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EUGREGARINORIDA IN *MYRMELEON* AND *EUROLEON*: FIRST EVIDENCE OF THE GREGARINES (PROTOZOA: APICOMPLEXA) IN ADULT ANTLIONS (INSECTA: NEUROPTERA: MYRMELEONTIDAE)

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ABSTRACT

During study of morphology of Neuroptera septate gregarines were found in the digestive tract of adult specimens of two antlion species, Myrmeleon hyalinus and Euroleon nostras. Micrographs and morphometric data of gamonts and trophozoites indicate that they belong to the genus Gregarina. However, additional studies will be required to identify gregarines at the species level. The present paper represents the first record of gregarines from adult antlions.

Key words: Gregarines, Eugregarinorida, Neuroptera, antlions, Myrmeleontidae, parasites

EUGREGARINORIDA IN *MYRMELEON* E *EUROLEON*: PRIMA EVIDENZA DI GREGARINE (PROTOZOA: APICOMPLEXA) IN ADULTI DI FORMICALEONE (INSECTA: NEUROPTERA: MYRMELEONTIDAE)

SINTESI

Durante uno studio sulla morfologia di neurotteri Formicaleone, sono state trovate gregarine nel tratto digerente di individui adulti di due specie, Myrmeleon hyalinus e Euroleon nostras. Dai dati morfometrici e dalle micrografie di gamonti e trofozoi emerge che essi appartengono al genere Gregarina. Gli autori rilevano la necessità di studi aggiuntivi al fine di identificare le gregarine a livello di specie. L'articolo rappresenta la prima segnalazione della presenza di gregarine in individui adulti di Formicaleone.

Parole chiave: Gregarine, Eugregarinorida, Neuroptera, Formicaleone, Myrmeleontidae, parassiti

INTRODUCTION

Gregarines (Eugregarinorida) are relatively large protozoan parasites in the guts and body cavities of several kinds of invertebrates, including annelids, tunicates, sipunculids and especially arthropods (Clopton, 2002; Ruckert & Leander, 2008). The anterior end is attached to the host via mucron in aseptate gregarines or epimerite in septate gregarines. Characteristic for gregarines is syzygy – the process in which two mature trophozoites pair up before the formation of a gametocyst. Life-cycle of nearly all species requires only one host. Gregarines move by gliding, bending and peristalsis (Clopton, 2002).

The majority of eugregarine species are reported from insects. The knowledge of their occurrence in insects is poor; gregarines have been reported from less than one percent of named insect species (Clopton, 2002).

The first gregarine genus recognized, *Gregarina* Dofour, 1828, was established for *Gregarina ovata* (Dofour, 1828) known as a parasite in the digestive tracts of earwigs (Dermaptera). In the period since *Gregarina* was erected the genus has grown to include more than 300 species primarily infecting coleopterans and orthopterans. As is often the case with nominate genera, *Gregarina* has become an agglomeration of taxa that includes a number of unrecognized or cryptic genera (see Clopton, 2002; Hays et al., 2004; Clopton & Hays, 2006; Clopton et al., 2008a, b).

The first record of gregarines in lacewings (Neuroptera) dates back to 1969 when Geus (1969) described *Hyalospora hemerobii* from brown lacewing *Hemerobius pini*. Later, in 1978 a new gregarine species, *Actinocephalus acanthaclisis* was described from larval antlion *Acanthaclisis baetica* originating from France (Marques & Ormières, 1978). In the present paper, gregarines from adult antlions are reported for the first time.

Tab. 1: Measurements of gregarines in *Myrmeleon hyalinus hyalinus* (in μm). Legend: TL - total length; LP - length of protomerite; WP - width of protomerite; LD - length of deutomerite; WD - width of deutomerite; WP:LP - ratio of the width of protomerite to the length of protomerite; WD:LD - ratio of the width of deutomerite to the length of deutomerite; WP:WD - ratio of the width of protomerite to the width of deutomerite; WP:TL - ratio of the width of protomerite to the total length; LP:TL - ratio of the length of protomerite to the total length.

Tab. 1: Meritve gregarin v volkcih vrste *Myrmeleon hyalinus hyalinus* (v μm). Legenda: TL - celotna dolžina; LP - dolžina protomerita; WP - širina protomerita; LD - dolžina deutomerita; WD - širina deutomerita; WP:LP - razmerje med širino protomerita in dolžino protomerita; WD:LD - razmerje med širino deutomerita in dolžino deutomerita; WP:WD - razmerje med širino protomerita in širino deutomerita; WP:TL - razmerje med širino protomerita in celotno dolžino; LP:TL - razmerje med dolžino protomerita in celotno dolžino.

Gregarines	Parameter									
	TL	LP	WP	LD	WD	WP:LP	WD:LD	WP:WD	WP:TL	LP:TL
Type A1	152.9	26.7	33	126.2	49.5	1.24	0.39	0.67	0.22	0.17
Type A2	128.5	24.6	25.1	103.9	42.3	1.02	0.41	0.59	0.20	0.19
Type A3	122.9	23.8	27.6	99.1	38.3	1.16	0.39	0.72	0.22	0.19
Type A4	143.8	24.4	32.3	119.4	45.5	1.32	0.38	0.71	0.22	0.17
Type B1	101.5	20.5	17.8	81	38	0.87	0.47	0.68	0.18	0.20

MATERIAL AND METHODS

Adult antlions *Myrmeleon hyalinus hyalinus* (Olivier, 1811) and *Euroleon nostras* (Geoffroy in Fourcroy, 1785) were reared from larval stages. Larvae of *M. hyalinus hyalinus* were collected in Douz (Tunisia) and larvae of *E. nostras* were collected in Katlanovo (Macedonia). Adults were fed in captivity with apricot jam and mealworm larvae, *Tenebrio molitor*. The mealworm larvae were macerated before being consumed by the adults.

Each antlion was dissected and its intestine was examined microscopically at magnifications 100x, 200x and 400x. In total, 5 adults of *M. hyalinus hyalinus* and 3 adults of *E. nostras* were examined for gregarine presence.

Observed gregarines were measured and photographed using a Nikon E 800 Microscope with a mounted digital camera Nikon DN100, and processed with Eclipse Net version 1.16.3 software. The following standard parameters of gregarine body (in μm), according to Lipa (1967) and Clopton (2004), were measured to describe the characteristics of pathogens in the investigated antlions: total length, length of protomerite, length of deutomerite, width of protomerite, and width of deutomerite.

RESULTS

Gregarines in *Myrmeleon hyalinus hyalinus*

In the gut of one male of *M. hyalinus hyalinus* five gregarines were found. Individuals were elongated and solitary. Measurements are given in Table 1. Two morphological types were distinguished. In one gregarine type (Type A), measuring 122.9–152.9 μm in length, protomerite had hemispherical shape and deutomerite

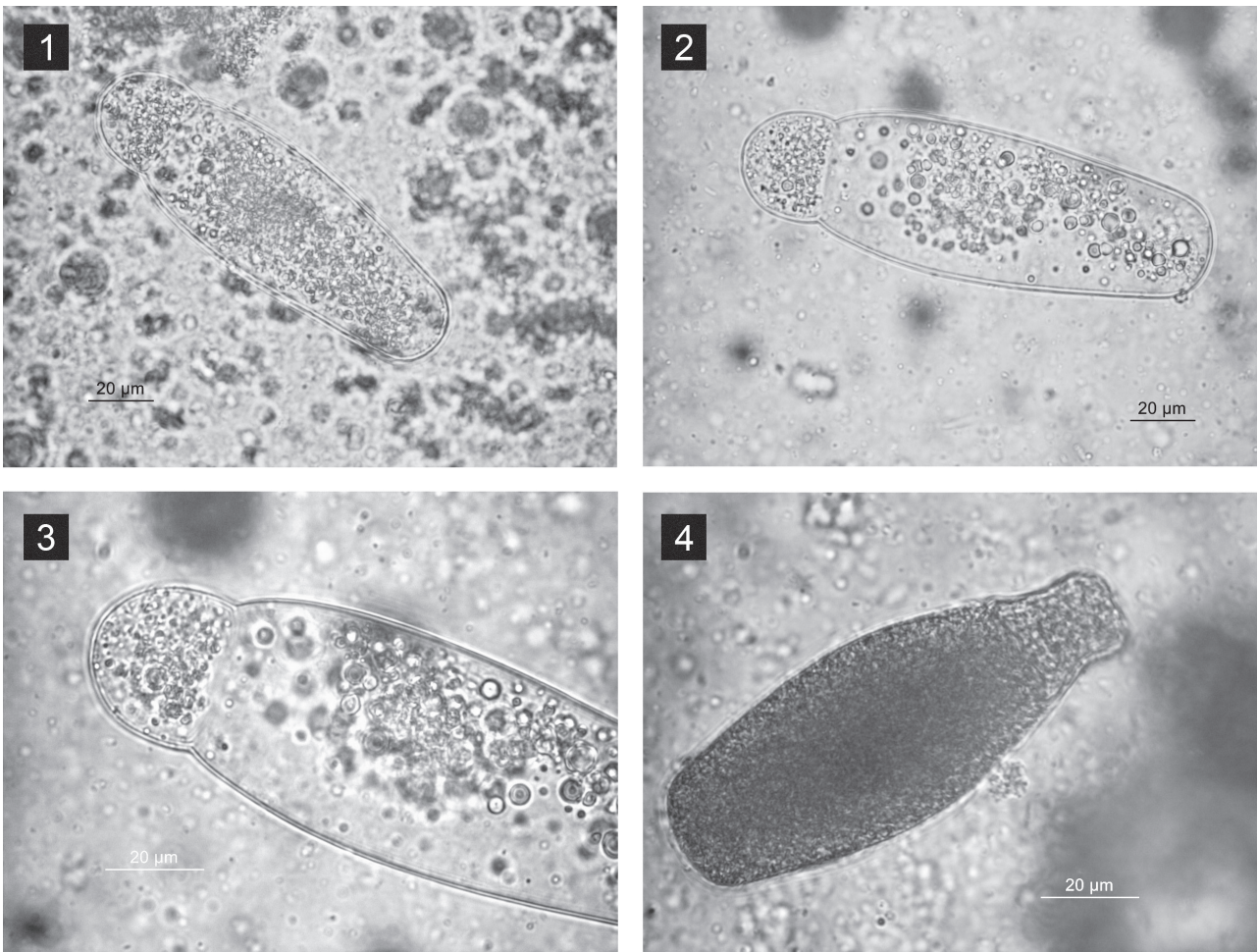


Plate 1 / Tabla 1:

Figs. 1-3: Gregarines of the Type A in *Myrmeleon hyalinus hyalinus*. Figs. 1, 2: Individuals from the gut lumen. Fig. 3: Detail of the protomerite. Fig. 4: An individual of the Type B in *M. hyalinus hyalinus*.

Sl. 1-3: Gregarine tipa A v volkcju vrste *Myrmeleon hyalinus hyalinus*. Sl. 1, 2: Osebki iz črevesnega lumna. Sl. 3: Detajl protomerita. Sl. 4: Osebek tipa B v volkcju vrste *M. hyalinus hyalinus*.

Tab. 2: Measurements of gregarines in *Euroleon nostras* (in µm). For legend see Table 1. Individuals marked with asterisk (*) were measured in syzygium.

Tab. 2: Meritve gregarin v volkcjih vrste *Euroleon nostras* (v µm). Za legendo glej Tabelo 1. Posamezni primerki, označeni z zvezdico (*), so bili izmerjeni v sizigiji.

Gregarines	Parameter									
	TL	LP	WP	LD	WD	WP:LP	WD:LD	WP:WD	WP:TL	LP:TL
1*	198	29	32.1	169	51.9	1.11	0.31	0.62	0.16	0.15
2*	160.2	24.6	34.9	135.6	46.8	1.42	0.35	0.75	0.22	0.15
3	239.4	34.6	33.3	204.8	52.8	0.96	0.26	0.63	0.14	0.14
4*	183.7	31.4	35.5	152.3	53.6	1.13	0.35	0.66	0.19	0.17
5*	151.1	24.3	28.3	126.8	42.9	1.16	0.34	0.66	0.19	0.16
6	212.5	30.4	33.8	182.1	54.5	1.11	0.30	0.62	0.16	0.14
7*	315	45.4	47.4	269.6	95.3	1.04	0.35	0.50	0.15	0.14
8*	372.1	27.2	50.3	344.9	115.1	1.85	0.33	0.44	0.14	0.07
9	201	27.9	31.3	173.1	68.3	1.12	0.39	0.46	0.16	0.14
10*	233.8	36.2	32.8	197.6	53.7	0.91	0.27	0.61	0.14	0.15

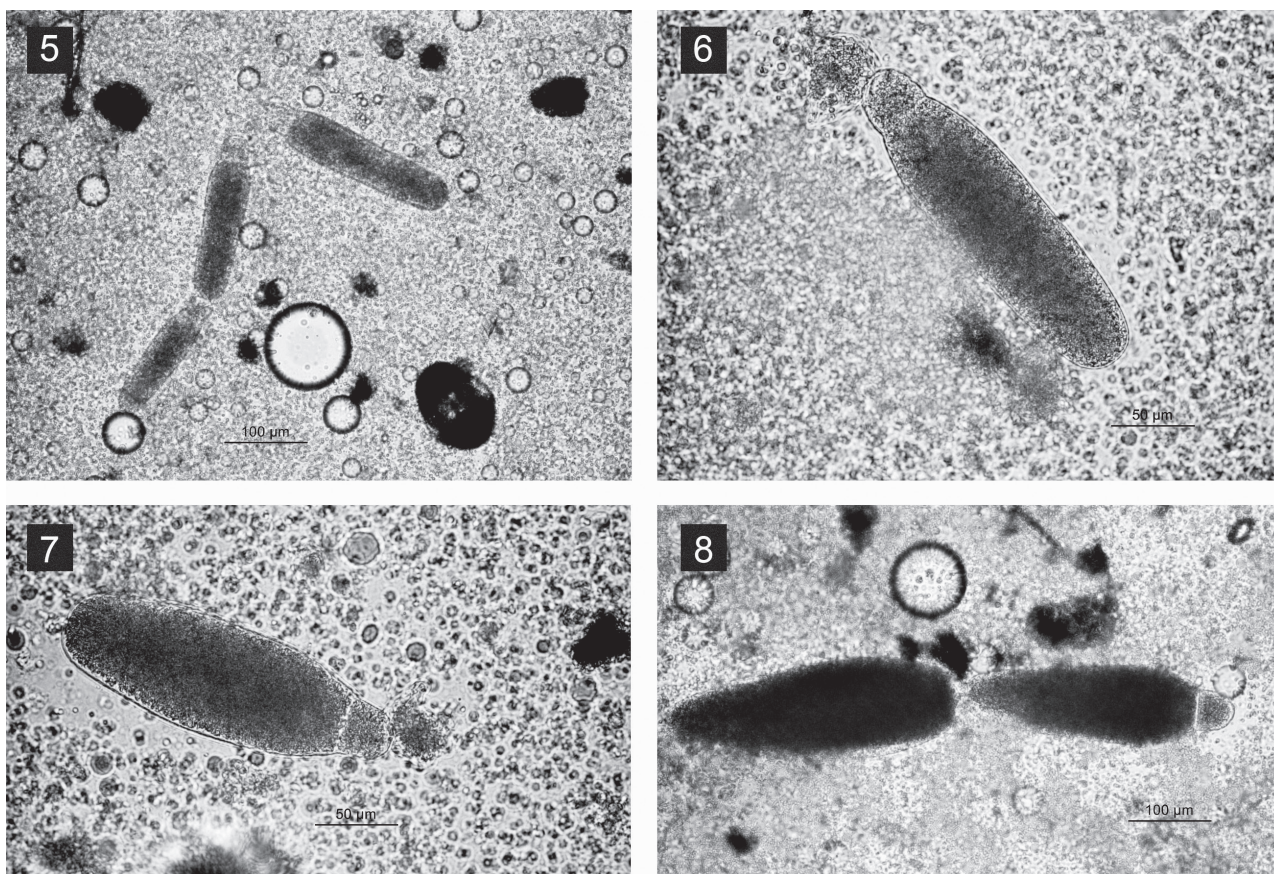


Plate 2 / Tabla 2:

Figs. 5-8: Gamonts in *Euroleon nostras*. Fig. 5: A group of gregarines; syzygy is shown on the left. Figs. 6, 7: Two solitary individuals. Fig. 8: Syzygy of caudofrontal type.
Sl. 5-8: Gamonti v volku vrste *Euroleon nostras*. Sl. 5: Skupina gregarin: na levi je prikazana sizigija. Sl. 6, 7: Dva posamezna osebka. Sl. 8: Sizigija kavdofrontalnega tipa.

was cylindrical to elongate ellipsoidal (Figs. 1-3). Constriction was noted at protomerite deutomerite septum. The other type (Type B) with 101.5 µm length was bottle-like shaped and protomerite was broadly conical (Fig. 4).

Gregarines in *Euroleon nostras*

One female *E. nostras* contained at least ten gregarines (Figs. 5-8). A few examples of syzygy were observed and they were of caudofrontal type (Fig. 8). Measurements are given in Table 2. Gregarines measuring 151.1–372.1 µm in length were elongate ellipsoidal to tongue-shaped with hemispherical protomerites.

DISCUSSION

Keys and micrographs of many European gregarine species are provided in monographs of Lipa (1967)

and Geus (1969). Marques & Ormières (1978) reported occurrence of gregarines in larval antlions. In the present study, gregarines are reported for the first time in adult antlions.

Morphometric analysis of the gregarines found in the digestive tract of adult antlions indicates that they belong to the genus *Gregarina*. According to the morphology, they resemble both gregarine species commonly occurring in *Tenebrio molitor* larvae, namely *Gregarina steini* Berndt, 1902 and *Gregarina cuneata* Stein, 1848. However, additional study will be required to identify gregarines in antlions at the species level. The adult antlions could be infected with gregarines during feeding with mealworm larvae.

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EUGREGARINORIDA V VOLKCIH MYRMELEON IN EUROLEON: PRVA NAJDBA GREGARIN (PROTOZOA: APICOMPLEXA) V ODRASLIH VOLKCIH (INSECTA: NEUROPTERA: MYRMELEONTIDAE)

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POVZETEK

Med favnističnimi raziskavami mrežekrilcev smo v prebavilih odraslih volkcev dveh vrst, *Myrmeleon hyalinus* in *Euroleon nostras*, našli septatne gregarine. Na osnovi mikrografij gamontov in trofozoitov ter morfometričnih podatkov sklepamo, da gregarine spadajo v rod *Gregarina*. Za določitev vrste bo potrebno opraviti še več opazovanj. V prispevku so prvič zabeležene gregarine v odraslih volkcih.

Ključne besede: Gregarine, Eugregarinorida, Neuroptera, volkci, Myrmeleontidae, paraziti

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