

INTESTINAL CONTENTS OF ADULT *OSMYLUS FULVICEPHALUS* (SCOP.)
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ABSTRACT

Crop and gut contents of field-collected adults of the European neuropteran species, Osmylus fulvicephalus (Scop.), were examined with glass slide preparations. Well chewed and partially digested insect fragments as well as pollen and fungal spores were found. Aphids, Heteroptera, Coleoptera, Diptera, and mites were noted. We assume that lepidopteran scales, pollen grains and fungal spores were swallowed by osmylid adults while feeding on honeydew. In one female's gut, a well preserved water flea, Chydorus sphaericus, was detected.

Key words: Neuroptera, intestinal contents, pollen, fungal spores, insects, *Chydorus sphaericus*

CONTENUTI INTESTINALI DI ADULTI DI *OSMYLUS FULVICEPHALUS* (SCOP.)
(NEUROPTERA, OSMYLIDAE)

SINTESI

Con l'ausilio di preparati microscopici gli autori hanno esaminato i contenuti del gozzo e dell'intestino di individui adulti di una specie europea di neurotteri, Osmylus fulvicephalus (Scop.). Tra i frammenti ben masticati e parzialmente digeriti hanno trovato polline, spore fungali e frammenti di insetti, quali afidi, eterotteri, coleotteri e ditteri. Gli autori suppongono che il neurottero abbia ingerito squame di lepidotteri, polline e spore mentre si nutrive di melata. Nel contenuto intestinale di una femmina è stato ritrovato un esemplare ben conservato di una specie di cladocero, Chydorus sphaericus.

Parole chiave: Neuroptera, contenuti intestinali, polline, spore fungali, insetti, *Chydorus sphaericus*

INTRODUCTION

The feeding biology of some lacewings (Neuroptera) is still insufficiently known. Adults and larvae of most neuropteran species are free-living predators and generalist feeders as they take a wide variety of small, soft bodied arthropod prey (Principi & Canard, 1984; Stelzl, 1991; Stelzl & Devetak, 1999). According to their feeding habits, some neuropteran families have been recognised as important predators in agroecosystems (e.g. Stelzl & Gepp, 1987; New, 1989; Stelzl, 1990; Stelzl & Devetak, 1999; Duelli, 2001; McEwen *et al.*, 2001). Only a few exceptions exist among lacewings, feeding on food of plant origin. Adults of Sisyridae and Osmylidae take both animal and plant food, and adults of many Chrysopidae are pollen or honeydew feeders (Tjeder, 1944; Kokubu & Duelli, 1983, 1986; Canard *et al.*, 1984; New, 1989; Stelzl & Devetak, 1999; McEwen *et al.*, 2001). On the other hand, adults of Nemopteridae seem to feed exclusively on pollen (Tjeder, 1967; Monserrat, 1996).

Osmylus fulvicephalus (Scopoli, 1763), the only wide-spread European osmylid species, occurs near water bodies, along streams and river banks. David (1936) reported that the species feeds on flowers, dead insects of various orders, and attacks conspecifics as well. Killington (1932) noted lepidopteran scales in its alimentary tract. Kokubu & Duelli (1986) examined the crop and gut contents of field-collected adult *O. fulvicephalus* and found a variety of food, consisting of fragments of insects, eriophyid mites, pollen, and algae. Stelzl (1991) detected aphids, dipterans and honeydew. The aim of this study is to present results of the observations on intestinal contents of *O. fulvicephalus* collected in central and southern Europe.

MATERIAL AND METHODS

Osmylus fulvicephalus adults were collected using a sweepnet and preserved in 70% ethanol. Individuals from the following places were used in the study: Croatia: Buzet, Bračana, 21. 5. 1986, 1 male, leg. C. Krušnik; Italy: Campigna National Park, Gran Duca Hotel, 25. 6. 2005, 2 males, leg. D. Devetak; Macedonia: Pletvar, Prilep, 28. 5. 1979, 1 male, leg. P. Jakšić; Montenegro: Durmitor National Park, G. Dobrilovina, 15. 6. 1985, 3 males, 2 females leg. D. Devetak and F. Janžekovič; Slovenia: Maribor, Zg. Radvanje, 22. 6. 1986, 3 males, 3 females, leg. D. Devetak; Slovenia: Medvode, Trnovec in the Ločnica valley, 24. 6. 1976, 2 females, leg. D. Devetak; Slovenia: Slovenj Gradec, Bukovska vas, 22. 5. 1983, 2 males, 2 females, leg. L. Slana, M. Ferenc, M. Štangelj, T. Novak; Slovenia: Tacen, 19. 6. 1976, 1 female, leg. D. Devetak.

Twenty-two individuals (13 males, 9 females) were dissected and parts of their digestive tract with the con-

tents were mounted in 70% ethanol on glass slides and examined microscopically. Identification of the arthropod fragments required extensive studies of literature on insect morphology (e.g. Meijere, 1901; Borror *et al.*, 1976; Steinmann & Zombori, 1985; Dettner & Peters, 1999 etc.) and preparation of glass slides for comparative analysis.

RESULTS

As the crop and gut contents showed no basic difference, and as there was no difference detected between the sexes, results on crop and gut contents of both sexes are presented together.

The crop and gut contents of almost all specimens contained well chewed insect fragments (Tab. 1). The exceptions were one male from Buzet (Croatia) and two freshly emerged males collected in Campigna National Park (Italy), which were obviously caught before feeding, for their crops and guts were empty. Only in a few cases it was possible to identify the insect order for the corresponding fragment, but mostly the origin of arthropod remains was unknown. In the preparations, fragments of insect antennae, compound eyes, legs, and wings were noted. Compound eyes frequently occurred in the intestinal contents, differing in the shape of lenses of their ommatidia (Figs. 1-2). Fragments of eyes with hexagonal lenses were common (Fig. 1) whereas those with heteropteran-like lenses were noted only twice (Fig. 2). Dipteran, coleopteran and heteropteran tarsi and lepidopteran scales were also found (Figs. 4-6). Aphids were present in the crops and guts of numerous preparations; in one female, an almost complete aphid was documented

Tab. 1: Occurrence of food items in crop and gut contents of *O. fulvicephalus* in terms of absolute numbers. Legend: N = total number of individuals investigated microscopically; n = number of individuals containing certain food item.

Tab. 1: Pojavljanje ostankov hrane v prebavilih vrste *O. fulvicephalus*, izraženo v absolutnih številkah. Legenda: N = število vseh pregledanih osebkov; n = število osebkov z ostanki določene hrane.

Food source (N = 22)	n
Homoptera: aphids	7
Heteroptera	2
Coleoptera	4
Diptera	5
Lepidoptera (scales)	5
Acarina	1
Crustacea: Cladocera	1
pollen	9
Fungi: micelia, spores	6
unidentified arthropod fragments	19

(Fig. 3). In another individual, a partially fragmented mite was recorded.

Unexpected was the finding of a well preserved water flea, *Chydorus sphaericus* (Fig. 7). This cladoceran was found in a female originating from a place close to a pond (Zg. Radvanje, Slovenia).

In a majority of digestive tracts, different kinds of pollen were found. Some of them were determined as pollen of the families Pinaceae (*Picea abies*, *Pinus*) and Apiaceae (Figs. 10-12). Mycelia (Fig. 8) and spores of unidentified fungi were common. In a few individuals (originating from Slovenia and Montenegro), asexual spores (conidia), called phragmospores, of unidentified fungi (probably of the Ascomycota-group) were recorded (Fig. 9).

DISCUSSION

The majority of Neuroptera are known as predators, feeding on various soft bodied arthropods. Based on arthropod fragments dominating in crops and guts, one can conclude that *Osmylus fulvicephalus* is mainly carnivorous. For both neuropteran families, Osmylidae and Sisyridae, algae, fungi and foliage were found to be an additional diet (Kokubu & Duelli, 1983, 1986). Fungal spores, fragments of heteropterans, coleopterans and cladocerans had not yet been documented for *O. fulvicephalus* before (Tab. 2). In neuropterid families, only the Nemopteridae seem to feed exclusively on pollen, and are thus considered trophic specialists (Monserrat, 1996).

In the gut of dissected specimens of Australian Kempyninae, a subfamily of Osmylidae, New (1983) found

pollen, fungi, and fragments of bark and foliage, but there was a lack of food of animal origin (Tab. 2).

Sheldon & MacLeod (1971) noted that adult green lacewings of species with non-predatory adults in the genus *Chrysoperla* scrape at the leaf and twig surface where honeydew is present. For the same species it was confirmed that sooty molds (Dematiaceae) growing directly on the honeydew are ingested with it (Sheldon & MacLeod, 1971). Lepidopteran scales can get trapped in the sticky honeydew when lepidopterans (butterflies and moths) fly close to homopterans producing honeydew. So the presence of lepidopteran scales in digestive tract does not necessarily mean that butterflies or moths are consumed by predators.

David (1936) reported that osmylid adults occasionally feed on dead insects and may even prey on weak conspecifics. The majority of individuals inspected in the present study contained also pollen, some of them in large amounts. As already suggested by Kokubu & Duelli (1986), the species does seem to actively feed on pollen. Obviously, some pollen grains and fungal spores could also have been swallowed by osmylid adults while feeding on honeydew.

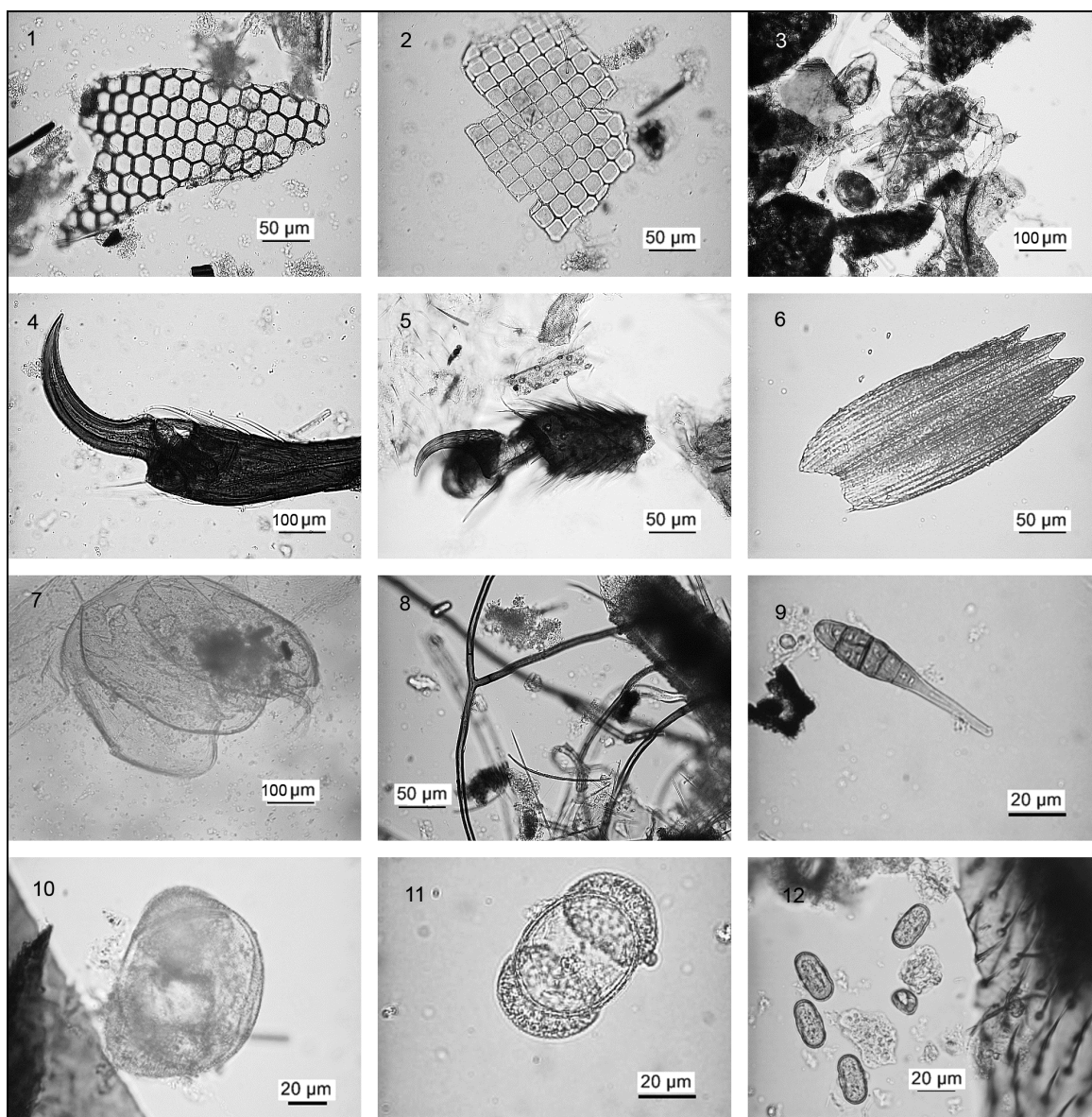
In one female's gut, a water flea (*Chydorus sphaericus*; Cladocera, Crustacea) was recorded. We assume that the flea was swallowed accidentally, probably while feeding on honeydew from the surface of floating leaves of water plants, which are often covered with aphids. A splash of a frog or a heavy raindrop may have catapulted the flea onto the leaf. It is known that water fleas at times occur in masses at the water surface. The speculation on the occasional acquisition of the cladoceran is supported by the fact that it was found almost intact, as

Tab. 2: Intestinal contents of Osmylinae and Kempyninae.

Tab. 2: Vsebinska prebavila poddružin Osmylinae in Kempyninae.

Food source	Subfamily		Reference
	Osmylinae	Kempyninae	
Homoptera: aphids	x		3, 4, 5
Homoptera: psyllids		x	2
Heteroptera	x		5
Coleoptera	x		5
Diptera	x		3, 4, 5
Lepidoptera	x	x	1, 2, 5
Acarina: Eriophyidae	x		3
Crustacea: Cladocera	x		5
pollen	x	x	2, 3, 5
algae	x		3
fungi	x	x	2, 5
bark fragments		x	2
foliage fragments		x	2
mineral particles	x		3

References / Reference: 1 – Killington (1932); 2 – New (1983); 3 – Kokubu & Duelli (1986); 4 – Stelzl (1991); 5 – this paper.



Figs. 1–12: Intestinal contents of *O. fulvicephalus*.

Sl. 1–12: Vsebina prebavil mrežekrilca *O. fulvicephalus*.

Fig. 1: Fragment of a compound eye with hexagonal lenses. / Sl. 1: Fragment sestavljenih oči s heksagonalnimi lečami.

Fig. 2: Fragment of a compound eye with quadratic lenses (a heteropteran-like eye). / Sl. 2: Fragment sestavljenih oči s kvadratnimi lečami (struktura spominja na oči stenic).

Fig. 3: An aphid. / Sl. 3: Listna uš.

Fig. 4: Distal part of a coleopteran tarsus. / Sl. 4: Distalni tarzalni del hrošča.

Fig. 5: Fragment of a dipteran tarsus. / Sl. 5: Tarzalni fragment dvokrilca.

Fig. 6: Lepidopteran scale. / Sl. 6: Luskica metulja.

Fig. 7: A water flea, *Chydorus sphaericus*. / Sl. 7: Vodna bolha, *Chydorus sphaericus*.

Fig. 8: Septate fungal hyphae. / Sl. 8: Septirane hife gliv.

Fig. 9: Phragmospore. / Sl. 9: Fragmospora.

Fig. 10: Pollen grain of spruce fir, *Picea abies*. / Sl. 10: Pelodno zrno smreke, *Picea abies*.

Fig. 11: Pollen grain of pine, *Pinus* sp. / Sl. 11: Pelodno zrno bora, *Pinus* sp.

Fig. 12: Pollen of Umbelliferae. / Sl. 12: Pelod kobulnice.

it was too small to be masticated into smaller pieces before it was swallowed. Kokubu & Duelli (1986) found in *O. fulvicephalus* green and brown coloured algae. Both findings indicate that adult osmylids are strongly linked to water bodies for feeding.

The size of neuropteran insects and the morphology of their mouthparts reflect the feeding ecology of a taxon. The morphology of the mouthparts in Nemopteridae proves that they are feeding only on pollen (Monserat, 1996). Sisyridae (with *Sisyra terminalis* as an example) feed mainly on aphids and eriophyid mites. This specialization may be due to their minute size (Kokubu & Duelli, 1983). Larger Neuroptera, like osmylids, ascalaphids, and myrmeleontids (Kokubu & Duelli, 1986; Stelzl & Gepp, 1990; Stelzl, 1991; Devetak *et al.*, 2002) are general predators feeding on a variety of arthropods.

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VSEBINA PREBAVIL ODRASLEGA MREŽEKRIŁCA *OSMYLUS FULVICEPHALUS* (SCOP.) (NEUROPTERA, OSMYLIDAE)

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POVZETEK

S tehniko izdelave mikroskopskih preparatov smo preučevali vsebino golše ter srednjega in zadnjega črevesa evropske vrste potočnega mrežekrilca, Osmylus fulvicephalus (Scop.). Med dobro prežvečenimi in delno prebavljenimi fragmenti smo našli pelodna zrna in spore gliv, med ostanki členonožcev pa listne uši, stenice, hrošče, dvokrilce ter pršice. Domnevamo, da je mrežekrilc pogoltnil luskice metuljev, pelodna zrna in spore gliv, ko se je hranil z medeno roso. V prebavilih enega osebkov smo našli dobro ohranjeno vodno bolho vrste Chydorus sphaericus.

Ključne besede: Neuroptera, vsebina prebavil, pelod, spore gliv, žuželke, *Chydorus sphaericus*

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