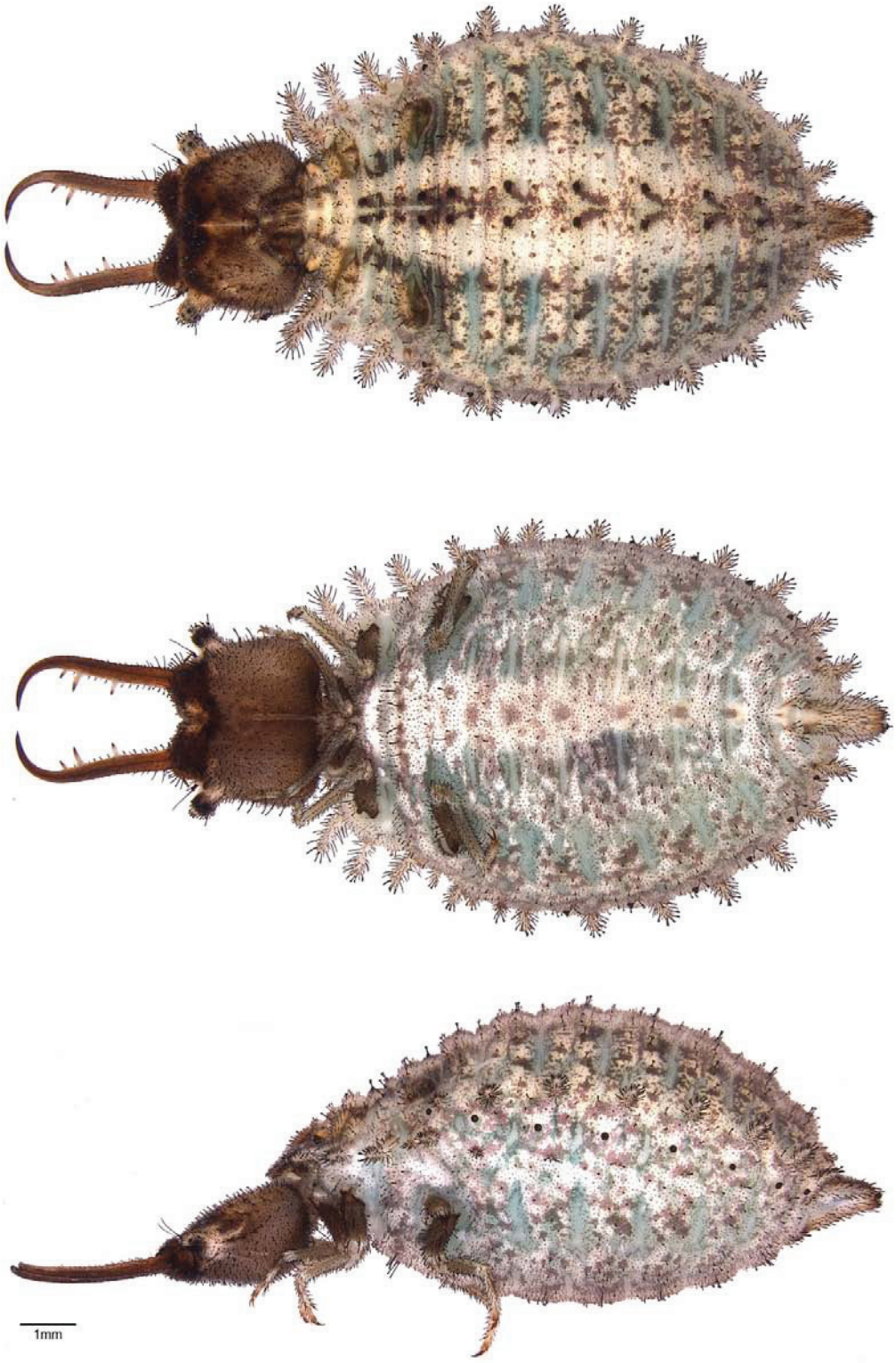

Figure 44. *Libelloides ictericus* (Charpentier, 1825): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [France: Hérault, St. Paul et Valmalle].

Figure 45. *Libelloides corsicus* (Rambur, 1842): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Sardinia, Alghero, Mt. Doglia].

Figure 46. *Libelloides siculus* (Angelini, 1827): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy, Sicily, Madonie].

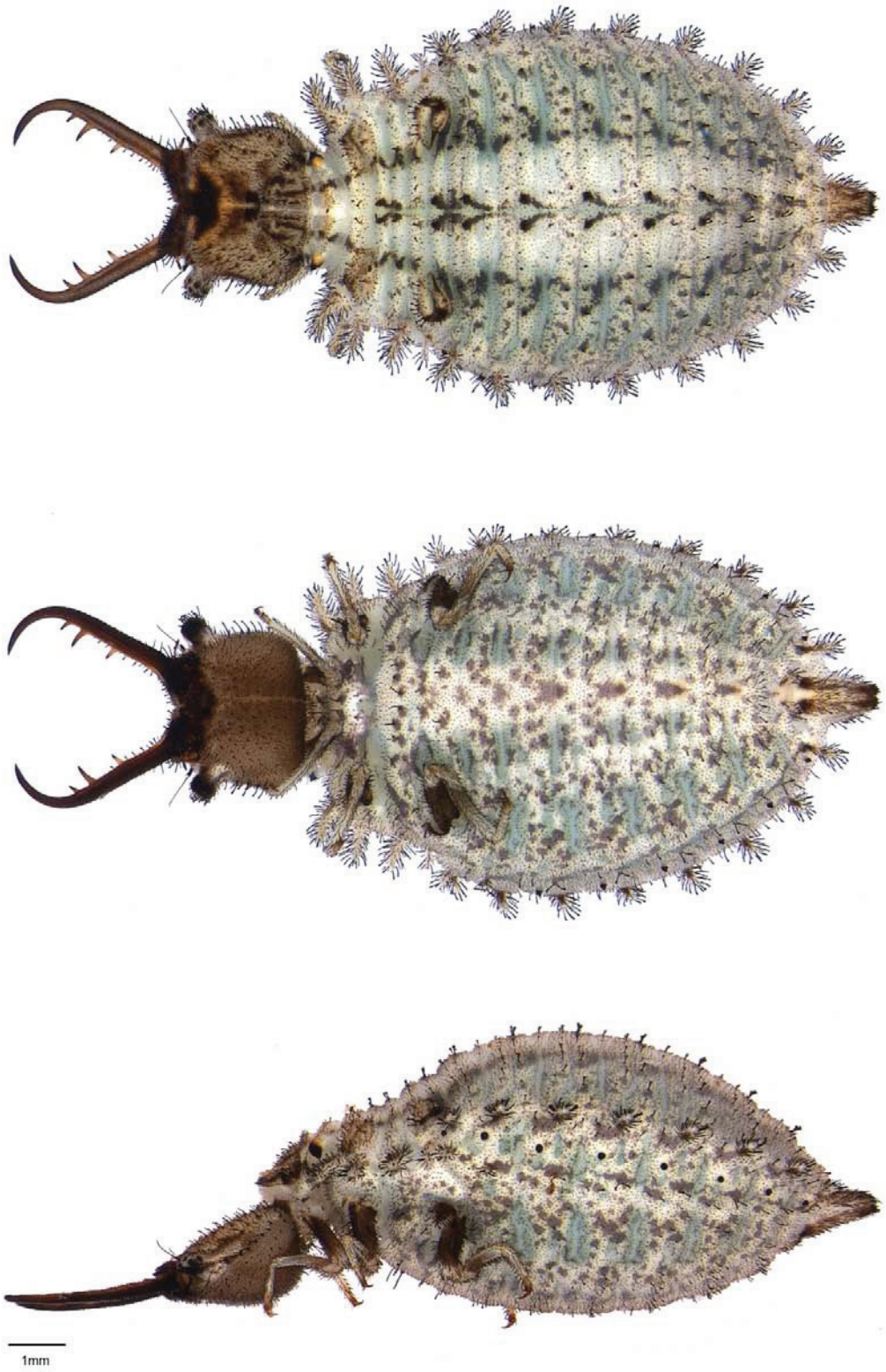

Figure 47. *Libelloides latinus* (Lefèbvre, 1842): 3rd instar larva, dorsal (above), ventral (middle) and lateral (below) view [Italy: Liguria, Pompeiana].

Conclusion

The secretive customs of the larvae of Myrmeleontidae and Ascalaphidae were always the main obstacle to their study. This is particularly remarkable for the larvae of ambush hunters species, in this respect a notable example is represented by *Macronemurus appendiculatus*, whose larva and ecology were *de facto* unknown despite it is a very common species, present in almost every arid and hot meadow of western Mediterranean Europe. Even the larvae of pit-building species, though this interesting behavior attracted the curiosity of naturalists for centuries, have been often overlooked in the well investigated Europe as it is demonstrated by the recent discovery of *Myrmeleon mariaemathildae* and *Myrmeleon punicanus* (Pantaleoni et al., 2010; Pantaleoni & Badano, 2012). The present study, conducted for a period of three years, allowed to cover the preimaginal stages of 14 genera of Myrmeleontidae and of the all 5 genera of Ascalaphidae of the European fauna. Between Myrmeleontidae, the larvae of *Neuroleon arenarius*, *Neuroleon assimilis*, *Megistopus lucasi* and *Myrmeleon gerlindae* are described for the first time while those of the poorly known *Dendroleon pantherinus* and especially of the above mentioned *Macronemurus appendiculatus* (whose description was unsatisfying) are extensively re-described. Moreover new light is shed on complex genera such as *Neuroleon* and *Myrmeleon* itself. Considering the family Ascalaphidae, all the genera have been examined, including the genus *Ascalaphus*, whose presence in Europe was recently discovered. The characteristic of the larvae belonging to the various genera of owlflies have been redefined and the larvae of *Ascalaphus festivus*, *Bubopsis agrionoides*, *Deleproctophylla australis*, *Libelloides corsicus*, *Libelloides siculus* and *Libelloides latinus* are described for the first time. Particularly noteworthy is the re-discovery of the larva of the rare *Puer maculatus*, a peculiar species that was even considered extinct in Europe (Aspöck U. & Aspöck H., 1987), originally described by Hagen (1873) but whose description was considered doubtful (Aspöck et al., 1980). Despite for the results attained in the present research, the state of knowledge of the larvae of European Myrmeleontidae and Ascalaphidae are far from be considered exhaustive being the preimaginal stages of many taxa still unknown. This problem is mainly due to the difficulty to locate the larvae in the field (and often even the imagoes), the localized distribution of some species and in some case their rarity. Moreover ecological information are often extremely fragmentary. An emblematic example is offered by *Nedroledon anatolicus* (Navás, 1914), a species distributed in the Balkan Peninsula and Anatolia of which only 7 specimens have been reported. Excluding some Centro-Asiatic species reaching the extreme limits of the European continent, the larvae of 7 genera and at least 15 species of Myrmeleontidae are still un-described, while the family Ascalaphidae counts 5 species with unknown preimaginal stages. The present work has the finality to constitute a base for the

identification and for undertake future studies on these peculiar insects, keeping in mind not only their interesting behaviours, but also their role as insect predators in arid environments and the potentiality to employ them as bio-indicators in fragile habitats such as sand dunes. This aim has been reached by means of the identification keys, the comparative descriptions of a such notable number of taxa of both families and the rich illustrations (whose role for identification purposes should not be underestimated) allowoing the identification of all the commonest genera and species of Western Europe.

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