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## OPILIONES (ARACHNIDA) AS A COMPONENT OF THE FOOD STUFFS OF SOME ANIMALS

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The article presents new data about Opiliones as a component of the food of Araneae, Formicidae, Lacertidae and Soricidae.

**Key words:** harvestmen, Opiliones, enemies.

The list of species which attack Opiliones and include them in their diet is not complete and in many cases it is controversial. This is due to the fact that in natural conditions these relationships can be rarely observed.

Therefore, when studying Opiliones in Mount Vitosha and some regions of the western parts of the Rhodope mountains, special attention was paid also to the natural enemies of harvestmen.

Scarce information about the enemies of harvestmen in Bulgaria is found in the publications of Христова (1962), Бешков, Пончев (1963), Симеонов (1963, 1964), Бешков (1970), Ангелов и др. (1972 *a, b*), Angelov et al. (1972), Томов (1990) and Ivanov (1990). All of the authors have worked upon the investigation of the stomach content of vertebrates. Similar investigations, enlarging the list of enemies of Opiliones, we find in the works of Savory (1928), Stipberger (1928), Bristowe (1941, 1949), Sankey (1949), Даревский (1953), Šilhavý (1956), Кырдей (1958), Прокофьева (1961), Thomas (1962), Crome et al. (1969), Gál (1969), Berry (1970), Robinson, Robinson (1970), Edgar (1971), Bruno (1973), Emmrich

(1974, 1975), Sirbu (1977), Holišova, Obrtel (1979), Obrtel, Holišova (1979, 1980), Рябищев и др. (1980), Петрусенко, Талпош (1981), Bauerová (1984, 1986, 1988), Burda, Bauerová (1985), Bauerová, Červený (1986), Bureš (1986), Kuvikova (1986), Klewen (1988), Галя, Зубков (1988), Křištin (1988 a, b), Tomek (1988), Андреева (1989), Hillyard, Sankey (1989), Петроченко (1992).

## MATERIAL AND METHODS

The field investigations were carried out in the Western Rhodopes: the village of Kossovo (700 m above s. l.) — R 1, v. Banite (720 m above s. l.) — R 2, v. Oryahovets (780 m above s. l.) — R 3, in the region of the Yagodinska cave (975 m above s. l.) — R 4, v. Vievo (1080 m above s. l.) — R 5, in the region of Rozhen (1450 m above s. l.) — R 6, and Mount Vitosha: the place of Shoumako (800 m above s. l.) — V 1, above the district of Dragalevtsi (800 m above s. l.) — V 2, the place of Chernya Kos (800 m above s. l.) — V 3, above Dragalevtsi (800–1100 m above s. l.) — V 4, above v. Chuypetlovo (1200 m above s. l.) — V 5, the place Bai Krustyu (1300 m above s. l.) — V 6, the Selimitsa hut (1305 m above s. l.) — V 7, Goli Vruh (1830 m above s. l.) — V 8.

Part of the materials (food remains of Opiliones) was collected on the webs of spiders. Spider webs were collected under stones and from walls 0.4 to 4 m high in the period from 05.08.1985 till 04.09.1988 and from 10.09.1991 till 04.10.1992 in the western parts of the Rhodopes and in Mount Vitosha. The webs were examined on the spot and only those in which remains of Opiliones had been found were collected. In many of the webs only legs of harvestmen are found, but since when attacked by Araneae, Opiliones autothomy their legs and often manage to save themselves (Šilhavý, 1956), such material for greater reliability has not been given.

The material from Formicidae was collected in a coniferous forest — (R 2A, 11.06.1986), and on a meadow — (R 2B, 17.09.1991; R 3, 07.10.1991).

For explaining the participation of harvestmen in the food of lizards (*Lacertidae*) there were investigated the stomach-content of 13 specimens of *Lacerta vivipara vivipara* Jacquin, collected in the period 23.02. – 13.08.1987 in Mount Vitosha (V 8), and four specimens *Lacerta muralis muralis* (Laurenti) collected on 12.05.1990 also in Mount Vitosha (V 5) with the help of pitfall traps filled with formaline (PTF).

The stomach content of 33 shrews (*Soricidae*), collected in the period 17.04. – 01.07.1987 by means of PTF in Mount Vitosha (V 1, V 4) was examined.

## RESULTS AND DISCUSSION

On the basis of the investigated food remains collected from the webs of 9 species of spiders (from 8 genera), 12 species and subspecies of Opiliones from 9 genera were established. The remains in the webs were mainly of *Phalangium opilio* L. and *Opilio ruzickai* Šilhavý, respectively with 13 and 9 specimens, followed

by *Mitopus morio* (Fabricius) and *Lacinius dentiger* (C. L. Koch), respectively with 6 and 5 specimens; *Paranemastoma aurigerum aurigerum* (Roewer) with 4 specimens; *Paranemastoma radewi* (Roewer) with 2 specimens; the remaining *Dicranolasma scabrum* (Herbst), *Trogulus nepaeformis* (Scopoli), *Paranemastoma aurigerum ryla* (Roewer), *Rilaena balcanica* Šilhavý, *Leiobunum rumelicum* Šilhavý and *Lacinius horridis* (Panzer) with 1 specimen. The results are shown in Table 1. These data confirm the assertion of Stipberger (1928), Bristowe (1941, 1949), Šilhavý (1956), Crome et al. (1969) and Edgar (1971) that spiders attack Opiliones and use them for food.

Table 1

Opiliones as a component of the food stuffs of invertebrate and vertebrate animals

Species feeding on Opiliones	Opiliones — preys	Locality
1	2	3
Araneae	1 ♀ <i>Phalangium opilio</i> L.	R 3
Araneae	1 ♀ <i>Opilio ruzickai</i> Šilhavý	V 4
Araneae	1 ♀ <i>Paranemastoma aurigerum aurigerum</i> (Roewer)	R 6
Araneae	1 ♀ <i>Trogulus nepaeformis</i> (Scopoli)	R 4
2 juv. <i>Theridion</i> sp.	1 ♀ <i>Phalangium opilio</i> L.	R 2
juv. <i>Steatoda castanea</i> (Olivier)	1 ♀ <i>Phalangium opilio</i> L.	V 6
♀ <i>Steatoda castanea</i> (Olivier)	ad. <i>Lacinius dentiger</i> (C. L. Koch)	
♂ <i>Steatoda bipunctata</i> (L.)	1 ♂, 2 ♀♀ <i>Mitopus morio</i> (Fabricius)	V 6
	1 ♂ <i>Lacinius dentiger</i> (C. L. Koch)	V 7
♀ <i>Steatoda triangulosa</i> (Walckenaer)	1 ♀ <i>Phalangium opilio</i> L.	R 2
juv. <i>Lyniphia</i> sp.	subad. ♂ <i>Phalangium opilio</i> L.	
♂ <i>Zilla thorelli</i> Auss.	1 juv. <i>Rilaena balcanica</i> Šilhavý	V 3
♀ <i>Araneus diadematus</i> Clerck	1 ♀ <i>Phalangium opilio</i> L.	R 3
	1 ♀ <i>Paranemastoma aurigerum aurigerum</i> (Roewer)	R 2
♂ <i>Meta segmentata</i> (Clerck)	2 ♀♀ <i>Paranemastoma radewi</i> (Roewer)	R 5
♂ <i>Tegenaria ferruginea</i> Panzer	1 ♂, 2 ♀♀ <i>Phalangium opilio</i> L.	R 2
♂ <i>Tegenaria ferruginea</i> Panzer	1 ♂ <i>Paranemastoma aurigerum aurigerum</i> (Roewer)	R 2
juv. <i>Tegenaria ferruginea</i> Panzer	1 ♀ <i>Paranemastoma aurigerum aurigerum</i> (Roewer)	R 2
juv. <i>Tegenaria ferruginea</i> Panzer	1 ♂, 1 ♀, 1 juv. <i>Opilio ruzickai</i> Šilhavý	V 1
juv. <i>Tegenaria ferruginea</i> Panzer	2 ♂♂, 2 juv. <i>Opilio ruzickai</i> Šilhavý	V 1
1 ♀, 1 juv. <i>Tegenaria ferruginea</i> Panzer	1 ♂, 1 ♀ <i>Lacinius dentiger</i> (C. L. Koch)	V 6
♀ <i>Tegenaria agrestis</i> (Walckenaer)	ad. <i>Phalangium opilio</i> L.	V 4
1 ♂, 1 juv. <i>Tegenaria silvestris</i> L. K.	1 ♀ <i>Mitopus morio</i> (Fabricius)	V 6

Table 1 (Continued)

1	2	3
juv. <i>Tegenaria silvestris</i> L. K.	1 ♀ <i>Mitopus morio</i> (Fabricius) 1 ♂ <i>Paranemastoma aurigerum</i> ryla (Roewer)	V 6
juv. <i>Tegenaria</i> sp.	1 ♂ <i>Lacinius dentiger</i> (C. L. Koch) 1 ♀ <i>Mitopus morio</i> (Fabricius)	R 2
juv. <i>Tegenaria</i> sp.	1 ♂ <i>Phalangium opilio</i> L. 1 ♂ <i>Opilio ruzickai</i> Šilhavý	V 7
juv. <i>Tegenaria</i> sp.	1 ♂ <i>Phalangium opilio</i> L. 1 ♀ <i>Lacinius horridus</i> (Panzer)	R 3
subad. ♀ <i>Tegenaria</i> sp.	1 ♂ <i>Leiobunum rumelicum</i> Šilhavý	R 4
juv. <i>Amaurobius</i> sp.	ad. <i>Dicranolasma scabrum</i> (Herbst)	R 1
Insecta:		
Formicidae:		
♀ <i>Formica pratensis</i> Retz.	1 juv. <i>Lacinius horridus</i> (Panzer)	R 2A
♀ <i>Formica cinerea</i> Mayr	1 juv. <i>Phalangium opilio</i> L.	R 2B
Reptilia:		
<i>Lacerta m. muralis</i> (Laur.)	<i>Pyza bosnica</i> (Roewer)	V 5
<i>Lacerta v. vivipara</i> Jacquin	2 ♂, 1 ♀, 1 juv. <i>Phalangium opilio</i> L. 1 juv. <i>Lacinius horridus</i> (Panzer) 1 ♀ <i>Rilaena triangularis</i> (Herbst) Phalangüidae indet.	V 8
Mammalia:		
<i>Sorex araneus</i> L.	<i>Paranemastoma radewi</i> (Roewer) <i>Carinostoma ornatum</i> (Hadzi) <i>Pyza bosnica</i> (Roewer) <i>Lacinius dentiger</i> (C. L. Koch) Opiliones indet.	V 1, V 4
<i>Sorex minutus</i> L.	<i>Paranemastoma radewi</i> (Roewer)	V 1, V 4

Out of the 24 species and subspecies of Opiliones in the western parts of the Rhodopes established so far (Starega, 1976; Митов, 1986 a, b) remains of only 9 species and subspecies of harvestmen had been found in spider webs. Out of the well known 25 species and subspecies found in Mount Vitosha (Starega, 1976; Митов, 1987) remains of 6 species and subspecies of Opiliones had been found in the webs.

At this stage of investigation we can accept that, in spider webs the remains of those specimens of Opiliones prevail which possess comparatively greater possibilities for moving at greater distance. This conclusion has a preliminary character. For more generalized conclusions more precise and extensive investigations are necessary.

Кърдей (1958) notes that insects do not attack harvestmen. Bristowe (1949) shares the opinion that eating of harvestmen by insects (Coleoptera, Odonata and predaceous Diptera) is not often observed. Edgar (1971) reports *Zelus* sp. (Re-

duviidae, Heteroptera) and Hillyard, Sankey (1989) — Carabidae as consumers of Opiliones. During our terrain observations ants from the genus *Formica*, carrying dead harvestmen, were found (Table 1). Besides, on the pedipalp of one female of *Phalangium opilio*, was found the plucked head of a ♀ *Formica cinerea* Mayr, biting a harvestmen (R 3). These facts support the observations of Stippenberger (1928) and Crome et al. (1969) who claim that harvestmen are attacked and eaten by ants.

Special attention was paid to the vertebrate animals as natural consumers of harvestmen. From the investigated 13 stomachs of *Lacerta v. vivipara* in 6 of them were found remains of harvestmen — in four of these cases it was possible to identify the remains to species: 4 specimens *Phalangium opilio* L. in the stomachs of 2 lizards; 1 specimen *Lacinius horridus* (Panzer) in the stomach of one lizard; 1 specimen *Rilaena triangularis* (Herbst) in the stomach of one lizard. And in the two other cases identification was possible to family (Phalangidae) only (Table 1). In the food of this lizard remains of long-legged and fast-moving Opiliones from the genera *Phalangium*, *Lacinius* and *Rilaena* are observed.

Investigating the stomach content of four specimens of *Lacerta m. muralis* (Laurenti) remains of Opiliones (*Pyza bosnica* (Roewer)) were established in only one of them (Table 1).

Investigating the stomach content of the collected 32 specimens of *Sorex araneus* L. and 1 specimen of *Sorex minutus* L., among the food particles of Lumbricidae, Gastropoda, Araneae, Lithobiidae, Insecta, the plant remains and the fruiting bodies of *Phyllactinia*, parts of bodies of Opiliones were also found.

Special investigations on the food of shrews in Bulgaria have not been done, general information on this matter is found in the works of Марков (1957, 1958, 1988); Пешев, Йотова (1962), Пешев, Симеонов (1974). Bristowe (1949), Bauerová (1984) and Kuvikova (1986) show that *Sorex* are natural enemies of Opiliones.

From the investigated stomachs of 32 *Sorex araneus* only in 14 of them were found harvestmen. In 11 of the cases the remains were determined to species level: 8 swollen specimens of *Paranemastoma radewi* (Roewer) were found in the stomachs of 8 shrews and by one specimen of *Carinostoma ornatum* (Hadzi), *Pyza bosnica* (Roewer) and *Lacinius dentiger* (C. L. Koch) — in 3 shrews. In the rest of the cases the determination was impossible even to family (Table 1).

In the stomach of *Sorex minutus* a specimen of *Paranemastoma radewi* (Roewer) was found.

The presence of comparatively slow-moving and hydrophilous species of Opiliones in the food of *Sorex araneus* is explicable, having in mind the way of its feeding and living. Probably this fact can be related to *Sorex minutus* too.

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