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ZOOLOGICKÉ

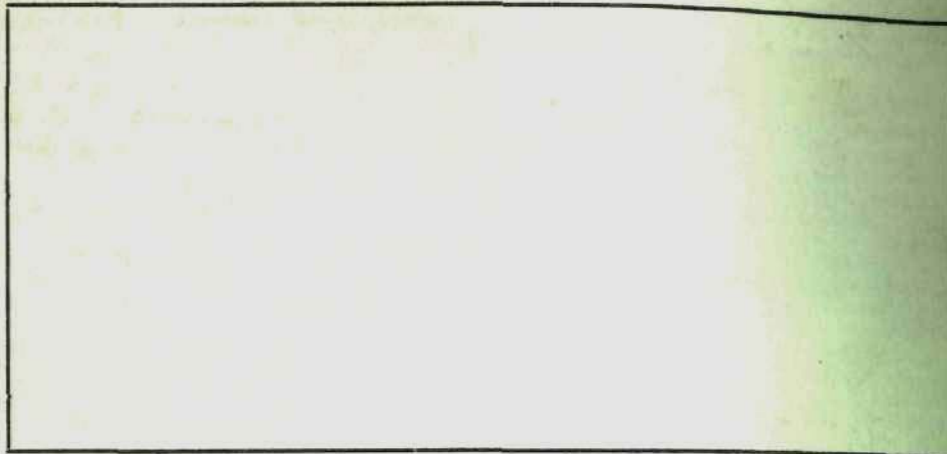
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**CZECHOSLOVAK ENCHYTRAEIDS (OLIGOCHAETA, ENCHYTRAEIDAE)
II. CATALOGUE OF SPECIES**

Josef CHALUPSKÝ jr.

Institute of Soil Biology, Czechoslovak Academy of Sciences,
Na sádkach 7, 370 05 České Budějovice, Czechoslovakia

In memory of Docent RNDr Miroslav Kunst, CSc

Abstract. 55 valid and 7 dubious enchytraeid and 1 propappid species are overviewed from Czechoslovakia. *Enchytraeus humiculator* Vejdovský, 1879 is suggested as a synonym of *E. albidus* Henle, 1837.

Representatives of the family Enchytraeidae (Oligochaeta) are important components of soil mesofauna, at first from the point of view of their high densities in some soils, at second for their activity in soil-forming processes. Yet we have not got a general idea about the enchytraeid fauna of Czechoslovakia, despite a number of data about them, which arose examining material from our country. The aim of this study is to summarize faunistic data of all former contributions and to set up a faunistic overview based on present taxonomic knowledge of the group (Nielsen and Christensen, 1959).

HISTORICAL OVERVIEW

Early reports on enchytraeids from the present Czechoslovak territory appeared in faunistic and taxonomic papers (Vejdovský, 1874, 1876, 1878, 1879a, b, 1884a, b, 1889; Štolc, 1887). In older literature Enchytraeidae were considered by some authors as pests on sugar beet roots (Stoklasa, 1891, 1897; Vejdovský, 1892a, b; Vaňha, 1892-93a, b, 1893; Vaňha and Stoklasa 1895). Those contributions contained some faunistic data about common species as *Enchytraeus buchholzi*, *E. albidus*, *Fridericia galba*, *F. perrieri*, *F. leydigi* and *Henlea nasuta*. A study on Czech freshwater organisms (Frič and Vávra, 1898) brought only one faunistic information on *Cognettia sphagnetorum*. At the beginning of the 20th century Vejdovský concerned himself with the general biological problems, often cytological in detail. Oligochaetes were most frequently a main subject of his research and therefore we have some adjoining faunistic and taxonomic data on Czechoslovak enchytraeids (Vejdovský, 1904, 1905a, b, c, d, e, 1907, 1909). Maule (1909) may have discussed only a single slide of section series of *Mesenchytraeus beumeri* to make considerations about enchytraeid nerve system (Hrabě, 1932 p. 3, Hrabě, pers. comm.). Rambousek (1921) tried to find out experimentally if the assumed enchytraeid injurious effect on sugar beet roots is actual. Kříženecký (1922) observed a formation of enchytraeid clumps after transferring the worms into water. Soudek (1925, 1928) carried out the first ecological observations on enchytraeids, but in his contributions the enchytraeids were not nearer determined. In the following years a number of contributions with faunistic data has

been published (Černosvitov, 1931a, 1942; Frankenberger, 1930; Stammer, 1936; Pax and Maschke, 1936; Pax and Willmann, 1937; Moszyński, 1938; Hrabě, 1937, 1942). Moreover, in the same period Černosvitov (1930) dealt with resorption of male sperm in Oligochaeta and Hrabě (1932) studied in detail mouth and pharyngeal organs of enchytraeids. By continuing disputations about the mouth organs (Vejdovský, 1934; Hrabě, 1933), Hrabě (1934) was forced to publish his results about them in a more known journal.

After World War II a key for determination of the Czechoslovak enchytraeid genera was published (Hrabě, 1954). The key was based on Černosvitov's (1937) monography of world enchytraeids. A contribution by Kunst (1954) was devoted to rotifers (Rotatoria) parasiting in enchytraeid's gut and 4 species of enchytraeids were recorded here, too. Lom (1957, 1959) discussed ciliate parasites (Ciliata) of invertebrates including enchytraeid worms and we can find there faunistic records of 19 species. Ertl et al. (1961) cited the old Frankenberger's record of enchytraeid as *Henlea* sp. Kunst (1965) pointed to *Cognettia sphagnetorum*, *C. glandulosa* and *Henlea ventriculosa*, on the base of former published data, which were typical for Czechoslovak moors and marshes. Ertlová (1968) contributed by single unspecified find of propappid from the Dunaj river. Růžička and Zajonc (1968) discussed the old views on enchytraeids as a pest of sugar beet roots. They concluded that the occurrence of these worms at plant roots may have accompanied the presence of another infection agent on rootlets. Sukop (1970) and Rosol and Kubíček (1971) reported some finds of undetermined enchytraeids from Moravský kras region. The same was done by Kubíková and Rusek (1976) from Doubráček hill in Český kras in Central Bohemia. Košel (1975) described a new enchytraeid species *Fridericia anomala* from Slovakia together with reports of further 5 species. Faunistic records of Slovak enchytraeids were supplemented by Šporka (1982a, b). Recently the author of this compilation has increased our knowledge of Czechoslovak enchytraeids (Chalupský, 1984, 1986; Chalupský and Lepš, 1985). Last, this overview ends with an account of 24 enchytraeid species from the Malé Karpaty mountains (Kasprzak, 1986).

A part of the above listed works is not of faunistic or taxonomic character, but it can be assumed that the enchytraeid material, which was investigated in them, came from the Czechoslovak territory (e. g. Kříženecký, 1922, etc.). One cannot decide, if some other data without precise localization really belong to the territory of the CSSR, e.g. the Karpaty mountains (Černosvitov, 1930). Nevertheless it seems probable that Černosvitov, giving the locality of the Karpaty, understood the present territory of USSR. Most localities labelled by Černosvitov (1931a) as NT — the Nízké Tatry mountains, are in the Chočské pohorí mountains in contemporary geographical understanding (Velký Choč, Čebrať, Hrboltova, Likava, Ružomberok). In some cases (e.g. *Fridericia zykovi*) it is not clear if the finds came truly from Czechoslovakia or if the author got the material from somewhere else. There are, too, some works (e.g. Kowalewski, 1914; Černosvitov, 1928; Kasprzak and Zajonc, 1980) dealing with boundary regions of neighbour countries, but the finds discussed in them obviously did not fall into the territory of the CSSR. In general Vejdovský's works the old finds were likely to be frequently repeated and their localities may have correspond to each other. In the same source the localities were not mentioned many times at all, or were placed only in a large territory, e.g. Bohemia, etc. In addition, Hrabě (1932 p. 4, 1934) examined 8 enchytraeid species from original Černosvitov's collection. Three of these species, *Lumbricillus lineatus*, *Cognettia anomala* and *Enchytraeus myrmecophilus*, would be

new for the CSSR territory, but there is no evidence if they have been collected there.

The terminology used in this paper is unified according to Nielsen and Christensen (1959). Despite, in some forms it cannot be decided with definite certainty about their correct taxonomic status due to the nomenclatorial changes, which have been advanced during the years. Only a small part of the old enchytraeid material may have been reexamined by Černosvitov (1931b p. 105), however, the majority has not been at all. That is why here comes a problem of validity of some species. E.g. *Henlea gubleri* Bretscher, 1903 was not appreciated by Nielsen and Christensen (1959), nor was it listed by Reynolds and Cook (1976, 1981). Černosvitov (1937) found it to be doubtful species. But Wileke (1967) put the species among members of Central European enchytraeid fauna. On the other hand, e.g. species *Henlea puteana* (Vejdovský, 1878) has been considered up to now as a valid species, but described on few specimens.

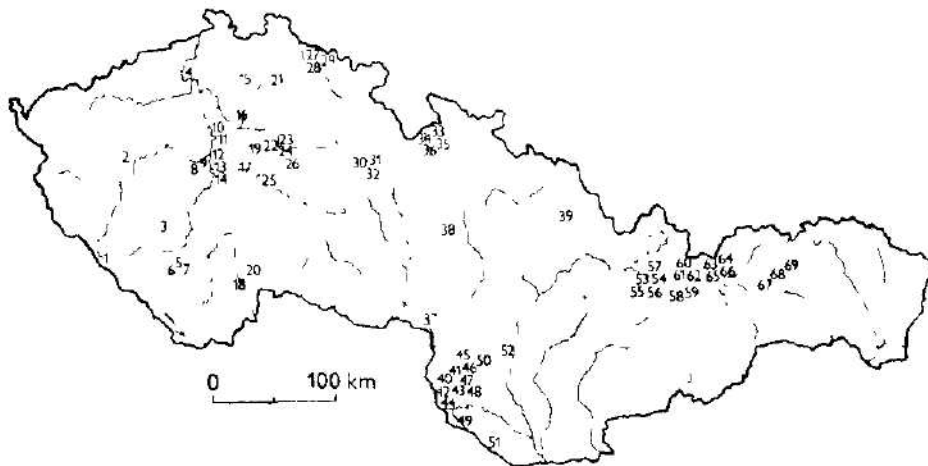


Fig. 1. Positions of Czechoslovak sampled localities (for numbers see text).

As regards exact quotations of the old literature there are some discrepancies. Some older contributions (Vejdovský, 1878, 1884a, 1904, 1905a, b, c, 1909, 1934; Štolc, 1887; Maule, 1909; Černosvitov, 1931a) were firstly read on the regular sessions of the Royal Czech Society of Sciences (Královská česká společnost nauk) and they were usually published next year. In this contribution several slight changes in data must have been performed in the sense of International Code of Zoological Nomenclature, Part III, Articles 8 and 9. The changes involve Vejdovský's species of 1878 transcribed as 1877 by mistake.

LIST OF LOCALITIES

The localities are lined up into three main regions: Bohemia, Moravia and Slovakia. Their positions are shown on the map (Fig. 1). They are provided with four-digit coding in accordance with a quadrated map of Czechoslovakia reserved for mapping occurrence of organisms (Buchar, 1982).

Bohemia: 1: Černé and Čertovo jezero (6845). 2: Plasy (6046). 3: Blatná (6549). 4: Litoměřice (5450). 5: Bavorov (6850). 6: Dlouhá Ves (6850). 7: Chelčice (6850). 8: Lety u Prahy (6051).

9: Řevnice u Prahy (6051). 10: Roztoky u Prahy (5852). 11: Praha, Praha Stromovka, Vršovice, Chuchle, Hloubětín, Kanálská zahrada (west of square of Jiří z Poděbrad) (5852--5952). 12: Jarov (6052). 13: Závist (6052). 14: Sázava (6152). 15: Dokey (5454). 16: Benátky (Gross Benátek) (5754?). 17: Habr (by Struhařov) (6054). 18: Třeboň (6954). 19: Kouřim (5955). 20: Jindřichův Hradec (6855). 21: Turnov (5456). 22: Pečky (5956). 23: Plaňany (5956). 24: Svojišice (5956). 25: Talmberk (by Uhlířské Janovice) (6156). 26: Červené Pečky (6057). 27: Špindlerův Mlýn (5259). 28: Vrchlabí (5359). 29: Krkonoše, Zelený potok valley (5260). 30: Vysoké Mýto (6062). 31: Tichá Orlice valley (by Chocet) (6063). 32: Litomyšl (6163).
 Moravia: 33: Adamov (Loc. III, Hrabě) (5867). 34: Králický Sněžník (Loc. VI, VIII, XII, XIII, XVIII, Hrabě, Three waterfalls, Pax and Willmann.) (5867). 35: Patzeltova jeskyně by Horní Morava (Gross Mohrau, Stammer, Loc. IX, Hrabě.) (5867). 36: Solná díra by Životice (Seitendorf, Stammer) (5867). 37: Lednice na Moravě (7267). 38: Bolihošť (by Prostějov) (6568). 39: Lysá Hora (6476).
 Slovakia: 40: Lozorno (7668). 41: Pernek (7668). 42: Bílý Kříž (7768). 43: Borinka (7768). 44: Rača (Loc. I/3, I/4, Kasprzak) (7768). 45: Plavecký Mikuláš (7469). 46: Kuchyňa (Loc. III/4, Kasprzak) (7669). 47: Králová (7669--7670). 48: Pezňok (7769). 49: Dunaj river by Samorín (7969). 50: Dolany (7570). 51: Dunaj river by Paľkovičovo (8171). 52: Borovec (by Piešťany) (7472). 53: Čebrať (6981). 54: Hrbolova (6981). 55: Likava (6981). 56: Ružomberok (6981). 57: Veľký Choč (6882). 58: Bystrá (7083). 59: Dumbier (7083). 60: Bala (6884). 61: Račkov potok (6884). 62: Roháče (6884). 63: Ladové pleso (6886). 64: Malé Huncovo pleso (6886). 65: Popradské pleso (6886). 66: Štrbské pleso (6886). 67: Čugov (7089). 68: Torysa river by Nižné Repáše (6990). 69: Torysa river by Brezovica (6991).

LIST OF VALID SPECIES

Propappus volki Michaelsen, 1916

Reports of *Propappus* sp. (Hrabě, 1942; Ertlová, 1968) concern most probably *P. volki*. The other species of the genus, *P. glandulosus* Michaelsen, 1905, is restricted to Lake Bajkal. The genus *Propappus* is rather obscure among enchytraeids having some features which resemble tubificids. Recently Coates (1986) has formed a new family of Propappidae for it. Thus it is now not included in the total number of enchytraeids of the CSSR.

Distribution: Germany, Great Britain, France, Spain, Yugoslavia, Austria?, Poland, USSR, Romania, Czechoslovakia: 33, 34 (Hrabě 1937), 51 (Ertlová, 1968), 60 (Šporka, 1982b), 61 (Hrabě, 1942), 68, 69 (Šporka, 1982a).

Mesenchytraeus armatus Levinsen, 1884

syn.: *M. setosus* Michaelsen, 1888; Vejdovský: 1905b, 1905c, 1907. Černosvitov: 1930, 1931a. Stammer: 1936. Hrabě: 1937. Moszyński: 1938.

Distribution: quite common in Europe, Czechoslovakia: 20 (Vejdovský, 1905e), 27 (Hrabě, 1937), 34 (Hrabě, 1937; Moszyński, 1938), 35 (Stammer, 1936), 43, 44 (Kasprzak, 1986), 56, 59, 63 (Černosvitov, 1931a), 60 (Šporka, 1982b), the Krkonoše (Černosvitov, 1930; Hrabě, 1937), without locality (Vejdovský, 1905b, 1907).

Mesenchytraeus beumeri (Michaelsen, 1886)

syn.: *M. (Pachytrilus) beumeri* (Michaelsen, 1886); Maule: 1909.

Distribution: Norway, Sweden, Denmark, Germany, Ireland, France, Italy, Yugoslavia, Roumania, Czechoslovakia: Bohemia (Vejdovský, 1907), without locality (Maule, 1909; Lom, 1959).

Mesenchytraeus flavidus Michaelsen, 1887

Distribution: Germany (Willeke), Italy (Černosvitov), Czechoslovakia: 11 (Černosvitov, 1930), 62 (Lom, 1959).

Mesenchytraeus flavus (Levinsen, 1884)

Distribution: Iceland, Norway, Sweden, Finland, Denmark, the Netherlands, Great Britain, Roumania, Czechoslovakia: 41, 43, 45, 47 (Kasprzak, 1986), the Krkonoše, the Karpaty (Černosvitov, 1930), the Český les (Vejdovský, 1905e), without locality (Vejdovský, 1905 d, 1907).

Mesenchytraeus gaudens Cognetti, 1903

syn.: *M. mencli* Vejdovský, 1905; Vejdovský: 1905e.

Distribution: Denmark, Italy, France, Czechoslovakia: 9 (Černosvitov, 1942), 66 (Černosvitov, 1931a), the Jizerské hory (Vejdovský, 1905e), the Krkonoše, Slovakia (Černosvitov, 1930), without locality (Vejdovský, 1907).

Mesenchytraeus glandulosus (Levinsen, 1884)

Distribution: Norway, Denmark, Germany, the Netherlands, France, Italy, Poland, Czechoslovakia: 41, 43, 45, 46, 47, 50 (Kasprzak, 1986).

Mesenchytraeus ogloblini Černosvitov, 1928

syn.: ? *M. moravicus* Vejdovský, 1905; Vejdovský: 1905e, 1907.

For the lack of original material it is not easy to recognize true taxonomic status of this name. Černosvitov (1931b p. 105) alone treated *M. ogloblini* as identical with *M. moravicus* Vejdovský, 1905 and with *M. flavus* (Levinsen, 1884) sensu Černosvitov, 1931. Later on Nielsen and Christensen (1959) carefully suggested to recognize *M. ogloblini* and *M. moravicus* to be synonyms, but both different from *M. flavus* (Levinsen, 1884). Finally *M. flavus* sensu Černosvitov, 1931 was defined by them as a new species *M. groenlandicus* Nielsen et Christensen, 1959. Distribution: USSR, Czechoslovakia: 39 (Vejdovský, 1905e), without locality (Vejdovský, 1907).

Cernosvitoviella atrata (Bretscher, 1903)

Distribution: not rare in Europe, Czechoslovakia: 60 (Šporka, 1982b).

Cernosvitoviella carpatica Nielsen et Christensen, 1959

syn.: *Enchytraeoides atratus* (Bretscher, 1903); Černosvitov: 1930, 1931a.

The species was first reported by Černosvitov (1928) as *Enchytraeoides atratus* (Bretscher, 1903). Later on Nielsen and Christensen (1959) found the same species in Denmark and recognized in it a new species, named *Cernosvitoviella carpatica* nom. nov.

Distribution: Denmark, Poland, USSR, Czechoslovakia: 63, 64 (Černosvitov, 1931a), the Karpaty (Černosvitov, 1930).

Cernosvitoviella tatrensis (Kowalewski, 1916)

syn.: *Pachydritus* (*Marionina*) *tatrensis* (Kowalewski, 1916); Hrabě: 1937.

Distribution: Poland, Czechoslovakia: 34 (Hrabě, 1937).

Cognettia glandulosa (Michaelsen, 1888)

syn.: *Enchytraeoides glandulosus* (Michaelsen, 1888); Černosvitov: 1930, 1931a. *Pachydritus* (*Marionina*) *glandulosus* Michaelsen, 1888; Hrabě: 1937.

Distribution: very common in Europe, Czechoslovakia: 33 (Hrabě, 1937), 58, 59, 63 (Černosvitov, 1931a), the Karpaty (Černosvitov, 1930).

Cognettia pari (Moszyński, 1938)

syn.: *Marionina pari* Moszyński, 1938; Moszyński: 1938.

Distribution: Germany (Schwank), Czechoslovakia: 34 (Moszyński, 1938).

Cognettia sphagnetorum (Vejdovský, 1878)

syn.: *Pachytrilus sphagnetorum* Vejdovský, 1878; Vejdovský: 1878, 1879a, 1884a, b; Frič and Vávra: 1898. *Enchytraeoides sphagnetorum* (Vejdovský, 1878); Černosvitov: 1930, 1931a. *Pachytrilus (Marionina) sphagnetorum* Vejdovský, 1878; Hrabě: 1937. *Marionina sphagnetorum* (Vejdovský, 1878); Lom: 1959.

Distribution: very common in Europe, Czechoslovakia: 1 (Frič and Vávra, 1898), 5 (Chalupský, 1984), 15 (Vejdovský, 1878, 1879a, 1884a), 34 (Hrabě, 1937), 41, 42, 44, 45, 47, 48, 50 (Kasprzak, 1986), 56, 65 (Černosvitov, 1931a), 60 (Šporka, 1982b), the Krkonoše, the Český les (Lom, 1959), Bohemia (Vejdovský, 1884b), Slovakia (Černosvitov, 1930).

Achaeta bohémica (Vejdovský, 1879)

syn.: *Anacheta bohémica* Vejdovský, 1879; Vejdovský: 1879b, 1884a, b.

Distribution: not rare in Europe, Czechoslovakia: 11 (Vejdovský, 1884a, b), 34 (Hrabě, 1937), the Karpaty (Černosvitov, 1930), without locality (Vejdovský, 1879b).

Achaeta camerani (Cognetti, 1899)

Distribution: Denmark, Germany, Great Britain, Italy, DDR, Poland, Czechoslovakia: 40, 42, 44, 50 (Kasprzak, 1986).

Achaeta eisenii Vejdovský, 1878

syn.: *Anacheta eisenii* (Vejdovský, 1878); Vejdovský: 1879a, 1884a, b, 1905c

■ Vejdovský collected this species in Prague, in the garden of the former Museum in the street "Na Příkopech". There is a National Bank on this site now. Vejdovský's (1905c p. 4) opinion was that the species was introduced there in the soil on plant roots. The plants were brought by Emanuel Purkyně from various parts of Bohemia.

Distribution: not rare in Europe, Czechoslovakia: 11 (Vejdovský, 1878, 1879a, 1884a, b, 1905c), 42, 46, 47, 50 (Kasprzak, 1986), 53 (Černosvitov, 1931a).

Enchytronia annulata Nielsen et Christensen, 1959

Distribution: Denmark, the Netherlands, DDR, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985).

Enchytronia parva Nielsen and Christensen, 1959

syn.: *Enchytronia* sp.; Chalupský: 1986, Chalupský and Lepš: 1985.

During my investigation, based on the material from Bavorov, I thought that the species was *E. parva*. In the following years, having more specimens, I had to abandon that view and left the species as a less obligatory *Enchytronia* sp. Further study may help to decide about its true taxonomic position. The differences between *E. parva* and *Enchytronia* sp. sampled in Bavorov are mentioned by Chalupský (1986). As this find was the first from the CSSR, *Enchytronia parva* must be deleted from the list of Czechoslovak enchytraeids.

Distribution: not rare in Europe, Czechoslovakia: 15 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985).

Henlea nasuta (Eisen, 1878)

syn.: *Enchytraeus leptodera* Vejdovský, 1879; Vejdovský: 1879a, 1884a, b, 1905d, 1907. Vaňha: 1893. Vaňha and Stoklasa: 1895.

According to the old Ude's (1892 p. 90) view, *Henlea nasuta* (Eisen, 1878) and *H. leptodera* (Vejdovský, 1879) are synonyms. Despite this Černosvitov (1928) recognized again *H. leptodera*, but in his later contribution (Černosvitov, -937) he absolutely avoided the name on the *Henlea* species list.

Distribution: very common in Europe, Czechoslovakia: 11 (Vejdovský, 1879a; Černosvitov, 1930), 14, 19, 25 (Vejdovský, 1879a), the Orlické hory (Lom, 1959), 56, 57 (Černosvitov, 1931a), Bohemia (Vaňha, 1893; Vejdovský, 1884b), Bohemia, Moravia and Slovakia (Vaňha and Stoklasa, 1895), the Karpaty (Černosvitov, 1930), without locality (Vejdovský, 1905d, 1907).

Henlea perpusilla Friend, 1911 augm. Černosvitov, 1937

Distribution: very common in Europe, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985), 42, 45, 47, 50 (Kasprzak, 1986).

Henlea puteana (Vejdovský, 1878)

syn.: *Enchytraeus puteanus* Vejdovský, 1878; Vejdovský: 1878, 1879a, 1884b.

This species was correctly described on the basis of probably only a few specimens, which were pumped out of the well.

Distribution: Great Britain (Friend), Czechoslovakia: 38 (Vejdovský, 1878, 1879a), Moravia (Vejdovský, 1884b).

Henlea ventriculosa (d'Udekem, 1854)

syn.: *Enchytraeus ventriculosus* d'Udekem, 1854; Vejdovský: 1874, 1878, 1879a, 1884a, b.

Distribution: very common in Europe, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985), 6 (Chalupský, 1984), 11 (Vejdovský, 1878), 19 (Vejdovský, 1874), 31 (Kunst, 1954), 50 (Kasprzak, 1986), the Krkonoše (Černosvitov, 1930), Bohemia (Vejdovský, 1884a, b), without locality (Vejdovský, 1879a, 1884a; Lom, 1959).

Buchholzia appendiculata (Buchholz, 1862)

syn.: *Enchytraeus pellucidus* Vejdovský, 1878; Vejdovský: 1878. *E. appendiculatus* Buchholz, 1862; Vejdovský: 1879a, 1884a, b.

Distribution: common in Europe, Czechoslovakia: 11 (Vejdovský, 1878), 40, 41, 42, 43, 44, 45, 46, 47, 48, 50 (Kasprzak, 1986), 53 (Černosvitov, 1931a), 67 (Košel, 1975), vicinity of Prague (Lom, 1959), Bohemia (Vejdovský, 1884a, b), without locality (Vejdovský, 1879a).

Bryodrilus ehlersi Ude, 1892

Distribution: not rare in Europe, Czechoslovakia: 8 (Černosvitov, 1942), 11, Slovakia, the Karpaty (Černosvitov, 1930), 29 (Vejdovský, 1904), 41, 42, 43, 44, 45, 47, 48, 50 (Kasprzak, 1986), 54, 55, 56, 66 (Černosvitov, 1931a), the Jizerské hory (Vejdovský, 1905a), without locality (Lom, 1959).

Fridericia alata Nielsen et Christensen, 1959

Distribution: Finland, Denmark, Great Britain, DDR, Poland, Roumania, Cze-

choslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985), 40, 41, 43, 44, 45, 47, 50 (Kasprzak, 1986).

Fridericia anomala Košel, 1975

Distribution: Czechoslovakia: 67 (Košel, 1975).

Fridericia aurita Issel, 1905

Distribution: not rare in Europe, Czechoslovakia: 57 (Černosvitov, 1931a) Slovakia (Černosvitov, 1930).

Fridericia bisetosa (Levinsen, 1884)

Distribution: common in Europe, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985), 11, Slovakia (Černosvitov, 1930), 37, vicinity of Prague, the Orlické hory (Lom, 1959), 40, 41, 42, 43, 44, 45, 46, 47, 48, 50 (Kasprzak, 1986), 53, 54, 56, 57 (Černosvitov, 1931a).

Fridericia bulboides Nielsen et Christensen, 1959

Distribution: common in Europe, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985), 6 (Chalupský, 1984), 40, 43, 45, 46, 50 (Kasprzak, 1986).

Fridericia bulbosa (Rosa, 1887)

Distribution: common in Europe, Czechoslovakia: 34 (Pax and Willmann, 1937), 37, the Orlické hory (Lom, 1959), 40, 42, 43, 44, 45, 46, 47, 48, 50 (Kasprzak, 1986).

Fridericia callosa (Eisen, 1878)

Distribution: not rare in Europe, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985).

Fridericia connata Bretschner, 1902

Distribution: not rare in Europe, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985), 41, 42, 43, 45, 47 (Kasprzak, 1986).

Fridericia galba (Hoffmeister, 1843)

syn.: *Enchytraeus galba* Hoffmeister, 1843; Vejdovský: 1874, 1878, 1879a, 1884a, b. Vaňha: 1893. Vaňha and Stoklasa: 1895

Distribution: very common in Europe, Czechoslovakia: 5 (Chalupský, 1984), 11 (Vejdovský, 1878), 17 (Vejdovský, 1874), 34 (Pax and Willmann, 1937), 36 (Stammer, 1936), 37, the Orlické hory (Lom, 1959), 56 (Černosvitov, 1931a), 67 (Košel, 1975), 31 (Kunst, 1954), 40, 41, 43, 44, 45, 46, 47, 48, 50 (Kasprzak, 1986), Bohemia (Vejdovský, 1884a, b; Vaňha, 1893), Bohemia, Moravia and Slovakia (Vaňha and Stoklasa, 1895), Slovakia (Černosvitov, 1930), without locality (Hrabě, 1932, 1934).

Fridericia gracilis Nielsen et Christensen, 1959

Distribution: Denmark, Germany, the Netherlands, DDR, Poland, Romania, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985).

Fridericia hegemon (Vejdovský, 1878)

syn.: *Enchytraeus hegemon* Vejdovský, 1878; Vejdovský: 1878, 1879a, 1884a, b.

Distribution: not rare in Europe, Czechoslovakia: 11 (Vejdovský, 1878, 1879a, 1884a, 1905b), 12, 13 (Vejdovský, 1905b), 10, 14, 18, 19, 25 (Vejdovský, 1879a, 1884a), 37, the Orlické hory (Lom, 1959), vicinity of Prague (Lom, 1957, 1959), Bohemia (Vejdovský, 1884b), Slovakia (Černosvitov, 1930), without locality (Vejdovský, 1905c, 1905d, 1907).

Fridericia leydigi (Vejdovský, 1878)

syn.: *Enchytraeus leydigii* Vejdovský, 1878; Vejdovský: 1878, 1879a, 1884a, b. Vaňha: 1893. Vaňha and Stoklasa: 1895.

Fridericia maculata Issel, 1904

Distribution: Iceland, Finland, Denmark (Germany, the Netherlands, Great Britain, Italy, Austria, DDR, Poland, Hungary, Czechoslovakia: 41, 42, 43, 44, 45, 47, 50 (Kasprzak, 1986)

Distribution: common in Europe, Czechoslovakia: 5 (Chalupský, 1984), 11 (Vejdovský, 1878, 1879a, 1884a; Černosvitov, 1930), 53, 54, 56, 57 (Černosvitov, 1931a), Bohemia (Vaňha, 1893; Vejdovský, 1884b), Moravia and Slovakia (Vaňha and Stoklasa, 1895), the Malé Karpaty (Kasprzak, 1986), without locality (Lom, 1959).

Fridericia nemoralis Nurminen, 1970

Distribution: Sweden, Finland, Hungary, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985), 7 (Chalupský, 1984).

Fridericia paranemoralis Dózsa-Farkas, 1982

Distribution: Hungary, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985).

Fridericia paroniana Issel, 1904

Distribution: common in Europe, Czechoslovakia: 5 (Chalupský, 1984), 40, 41, 42, 43, 44, 45, 46, 47, 48, 50 (Kasprzak, 1986), 67 (Košel, 1975).

Fridericia perrieri (Vejdovský, 1878)

syn.: *Enchytraeus perrieri* Vejdovský, 1878; Vejdovský: 1878, 1879a, 1884a, b. Vaňha 1893

Distribution: very common in Europe, Czechoslovakia: 2, 22, 23, 24, 26, 28, 30, 32 (Stoklasa, 1891), 31 (Kunst, 1954), 37, the Orlické hory (Lom, 1959), 42, 45, 47, 50 (Kasprzak, 1986), vicinity of Prague (Vejdovský, 1905b), Bohemia (Vejdovský, 1884b; Vaňha, 1893), without locality (Vejdovský, 1878, 1879a, 1884a, 1907).

Fridericia polychaeta Bretschler, 1900

This species, at first considered as doubtful by Nielsen and Christensen (1959), has been recently revalidated (Healy, 1976). The species is suspected as not being found on the territory of the CSSR. Černosvitov (1930) reported its locality only under a wide term "Karpáty".

Distribution: France, Switzerland, Poland, Czechoslovakia?: the Karpáty (Černosvitov, 1930).

Fridericia ratzei (Eisen, 1872)

syn.: *Enchytraeus lobifer* Vejdovský, 1879; Vejdovský: 1879a, 1884a, b. *Fridericia lobifera* (Vejdovský, 1879); Lom: 1959. *Fridericia dura* (Eisen, 1879); Lom: 1959.

Distribution: very common in Europe, Czechoslovakia: 11 (Vejdovský, 1884a; Černosvitov, 1930), 4, 18 (Vejdovský, 1879a, 1884a), 19 (Vejdovský, 1884a), 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985), 6 (Chalupský, 1984), 3, 37, vicinity of Prague, the Krkonoše, the Orlické hory mountains (Lom, 1959), 40, 42, 43, 45, 46, 47, 48, 50 (Kasprzak, 1986), 57 (Černosvitov, 1931a), Bohemia (Vejdovský, 1884b), Slovakia (Černosvitov, 1930), without locality (Hrabě, 1932, 1934).

Fridericia singula Nielsen et Christensen, 1961

Distribution: Denmark, DDR, Poland, Hungary, Roumania, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985), 7 (Chalupský, 1984).

Fridericia striata (Lovinsen, 1884)

Distribution: not rare in Europe, Czechoslovakia: without locality (Lom, 1959).

Fridericia sylvatica Healy, 1979

Distribution: Great Britain, Ireland, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985).

Fridericia tubulosa Dózsa-Farkas, 1972

Distribution: Poland, Hungary, Czechoslovakia: 40, 42, 43, 45, 47 (Kasprzak, 1986).

Enchytraeus albidus Henle, 1837

syn.: *E. vermicularis* Hen., Vejdovský: 1874. *E. humiculator* Vejdovský, 1879; Vejdovský: 1879a, 1884a, b, 1905a, b, c, 1907. Vaňha: 1893. Vaňha and Stoklasa: 1895. Kříženecký: 1922.

Enchytraeus humiculator Vejdovský, 1879 should be regarded as a synonym of *E. albidus* Henle, 1837. This opinion is based on the following consideration. Vejdovský (1905b p. 2) had never accepted *E. albidus* Henle as valid name, because of poor and its unsatisfactory description and the possibility to label by it many other species. It led him to describe that form properly as *E. humiculator*, which was later regarded by Michaelsen and generally after him as *E. albidus*. There is no other way how to approach to the early brief descriptions. The old species described incompletely must be invalidated, or we must admit that under this name it has been decided to accept certain form. And hence all names that arose meanwhile and belonged to this form must be considered as younger synonyms. **Distribution:** cosmopolite, Czechoslovakia: 11 (Vejdovský, 1874; Černosvitov, 1930), 16 (Vejdovský, 1874), 19 (Vejdovský, 1874, 1879a), 52 (Růžička and Zajonc, 1968), vicinity of Prague (Vejdovský, 1905b), Bohemia (Vejdovský, 1884a, b; Vaňha, 1893), Bohemia, Moravia and Slovakia (Vaňha and Stoklasa, 1895), without locality (Vejdovský, 1905a, c, 1907; Kříženecký, 1922; Hrabě, 1932, 1934; Lom, 1959).

Enchytraeus buchholzi Vejdovský, 1878

Distribution: very common in Europe, Czechoslovakia: 5 (Chalupský, 1984, 1986; Chalupský and Lepš, 1985), 6, 7 (Chalupský, 1984), 11 (Vejdovský, 1878, 1884a), 2, 22, 23, 24, 26, 28, 30, 32 (Stoklasa, 1891), 31 (Kunst, 1954), 35 (Hrabě, 1937), 36 (Stammer, 1936), 40, 41, 42, 43, 44, 45, 46, 47, 50 (Kasprzak, 1986), Bohemia (Vejdovský, 1884b; Vaňha, 1893), Bohemia, Moravia and Slo-

vakia (Vaňha and Stoklasa, 1895), without locality (Vejdovský, 1879a, 1907; Lom, 1959).

Enchytraeus bulbosus Nielsen et Christensen, 1963

Distribution: Spain, Czechoslovakia: 67 (Košel, 1975).

Enchytraeus lacteus Nielsen et Christensen, 1961

Distribution: Norway, Finland?, Denmark, Great Britain, Poland, Hungary, Czechoslovakia: 67 (Košel, 1975).

Enchytraeus norvegicus Abrahamsen, 1969

Distribution: Norway, Austria, Poland, Hungary, Czechoslovakia: 40, 41, 42, 45, 47, 50 (Kasprzak, 1986).

Lumbricillus pagenstecheri (Ratzel, 1869)

syn.: *Pachydriulus pagenstecheri* (Ratzel, 1869); Vejdovský: 1879a, 1884a, b.

Distribution: Iceland, Norway, Finland, Denmark, Germany, the Netherlands, Ireland, Roumania, Czechoslovakia: 11 (Vejdovský, 1884a), 19 (Vejdovský, 1879a, 1884a), Bohemia (Vejdovský, 1884b).

Lumbricillus rivalis Levinsen, 1883, augm. Ditlevsen, 1904

syn.: *Pachydriulus subterraneus* Vejdovský, 1889; Vejdovský: 1889.

Distribution: Iceland, Norway, Finland, Denmark, Germany, Ireland, France, Austria, USSR, Roumania, Czechoslovakia: 11 (Vejdovský, 1889).

Marionina argentea (Michaelsen, 1889)

syn.: *Enchytraeus argenteus* Michaelsen, 1889; Lom: 1959.

Distribution: not rare in Europe, Czechoslovakia: the Krkonoše (Lom, 1959).

Marionina riparia Bretscher, 1899

syn.: *Enchytraeoides riparius* (Bretscher, 1899); Černosvitov: 1930.

Distribution: not rare in Europe, Czechoslovakia: 11 (Černosvitov, 1930).

LIST OF DOUBTFUL SPECIES

Henlea dicksoni (Eisen, 1878)

syn.: *Henleanella dicksoni* (Eisen, 1878); Hrabě: 1937.

Distribution: Germany, the Netherlands, Great Britain, Ireland, Switzerland, Austria?, Poland, the USSR, Czechoslovakia: 34 (Hrabě, 1937), 59 (Černosvitov, 1931a), the Karpaty (Černosvitov, 1930), without locality (Lom, 1959).

Henlea gubleri Bretscher, 1903

Distribution: Switzerland, Poland, Czechoslovakia: 36 (Stammer, 1936).

Henlea rhaetica Bretscher, 1903

syn.: *Henlea* sp.; Ertl et al.: 1961.

The species *H. rhaetica* was mentioned by Piguët and Bretscher (1913 p. 89) as a synonym of *Henlea dorsalis* Bretscher, 1902. The later species was listed as doubtful by Černosvitov (1937). Nielsen and Christensen (1959) avoided it

absolutely, but Wilcke (1967) discussed the species *H. dorsalis* as being a valid one. Distribution: Switzerland, Czechoslovakia: 49 (Frankenberger, 1930).

Henlea rosai Bretscher, 1899

Distribution: Switzerland, Czechoslovakia: 49 (Černosvitov, 1942), 63 (Černosvitov, 1931a).

Fridericia variata Bretscher, 1902

Distribution: Ireland, France, Switzerland, Poland, Czechoslovakia: 63 (Černosvitov, 1931a), Slovakia (Černosvitov, 1930).

Fridericia zykovi Vejdovsky, 1903

The species was described from USSR. Vejdovský's (1905c, d, e, 1907) reports concerned probably the same material from the original bulk supplied by Zykov (?) (e.g. Vejdovský, 1905d p. 87).

Distribution: USSR, Czechoslovakia?: without locality (Vejdovský, 1905c, d, e, 1907).

Pachydriulus fossor Vejdovský, 1878

Perhaps a species of *Lumbricillus* described upon juvenile specimens only.

Distribution: Czechoslovakia: 21 (Vejdovský, 1878, 1879a, 1884a), without locality (Vejdovský, 1884b).

DISCUSSION

In total, 55 valid and 7 doubtful enchytraeid species have been recorded from the Czechoslovak territory. 38 species have been reported from Bohemia, 17 from Moravia and 38 from Slovakia. In agreement with a newly established family Propappidae Coates, 1986, the species *Propappus volki* Michaelsen, 1916 is counted separately from the other enchytraeids in this contribution. Faunistically the most investigated European countries include Denmark with 87 enchytraeid species (Nielsen and Christensen, 1959, 1961, 1963), Ireland with 80 and France with 73 species (Healy, 1980). Enchytraeid faunas of these lands are enriched with marine littoral species. Healy (1980 p. 437) comments on the state of knowledge of European enchytraeids: "The length of national lists probably reflects the intensity of collecting and the type of soils sampled rather than the faunal richness." The number of enchytraeid species of the CSSR, with wide range of climatological and pedological conditions, is likely to be extended substantially after further field ecological observations.

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**PLANT SUBSTRATE AND THE POST-EMBRYONAL DEVELOPMENT
OF NIGMA FLAVESCENS (ARANEAE: DICTYNIDAE)**

Jaromír HAJER

Department of Biology, Pedagogical faculty, České mládeže 8,
400 00 Ústí nad Labem, Czechoslovakia

In memory of Docent RNDr Miroslav Kunst, CSc.

Abstract. The ontogeny of *Nigma flavescens* (Walek., 1925) (Araneae: Dictynidae) was studied under laboratory conditions. The choice of a suitable plant for breeding, whose aim is to obtain the youngest post-embryonal stages proved to be the limiting precondition of success. Microscopic observations of a leaves *Phylodendron scandens* proved a destruction of the surface of the leaves down to the mesophyll level. The content of the plant cells had been apparently used by nymphs of 1st instar as a source of food.

INTRODUCTION

Spiders are zoophagous and feed mainly on insects. It was therefore surprising when R. B. Smith and T. P. Mommson (1984) reported that young *Aranus diadematus* can feed on microscopic organic food, pollen and fungus spores, which gets stuck on the sticky spirals of their webs. This remarkable discovery is in correspondence with some results of my study of ontogenetic cycles of spiders.

OBSERVATIONS AND DISCUSSION

The aim of my recent research was to find and describe the development of the spinning apparatus and its function in post-embryonal stages of the ontogenetic cycle in several families of cribellatae spiders. In addition to three pairs of spinnerets these spiders are equipped with a cribellum producing a secret which covers in a thin layer those parts of the web which serves to catch the prey. This is accomplished by the assistance of the calamistrum, an organ formed by a row of hairs on the metatarsus of the fourth pair of legs. For evaluation of postembryonic changes of the spinning apparatus of both the material collected and observed at localities with large populations and bred under laboratory conditions was used. The latter is clearly defineable as to the stage, instar, fertilization and age; all these parameters are important for the evaluation of the development of the spinning apparatus and its secretive ability.

Nigma flavescens (Walek., 1925) (Dictynidae) is one of the species whose entire ontogenetic cycle was studied in laboratory conditions. These spiders are tiny, their cephalothorax does not usually exceed 1.2 mm in male adults and 1.8 mm in female adults. They make their webs for catching prey on leaves, and were found on leaves of young oaks (*Quercus robur* L.). The subadults can be kept on a variety of room plants as well as in vials on wet filter paper. However the adult females always left after fertilizations most of the plants on which they had been kept while at subadult stage. The choice of a suitable plant proved to be the limiting

precondition of successful breeding. During the study of the development of 43 cocoons made by adult *Nigma flavescens* females on the leaves of *Philodendron scandens* it was found that this plant is the most advantageous for the development of the cocoons. The cocoons were always placed on terminally situated young leaves and were woven in thin sheet-webs. The whole nest is covered from above with a web which both protects the female and serves to catch the prey. The cocoons were made in the same way as in natural environment and developed in June and July.

The white larvae practically do not move. Their spinning apparatus develops as three pairs of low, nonsegmented tubercles, without spinning glands and without their outer spigots. The next ontogenetic stage, nymphs of the 1st instar, are rather active. Their bodies are covered with various pilose structures. The spinning apparatus of first instar nymphs is formed by three pairs of segmented spinnerets with differentiated spigots and functioning spinning glands attached to them. However the cribellum, spinning glands and their outer spigots are not yet present. That is why they cannot any prey. For another 2–3 days these young spiders move in their common nest on the surface of the leaf. First they are all white, but on the third day their abdomen becomes green, larger and sticky. Microscopic observations proved destruction of the surface of the leaves down to the mesophyll level. The content of the plant cells had been undoubtedly used as a source of food indispensable for further development, next ecdysis and successive leaving of the common nest at the 2nd instar stage of nymphs. At this stage the spinning apparatus is already complete including the cribellum and calamistrum that enable the construction of three-dimensional webs for catching animal food.

The described phenomenon will be investigated. Its importance is, above all, given by the fact that are classified as zoophags. The youngest nymph stage in some other species, may possibly use plant substrate for feeding as well. I suppose the same results as with *Nigma flavescens* will be obtained with *Nigma viridissima* (Walck., 1802) and *Brigittea latens* (Fabr., 1775). I have studied the latter at various localities in Úhošť near Kadaň in 1981–1986. The adult females were always found with cocoons solely on leaves of *Cornus sanguinea* on the south-west side of a hill.

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GRAPTOLEBERIS TESTUDINARIA (CLADOCERA, CHYDORIDAE) IN SLOVAKIA

Igor HUDEC

Bodrog and Hornád watersheds, Ďumbierska 16, 041 59 Košice, Czechoslovakia

Abstract. Intraspecific variability of *Graptoleberis testudinaria* (Fischer, 1848) and distribution of morphologically different groups of populations in Slovakia (eastern part of Czechoslovakia) were studied. Short diagnosis of *Graptoleberis testudinaria pannonica* Daday, 1903 and first description of male is given. *G. t. testudinaria* was found among the Slovakian populations, but not *G. t. husheki* Radzimski, 1982. Populations were nondominant in most of the samples. The species was frequently sampled in plant association of *Lemna minoris* and *Hydrocharitum*.

Graptoleberis testudinaria (Fischer, 1948) is a species regarded as cosmopolitan(?) (Hrbáček et al., 1978). The species includes morphologically different forms of various taxonomic value (sibling species?). Trinominal nomenclature is used throughout the paper in the sense of different morphological groups of populations.

The neotype of *Graptoleberis testudinaria testudinaria* was designated by Radzimski (1982) from the type locality (suburbs of Leningrad). The species was found all over the Europe where Cladocera were examined (Hrbáček et al., 1978): *G. t. testudinaria* (Fischer) and emend. Radzimski; *G. t. pannonica* Daday; *G. t. slovenica* Šrámek-Hušek; *G. t. alexandrinae* Negrea and *G. t. husheki* Radzimski.

All Czechoslovak populations were included in *G. t. husheki* after Šrámek-Hušek's (1962) diagnosis in Radzimski (1982). *G. t. slovenica* Šrámek-Hušek, 1962 and *G. t. alexandrinae* Negrea, 1982 are known only from the type locality. *G. t. pannonica* was described from Hungary, from the vicinity of Lake Balaton (Daday 1903) and found from upper part of the River Don (Smirnov, 1971) and from Darvas pond, Hortobágy National Park (Forró, Ronkay, 1983).

MATERIAL AND METHODS

Graptoleberis testudinaria (Fischer, 1848)

List of samples (Fig. 1 — black dots): 26*/ Gabčíkovo (8171)**, shallow pool with sandy bottom, May 12, 1955; 280/ Komárno (8274), pool in inundation of the River Small Donau, July 5, 1956; 766/Čierna nad Tisou (7598), swamp with *Carex* sp., April 23, 1970; 928/ Ipelské Predmostie (7980), swamp with *Typha* sp. and *Batrachium* sp., May 28, 1970; 990/ Rad (7597), channel for irrigation, June 2, 1970; 1107/ Čičov (8772), pool, September 29, 1970; 1108/ Čičov, Lake "Lyon", September 29, 1970; 1125/ Šurany — Úľany nad Žitavou (7975), arm of the River Nitra, September 30, 1970; 1754/ Zátin (7597), large pool, no plants, sandy bottom near the River Latorica, May 26, 1973; 1756/ Zátin — Oborín (7497), ox-bow of the River Latorica, May 27, 1973; 1980/ Somotor (7596), fish pond, April 22, 1981; 2024/ Strážne (7697), large pool, October 23, 1981; 2025/ Strážne — Veľký Kamenec (7697), channel with plants, October 23, 1981; 2053/ Veľké Kapušany — Leles (7498), deep pool in inundation of the River Latorica with *Trapa natans* and *Ceratophyllum demersum* August 11, 1982; 2287/ Boľ — Zátin (7597), pool

* Number of samples.

** Number of quadrangle (Buchar, 1982)

with *Marsiella quadrifolia* and *Myriophyllum* sp., August 11, 1982; 2329/ Toň — Trávník (8272), channel, August 15, 1982; 2524/ Velké Kosihy settlement Malé Kosihy (8273), deep channel, August 29, 1983; 2529/ Komárno settlement Lándor (8274), ox-bow of the River Nitra, August 30, 1983; 2532/ Komárno settlement Hadovec (8274), large channel, August 30, 1983; 2559/ Dubnica nad Váhom settlement Prejta (7075), large ox-bow, November 11, 1983; 2563/ Nové Mesto nad Váhom — Rakofuby (7273), November 11, 1983; 2564/ Piešťany (7472), arm of the River Váh, muddy bottom, no plants, November 11, 1983.

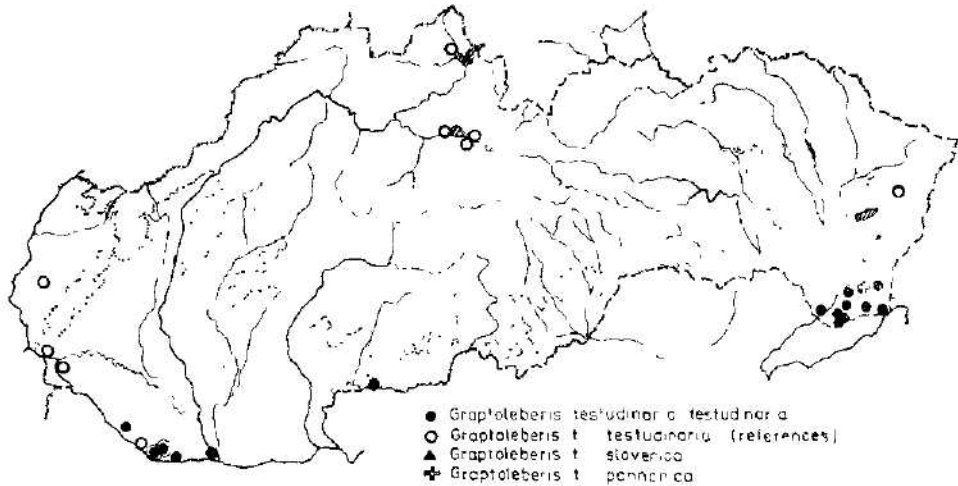


Fig. 1. Distribution of *Graptoleberis testudinaria* in Slovakia.

All samples are from the Museum of Upper Nitra in Prievidza (col. Dr. J. Brtek).

15-H/ Viničky (7596), arm of the River Bodrog, October 8, 1980; 17-H/ Veľký Kamenec (7696), arm "Karča", October 8, 1980; 25-H/ Veľký Kamenec, arm "Karča", June 6, 1981; 246/ Veľký Kamenec, arm "Karča", October 12, 1983; 25-H/ Kráľovský Chlmec (7597), swamp with *Salvinia natans*, *Lemna trisulcata*, October 8, 1980; 31-H/ Somotor (7596), arm of the River Bodrog, October 8, 1980; 63-H/ Somotor, arm of the River Bodrog, November 26, 1980; 244-H/ Somotor, arm of the River Bodrog, October 12, 1983; 86-H/ Veľké Kapušany — Leles (7498), arm of the River Latorica, April 2, 1981; 204-H/ Veľké Kapušany — Leles, arm of the River Latorica, September 22, 1981; 227-H/ Veľké Kapušany — Leles, arm of the River Latorica, July 11, 1983; 235-H/ Veľké Kapušany — Leles, arm of the River Latorica, August 9, 1983; 242-H/ Veľké Kapušany — Leles, arm of the River Latorica, October 12, 1983; 185-H/ Veľké Kapušany — Leles, pool in inundation of the River Latorica, August 5, 1981; 236-H/ Zátin — Boľ (7597), large swamp with *Stratiodes aloides*, August 9, 1983.

List of references from the territory of Slovakia (Fig. 1 — open circles): Daday (1888): (*Alona testudinaria*): Liptó-Szent-Miklós (Liptovský Mikuláš), Démenfalú (Demänová), Besényifalú (Bešeňová), Czerna (Čierne); Ortvay (1902): (*A. testudinaria*): region of Bratislava (no locality); Vranovský, Ertl (1958): (=): Žitný ostrov — Gabčíkovo, Čičov, podunajské Biskupice, Medvďov; Ertl (1960): (=): Malacky — fish pond; Kubíček (1958): (=): Remetské Hámre (Lake Veľké Vihorlatské jazero); Terek (1981): (=): Remetské Hámre (Lake Veľké Vihorlatské jazero); Vilček, Fúzia (1973): (=): Klin (moor in Orava); Vranovský (1981): (=): Čičov; Terek, Brázda (1983): (=): Nová Sedlica — fish pond.

Graptoleberis testudinaria slovenica Šrámek-Hušek, 1962 (Fig. 1 — triangle) — only from references: pool in a moor now flooded (Orava reservoir). No further individuals from moors of Orava territory were found.

Graptoleberis testudinaria pannonica Daday, 1903 (Fig. 1 — cross) 243-H/ Zátin — Boľ (7697), large swamp with *Stratiodes aloides*, plant association *Hydrocharition* (Hudec 1987), October 12, 1983 (6 ephyppial females, 19 parthenogenetic females and 3 males). All individuals are mounted in Canada balsam, stained with lignin pink and chlorazol black E and mounted in 6 slides. One slide is deposited in the Hungarian Natural History Museum, Budapest. Three

Table 1. Measurements of *Graptoleberis testudinaria*

Nr. of samples	up to	length (mm)	$\bar{X} \pm s_x$	up to	width (mm)	$\bar{X} \pm s_x$	ratio length/width	N	sex
<i>G. t. testudinaria</i>									
2024 185-H	0.60		0.53 ± 0.04	0.32		0.28 ± 0.03	1.89 ± 0.05	15	parth. females
	0.56	0.57	0.50 ± 0.04	0.32	0.32	0.27 ± 0.02	1.85 ± 0.06	14	parth. females
255-H		0.67			0.32		1.78	1	ephupp. female
		0.60			0.30		1.90	1	ephupp. female
		0.41			0.33		1.81	1	ephupp. female
	0.57		0.47 ± 0.03	0.31	0.21	0.28 ± 0.02	1.95	1	male
	0.51		0.45 ± 0.02	0.27		0.26 ± 0.01	1.71 ± 0.01	36	parth. females
	0.37		0.35 ± 0.02	0.23		0.20 ± 0.02	1.77 ± 0.05	16	ephupp. females
	0.38		0.33 ± 0.04	0.21		0.18 ± 0.02	1.81 ± 0.15	9	juv. females
							1.90 ± 0.15	13	males
<i>G. t. pannonicus</i>									
	0.67		0.56 ± 0.11	0.27		0.24 ± 0.04	2.37 ± 0.14	19	parth. females
	0.64		0.59 ± 0.03	0.27		0.26 ± 0.01	2.30 ± 0.03	6	ephupp. females
		0.44			0.21		2.10	1	male
		0.41			0.17		2.41	1	male
		0.33			0.16		2.06	1	juv. male

slides in Museum of Upper Nitra in Prievidza (coll. Nr. VII(a— 3344/512—514) and remaining material in author's collection.

RESULTS

Graptoleberis testudinaria (Plate 1 Figs 1, 2, 6, Gigs 19—24)

Detailed diagnosis can be found in different papers (Lilljeborg, 1901; Flössner, 1972; Gulyas, 1974 ect.) also in the newest Cladocera manuals (Negrea, 1983; Margaritora, 1984). Morphology is treated in Freyer (1968). Populations examined belong to *Graptoleberis testudinaria testudinaria* and they agree with the drawing of neotype by Radzimski (1982).

Biology. *Graptoleberis testudinaria testudinaria* was found mostly in littoral zone in permanent waters with well developed vegetation. It was usually subdominant in the most samples. The value of the abundance be influenced by the methods of sampling. The species was commonly found in the plant association *Lemnion minoris* and *Hydrocharition* (Hudec 1987) and also among the floating water plants. Often cococcurred with the following species of Cladocera: *Simocephalus vetulus* (O. F. Müller), *S. exspinosus* (Koch), *Alonella excisa* (Fischer), *Alona rectangula* Sars, *Pleurocus truncatus* (O. F. Müller) *P. laevis* Sars, *P. trigonellus* (O. F. Müller) and *Chydorus sphaericus* (O. F. Müller) emend. Frey.

Part of material examined is deposited as permanent slides in the Museum of Upper Nitra in Prievidza (coll. Nr. VII/a-3344) 398—402, 515—518).

Graptoleberis testudinaria pannonica Daday, 1903 (Plate 1 Figs 3—5; Figs 4—18)*

Head (Figs 4, 9) typical for the genus. Head shield with prominent sculpture and slightly prominent posteriorly. Ocellus a little smaller than eye. Head pores (Fig. 8) identical with those of *G. t. testudinaria*. Labral plate (Fig. 10) with slightly pointed tip and short fine bristles near ventral margin (similar to *G. t. alexandrinae* Negrea).

Antennules (Fig. 7) completely covered with the head shield with seven olfactory setae on the tip and one short seta in 1/3 from the base.

Antennae (Fig. 9) setae 0.0-3/0-1-3, spines 1-0-1/0-0-1. Carapac (Pl. 1 Fig. 3, Figs 4, 12) — general shape as in *G. t. testudinaria* but more elongated and slightly tapering to posterior part. Maximal width in 1/4 from the head. Coarse reticulation consists of transversal and elongated lines forming rectangular pattern. Postero-ventral corner with 3—5 marginal denticles (mostly 3). Ventral margin rather even with feathered setulation on 2/3 of total length and fine short setulation along posterior corner.

Ephippium (Fig. 4) primitive of dark brown colour with one egg. Shape of ephippium is marked off only by brown colour.

First thoracic limb (Fig. 11) agrees with *G. t. testudinaria*.

Postabdomen (Plate 1 Fig. 4; Figs 5, 6) slightly elongated. Ventral margin convex. Dorsal margin nearly even, rounded near terminal claw and slightly concave in anal groove. Dorsal margin armed with 5—6 groups of small denticles on small tubercles. Each group consists of 5—6 nearly identical denticles. Lateral side with 7—8 groups of fine hairs. Anal groove ornamented with fine setules.

Terminal claw (Fig. 6) short with one minute basal spine and fine setulation along dorsal margin. Ventral margin with 2—4 short setae. Whole arrangement of setulation agrees with that of *G. t. testudinaria*.

* Plate 1 and Figs 4—22 will be found at the end of issue.

Male (Figs 13—18) shape of the carapace as in juvenile female. Head shield and carapace with coarse rectangular reticulation, similar to that of females.

First thoracic limb (Fig. 16) corm similar to that of female. The tuft of spicules is situated just opposite to the tip of the copulatory hook. The copulatory hook U-shaped, slightly pointed. Outer distal lobe with one long seta, inner distal lobe with three setae. Posterior part similar to that of female.

Biology. *Graptoleberis testudinaria pannonica* was found only once. It seems that its biology is similar to that of *G. t. testudinaria*. Both *G. t. testudinaria* and *G. t. pannonica* were found on the same locality (Hudoc 1987) but not on the same date and sample.

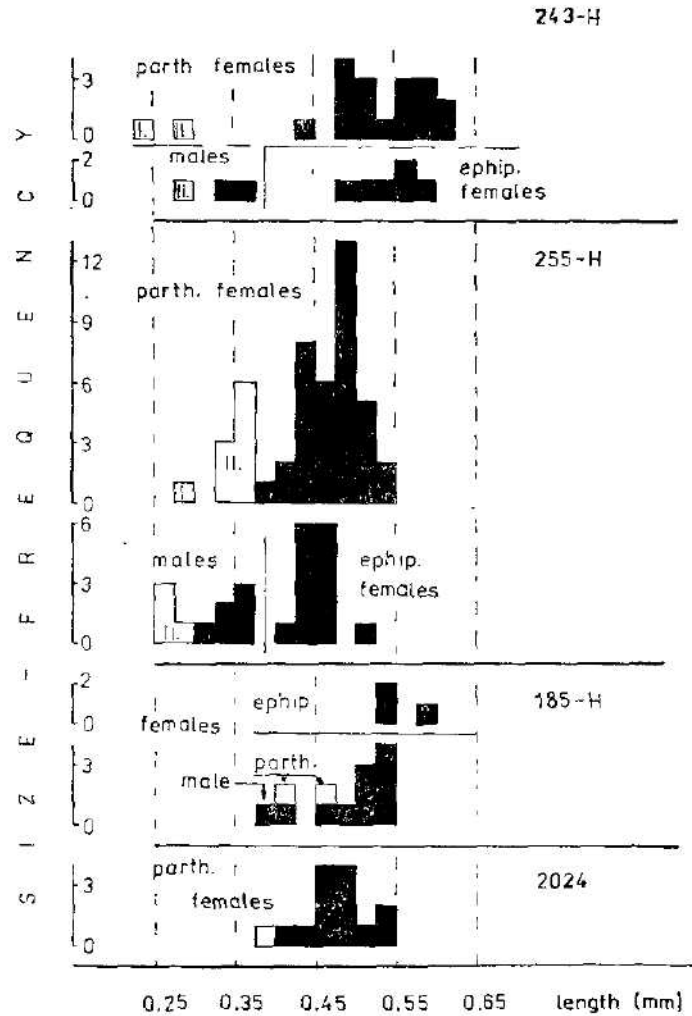


Fig. 2. Size-frequency histogram of *Graptoleberis testudinaria pannonica* (243-H) and *Graptoleberis testudinaria testudinaria* (255-H, 185-H 2024) (black dots — adult individuals, empty circles — juveniles, I. — first instar, II. — second instar).

Comparison

Size-frequency analysis in *Graptoleberis t. testudinaria* and *Graptoleberis t. pannonica* did not reveal any significant differences (Fig. 2, 3). Characteristic is the length/width ratio where all examined populations of *Graptoleberis t. testudinaria* differed from *Graptoleberis t. pannonica* (Tab. 1), ehippial females too.

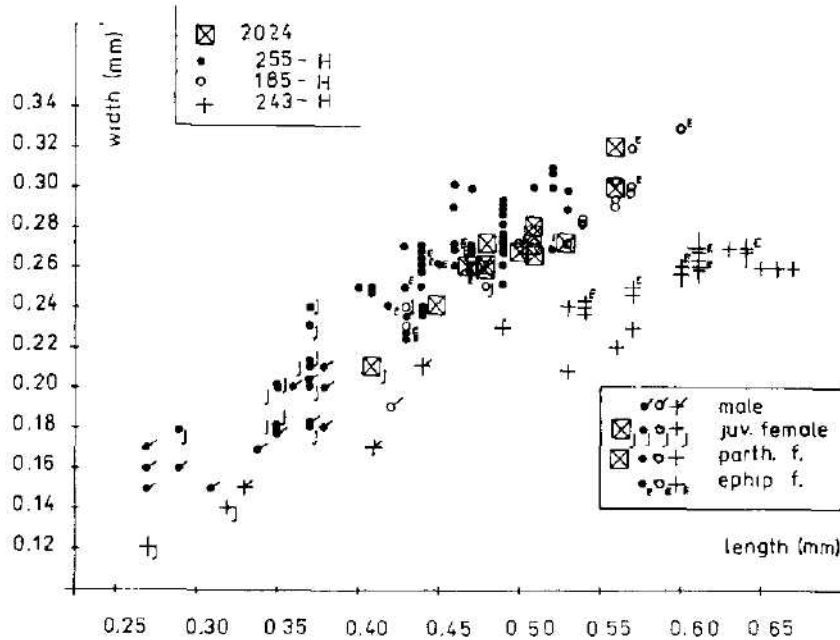


Fig. 3. Relationship between body length and body width in *Graptoleberis t. pannonica* (243-H) and *Graptoleberis t. testudinaria* (255-H, 185-H, 2024).

Tab. 2. Differential diagnosis of females

Character	<i>Graptoleberis testudinaria testudinaria</i>	<i>Graptoleberis testudinaria pannonica</i>
length	up to 0.60	up to 0.67
ratio length/width	1.50–1.89	2.20–2.59
antennules	one short seta near the tip	one short seta in 1/3 from base
general shape on shell valves	semicircular	elongated, slightly tapering distally
reticulation	hexagonal near dorsal margin	rectangular near dorsal margin
	2	3
denticulation on postero--corner postabdomen	(1–3) tapering distally, conical behind anal groove	(3–5) elongated, tapering to the terminal claw

Structure of postabdomen permits clear separation of *Graptoleberis t. testudinaria* from *Graptoleberis t. pannonica*. All individuals of *Graptoleberis t. testudinaria* have conically shaped postabdomen while that in *Graptoleberis t. pannonica* is more elongated in adults as well as in juveniles. Arrangement of setulation is similar in both forms (?).

Two denticles on postero-ventral corner are characteristic for *Graptoleberis t. testudinaria* (98% and all individuals from samples 255-H). Only sporadically one or three denticles were found but only on one of the valves. Three denticles are characteristic for *Graptoleberis t. pannonica*.

Arrangement of setulation on ventral margin of valves is the same in both.

Antennules of *Graptoleberis t. testudinaria* and *Graptoleberis t. pannonica* differ in the position of minute seta. We found some individuals of *Graptoleberis testudinaria* that have four more minute hairs over the minute setae (Fig. 22b) on margin of antennal body. ¶

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**THE EFFECT OF MACROZOOBENTHOS OF A FOREST BROOK
ON THE DESTRUCTION OF THE LEAF MATERIAL (OFF-FALL)**

Zdeněk KUBIŠTA¹ & Lea HOUŠKOVÁ²

¹Institute of Systematical and Ecological Biology, Czechoslovak Academy of Sciences,
Květná 8, 603 65 Brno, Czechoslovakia and ²Faculty of Science, J. E. Purkyně University,
Kotlářská 2, 611 00 Brno, Czechoslovakia

Abstract. In the period of May, 1982 to July, 1983, we followed the dynamics of zoobenthos, leaf eating and detritivorous animals and the amount of leaves in a small forest brook near the Brno Reservoir. Altogether about 50 taxa were determined. Mean total abundances and biomasses drop in the direction down the stream. The mutual ratio of leaf eating animals and detritivores downstream changed in favour of the detritivores. The leaves fallen to the brook in autumn were practically degraded in the course of the year. The leaves of the *Fagus sylvatica* and of the *Quercus robur* were preserved longest. The amount of detritus dry weight varies greatly throughout the period at different stations, so that no common trend can be traced for the whole stream. By statistical processing of the results we found certain relations between the abundance (and/or biomass) of animals and the decrease in leaves in the brook.

INTRODUCTION

One of the fundamental features of all natural communities is the decomposition of dead organic materials which gradually releases the potential energy necessary for the development, growth and reproduction of animal communities. So far little has been known about these processes of decomposition taking place in water systems although many foreign authors have dealt with these problems (Darnell 1964; Minshall 1967; Kaushik, Hynes 1968; Mathews, Kowalczewski 1969; Kaushik, Hynes 1971; Cummins 1972; Haeckel et al., 1973; Iversen 1973; Caspers 1975; Iversen 1975; Suberkropp et al., 1975; Anderson, Sedell 1979; Saunders et al., 1980; Tolkamp 1980; Ladle 1982; Minshall et al., 1983).

Special attention is paid to small streams flowing (at least in part) through a forest region. Many authors have found that the prevailing source of food of animal communities is organic material of allochthonous origin, whereas autochthonous primary production participates in the total animal production in small forest brooks less (great shadow prevents direct utilization of solar energy in photosynthesis). All biotic material of autochthonous (dead organisms, their secretions, feces, etc.) as well as allochthonous origin (fallen leaves of trees, flowers, fruits, seeds, fragments of wood) is subject to mechanical destruction and biochemical degradation and at different stages of its decomposition it is considered detritus accumulating in the quiet parts of the stream.

On falling into the water the leaves (after extraction of soluble materials) are subject to colonization and partial degradation by microorganisms, which results in changing the leaves into more digestible components. The leaves can be degraded into smaller parts mechanically (by physical abrasion) or biotically (due to the activity of digestion systems of animals). The feces of leaf consumers, together with the associated microflora, then become food of other invertebrates. The gradual reduction of the size of parts of food makes it possible for them to be liquidated by

animals with smaller alimentary canals. In that way a part of the benthic food chain is created with detritus reutilization.

The relative importance of the allochthonous organic material in the metabolism of water communities depends on the size and character of the stream and on the factors affecting the autochthonous production.

In this paper, which was elaborated as a diploma thesis at the Department of Animal and Human Biology, Faculty of Science, J. E. Purkyně University, we turned our attention to following the changes in the amount of benthic organisms, allochthonous organic material and some abiotic factors in a small forest brook. The results concerning the dynamics of changes in macrozoobenthos and its potential food source — the allochthonous leaf material — are the objective of the present report.

CHARACTERISTIC OF THE STREAM

The studied stream is a right-bank tributary of the Brno Reservoir in the region northwest of Brno. It springs in Riša's well and the whole brook, 3.2 km long, with a mean gradient of 5.2‰, flows through a forest in which deciduous and coniferous trees interchange. The prevailing species of deciduous trees are *Fagus sylvatica*, *Quercus robur*, *Carpinus betulus*, *Alnus glutinosa* and *Populus tremula*.

In the lower part the brook flows under the road and empties into a small reservoir at Rakovec, from where it is connected through a channel with the reservoir.

The mean annual air temperature there is 8–9 °C, the mean annual precipitation being 500–550 mm. In the period followed (May, 1982–July, 1983) the precipitation sum was 640 mm, i.e. the mean for one month is 43.7 mm.

Throughout the period of study the water of the stream was sufficiently saturated with oxygen. The percentage of saturation varied between 84.69% and 112.91%.

The dynamics of changes was followed at three selected stations. Station one was situated at the distance of 410 m from the spring in a deep valley Kočičí žleb where the slopes fall abruptly to the stream proper. The bottom of the stream is in autumn completely covered with leaves which gradually disappear in the course of the year, but a certain part of them remains till the following autumn. Station two was selected at the distance of 1,160 m from the spring. The width of the valley increases there to about six metres. The amount of leaves fallen to the stream is less than at station one: at the beginning of winter the leaves cover less than 50% of the bottom area, in spring the leaves occur only in places (near the banks there are accumulations of sedimented detritus) and in summer only isolated leaves were found. Station three lies at the distance 2,440 m from the spring. The stream flows through the right side of a broad valley (about 50 m wide). From the right hand side the stream is shaded by a deciduous forest and from the left hand side it is separated by a continuous line of trees from the adjacent meadow. The leaves at the bottom of the stream are substantially less numerous (also during the autumn falling) than at stations one and two. In spring they cover less than 5% of the area of the bottom and in the course of summer they practically disappear.

METHODS

Samples were taken altogether 11 times (13 May, 28 June, 2 Aug., 18 Oct., 19 Nov., 21 Dec., 1982, 7 Mar., 28 Mar., 21 Apr., 2 June, 18 July, 1983). For taking quantitative samples of benthic organisms we used the frame collector — Surber's net with the mesh of 0.6 mm. A folding frame made it possible to delimit the bottom area of 800 cm². On classification the material was fixed with 4% formaldehyde. To determine the biomass formaldehyde weight was used which was determined after more than 6 month fixation. The organisms were first dried in a battery centrifuge and weighed on an analytical balance with the accuracy of 10⁻³ g.

Leaves from the bottom of the stream were collected with Surber's net as well. On the determination of the individual species of leaves they were first dried at room temperature and then in an electric drying oven at 110 °C to constant weight. The leaves thus dried were then weighed on an analytical balance with the accuracy of 1 mg. From the values obtained the mass of the dry weight of leaves falling to 1 m² of the stream bottom was calculated.

From June 1982 also detritus samples were taken. By means of a ball pipette we filled a 100 ml polyethylene bottle with fine sedimented detritus from the quiet part of the bottom. In the laboratory we let the detritus sediment and then transferred the sedimented detritus into

Tab. 1. Abundance (n.m⁻²) of the individual taxa of macrozoobenthos found in the course of the period studied

Taxon	Stations		
	1	2	3
<i>Dugesia gonocephala</i>	322	1,056	856
<i>Paragordionus bohemicus</i>	12	—	—
Enchytraeidae g. sp.	12	—	—
<i>Bilimnella austriaca</i>	12	—	25
<i>Hydracarina</i> g. sp.	74	25	12
<i>Gammarus fossarum</i>	24,123	8,186	13,069
<i>Heptagenia lateralis</i>	98	—	36
<i>Rhithrogena semicolorata</i>	—	25	50
<i>Leoperta</i> sp.	24	12	12
<i>Leuctra braueri</i>	559	13	—
<i>Leuctra nigra</i>	360	62	210
<i>Leuctra</i> sp.	75	—	50
<i>Nemoura</i> sp.	335	49	385
<i>Protonemura</i> sp.	—	—	111
<i>Agapetus fuscipes</i>	12	137	62
<i>Agapetus</i> sp.	—	12	—
<i>Chaetopteryx villosa</i>	647	49	360
<i>Crunoecia irrorata</i>	38	—	—
<i>Hydropsyche fulvipes</i>	—	209	149
Limnephilinae g. sp.	150	99	187
<i>Plectrocnemia conspersa</i>	75	62	—
Polycentropodidae g. sp.	—	12	—
<i>Potamophylax nigricornis</i>	297	225	—
<i>Potamophylax</i> sp.	49	88	62
<i>Sericostoma</i> sp.	173	149	25
<i>Silo</i> sp.	—	—	25
<i>Wormaldia occipitalis</i>	—	75	—
<i>Brillia modesta</i>	12	25	347
Chironominae g. sp.	—	—	50
<i>Dianesa thienemanni</i>	—	—	37
<i>Dicranota</i> sp.	50	12	—
<i>Dixa cf. maculata</i>	24	60	12
<i>Dixa nebulosa</i>	37	—	—
<i>Dixa submaculata</i>	12	—	—
<i>Endochironomus tendens</i>	—	—	12
<i>Eukiefferiella bavarica</i>	—	25	—
<i>Eukiefferiella discoloripes</i>	—	25	—
Limoniidae g. sp.	—	37	—
<i>Macropelopia nebulosa</i>	12	—	—
<i>Micropsectra praecox</i>	99	87	832
Orthocladinae g. sp.	—	24	—
<i>Ozycera</i> sp.	—	25	—
<i>Ptychoptera</i> sp.	75	62	—
<i>Rheocricotopus effusus</i>	—	—	12
Simuliidae g. sp.	—	37	86
<i>Thienemannimyia</i> sp.	—	12	—
Tipulidae g. sp.	—	24	12
<i>Tonnoiriella pulchra</i>	62	37	149
<i>Trissocladius distylus</i>	—	—	12
<i>Trissocladius lugubris</i>	—	—	12
Diptera g. sp.	12	—	12
<i>Helodes</i> sp.	596	586	521
<i>Hydraena</i> sp.	37	37	37

Tab. 2. Abundance (n.m⁻³) and biomass (g.m⁻³) of taxonomic groups of zoobenthos at station I. A — abundance, B — biomass

Date 1982/1983	13. 5.	28. 6.	2. 8.	18. 10.	19. 11.	21. 12.	7. 3.	28. 3.	21. 4.	2. 6.	18. 7.	Mean
Turbellaria	A 74	—	—	124	37	—	50	—	—	37	—	39
B	0.819	—	—	1.801	0.720	—	1.403	—	—	1.217	—	0.842
Nematomorpha	A	—	—	—	—	—	—	—	—	12	—	1
B	—	—	—	—	—	—	—	—	—	0.225	—	0.021
Oligochaeta	A	—	—	—	12	—	—	—	—	—	—	1
B	—	—	—	—	0.280	—	—	—	—	—	—	0.025
Gastropoda	A	—	—	12	—	—	—	—	—	—	—	1
*B	—	—	—	—	—	—	—	—	—	—	—	—
Acarina	A	—	—	—	—	—	—	—	—	74	—	7
B	—	—	—	—	—	—	—	—	—	0.280	—	0.025
Amphipoda	A	3.565	1.640	348	2.124	4.149	2.869	1.925	1.640	969	3.242	2.193
B	35.031	23.056	10.898	25.317	22.919	44.300	25.702	20.522	15.130	7.628	21.863	22.033
Ephemeroptera	A	12	—	—	—	50	24	—	—	—	—	9
B	0.409	—	—	—	0.298	0.869	0.386	—	—	—	—	0.178
Plecoptera	A	99	25	—	62	87	199	248	99	199	37	123
B	0.521	1.018	—	0.310	0.484	1.763	1.577	1.043	1.465	1.416	0.521	0.920
Trichoptera	A	174	25	—	76	62	137	422	248	99	124	131
B	5.578	1.317	—	2.272	2.459	1.367	2.274	9.416	7.404	3.665	10.981	4.248
Diptera Chironomidae	A	12	99	12	—	—	—	—	—	—	—	11
B	0.273	0.223	0.149	—	—	—	—	—	—	—	—	0.059
Diptera varia	A	—	—	12	48	75	25	25	50	—	—	25
B	—	—	0.149	0.360	0.347	1.167	0.320	0.298	1.043	—	—	0.335
Coleoptera	A	—	—	174	87	198	37	35	49	62	—	58
B	—	—	2.993	1.527	2.310	0.773	0.732	0.670	0.670	0.650	—	0.878

* Biomass was not determined.

porcelain dishes. In the drying oven the samples were dried to constant weight at 110 °C and weighed on an analytical balance (dry weight). The content of organic materials was determined once for all samples. The samples in aluminum crucibles were charred on a gas burner; in a muffle oven they were then ashed at 600 °C and after cooling in a desiccator weighed on an analytical balance. Thus we obtained the mass of inorganic materials (ash) contained in that detritus; subtracting its value from the dry weight of detritus we obtained the mass of organic materials.

RESULTS

Qualitative composition of zoobenthos

In the course of the period followed altogether 11 samples of benthic fauna were taken from each station. The species pattern of macrozoobenthic organisms did not differ too much at the individual stations. A list of the found taxa is given here with a note saying at which stations the given taxa occurred (Tab. 1).

Altogether more than 50 taxa were found, some of which being common to all three stations.

The richest as for the number of taxa appears to be station 2 (about 36 taxa), stations 1 and 3 being approximately equal as far as the number of taxa is concerned (about 30 taxa).

Quantitative composition of zoobenthos

In Tabs. 2, 3, and 4 the numerical representation of taxonomic groups of the benthic fauna is expressed in each sample. Similarly, the tables give the values of biomass (in the Gastropoda group the biomass could not be determined due to the fact that only empty shells were found).

Station 1: The mean total abundance of organisms found at that station was 2,589 individuals per m² (for 11 samples takings). On the average the most frequently represented was *Gammarus fossarum* (2,193 n.m⁻²), further Trichoptera (131 n.m⁻²) and Plecoptera (123 n.m⁻²). *Gammarus fossarum* always constitutes more than 60% of all the individuals found.

The order of groups according to the dropping mean abundance also corresponds to the order of groups according to the mean values of biomass, where the highest values were those of *Gammarus fossarum* (22.933 g.m⁻²), Trichoptera (4.248 g.m⁻²) and Plecoptera (0.920 g.m⁻²). The share in the total biomass of *Gammarus fossarum* was more than 50%.

Station 2: At that station a lower mean total abundance was found than at station 1; it was 1,041 individuals per m². Again the most frequent was *Gammarus fossarum* with the mean value of 744 n.m⁻², followed by Trichoptera (102 n.m⁻²) and Turbellaria (96 n.m⁻²). *Gammarus fossarum* constitutes the highest percentual representation in each sample, but these values are lower than those in station 1.

The groups having the largest shares in the total mean abundance also have the largest shares in the total biomass: *Gammarus fossarum* (11.297 g.m⁻²), Trichoptera (3.464 g.m⁻²), Turbellaria (1.769 g.m⁻²).

Station 3: There we noted the lowest values of abundance of the individual taxa. In the sampling of 2 Aug., 1982, no animal benthic organism was found using the above method.

Numerically it was again *Gammarus fossarum* which is represented most frequently. On 21 Apr., 1983 we took an aggregation of leaves from the stream bottom in which evidently a great accumulation of juvenile individuals of *Gammarus fossarum* had taken place. That is why the found abundance of 7,540 n.m⁻² is an accidental agglomeration, not corresponding to the actual situation (also in view

Tab. 3. Abundance ($n \cdot m^{-2}$) and biomass ($g \cdot m^{-2}$) of taxonomic groups of zoobenthos at station 2, A — abundance, B — biomass

Data 1982/1983		13. 5.	28. 6.	2. 8.	18. 10.	19. 11.	21. 12.	7. 3.	28. 3.	21. 4.	2. 6.	18. 7.	Mean
Turbellaria	A	373	50	—	50	37	50	50	87	136	50	173	96
	B	5.565	1.229	—	1.714	1.304	1.142	1.055	1.354	3.118	1.242	1.739	1.769
Acarina	A	—	—	—	25	—	—	—	—	—	—	—	2
	B	—	—	—	0.301	—	—	—	—	—	—	—	0.027
Amphipoda	A	1.975	273	124	398	1.429	1.490	1.466	149	311	149	422	744
	B	26.758	10.248	2.757	5.986	10.469	15.776	28.050	10.822	6.807	2.211	4.398	11.297
Ephemeroptera	A	—	—	—	—	—	—	—	—	—	25	—	2
	B	—	—	—	—	—	—	—	—	—	0.670	—	0.061
Plecoptera	A	25	—	—	—	12	50	25	12	12	—	—	12
	B	0.633	—	—	—	0.310	1.068	0.236	0.347	0.248	—	—	0.257
Trichoptera	A	124	25	62	99	12	75	112	149	211	50	198	102
	B	4.646	1.627	3.727	2.558	0.745	1.690	2.224	2.672	2.373	0.323	16.727	3.464
Diptera Chironomidae	A	—	—	—	25	12	124	12	62	—	—	—	21
	B	—	—	—	0.620	0.124	0.422	0.161	0.372	—	—	—	0.154
Diptera varia	A	37	—	—	25	124	—	36	—	—	25	—	23
	B	0.559	—	—	0.230	2.086	—	12.495	—	—	0.596	—	1.450
Coleoptera	A	25	—	—	75	75	—	861	112	25	25	—	39
	B	0.336	—	—	1.382	0.745	—	1.454	1.142	0.397	0.496	—	0.592

Tab. 4. Abundance ($n.m^{-2}$) and biomass ($g.m^{-2}$) of taxonomic groups of zoobenthos at station 3, A - abundance, B - biomass

Date 1982/1983	13. 5.	28. 6.	2. 8.	18. 10.	19. 11.	21. 12.	7. 3.	28. 3.	21. 4.	2. 6.	18. 7.	Mean
Turbellaria	A 75	136	—	—	25	25	26	149	74	74	273	78
	B 1.166	2.571	—	—	1.155	0.745	0.596	2.968	1.304	1.577	4.472	1.504
Gastropoda	A —	—	—	—	—	—	—	—	—	—	—	26
	*B —	—	—	—	—	—	—	—	—	—	—	2
Acarina	A —	—	—	—	—	—	—	—	—	—	—	—
	B —	—	—	—	—	—	—	—	—	—	—	1
Amphipoda	A 721	99	—	373	1.031	696	224	2.149	7.540	62	174	0.016
	B 13.404	1.665	—	4.844	7.002	5.292	2.347	15.553	70.571	0.845	2.460	1.188
Ephemeroptera	A —	—	—	25	—	—	12	25	12	12	—	11.344
	B —	—	—	0.396	—	—	0.236	0.372	0.385	0.285	—	8
Plecoptera	A 37	—	—	223	62	149	50	199	49	—	—	0.162
	B 1.055	—	—	1.569	0.608	1.192	0.545	0.869	0.273	—	—	70
Trichoptera	A 50	62	—	25	12	25	—	174	422	26	75	0.656
	B 1.565	1.503	—	0.694	0.968	0.173	—	0.994	10.535	0.249	0.547	1.566
Diptera Chironomidae	A 49	—	—	50	25	347	74	819	87	—	—	132
	B 0.322	—	—	0.111	0.037	0.621	0.472	0.832	0.198	—	—	0.236
Diptera varia	A —	24	—	25	24	25	24	—	—	—	—	11
	B —	0.360	—	0.644	13.974	0.621	0.559	—	—	—	—	1.469
Colleoptera	A —	25	—	149	25	—	12	223	99	—	—	51
	B —	0.248	—	1.986	0.708	—	0.310	3.152	2.000	—	—	0.819
												0.838

* Biomass was not determined.

of the other samples from that station). That fact affected considerably the mean total abundance for 11 samples — 1,620 n.m⁻², the same as the mean total biomass — 17.681 g.m⁻². If the sample of 21 Apr. is disregarded, the mean total abundance is 952 n.m⁻² and the biomass 10.905 g.m⁻². The mean abundance of the species *Gammarus fossarum* is 1,188 n.m⁻², (552 n.m⁻² if the sample of 21 Apr. is discounted). In further groups the occurrence was lower: Diptera 143 n.m⁻², Tubelaria 78 n.m⁻², Plecoptera 70 n.m⁻². Percentual representation of the species *Gammarus fossarum* in the individual samples varies between 28.7 and 90.9%.

Neglecting the biomass value of 21 Apr., the mean biomass of *Gammarus fossarum* is 5.421 g.m⁻². Diptera reach on the average the value of 1.705 g.m⁻², Trichoptera 1.566 g.m⁻², and Tubelaria 1.504 g.m⁻².

Dynamics of trophic groups

All taxa whose occurrence in the period followed was recorded, have been classified — according to Minshall (1967) and Tolkamp (1980) — into four trophic groups:

- 1) Animals feeding mostly on detritus and algae (further only detritovores)
- 2) Animals feeding on decomposing leaves of allochthonous origin (further only leaf eating animals)
- 3) Predatory animals
- 4) Indifferent benthic animals

Taxa were classified to the trophic group according to the type of the prevailing food component. Detritovores are animals feeding mostly on fine particulate sedimental detritus; animals feeding on rough detritus (above all on leaves) are denoted as leaf eating animals. Indifferent benthonts are those taxa whose food is so varied that it is impossible to state the prevailing food component.

With respect to the objective of the present paper we concentrated above all on following the dynamics of the groups of leaf eating animals and detritovores. The following taxa were included into those groups:

Detritovores	Leaf eating animals
Annélida	Amphipoda
Enchytraeidae g. sp.	<i>Gammarus fossarum</i> Koch
Ephemeroptera	Plecoptera
<i>Heptagenia lateralis</i> (Curtis)	<i>Leuctra braueri</i> Kempny
<i>Rhithrogena semicolorata</i> (Curtis)	<i>Leuctra nigra</i> (Olivier)
Trichoptera	<i>Leuctra</i> sp.
<i>Agapetus fuscipes</i> Curtis	<i>Nemoura</i> sp.
<i>Agapetus</i> sp.	<i>Protonemura</i> sp.
<i>Silo</i> sp.	Trichoptera
Diptera	<i>Chaetopteryx villosa</i> (Fabricius)
<i>Brillia modesta</i> (Meigen)	<i>Potamophylax nigricornis</i> (Pictot)
<i>Diamesa thienemanni</i> Kieffer	<i>Potamophylax</i> sp.
<i>Dixa</i> cf. <i>maculata</i> Meigen	<i>Sericostoma</i> sp.
<i>Dixa nebulosa</i> Meigen	Diptera
<i>Dixa submaculata</i> Edwards	Limnephilinae g. sp.
<i>Endochironomus tendens</i> Fabricius	Limoniidae g. sp.
<i>Eukiefferiella bavarica</i> (Goetghebuer)	<i>Tipula</i> sp.
<i>Eukiefferiella discoloripes</i> (Thienemann)	Coleoptera
Chironominae g. sp.	<i>Helodes</i> sp.
<i>Macropelopia nebulosa</i> (Meigen)	

Micropspectra praecox (Meigen)
Orthocladinae g. sp.
Oxycera sp.
Ptychoptera sp.
Rhaocricotopus effusus (Walker)
Simuliidae g. sp.
Tonnosriella pulchra (Eaton)
Trisocladius distylus (Kieffer)
Trisocladius lugubria Fries

Coleoptera

Hydraena sp.

The size of the abundance of leaf eating animals in the individual samples is given in Tab. 5. At all three stations a drop in abundance was registered from May to minimum values in August. The highest ever abundance of leaf eating animals from the three stations (disregarding the above April at station 3) occurred at station 1. At all three stations one can observe rising abundance in the course of autumn months, followed by a gradual drop during spring and the beginning of summer.

From Tab. 5 it follows that the highest share in abundance of leaf eating animals is that of the order Amphipoda, represented here by the only species — *Gammarus fossarum* Koch. Data about the biomass of this species correspond to the values of biomass of the group Amphipoda in Tables 2, 3, and 4.

The abundance and the biomass of *Gammarus fossarum* at all three stations decreased from May to August 1982. During the autumn months there was an increase both in abundance and in biomass which lasted till December at station 1 and till March at station 2, but only till November at station 3. At that latter station a substantial increase in both abundance and biomass took place in spring months when at other stations the values gradually dropped.

On the whole it can be said that the highest abundance and biomass of *Gammarus fossarum* were observed at station 1, lower at station 2, and the lowest at station 3.

The abundance of detritivores found in the sampling is registered in Tab. 6. At station 1 the abundance increased from August to December. Then it dropped gradually as low as to the zero value in July. In the autumn season the number of detritivores also increased at station 2. The subsequent drop was, however, interrupted by a relatively high value of abundance in April. At station 3 the changes in detritivore abundance were the most dynamic. The first conspicuous increase occurred in October, the second in December, and the third (maximum) towards the end of March. From that date on the values kept decreasing up to the zero value in July.

It can be said that at all stations an increase in detritivore abundance was recorded in the course of autumn, in the period December to March a gradual decrease with a trend to the zero value in July.

Dynamics of the leaf material

To get an idea of the selfpurification abilities of the studied forest stream and to find the possible food relations we followed changes in the amount of leaves occurring on the bottom of the stream. The amount of leaves falling approximately on one square metre of the area in the annual autumn fall of leaves was to be documented by a sample taken on 3 November, 1983 (the fall-off of leaves almost finished). In this sample we only concentrated on collecting leaves covering the banks of the stream at the stations studied. At each station we chose three collecting areas of

Tab. 8. Abundance ($n.m^{-2}$) of representatives of taxonomic groups of leaf eating animals in the individual samples, L 1, L 2, L 3 - marking of the stations

Data 1982/1983	13. 5.	28. 6.	2. 8.	18. 10.	19. 11.	21. 12.	7. 3.	28. 3.	21. 4.	2. 6.	18. 7.	Total
Amphipoda	L 1 3,585	1,640	348	2,124	1,652	4,149	2,869	1,925	1,640	969	3,242	24,123
	L 2 1,975	273	124	398	1,429	1,460	1,466	149	311	149	422	8,186
	L 3 721	99	-	373	1,031	696	224	2,149	7,540	62	174	13,069
Plecoptera	L 1 99	25	-	62	87	298	199	248	75	199	37	1,329
	L 2 13	-	-	-	12	50	25	12	12	-	-	124
	L 3 26	-	-	223	61	149	50	199	49	-	-	756
Trichoptera	L 1 174	25	-	50	50	75	124	369	248	87	124	1,316
	L 2 100	13	50	74	12	25	75	87	49	-	125	610
	L 3 25	25	-	25	12	-	-	162	372	13	-	634
Diptera	L 1 -	-	-	-	-	-	-	-	-	-	-	-
	L 2 25	-	-	-	12	-	24	-	-	-	-	61
	L 3 -	-	-	-	12	-	-	-	-	-	-	12
Coleoptera	L 1 -	-	-	174	87	198	25	25	49	37	-	595
	L 2 25	-	-	50	75	-	74	112	25	25	-	386
	L 3 -	25	-	149	25	-	12	186	99	-	25	531

Tab. 6. Abundance (n.m⁻²) of representatives of taxonomic groups of detritivores in the individual samples,
L 1, L 2, L 3, — marking of the stations

Data 1982/1983	13. 5.	28. 6.	2. 8.	18. 10.	19. 11.	21. 12.	7. 3.	28. 3.	21. 4.	2. 6.	18. 7.	Total
Annelida	L 1	—	—	—	12	—	—	—	—	—	—	12
	L 2	—	—	—	—	—	—	—	—	—	—	—
	L 3	—	—	—	—	—	—	—	—	—	—	—
Ephemeroptera	L 1	12	—	—	12	50	24	—	—	—	—	86
	L 2	—	—	—	—	—	—	—	—	25	—	25
	L 3	—	—	25	—	—	12	25	12	12	—	86
Trichoptera	L 1	—	—	—	—	—	—	—	—	—	—	—
	L 2	—	—	—	—	—	—	12	112	25	—	149
	L 3	—	—	—	—	25	—	12	50	—	—	87
Diptera	L 1	12	—	12	37	50	25	25	25	—	—	333
	L 2	—	—	—	124	124	12	62	—	25	—	397
	L 3	49	12	—	372	372	98	819	87	—	—	1,549
Coleoptera	L 1	—	—	—	—	—	12	—	—	25	—	37
	L 2	—	—	—	—	—	12	—	—	—	—	37
	L 3	—	—	—	—	—	—	37	—	—	—	37

Tab. 7. Mass of the individual species of leaves (g dry weight . m⁻²) obtained in the sample on 3 Nov., 1983 (from the stream bottom)

	station 1	station 2	station 3
<i>Acer campestre</i>	—	0.303	—
<i>Acer pseudoplatanus</i>	—	0.528	158.291
<i>Alnus glutinosa</i>	—	47.488	2.428
<i>Betula verrucosa</i>	0.741	0.709	—
<i>Carpinus betulus</i>	36.140	14.933	6.872
<i>Corylus avellana</i>	—	—	19.283
<i>Euonymus europaea</i>	—	0.568	2.541
<i>Fagus sylvatica</i>	70.119	74.428	—
<i>Fraxinus excelsior</i>	—	116.888	4.791
<i>Malus silvestris</i>	—	—	9.559
<i>Populus tremula</i>	—	28.376	—
<i>Quercus robur</i>	38.024	0.907	4.811
<i>Salix</i> sp.	—	—	220.796
<i>Swida sanguinea</i>	—	0.844	2.832
<i>Tilia cordata</i>	112.209	—	—
<i>Ulmus carpinifolia</i>	—	—	2.796
<i>Ulmus montana</i>	—	2.920	—
Crushed leaves	189.030	56.519	27.573
Total	448.263	345.211	457.573

the size 0.5 by 0.5 m, collecting all leaves from them. After classification, drying and weighing them we calculated the mean amount of leaves on one collecting area and converted it to the area of one square meter. The established amounts of leaves in grammes of dry weight are given in Tab. 7.

The mass of the individual species of leaves and the total mass of leaves in each sample from the bottom of the stream are shown in Tabs. 8, 9, and 10. Most of the leaves remained throughout the period (with the exception of October) at station 1. Common for all three stations is the increase in the amount of leaves in the course of autumn up to the individual maximum values (station 1 — December, station 2 — October, and station 3 — November). The subsequent gradual decrease during the following months finishes in June. At stations 1 and 3 we observed a certain increase in spring (station 1 in April, station 3 in March). In July the amount of leaves at all stations increased, probably due to the shift from the banks of the upper reaches of the stream (the possible effect of the June precipitation).

Detritus

In the period of June, 1982 to July, 1983 we followed changes in the total amount of detritus as well as changes in the content of inorganic, but above all organic materials (the content of inorganic materials is called ash matter).

In contemporary studies under detritus is understood material of organic origin, permanently incapable of reproduction, including withered parts of plants and animals and particles of their decomposition (including feces and exuvia) and the associated microflora (Minshall 1967, Ladle 1982). Detritus can thus have several forms, differing above all by the size of its particles:

a) suspended detritus consisting of fine particles (particle size on the average 10-150 μ m)

Tab. 8. Mass of the individual species of leaves (g dry weight · m⁻²) at station 1 (from the bottom)

Data 1982/1983	13. 5.	28. 6.	2. 8.	18. 10.	19. 11.	21. 12.	7. 3.	28. 3.	21. 4.	2. 6.	18. 7.
<i>Acer pseudoplatanus</i>	—	—	4.273	—	—	—	—	—	—	—	—
<i>Betula verrucosa</i>	—	—	—	—	0.968	—	—	—	—	—	—
<i>Carpinus betulus</i>	1.690	—	—	6.385	18.670	—	0.957	2.870	7.776	—	—
<i>Fagus sylvatica</i>	142.21	10.994	24.198	33.839	142.33	119.62	54.224	27.131	86.658	15.665	95.681
<i>Quercus robur</i>	8.646	—	4.358	8.683	18.385	13.814	6.896	4.832	20.770	—	—
<i>Tilia cordata</i>	—	—	—	58.559	3.751	—	—	—	5.093	—	—
Crushed leaves	59.491	18.174	—	18.609	43.093	102.93	40.941	39.205	52.447	13.565	—
Total	212.038	29.168	56.95	118.07	227.20	236.37	102.85	74.088	172.74	29.230	95.081

Tab. 9. Mass of the individual species of leaves (g dry weight · m⁻²) at station 2 (from the bottom)

Data 1982/1983	13. 5.	28. 6.	2. 8.	18. 10.	19. 11.	21. 12.	7. 3.	28. 3.	21. 4.	2. 6.	18. 7.
<i>Acer pseudoplatanus</i>	—	—	—	—	—	—	—	—	—	—	—
<i>Alnus glutinosa</i>	—	—	—	5.440	1.167	—	—	—	—	—	—
<i>Betula verrucosa</i>	—	—	—	—	4.298	—	—	—	—	—	—
<i>Carpinus betulus</i>	—	—	—	1.267	—	—	—	—	—	—	—
<i>Corylus avellana</i>	—	—	—	5.490	1.552	—	—	—	—	—	—
<i>Fagus sylvatica</i>	—	—	—	—	38.645	—	—	—	—	—	—
<i>Fraxinus excelsior</i>	13.242	1.664	—	58.683	80.658	107.70	35.652	8.993	3.565	—	1.763
<i>Populus tremula</i>	—	—	—	75.950	—	—	—	—	1.018	—	—
<i>Quercus robur</i>	—	—	—	18.633	20.037	6.211	1.801	—	—	—	1.739
<i>Tilia cordata</i>	—	—	—	—	10.695	6.658	2.012	1.701	1.664	—	—
Crushed leaves	17.577	—	—	2.732	—	—	—	—	—	—	—
Total	30.819	1.664	—	220.493	210.87	178.26	67.701	32.917	10.880	—	3.502

Tab. 10. Mass of the individual species of leaves (g dry weight · m⁻²) at station 3 (from the bottom)

Data 1982/1983	13. 5.	28. 6.	2. 8.	18. 10.	19. 11.	21. 12.	7. 3.	28. 3.	21. 4.	2. 6.	18. 7.
<i>Acer campestre</i>	—	—	—	—	12.807	—	—	—	—	—	—
<i>Acer negundo</i>	—	—	—	—	15.888	—	—	—	—	—	—
<i>Acer pseudoplatanus</i>	—	—	—	29.616	13.267	2.385	3.503	21.143	—	—	—
<i>Carpinus betulus</i>	—	—	—	1.836	—	—	—	—	—	—	—
<i>Corylus avellana</i>	—	—	—	—	53.925	29.965	—	—	—	—	—
<i>Fagus sylvatica</i>	7.444	—	—	—	10.857	—	2.012	—	—	—	—
<i>Fraxinus excelsior</i>	—	—	—	11.304	6.832	—	—	—	4.137	—	—
<i>Populus nigra</i>	—	—	—	9.391	—	—	—	—	—	—	—
<i>Populus tremula</i>	—	—	—	—	1.527	1.913	—	—	—	—	—
<i>Quercus robur</i>	—	—	—	—	10.472	—	1.665	9.640	10.385	—	—
<i>Salix</i> sp.	—	—	—	19.031	7.801	1.267	—	4.907	—	—	—
<i>Ulmus</i> sp.	—	—	—	26.931	—	—	—	—	—	—	—
Crushed leaves	36.137	—	—	19.165	32.427	13.868	6.050	39.689	20.795	—	4.919
Total	43.681	—	—	117.190	166.85	49.118	13.130	76.879	36.317	—	4.919

Tab. 11. Content of ash matters and organic substances in the detritus dry weight at individual stations

Data 1982/1983	Detritus (g dry weight)			Ash matters (g)			Organ. substances (g)		
	L 1	L 2	L 3	L 1	L 2	L 3	L 1	L 2	L 3
28. 6.	4.347	3.837	3.675	3.160	2.724	2.896	1.187	1.113	0.779
2. 8.	2.838	4.969	1.662	2.341	3.648	1.396	0.497	1.321	0.266
18. 10.	1.386	4.896	3.210	0.945	3.447	2.806	0.441	1.449	0.404
19. 11.	0.665	3.667	1.311	0.489	2.254	1.057	0.176	1.413	0.254
21. 12.	3.424	2.586	1.777	2.618	1.804	1.300	0.806	0.782	0.477
7. 3.	1.233	1.137	2.582	0.901	0.820	2.161	0.322	0.317	0.421
28. 3.	1.151	1.281	1.376	0.829	0.918	1.089	0.322	0.363	0.287
21. 4.	1.106	2.501	2.227	0.786	1.913	1.799	0.320	0.588	0.428
2. 6.	2.357	2.090	0.967	1.562	1.406	0.639	0.795	0.684	0.328
18. 7.	2.250	3.636	1.945	1.616	2.767	1.460	0.634	0.869	0.485
Mean	2.076	3.060	2.073	1.525	2.170	1.660	0.522	0.890	0.413

b) sedimented detritus consisting of fine particles (the employed abbreviation FPOM*; particle size less than 1 mm)

c) coarse detritus containing leaves and vegetation fragments (the employed abbreviation CPOM**; particles on the average bigger than 1 mm).

We only dealt with sedimented detritus which is also called finely particulate non-living organic material in sediments. In further text this material is referred to only as detritus.

Maximum amounts of detritus, ash matter and organic substances fall to the period of June—October, 1982 (see Tab. 11), whereas the minimum amount was found in different months at different stations. The share of organic substances in the total dry weight never exceeded 40%, the mean value being 24.7%. In the summer season a higher amount of detritus was at all stations (as well as the contents of ash matters and organic substances) than in other seasons. An exception is the sample of 21 Dec., 1982, with high dry weight of detritus — that can be in connection with a considerably extensive autumn fall-off of leaves. It cannot, however, be said that the increase or the decrease in the amount of detritus as against the preceding sampling was found at all stations on the same day.

The established profile of changes in the amount of detritus at the individual stations differs considerably, so that a common trend valid for the whole length of the stream and the period studied can hardly be found. In our opinion this is greatly due to the methods of sampling; the individual samples were taken from areas of different size.

At station 1 the amount of detritus as well as the content of organic substances drops in the period of June to November, 1982 (at that time detritus is practically the only available food of animals — excepting predators). The increase in dry matter as well as in organic matter of the detritus in December can be due to the degradation of leaves which had got to the stream during the autumn fall-off. Further increase in July, 1983 can be due to the gradual slide of the fallen leaves from the steep slopes of that station.

At station 2 the drop in the amount of detritus takes place in the period of August

*FPOM — finely particulate organic matter.

** CPOM — coarsely particulate organic matter.

to the beginning of March; it is possible that detritus may drift downstream. Snow thawing can increase the transfer of leaves into the stream, thus increasing the amount of detritus as well.

At station 3 considerable variation in the amount of detritus was found. The increase in the amounts of both dry weight and organic substances in the period of November to early March may be affected — besides the degradation of leaf material — also by the discharge and the run-off from higher stations.

Mutual correlations

In the following stage we tried to find whether there existed interrelations between some values obtained. We verified our hypotheses mathematically by the determination of the selective correlation coefficient and by verifying the hypothesis of independence by means of the Student distribution.

First we verified the dependence of the size of abundance of the species *Gammarus fossarum* on the size of the decrease in leaves for the individual stations. As the basis for the calculation of the decrease in leaves we chose the largest found amount of leaves at the given station and from it we gradually subtracted the amount of leaves found in the subsequent samples. To the calculated decreases in leaves for the individual samples we put the corresponding values of abundances and calculated the selection correlation coefficient.

The above relation was mathematically proved for only stations 2 and 3. At station 2 the selection correlation coefficient had the value $R = -0.839$, the level of significance equalled 0.99. The correlation coefficient for the same relation at station 3 had the value $R = -0.939$ at the level of significance 0.99. Relatively high values of the correlation coefficients and levels of significance can result in the assumption that the correlation of *Gammarus fossarum* on the decrease in leaves will be statistically demonstrable at station 1 as well. It was, however, impossible to verify this assumption. A possible explanation is that the obtained decreases are so small with respect to the amount of leaves that they have no effect on the abundance of *Gammarus fossarum*, or that some other factors may be in play (like the methods of sampling, etc.).

Similar results were obtained when verifying the correlation of the size of biomass of the species *Gammarus fossarum* on the decrease of leaves. This correlation was demonstrated only at station 3 ($R = -0.930$, level of significance 0.975). By statistical procession we also found the validity of the dependence of leaf eating animals on the decrease in leaves, again at stations 2 and 3. In the case of station 2 the values were $R = -0.820$ and level of significance 0.975. The selection correlation coefficient at station 3 had the value $R = -0.936$ at the level of significance 0.995. Another mathematically verified relation was the dependence of the abundance of the whole benthos on the decrease in leaves. Also in this case it was demonstrated only for stations 2 and 3. The calculated correlation coefficient for station 2 had the value $R = -0.825$, the level of significance equalling 0.975. For the same correlation at station 3 the value of the coefficient was $R = -0.931$, the level of significance 0.975. The last proved dependence was that of benthos biomass of station 3 on the decrease in leaves at the same station. From the level of significance 0.950 ($R = -0.876$) there follows a not very close relation, due to probably an irregular frequency of occurrence of large forms of isolated species of animals.

Negative values of the selection correlation coefficients witness the fact that the given dependences are inversely proportional.

DISCUSSION

Some results found by us were compared with data found by Procházková (1972) in the same stream in 1970/1971. She took samples of macrozoobenthos in the period of 17 May, 1970 to 14 Aug., 1971 in regular intervals of three weeks at five stations. Altogether she took 21 samples from each station and determined 89 taxa of benthos. The most numerous species were found in the lower reaches of the stream (stations 4 and 5), the poorest was station 2. In the course of our research in 1982/83 we took 11 samples of each station. We only found 50 taxa; station 2 appeared to be the richest in species. Procházková (1972) states the mean annual total abundance and biomass of zoobenthos. We can only state the mean total abundance and biomass for the period studied (owing to the number and time distribution of sample taking), but these values can by no means express the situation in the whole stream, since we did not take samples near the spring and the mouth of the stream (stations 1 and 5 in Procházková. Procházková 1972 — mean total abundance: 2,420 n.m⁻², mean total biomass: 19.6 g.m⁻². Our results — mean total abundance: 1,747 n.m⁻², mean total biomass: 22.290 g.m⁻².

Stations 1 and 3, followed by us, correspond by their location approximately to stations 2 and 4 of Procházková. Therefore we also compare some biotic factors from those stations. Besides those stations we also compare station 2 with station 3 followed by Procházková. This comparison can be partly inaccurate, since the two stations are separated from each other by a small reservoir (pond). Procházková (1972) — mean total abundance: at the station 2 — 4,180 n.m⁻², at the station 3 — 3,250 n.m⁻², at the station 4 — 1,620 n.m⁻². Our results — mean total abundance: at the station 1 — 2,589 n.m⁻², at the station 2 — 1,041 n.m⁻², at the station 3 — 1,620 (952 n.m⁻²). Procházková 1972 — mean total biomass: at the station 2 — 27.5 g.m⁻², at the station 3 — 25.3 g.m⁻², at the station 4 — 12.1 g.m⁻². Our results — mean total biomass: at the station 1 — 30.164 g.m⁻², at the station 2 — 19.071 g.m⁻², at the station 3 — 17.681 (10.905) g.m⁻². The data for station 3 followed by us are affected by the sample of 21 Apr., 1983. The values without including that sample are given in brackets, thus it can be concluded that in the two cases we registered the lowering in both abundance and biomass down the stream. This can be in connection with a considerable amount of allochthonous organic material in the form of leaves in the upper reaches of the stream and a gradual decrease of this food down the stream.

We also compared the mean percentual shares of some taxonomic groups in the mean total abundance and biomass at the three comparable stations mentioned

Tab. 12. Comparison the mean percentual shares of *Gammarus fossarum* in the mean total abundance (A) and biomass (B) at the three comparable stations

Author		Stations		
Procházková (1972)		2	3	4
	A %	56.7	62.5	63.6
	B %	67.3	52.5	65.1
Our results		1	2	3
	A %	84.7	71.5	73.3
	B %	76.0	59.2	64.2

above individually — Tab. 12. Procházková (1972) recorded an increase in the representation of *Gammarus fossarum* both in abundance and in biomass in the direction downstream. In our case there appears a rather dropping trend of these representations; the mean values at station 3 include also the disfigured values from the sample of 21 Apr., 1983, which increased the total mean representation of *Gammarus fossarum*. Due to the fact that *Gammarus fossarum* feeds above all on leaves, the decline of its representation down the stream can be expected.

Plecoptera. We found a variation of the percentual representation in biomass and in abundance along the stream. Procházková (1972) gives a higher share of Plecoptera in the total abundance than we do, but a lower share in total biomass. Trichoptera. In the two papers a variation in the representation in total abundance and biomass was stated. But on the whole Procházková found a lower share of Trichoptera in the total abundance and biomass than we did.

Diptera — Chironomidae, Diptera varia. Procházková states a dropping trend in the share of Chironomidae and other Diptera in the total abundance and biomass. We, however, recorded a rising trend down the stream. Most of the representatives of Diptera were ranked among the detritivores, in which — in accordance with the changes in the food offer — a rising abundance can be expected down the stream.

Certain differences between our results hinted here can be attributed to a number of biotic and abiotic factors. Procházková took more samples of zoobenthos in regular intervals and also determined more taxa. Thus she was able to better express the seasonal changes in the abundance and biomass of benthos. Biotic conditions in the stream in 1982–83 may have been affected by the low hydrological condition of the stream which called forth changes in physico-chemical factors. To a certain extent it is possible to take into consideration also the influence of life cycles of some zoobenthos representatives taking several years and the effect of their migration movements (above all in the case of *Gammarus fossarum*).

Procházková also briefly mentions the percentual representation of food groups at the individual stations. She distinguishes groups of carnivorous, detritivorous and indifferent animals. She, however, does not state taxa included in those groups. In our opinion she included among detritivores not only animals feeding on fine detritus, but also those feeding on coarse detritus — leaves (this is in accord with foreign authors). She registered a variation in the mean percentual representation of trophic groups at the individual stations, so that it cannot be said that the share of some of the above groups increases or decreases down the stream. Her results are difficult to compare with ours, just because of the fact that we separate leaf eating animals (whose percentual representation decreases down the stream) from detritivores (in which this representation increases). If we take our groups of detritivores and leaf eating animals as one group (corresponding to detritivorous animals in Procházková), we shall arrive at a conclusion that the percentual share of this unified group decreases down the stream. This is easy understand, as in animals feeding on leaves we always recorded a much higher representation than in the detritivores.

The dynamics of the macrozoobenthos in a small stream in the surroundings of Brno was also dealt with by Obrdlík (1968). He followed the population of a stony and sandy habitat in the stream by benthic animals. He carried out his research in a small brook (a tributary of the Ponávka) which, by its abiotic factors as well as the species pattern of zoobenthos, is comparable to the brook in Kočičí žleb valley. Some of our findings at station 2 in Kočičí žleb valley are compared with his at the station Mokrá hora — Tab. 13. In the Ponávka tributary Obrdlík

Tab. 13. Representation of some taxonomic groups in total abundance (A) and biomass (B) at the station 2 in Kočičí žleb and at the station Mokrá Hora

		Mokrá Hora	Station 2
Amphipoda	A %	68	71.5
	B %	59.4	59.2
Ephemeroptera	A %	8	0.2
	B %	6.1	0.3
Plecoptera	A %	3	1.2
	B %	4.6	1.3
Trichoptera	A %	1	9.8
	B %	8.6	18.2
Diptera	A %	18	4.2
	B %	13.5	8.4

(1968) found a higher representation of taxonomic groups Ephemeroptera, Plecoptera, Diptera in total abundance and biomass than we did in Kočičí žleb valley. The group Trichoptera is, however, more represented in Kočičí žleb valley percentually both in total abundance and biomass. The share of Amphipoda in the abundance and the biomass is approximately the same in the two streams.

Obrdlík (1968) states the mean annual abundance and biomass separately for the stony and for the sandy habitats. For the sake of comparison we use average values of the two habitats: Obrdlík (1968) — \bar{x} annual abundance: 1,021 n.m⁻², \bar{x} annual biomass: 6.1 g.m⁻². Our results — \bar{x} total abundance in 11 samples: 1,041 n.m⁻², \bar{x} total biomass in 11 samples: 19,071 g.m⁻². A relatively high value of the mean total abundance of zoobenthos in Kočičí žleb valley may have been influenced by a higher representation of the taxonomic group Trichoptera.

In the present paper we also dealt with changes in the amount of organic detritus. Foreign authors consider also discernible parts of leaves and whole leaves to be a part of detritus. They classify separately dissolved and suspended organic material (Minshall 1967). Then they usually distinguish detritus as finely particulate (FPOM) and coarsely particulate (CPOM) organic material (Anderson, Sedell, 1979; Saunders et al. 1980).

As we wanted to investigate the relation of fine and leaf detritus, the relation between the consumers of those food sources as well as the relation of food sources to trophic groups, we used the classification of animals into leaf eating and detritivores.

Haeckel et al., (1973) say that quantitative population of *Gammarus fossarum* is controlled by the amount of accumulated leaves yielding them shelter and food. Our sample of 21 Apr., 1983 at station 3 can only confirm this statement. Lehman (ex Haeckel et al. 1973) gives the abundance of 4,000 n.m⁻², and Meijering (ex Haeckel et al. 1973) 3,600 n.m⁻² for Amphipoda. Haeckel et al. (1973) also stress the migratory motions of *Gammarus fossarum* up and down the stream in searching for leaf accumulations. This is evidently reflected in the size of actual abundances of *Gammarus fossarum* particularly in spring and summer months, when leaves on the bottom of the stream form isolated accumulations.

Individual authors give different trophical classifications of zoobenthos. Very often the authors give classifications similar to the following one: 1) scrapers and grazers — feeding on periphyton and fine organic material, 2) shredders — feeding

on CPOM, 3) collectors (feeding on FPOM), 4) predators (according to Tolkamp 1980).

Approximately it can be said that the group of animals feeding on detritus and algae, as we describe it in the present paper, includes Tolkamp's groups one and three, whereas the group of leaf eating animals corresponds to his group two.

Minshall et al. (1983) deals with longitudinal zonation of invertebrates. He proves that the number of shredders decreases down the stream, in collectors there is a trend of abundance increase down the stream.

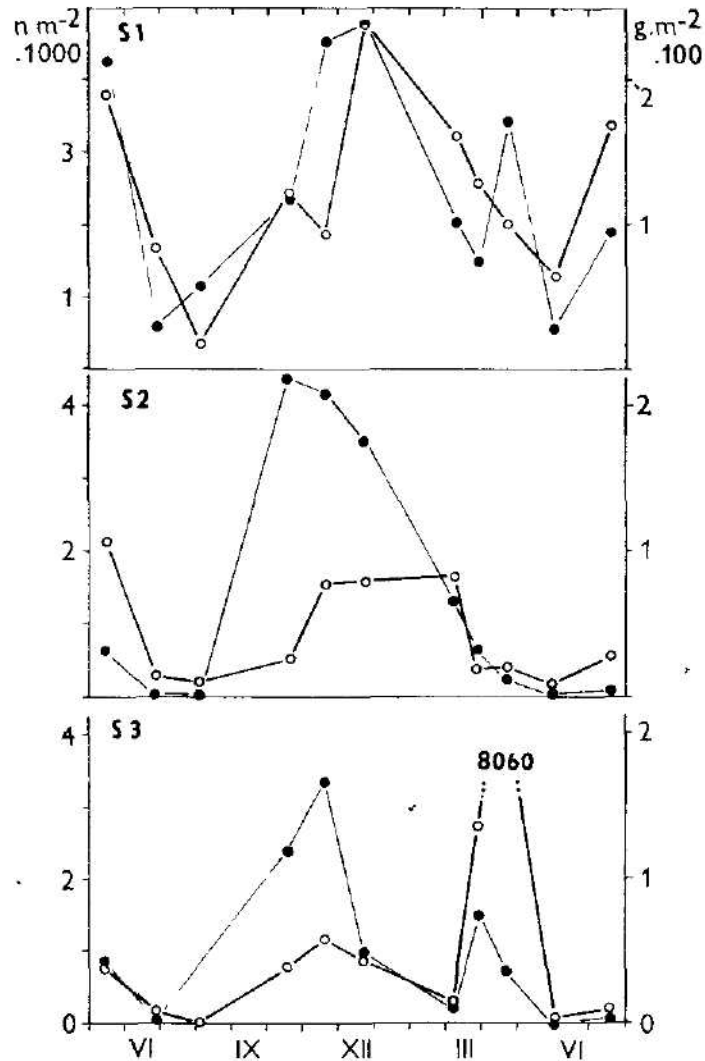


Fig. 1. The profile of changes in the abundance of leaf eating animals and the amount of leaf dry weight in the course of the period studied. Abscissa — dates of sample taking (months), ordinate—abundance of leaf eating animals ($n.m^{-2}$), amount of leaves ($g.m^{-2}$).

The importance of allochthonous organic matter is stressed by practically all the above authors. The important role of macroinvertebrates in the degradation of that material is demonstrated by Caspers (1975), Cummins (ex Saunders et al. 1980), Darnell (1964). Mathews and Kowalczewski (1969) consider the share of macroinvertebrates in the degradation of material of allochthonous origin in the river Thames negligible. Anderson and Sedell (1979) say among others that without the presence of leaf eating animals the followed alder leaves lost 50% of their mass in 70 to 90 days, whereas the same decrease was observed in 40 days when the animals were present. From graph 1 representing the profile of changes in the size of the abundance of leaf eating animals and in amount of leaf in the stream of Kočířský žleb valley in the period studied the similarity in the course of the two changes can be clearly seen.

Comparing the mass of leaf dry weight found at the individual stations in the samples of 3 Nov., 1983 (on the average about 416 g dry weight per m²) with the size of the supply of allochthonous material into the stream quoted in literature, no major differences are found. Anderson and Sedell (1979) give the values of 352 to 660 g dry weight per m² per year. Ladle (1982) 400 to 500 g dry weight m⁻² year⁻¹.

Data about the dynamics of allochthonous material in the stream can be found in Minshall (1967) and Anderson and Sedell (1979). The former states the beginning in August, maximum at the turn of autumn and winter and minimum at the time of the summer solstice. In the latter authors only the beginning is stated (late summer) as well as the end (autumn) of the supply.

In our opinion the results obtained illustrate seasonal changes going on in a small forest stream. Particularly evident is a considerable selfpurification ability of the stream in which the annual supply of a great amount of organic material in the course of the year is practically degraded. Besides physical and chemical processes, an irreplaceable share in this process is that of benthic animals. At the same time it is possible to observe continuous changes in the structure of zoobenthos corresponding to changes in the food offer in the individual parts of the stream, which is in accordance with the theory of the "river continuum".

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NEMATODES OF FRESHWATER FISHES FROM NORTH VIETNAM.
PART 1. CAMALLANOIDEA AND HABRONEMATOIDEA

František MORAVEC¹ & Ottó SEY²

¹Institute of Parasitology, Czechoslovak Academy of Sciences, Branišovská 31,
370 05 České Budějovice, Czechoslovakia and ²Department of Zoology, Janus
Pannonius University, Ifjúság útca 6, 7604 Pécs, Hungary

Abstract. An extensive material of parasitic nematodes, collected from 22 species of freshwater fishes from North Vietnam (the Red River near Hanoi), has been examined. Altogether 24 nematode species were found of which members of the superfamilies Camallanoidea and Habronematoidea are dealt with in the present paper. These include: *Camallanus cotti*, *Neocamallanus ophicephali*, *Procamallanus* (*Procamallanus*) *petterae* sp. n., *P.* (*Spirocamallanus*) *fulvidraconis*, *P.* (*Spirocamallanus*) *bagarii*, *Spinitectus ophicephali*, *S. ranae* and *Spinitectus* spp. juv. *Procamallanus* (*P.*) *petterae* sp. n. from *Pseudobagrus fulvidraco* is characterized mainly by the absence of small processes at the tail tip of female, smooth inner surface of buccal capsule, presence of the gubernaculum, structure of the male tail and some other features. *Neocamallanus* Ali, 1957 is considered a valid genus, whereas *Onchocamallanus* Petter, 1979 is synonymized with *Procamallanus* Baylis, 1923. *Camallanus fotedari* Raina et Dhar, 1972 is considered a junior synonym of *C. cotti* Fujita, 1927, while *Neocamallanus singhi* (Ali, 1957), *N. yehi* Fernando et Furtado, 1963 and *N. sindensis* Akram, 1976 are considered to be synonymous with *N. ophicephali* (Pearse, 1933). *Spinitectus ranae*, currently an amphibian parasite, has been recorded from a fish host for the first time. Five species have not yet been reported from Vietnam. The findings include several new host records. All the nematodes have been briefly described and illustrated and some problems concerning their taxonomy and geographical distribution have been discussed.

Knowledge of the parasites of fishes has accumulated in many parts of the world, especially in Europe, the USSR and North America, but research commitments to the study of the parasites of freshwater fishes of the South-Eastern Asia have, until now, been sporadic and inadequate. In spite of the fact that the territory of Vietnam is of special interest from the zoogeographical point of view and it is well-known for its richness of the freshwater fish fauna, little is known of the parasites of fishes in this country. However, such investigations in Vietnam are not of theoretical significance only, but in addition to the recognition of the fauna of parasites and the geographical distribution of its individual members, the results may prove to be important as well from the medical and veterinary viewpoint, particularly in the connection with extension of the breedings of economically important fish.

A few papers have so far been published dealing with the helminth fauna of Vietnamese freshwater fishes, but most of them concerned monogeneans, digeneans and acanthocephalans only (see Demshin 1965, Oshmarin 1965, Gussev 1966, Ha Ky 1968, Kulakova and Ha Ky 1976). In spite of several papers dealing with nematodes from fishes from South Vietnam (e.g. Le-Van-Hoa and Pham-Ngoc-Khue 1967, 1970, Le-Van-Hoa and Bui-Thi Lien-Huong 1969), the only available data on the nematodes parasitizing freshwater fishes in North

Vietnam are, as far as the present authors know, those provided by Ha Ky (1969, 1971), who reported from there a total of twelve nematode species including five new to science. But as a whole this area remains still little-known in this respect.

In 1984, during his visit to Vietnam, the second author (O. Sey) examined for helminths a number of freshwater fishes collected in 1960–1975 from the Red River near Hanoi and deposited in the collections of the Department of Vertebrate Zoology, Hanoi University, in Hanoi. The results of the systematic evaluation of nematodes of the subfamilies Camallanoidea and Habronematoidea are presented in this paper.

MATERIALS AND METHODS

Of a number of fishes examined, originating from the Red River near Hanoi, altogether 22 fish species of 7 families proved to harbour parasitic nematodes. A total of 24 species of parasitic nematodes was recorded. The nematodes were fixed *in situ* in 70% ethanol and were cleared with glycerine for examination; *en face* views were prepared according to Anderson's (1958) method. All drawings were made with the aid of a camera lucida. All specimens have been deposited in the helminthological collection of the Institute of Parasitology, Czechoslovak Academy of Sciences, in České Budějovice, Czechoslovakia. In the following account of the species encountered, measurements are given in millimetres.

REVIEW OF SPECIES

Fam. Camallanidae Railliet et Henry, 1915

1. *Camallanus cotti* Fujita, 1927 (Fig. 1)

Syn.: *Camallanus zacconis* Li, 1941; *C. fotedari* Raina et Dhar, 1972.

Host: *Bagarius bagarius* (fam. Sisoridae).

Localization: intestine.

Description: Medium-sized nematodes with big, orange-brown buccal capsule typical of genus. Mouth opening slit-shaped, surrounded by four oral papillae and four sclerotized plates. Valves of buccal capsule roughly pentagonal upon lateral view, supported inside by smooth longitudinal ribs. Narrow, sclerotized ring present at bottom of capsule. Tridentes large, only moderately surpassing posterior border of buccal capsule. Deirids not observed.

Male (2 specimens): Length of body 3.40–3.58, maximum width 0.150–0.163. Length of buccal capsule including basal ring 0.090–0.102, maximum width 0.099–0.102; size of basal ring 0.060–0.066 × 0.007. Each valve of buccal capsule strengthened internally by 15 longitudinal ribs, some of them being incomplete. Length of tridentes 0.083. Muscular oesophagus measuring 0.354–0.367, glandular oesophagus 0.435–0.476 long. Nerve ring and excretory pore 0.177–0.190 and 0.231–0.245, respectively, from anterior extremity. Posterior end of body provided with caudal alae. Papillae pedunculated: 7 pairs preanal and 6 pairs postanal. Postanal papillae of first three pairs close together. Cloacal opening surrounded by two transverse mounds, appearing upon lateral view as two pairs of small sessile papillae. Spicules unequal, simple; length of larger spicule 0.135–0.156, of smaller, less sclerotized spicule 0.105–0.108. Length of tail 0.102–0.111.

Female (1 specimen): Body length of female with eggs in uterus 6.57, maximum width 0.245. Length of buccal capsule including basal ring 0.159, maximum width 0.144; size of basal ring 0.090 × 0.015. Each valve bearing 16 longitudinal ribs. Length of tridentes 0.135. Muscular oesophagus 0.557, glandular oesophagus 0.625 long. Nerve ring 0.313 from anterior extremity, excretory pore not located. Tail very elongate, 1.16 long; tip of tail rounded, without any processes. Vulva slightly

postequatorial, 3.03 from posterior end of body; vulvar lips elevated. Vagina muscular, directed posteriorly. Uterus, extending posteriorly nearly to end of tail, filled with numerous eggs.

Comments: — The nematodes of the present material correspond by their morphology to the species *C. cotti*, as it has been redescribed by Yamaguti (1941a). The only difference is the number of postnatal papillae in male; there are 7 pairs

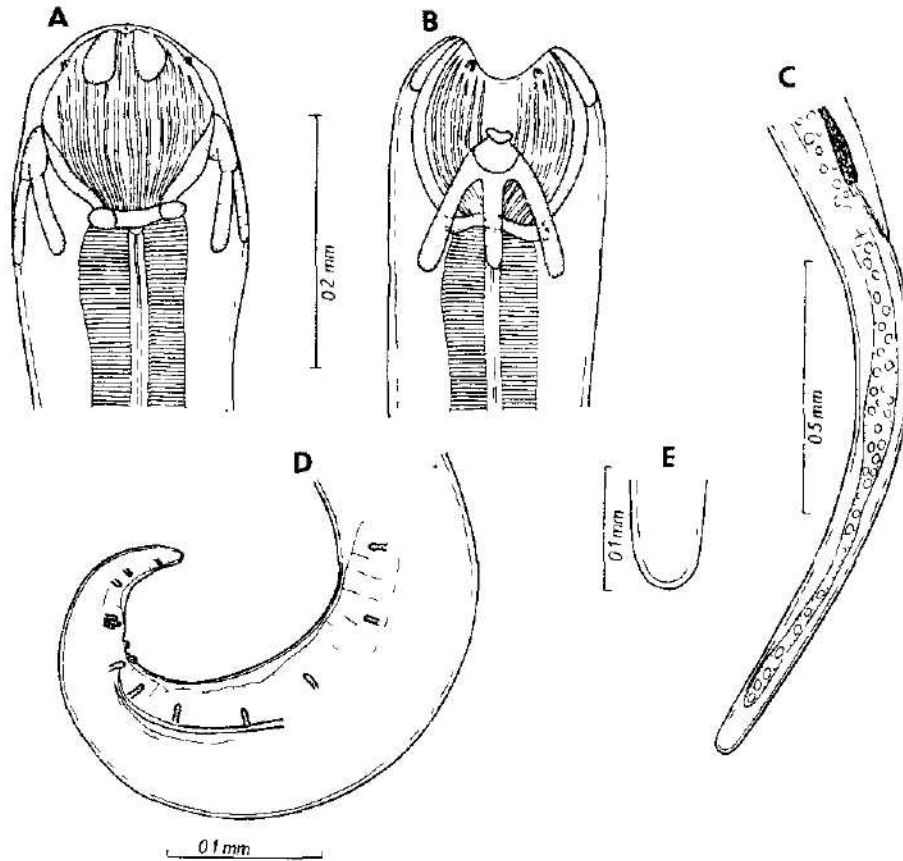


Fig. 1. *Camallanus cotti* Fujita, 1927. A, B — buccal capsule of gravid female, lateral and dorsoventral views; C — tail of female; D — tail of male; E — distal tip of female tail.

present according to Yamaguti (1941a), but the last but one is lacking in some individuals; in both specimens of the Vietnamese material only 6 pairs of postanal papillae were present. The morphology of our nematodes corresponds as well to that of the nematodes found in the gut of the Far-eastern fish *Misgurnus anguillicaudatus* kept in an aquarium in western Canada that we also consider to be *C. cotti* (unpublished).

According to Moravec (1973), *Camallanus zacconis* Li, 1941 reported from freshwater fishes from Japan and China, is a junior synonym of *C. cotti*. Also *Ca-*

mallanus fotedari described from *Noemacheilus kashmirensis* from India (Kashmir) (see Raina and Dhar 1972) seems to be morphologically and biometrically identical with *C. cotti*. *C. fotedari* has been reported by Campana-Rouget et al. (1976) from the aquarium fishes *Lebistes reticulatus* and *Brachydanio rerio* in Europe; according to these authors, *C. cotti* differs distinctly from *C. fotedari* in that its vulva is situated more posteriorly. The data concerning the position of the vulva of *C. cotti* were probably taken over from the paper of Stumpp (1975) who had identified as *C. cotti* the nematodes found in various species of aquarium fishes in Europe. But as far as Stumpp's data are correct, then it is obvious that the parasite was misidentified in this case. According to Yamaguti (1941a), the vulva in *C. cotti* divides body length in ratio 1.2–1.45 : 1; this ratio is 1.2 : 1 in the female of the present material. Also in gravid females of *C. cotti* from the above mentioned material from *M. anguillicaudatus* the vulva was always situated a short distance below mid-body, like in *C. fotedari*. Therefore, we consider *C. fotedari* Raina et Dhar, 1972 a junior synonym of *C. cotti* Fujita, 1927.

This parasite has been reported from a number of fish species belonging to various families and orders (largely Cypriniformes) from the region of eastern, south-eastern and southern Asia, namely from Japan (Fujita 1927a, Yamaguti 1941a), the R. Amur basin in the USSR (Dogel and Akhmerov 1959, Roytman 1963) and China (Chen 1973, Wang et al. 1979, Wu 1984); under the synonyms *C. zacconis* and *C. fotedari* it has been reported from Korea (Li 1941), China (Wang et al. 1979) and India (Raina and Dhar 1972). It occurs as well in the breedings of aquarium fishes in Europe where it was probably brought in along with exotic fishes imported from Singapore (see Campana-Rouget et al. 1976). Khan and Yaseen (1969) have reported *C. cotti* from marine fishes in Bangladesh, but the nematodes were evidently misidentified in this case, as suggested by the accompanying drawing of the female tail.

C. cotti has not yet been recorded from Vietnam and *Bagarius bagarius* represents a new host record. *C. cotti* can be distinguished from the only other, inadequately described *Camallanus* member reported from North Vietnam, *C. alii* Ha Ky, 1971 from *Cirrhitina molitorella*, by its markedly smaller body measurements.

2. *Neocamallanus ophicephali* (Pearse, 1933) (Fig. 2)

Syn.: *Camallanus ophicephali* Pearse, 1933; *C. yehi* Fernando et Furtado, 1964; *Camallanides hemidentata* Majumdar, 1965; *Neocamallanus bengalensis* Soota et Chaturvedi, 1971; *N. apapillata* Ghosh et Majumdar, 1972; *N. ophicephali* Rehana et Bilquees, 1972; *Camallanus adamsi* Bashirullah, 1974; *Neocamallanus sindensis* Akram, 1976; *N. thapani* Agrawal et Mishra, 1978; *N. barrilliensis* Sharma et Sharma, 1980.

Host: "silurid fish" (?) (in fact probably a member of the Channidae — see Comments).

Localization: intestine.

Description of female (1 specimen): Medium-sized nematode with big orange-brown buccal capsule. Cuticle thick, transversely striated. Length of body of gravid female 8.39, maximum width 0.204. Mouth opening slit-shaped, surrounded by four oral papillae and four sclerotized plates. Valves of buccal capsule roughly pentagonal upon lateral view, supported inside by 22 smooth longitudinal ribs. Basal ring of capsule strongly developed, with spacious cavity; length of basal ring representing approximately half length of valves. Small, colourless, moderately sclerotized triangular formation reminding somewhat rudimentary trident present on dorsal and ventral sides of anterior portion of capsule, being 0.012 long and 0.021 wide. Length of buccal capsule including basal ring 0.087, that of lateral

valves 0.057; width of valves 0.081 in lateral view. Length of basal ring 0.030, its width 0.060. Muscular oesophagus 0.326, glandular oesophagus 0.721 long. Distance of nerve ring from anterior extremity 0.163, that of excretory pore 0.243, of small deirids 0.354. Intestine narrow. Tail 0.252 long, with bluntly rounded tip without any processes. Vulva slightly postequatorial, 4.79 from posterior end of body; vulvar lips almost non-elevated. Vagina muscular, directed posteriorly. Uterus containing numerous eggs and spirally coiled larvae 0.009–0.012 wide. Uterus reaching anteriorly almost to mid-length of glandular oesophagus, posteriorly not reaching rectum.

Comments: — The validity of the genus *Neocamallanus* Ali, 1957 (type species

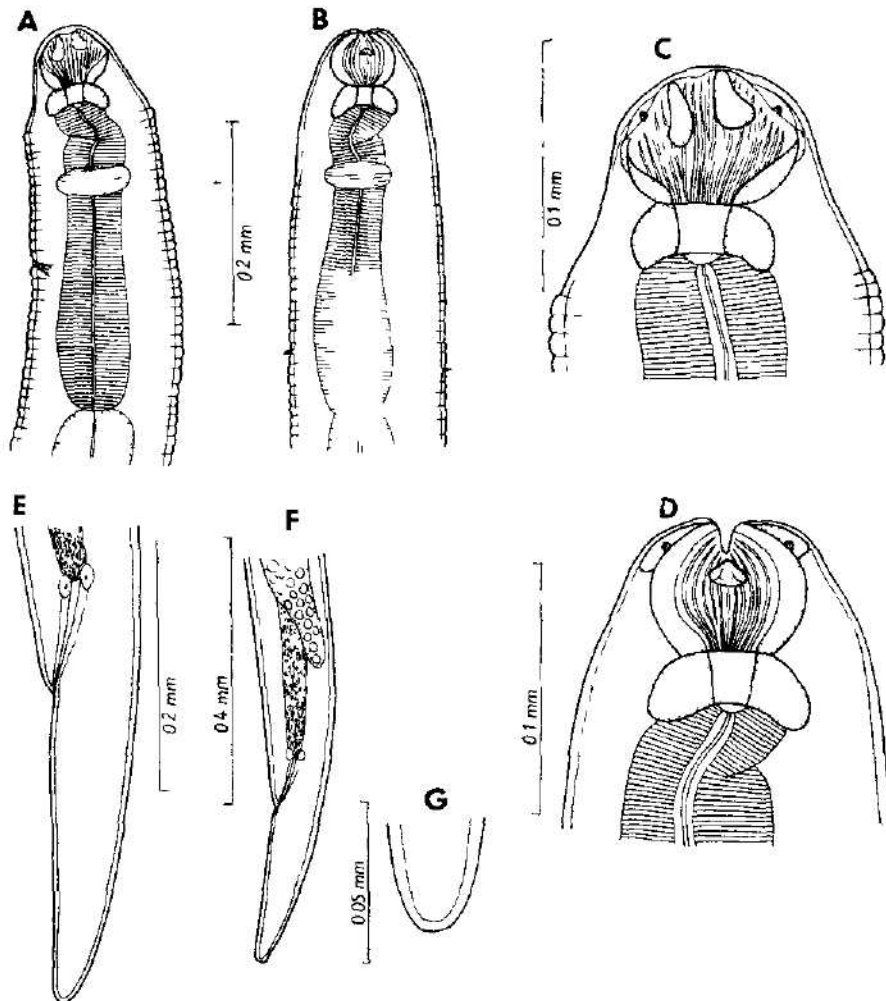


Fig. 2. *Neocamallanus ophiocephali* (Phearse, 1933) — female. A, B — head end, lateral and dorsal views; C, D — buccal capsule, lateral and dorsoventral views; E — tail; F — posterior end of body; G — distal tip of tail.

N. singhi Ali, 1957) has been discussed by many recent authors whose opinions in this respect are often antagonistic. Yeh (1960a) synonymized this genus with *Camallanus* Railliet et Henry, 1915 as he did not give any importance to the presence of tridents on the bucal capsule. This was followed by Chabaud (1975) and Petter (1879a) who, however, considered *Neocamallanus* a synonym of *Paracamallanus* Yorke et Maplestone, 1927, emphasizing the character of the basal ring of the capsule; this view was accepted e.g. by Sood (1980) and Soota (1983). On the other hand, many authors (e.g. Ha Ky 1971, Agrawal and Mishra 1980, De and Majumdar 1984) have considered *Neocamallanus* to be valid. In our opinion it is necessary to consider *Neocamallanus* an independent genus, because these nematodes expressively differ from members of *Camallanus* and *Paracamallanus* by the absence of tridents on the buccal capsule and some other features. Due to the fact that many species have been described from the Oriental Region the generic belonging of which is problematic because of their inadequate descriptions, we consider as members of *Neocamallanus* only the species characteristic of the absence of tridents, presence of the highly developed basal ring of the capsule with spacious cavity and presence of smooth longitudinal ribs on the inner surface of lateral valves of the capsule.

Many species were described from fishes (mainly of the family Channidae) of the Oriental Region that were later synonymized with *Neocamallanus singhi* Ali, 1957 (see Sood 1980, Soota 1983, De and Majumdar 1984), a species described originally from *Ophicephalus punctatus* from India (Ali 1957) and redescribed by Khan and Yaseen (1969), Sood (1980) and De and Majumdar (1984) from specimens from *O. punctatus* and *O. striatus* from Bangladesh and India. However, the morphology of this species corresponds, more or less, to the description of *N. ophicephali* (Pearse, 1933) which was previously described from *Ophicephalus striatus* from Thailand (Pearse 1933) and its females were later redescribed by Karve (1941) from specimens collected in *O. marulius* in India. The main differences between *N. ophicephali* and *N. singhi* are in the length of the right spicule (0.35 mm) and, allegedly, the presence of minute tridents in males of the first species. But the original description of *N. ophicephali* is poor; it is obvious that, in this case, the small, weakly sclerotized formations observed in our specimen from Vietnam and mentioned by Karve (1941) as "small chitinized projections" were taken for tridents. Although these formations have not been described in *N. singhi*, the re-examination of the specimens that served to De and Majumdar (1984) to a re-description of this species revealed the presence of these formations. As to the length of spicules, this was probably given erroneously in the original description of *N. ophicephali*, the spicules of *N. singhi* are poorly sclerotized and, accordingly, often indistinct. Since there are no substantial morphological differences between *N. ophicephali* and *N. singhi* and because both these species have been reported from the same or related host species from near geographical regions, we consider *N. singhi* Ali, 1957 a junior synonym of *N. ophicephali* (Pearse, 1933). The conspecificity of both these species is also indicated by the find of one male nematode from "Thai goby" from Thailand (unpublished) the morphology of which corresponds to the descriptions of *N. singhi*.

Two other species can be also considered conspecific with *N. ophicephali*, namely *N. yehi* Fernando et Furtado, 1963 and *N. sindensis* Akram 1976, inadequately described from *O. striatus* from Singapore and from *O. punctatus* from Pakistan, respectively; both these species are to differ from *N. ophicephali* principally in the length of spicules, these being, however, moderately sclerotized and consequently

ill-visible in these nematodes. Fernando and Furtado (1963) did not exclude the possibility that *N. yehi* and *N. ophicephali* were identical. Also some other species described from this region may be conspecific with *N. ophicephali*.

The principal hosts of this wide-spread parasite are members of the family Channidae, exceptionally it has been recorded from other fishes. Although the specimen of the present material was labelled as "from a silurid fish", in fact the host was probably a channid fish (snakehead); the same fish specimen harboured also the nematode *Pingus sinensis*, a specific parasite for the Channidae.

The hitherto data indicate that *N. singhi* occurs in Pakistan, India, Bangladesh, Thailand and Singapore; it has not previously been recorded from Vietnam. Ha Ky (1971) described a new species, *Neocamallanus maculati*, from *Ophicephalus maculatus* from North Vietnam, he distinguished it from *N. singhi* (= *N. ophicephali*) by more numerous caudal papillae in the male and by their arrangement. It appears according to the drawing that the longitudinal ribs on the valves of the buccal capsule are armed by teeth in this species, but this is not mentioned in the species description; Petter (1979a) listed this parasite in the morphological group of *Procamallanus* species noted for the presence of toothed ribs. In view of the inadequate description of *N. maculati* its identity with *N. ophicephali* cannot be excluded; however, for the time being we consider it an independent species.

The development and morphogenesis of *N. ophicephali* (under its synonyms *Camallanus adamsi* and *Neocamallanus singhi*) were studied by Bashirullah and Ahmed (1976) and De et al. (1984).

3. *Procamallanus (Procamallanus) petterae* sp. n. (Fig. 3)

Host: *Pseudobagrus fulvidraco* (fam. Bagridae).

Localization: intestine.

Locality: Red River near Hanoi, Vietnam (date of collection not exactly determined — in 1960–1975).

Deposition of specimens: Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice, Helm Coll. No. X-50 (holotype, allotype and one paratype).

Description: Medium-sized nematodes; cuticle thick, transversely striated; body reddish-coloured. Mouth opening spherical, provided with four mouth papillae and two lateral amphids. Orange-brown buccal capsule longer than wide, its anterior margin formed by six transverse, crescent-shaped sclerotized projections surrounding mouth aperture. Besides basal ring, base of capsule strengthened by additional, less sclerotized ring. Inner surface of buccal capsule smooth. Muscular oesophagus slightly shorter than glandular one; latter opening into intestine through valves. Deirids inconspicuous, situated slightly below nerve ring level; excretory pore at mid-length of distance between nerve ring and end of muscular oesophagus.

Male (1 specimen — holotype): Length of body 3.22, maximum width 0.109. Buccal capsule including basal ring 0.072 long and 0.051 wide; size of basal ring 0.012×0.033 . Length of muscular oesophagus 0.394, of glandular oesophagus 0.503. Nerve ring 0.163 from anterior extremity, excretory pore and deirids not located. Posterior end of body bent ventrally, provided with lateral alae. 10 pairs of pedunculate preanal papillae present. Postanal papillae 6 pairs in number: first three pairs of big pedunculate papillae close together as well as fourth and fifth pairs; papillae of fourth and sixth pairs lobe-like, situated laterally, remaining pairs sub-ventral. In addition to these, two pairs of small sessile papillae surround cloacal opening of which one pair being preanal and one postanal. Unequal spicules simple, moderately sclerotized, badly visible; right spicule 0.186, left spicule 0.111 long.

Slightly sclerotized, colourless gubernaculum present, being 0.042 long. Tail rather short (0.051), with rounded tip.
 Female (2 specimens; allotype, measurements of paratype in brackets): Body

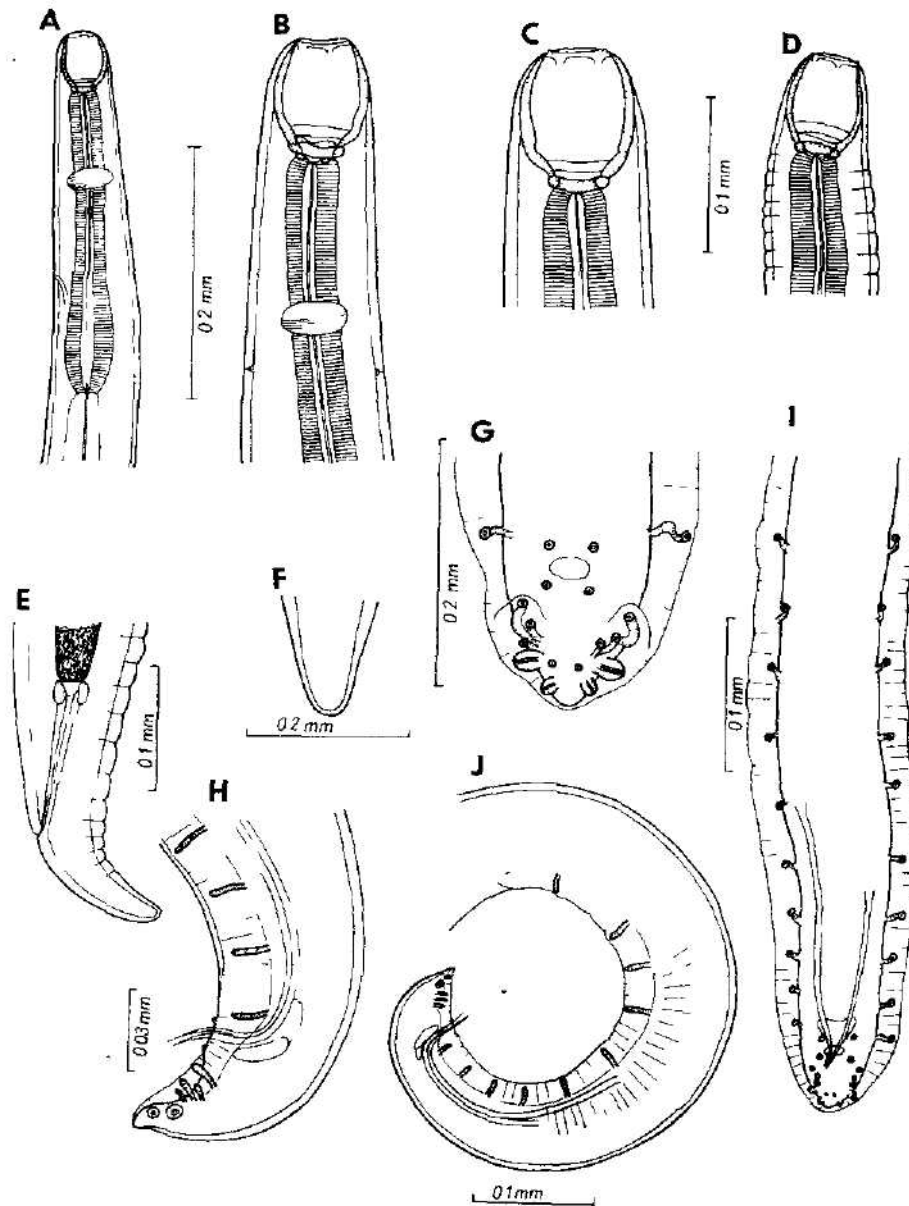


Fig. 3. *Procamallanus (Procamallanus) petterae* sp. n. A, B - anterior end of female, lateral and dorsal views; C, D - buccal capsule of female and male, both lateral views; E - female tail; F - tip of female tail; G, H - tail of male, ventral and lateral views.

7.39 (6.46) long and 0.150 (0.163) wide. Length of buccal capsule including basal ring 0.099 (0.090), width 0.075 (0.066); size of basal ring 0.012×0.045 (0.012×0.036). Length of muscular oesophagus 0.490 (0.422), of glandular oesophagus 0.653 (0.544). Nerve ring 0.258 (0.190) and excretory pore 0.394 (—) from anterior extremity. Vulva postequatorial, 3.09 (2.92) from posterior extremity; vulvar lips elevated. Uterus containing numerous eggs in allotype and eggs and larvae (0.015 wide) in paratype. Tail conical, 0.114 (0.066) long, with bluntly rounded tip without any processes.

Comments: — Many species of the genus *Procamallanus* Baylis, 1923 have so far been described from freshwater fishes (mainly siluroids) from southern and south-eastern Asia (see e.g. Ivashkin et al. 1971, Soota 1983 and others). However, most species descriptions are inadequate which complicates considerably the specific identification of these nematodes, in spite of the fact that many nominal species have already been synonymized during several recent years (see e.g. De and Moravec 1980, Soota 1983).

Of the members of *Procamallanus* noted for possessing of the smooth buccal capsule lacking spiral thickenings (ribs) in both sexes, mainly the species characteristic of the presence of three small processes at the tail tip of mature females occur in freshwater fishes in this region; the presence or absence of these processes is one of the reliable specific features in members of this genus (see Moravec and Amin 1978, De and Moravec 1980). Out of many species of this morphological group parasitic in freshwater fishes of southern and south-eastern Asia, the caudal processes at the tail tip of females are lacking only in *P. planoratus* Kulkarni, 1935, *P. heteropneustus* Ali, 1957 (syn. *P. clarius* Ali, 1957), *P. cancellus* Bashirullah et Hafizuddin, 1974, and *P. intermeda* Siddiqi et Khattak, 1984. But the first two named species distinctly differ from *P. petterae* sp. n. by the absence of a gubernaculum, by smaller spicules and different structure of the posterior end of male body. *P. cancellus* and *P. intermeda* were described from females only; *P. cancellus* can be differentiated from *P. petterae* sp. n. by its markedly larger measurements of the body and the buccal capsule and by the presence of 20 ridge-like elements at the anterior rim of the latter, while *P. intermeda* differs principally in the shape of the buccal capsule which is wider than long in this species.

By its body structure in females (particularly the structure of buccal capsule and the shape of tail), *P. petterae* sp. n. is very similar to the females reported by Petter (1978) as *Procamallanus* sp. from the silurid fish *Ompok* sp. from Malaysia; it is possible that both these forms are conspecific.

P. petterae sp. n. has been named in honour of Dr. Annie J. Petter, Laboratoire de Zoologie associé au CNRS, Muséum national d'Histoire naturelle, Paris, who contributed greatly to the taxonomy of fish nematodes.

Only one species of *Procamallanus*, *P. clarius* Ali, 1957 (= *P. heteropneustus* Ali, 1957) from *Clarias fuscus*, has so far been reported from Vietnam (see Ha Ky 1969, 1971).

4. *Procamallanus* (*Spirocamallanus*) *fulvidraconis* Li, 1935 (Fig. 4)

Hosts: siluriform fishes *Hemibagrus elongatus* (fam. Bagridae) and *Cranoglanis sinensis* (fam. Cranoglanidae).

Localization: intestine.

Description of female (1 specimen from *H. elongatus*; measurements of 3 specimens from *C. sinensis* given in brackets): Medium-sized nematodes. Cuticle very thick, with dense transverse striation. Body length of gravid female from *H. elon-*

gatus 9.41, maximum width 0.218; body length of females from *C. sinensis*, containing only numerous eggs in uterus, (5.67—7.63), width (0.136—0.163). Mouth opening spherical, provided with four mouth papillae and two lateral amphids. Orange-brown buccal capsule longer than wide, its anterior margin formed by six transverse, crescent-shaped sclerotized projections surrounding mouth aperture. Inner surface of capsule provided with numerous, inconspicuous interrupted spiral thickenings. Besides well sclerotized basal ring, base of capsule strengthened by additional, less sclerotized ring composed of three parts — one dorsal and two

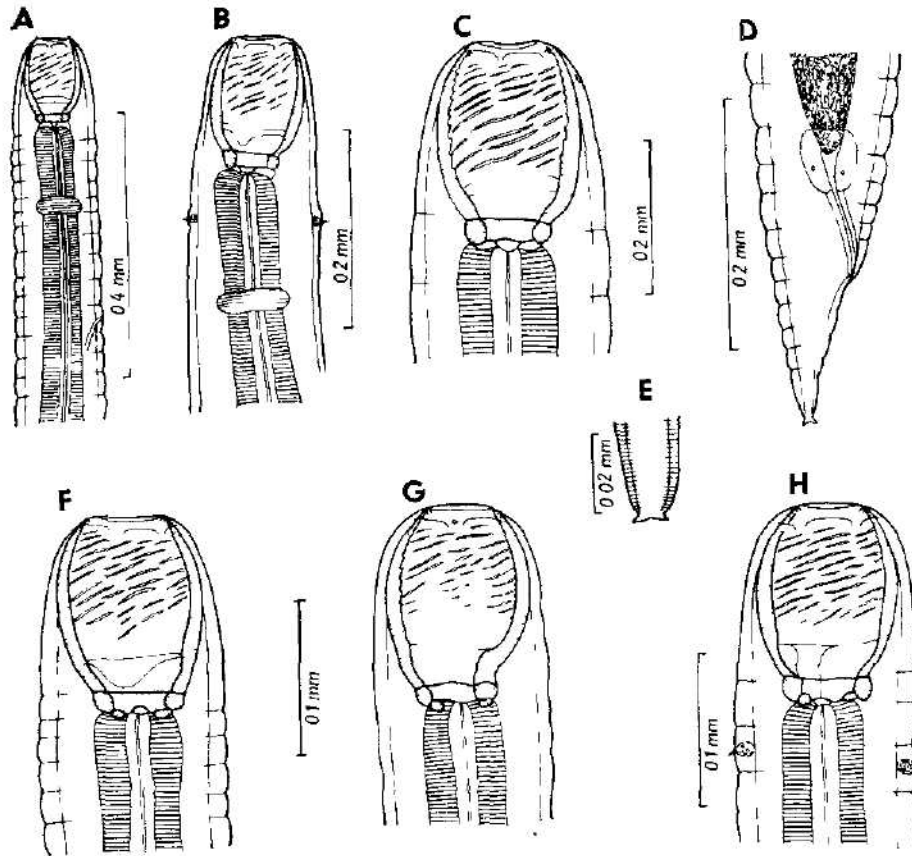


Fig. 4. *Procamallanus (Spirocamallanus) fulvidraconis* Li, 1935. A — anterior end of gravid female; B — head end of gravid female, dorsoventral and lateral views; D — tail of gravid female; E — tip of female tail; F—H — buccal capsule of the same female, lateral, dorsal and ventral views. (A—E — from *Hemibagrus elongatus*, F—H — from *Cranoglanis sinensis*).

ventrolateral; this formation appearing to be continuous in dorsal view, whereas in ventral view it appears to form lobe-like denticles at base of capsule. Length of buccal capsule including basal ring 0.138 (0.126—0.141), width 0.096 (0.096—0.102); size of basal ring 0.018×0.057 ($0.018-0.021 \times 0.057-0.063$). Length muscular oesophagus 0.748 (0.694—0.734), of glandular oesophagus 0.775 (0.748—0.830).

Nerve ring 0.272 (0.272–0.286), excretory pore 0.462 (0.367–0.394) and deirids 0.192 (0.165) from anterior extremity; latter well developed, situated slightly below buccal capsule. Vulva postequatorial, 3.62 (2.14–3.02) from posterior extremity; except for largest specimen, vulvar lips elevated. Uterus containing numerous first-stage larvae (only eggs were present in specimens from *C. sinensis*); it extends anteriorly to anterior end of glandular oesophagus, posteriorly nearly to rectum. Tail conical, 0.114 (0.081–0.108) long, with three mucrons 0.003–0.004 long at tip. Comments: — In 1952, Olsen erected an independent genus *Spirocamallanus* to accommodate the *Procamallanus* species possessing the buccal capsule strengthened internally by spiral thickenings (ribs); although some authors do not recognize the genus *Spirocamallanus*, the majority of recent writers (e.g. Yeh 1960a, Ivashkin et al. 1971, Chabaud 1975, Petter 1979b, Soota 1983) consider it a valid genus. But Moravec and Amin (1978) while studying the morphology of *Procamallanus siluri* Osmanov, 1964 from Afghanistan found that this species could not be assigned either to *Procamallanus* or *Spirocamallanus*, the morphology of the buccal capsule of males of *P. siluri* corresponds to the first genus, whereas that of conspecific females is typical of the latter genus. Since the presence or absence of spiral thickenings on the capsule is the only criterion to distinguish both these genera, we take both these morphological groups of species for congeneric. However, from the practical reasons we suggest to retain *Spirocamallanus* as a subgenus of *Procamallanus* to accommodate the species characteristic of the presence of spiral thickenings on the capsule of both sexes. For the species possessing spiral thickenings in females only (so far only *P. siluri*), we suggest to establish an independent subgenus *Spirocamallanoides* subgen. n. (type species *P. (S.) siluri* Osmanov, 1964).

Since only female nematodes were present in our material from *H. elongatus* and *C. sinensis*, their assignment to the species *P. fulvidraconis* is only provisional; this identification is based on the morphology and measurements of females, the type of hosts and geographical distribution. The females of this species somewhat resemble those of *P. mysti* Karve, 1952; the latter species has recently been re-described by De et al. (1986) who have synonymized with it a number of nominal species described mainly from various siluriform fishes of the Indian Subcontinent; in contrast to *P. fulvidraconis*, the females of *P. mysti* are noted for somewhat smaller measurements of the body and the buccal capsule (see De et al. 1986).

P. fulvidraconis was originally described from *Pseudobagrus fulvidraco* (Bagridae) from China; from the type host and some other fish species this parasite has been reported from China and the Soviet Far East (Li 1935, Dogel and Akhmerov 1959, Chen 1973, Wang et al. 1978, Wu 1984). The data concerning the occurrence of this species in fishes of the Soviet Central Asia (Skryabina 1974) are erroneous (see Moravec and Amin 1978). The present find of *P. fulvidraconis* is the first report of this parasite from Vietnam and *H. elongatus* and *C. sinensis* are new host records.

The development of *P. fulvidraconis* in the intermediate host (copepods) was studied by Li (1935).

5. *Procamallanus* (*Spirocamallanus*) *bagarii* Karve et Naik, 1951 (Fig. 5)

— Syn.: *Procamallanus aspiculus* Khora, 1955

Host: *Bagarius bagarius* (fam. Sisoridae).

Localization: intestine.

Description: Medium-sized nematodes. Cuticle thick, transversely striated; mouth opening spherical, provided with four mouth papillae and two lateral

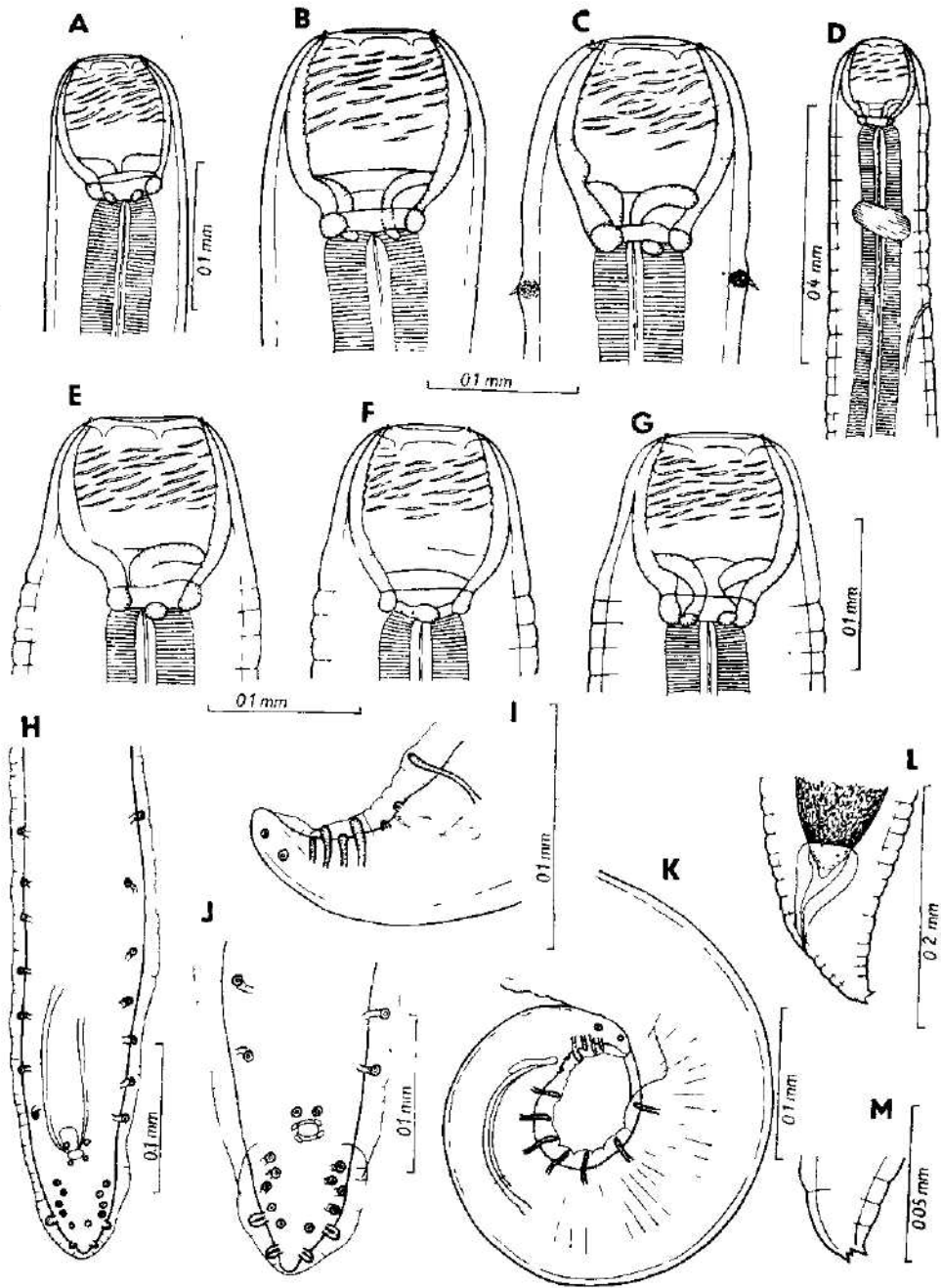


Fig. 5. *Procacallanus* (*Spirocacallanus*) *bagara* Karve et Naik, 1951. A — buccal capsule of male, lateral view; B, C — buccal capsule of female, lateral and dorsoventral views; D — anterior end of female; E—G — buccal capsule of female, lateral, dorsal and ventral views (same specimen); H — posterior end of male, ventral view; I, J — tail of male, lateral and ventral views; K — posterior end of male, lateral view; L — tail of gravid female; M — tail tip of female.

amphids. Orange-brown buccal capsule strongly sclerotized, wide, its anterior margin formed by six transverse sclerotized plates surrounding mouth aperture. Besides basal ring, base of buccal capsule provided with three forwardly directed, heavily sclerotized fold-like projections, one dorsal and two subventral, corresponding to three sectors of oesophageal tube. Inner surface of buccal capsule with numerous discontinuous ridges, most of them being oblique, some almost transverse. Muscular oesophagus slightly shorter than glandular one; latter opening into intestine through valves. Deirids developed, situated slightly below posterior end of buccal capsule.

Male (3 specimens): Length of body 4.24–5.33, maximum width 0.122–0.136. Buccal capsule including basal ring 0.099–0.117 long, its width 0.078–0.087; size of basal ring 0.018×0.054 –0.060. Length of muscular oesophagus 0.517–0.585, of glandular oesophagus 0.625–0.680. Nerve ring 0.218–0.245, deirids 0.122–0.190 and excretory pore 0.340–0.354 from anterior extremity. Posterior end of body bent ventrally, provided with lateral alae. 7 pairs of subventral pedunculate preanal papillae present. Postanal papillae 7 pairs in number: first four pairs of big pedunculate papillae subventral, fifth and seventh pairs lateral; sixth pair represented by small sessile papillae situated ventrally. In addition to these, one pair of small sessile papillae present in front of cloacal opening; cloacal opening surrounded by four minute, slightly sclerotized plates. Two unequal, simple spicules present, both being poorly sclerotized (especially left one) and consequently ill-visible. Length of right spicule 0.165–0.186, of left spicule 0.105–0.114. Gubernaculum moderately sclerotized, 0.033–0.039 long. Tail 0.060–0.072 long, tip of tail rounded.

Female (2 specimens): Body of gravid females 6.66–9.07 long and 0.163–0.245 wide. Length of buccal capsule including basal ring 0.135–0.144, width 0.114–0.126; size of basal ring 0.018 – 0.024×0.066 –0.069. Length of muscular oesophagus 0.734–0.762, of glandular oesophagus 0.802. Nerve ring 0.272–0.286, deirids 0.163–0.177 and excretory pore 0.354–0.449 from anterior extremity. Vulva situated 2.45–3.36 from posterior end, vulvar lips elevated. Vagina directed posteriorly. Uterus containing numerous first-stage larvae 0.012–0.015 wide; uterus reaching anteriorly posterior end of muscular oesophagus, posteriorly extending almost up to rectum. Tail conical, short, its tip provided with three small mucrons 0.003 long; length of tail 0.063–0.099.

Comments: — In 1979, Petter established *P. bagarii* Karve et Naik, 1951 a type species of her new genus *Onchocamallanus* that she characterized by the presence of transverse ridges on the inner surface of the buccal capsule and three sclerotized processes protruding out of the bottom of the capsule. Later this genus is recognized also by Soota (1983). In our opinion, these features cannot be considered sufficient to establish a new genus. We found the ridges on the buccal capsule of *P. bagarii* to be mostly oblique, although some of them, mainly near the anterior margin of the capsule, were practically transverse; similar nature of these ridges is also found in some other members of *Procamallanus*, e.g. in *P. sibirici* Osmanov, 1964 (see Moravec and Amin 1978). As to the presence of three sclerotized processes at the bottom of the capsule, similar formations, although less developed and less sclerotized than in *P. bagarii*, seem to be present in other members of *Procamallanus*; the degree of sclerotization of these formations is apparently different in different species, similarly as the degree of sclerotization of the spicules and the gubernaculum; therefore, we consider the presence of heavily sclerotized processes at the bottom of the capsule of *P. bagarii* to be only a specific feature. However, from practical reasons, it would be possible to think of retaining *Oncho-*

camallanus as a subgenus of the genus *Procamallanus*; but for the time being we are listing *P. bagarii* in the subgenus *Spirocamallanus*.

P. bagarii was originally described by Karve and Naik (1951) from the catfish *Bagarius bagarius* from India (Pune, Bombay), where it was recorded by the same authors also from *Callichrous* (= *Ompok*) *bimaculatus*. Later Khera (1955) described another species, *P. aspiculus*, from *B. bagarius* from India; this is now considered a synonym of *P. bagarii* (see Petter 1979b, Soota 1983). The nematodes from *Ophicephalus striatus* from India, reported by Majumdar (1961) as *P. aspiculus*, belonged in fact to the other species and genus (see also Petter 1979b). Hence, the present find of *P. bagarii* represents the third record of this species at all and its first record outside the territory of India.

Fam. Cystidicolidae (Skrjabin, 1946, subfam.)

6. *Spinitectus ophicephali* Ha Ky, 1971 (Fig. 6)

Hosts: *Ophicephalus maculatus* (fam. Chanuadac) and (?) *Pseudobagrus fulvidraco* (fam. Bagridae).

Localization: intestine.

Description (based on specimens from *O. maculatus*): Small, whitish nematode with thick cuticle. Head end rounded, posterior end conical. Surface of body provided with transverse rings of small conical spines; anterior rings interrupted a both sides of body by lateral lines. First 5–6 rings somewhat raised, first two ring close to each other. Largest spines present in anterior 5–6 rings; spines gradually diminishing posteriorly. Female body annulated up to posterior extremity, annulation of male ending just in front of area rugosa. Mouth aperture dorsoventrally elongated, with sclerotized rim. Two small lateral pseudolabia present, each of them being continuous posteriorly into a thickened pulp provided with two mouth papilla and minute amphid. Annulation of specimens with properly extended anterior end starting slightly in front of anterior end of muscular oesophagus. Vestibule straight, thin-walled, with anterior end distinctly distended to form funnel-shaped prostom in lateral view. Oesophagus divided into anterior muscular and posterior glandular sections. Nerve ring encircling oesophagus approximately between second and third rings of cuticular spines, excretory pore situated below fourth ring.

Male (5 specimens): Length of body 2.50–3.22, maximum width 0.096. Body bearing 67–101 rings of cuticular spines, maximum length of spines 0.015; first ring, containing from 22 to some 24 spines, 0.075–0.111 from anterior extremity. Length of whole vestibule including prostom 0.051–0.057, length of prostom 0.012–0.015, its width 0.018. Muscular oesophagus measuring 0.222–0.255, glandular oesophagus 0.624–0.765. Nerve ring and excretory pore 0.135–0.150 and 0.186–0.240, respectively, from anterior extremity. Posterior end of body spirally coiled, provided with narrow subventral alae. Tail conical, 0.096–0.117 long, ending in sharp point. Area rugosa well developed. Caudal papillae: 4 pairs preanal, 1 pair adanal and 5 pairs postanal pedunculated papillae present: last three pairs of postanals close together; last but one pair of papillae shifted ventrally. Left (larger) spicule slender, 0.693–0.750 long; its distal end slightly bent, provided with ventral membranous ala; shaft of this spicule 0.270–0.321 long, representing 38–41% of whole spicule length. Right (smaller) spicule broader, 0.096–0.111 long. Length ratio of spicules 1 : 6.4–7.8.

Female (10 specimens from *O. maculatus*; measurements of 1 specimen from *P. fulvidraco* in brackets): Length of body of gravid females 2.97–4.22 (4.27), maximum width 0.122–0.150 (0.150). Total number of rings of cuticular spines

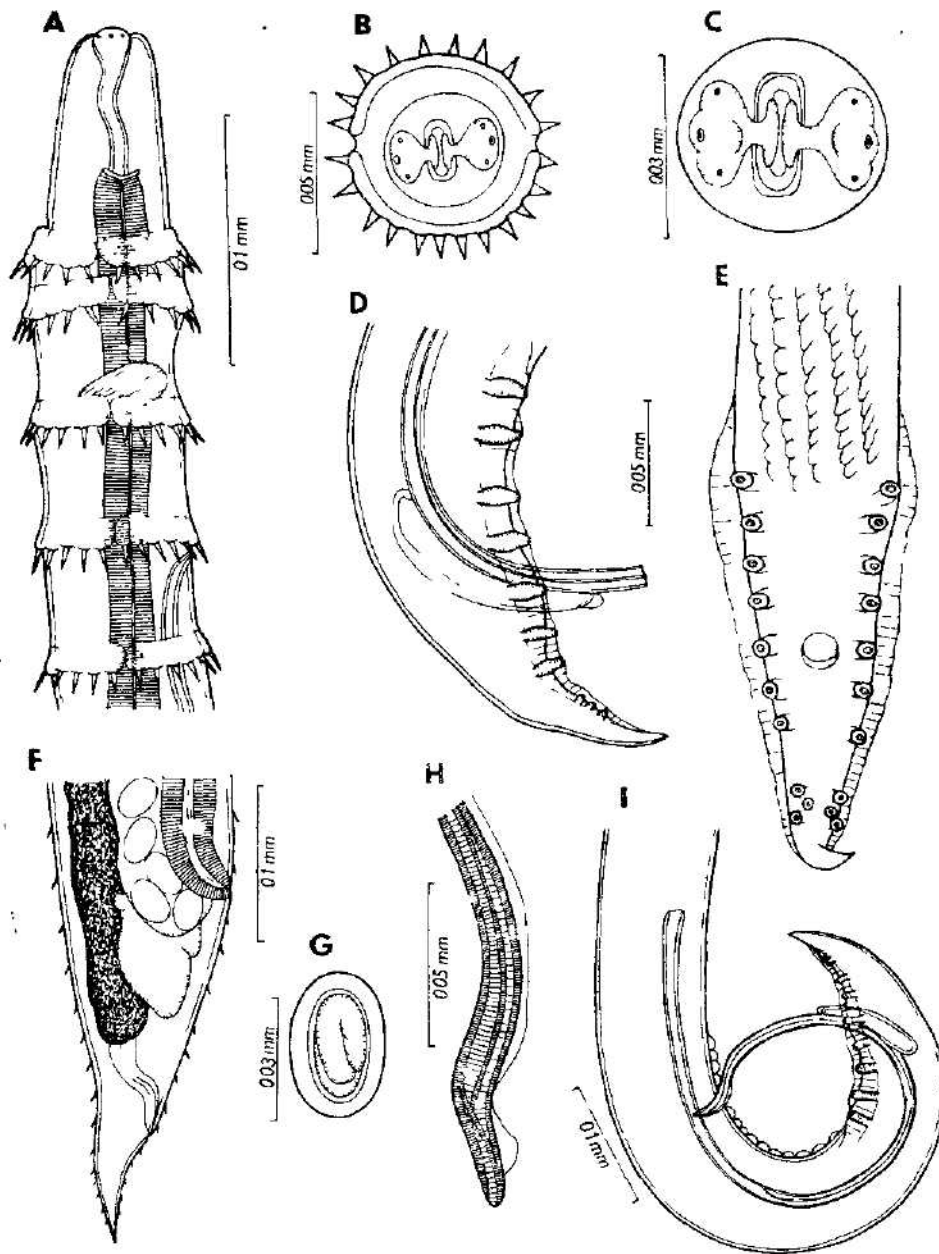


Fig. 6. *Spinitectus ophicephali* Ha Ky, 1971. A — anterior end of gravid female; B — anterior end of female, apical view; C — head end, apical view; D, E — tail of male, lateral and ventral views; F — posterior end of female; G — mature egg; H — distal tip of larger spicule; I — posterior end of male, lateral view.

140–144 (178), maximum length of spines 0.012 (0.012); first ring, containing 22 (22) spines, 0.081–0.093 (0.120) from anterior extremity. Length of vestibule including prostom 0.057–0.063 (0.060); prostom 0.015 (0.015) long and 0.018 (0.018) wide. Length of muscular oesophagus 0.210–0.249 (0.300), of glandular oesophagus 0.726–0.765 (0.771). Nerve ring and excretory pore 0.129–0.150 (0.165) and 0.177–0.240 (0.261), respectively, from anterior end. Vulva situated in posterior part of body, 0.270–0.300 (0.420) from posterior extremity and 0.189–0.222 (0.333) from anal opening. Vagina muscular, directed anteriorly. Mature eggs oval, thick-walled, larvated, with smooth surface; their size 0.039–0.042 × 0.024 (0.036–0.039 × 0.024–0.027). Tail conical, 0.078–0.087) long, bearing 6 rings of tiny cuticular spines.

Comments: — In 1971, Ha Ky described a new species of *Spinitectus*, *S. ophicephali*, from the digestive tract of *Ophicephalus maculatus* in North Vietnam. By their morphology and measurements our specimens correspond, more or less, to this species differing, however, in the markedly larger spicules and the number of caudal papillae in the male and by slightly larger eggs. But it is apparent from the original illustration of the male posterior end of *S. ophicephali* (see Ha Ky 1971) that this was studied in lateral view only: consequently, the group of the three last, minute caudal papillae was undoubtedly overlooked. According to the drawing of spicules, it is apparent that the right (smaller) spicule was mistaken for the left (larger) one, this being also indicated by its length, whereas the distal end of the left spicule was erroneously considered to be right (smaller) spicule; the anterior, larger part of the left spicule was not probably observed due to its overlapping by other internal organs. Taking into account that our nematodes are otherwise in accordance with the description of *S. ophicephali*, originating from the same host species from the same geographical area, we consider them identical with this species. ♀ ♂

By its morphology, *S. ophicephali* is very similar to *S. gigi* Fujita, 1927, as it has been redescribed by Yamaguti (1935), and it is possible that both species are identical. Yamaguti (1935) gave greater body measurements for *S. gigi*, but these are similar to those in *S. ophicephali* according to Belous (1952). *S. gigi* has been reported from catfishes of the family Bagridae (*Pseudobagrus nudiceps* and *P. fulvidraco*) from Japan, Soviet Far East and China (Fujita 1927b, Yamaguti 1935, Belouss 1965, Chen 1973, Wu 1984). The identity of *S. ophicephali* and *S. gigi* is suggested also by the present find of a female of *Spinitectus* from *P. fulvidraco* which is morphologically identical with *S. ophicephali* females from *O. maculatus*; therefore, it is provisionally assigned to this species. It is well-known that some species of *Spinitectus* may parasitize as adults fishes of different orders. Nevertheless, considering the insufficiently known morphology of *S. gigi*, we are retaining *S. ophicephali* as an independent species.

From the freshwater fishes of India and other countries of the Oriental Region a number of *Spinitectus* species were described that were established on the basis of the features subjecting to a considerable individual variability; from this reason, they cannot be diagnosed at present (see Petter 1979c); some of them might be identical with *S. ophicephali* or/and *S. gigi*. A very similar and possibly identical with *S. ophicephali* is also *S. malayensis* Petter, 1979, described from *glyptothorax major* (Bagridae) from Malaysia, that is mainly characterized by its somewhat smaller measurements; this species has been established only on the basis of the host type and the geographical site of the findings (Petter 1979c).

7. *Spinitectus ranae* Morishita, 1926 (Fig. 7)

Host: *Hemibagrus elongatus* (fam. Bagridae).
Localization: intestine.

Description: Whitish, medium sized nematodes with thick cuticle. Head end rounded, posterior end conical. Surface of body provided with transverse rings of small spines; anterior rings interrupted at both sides of body by lateral lines. First 5-6 rings distinctly raised, first two rings not being closer to each other than other

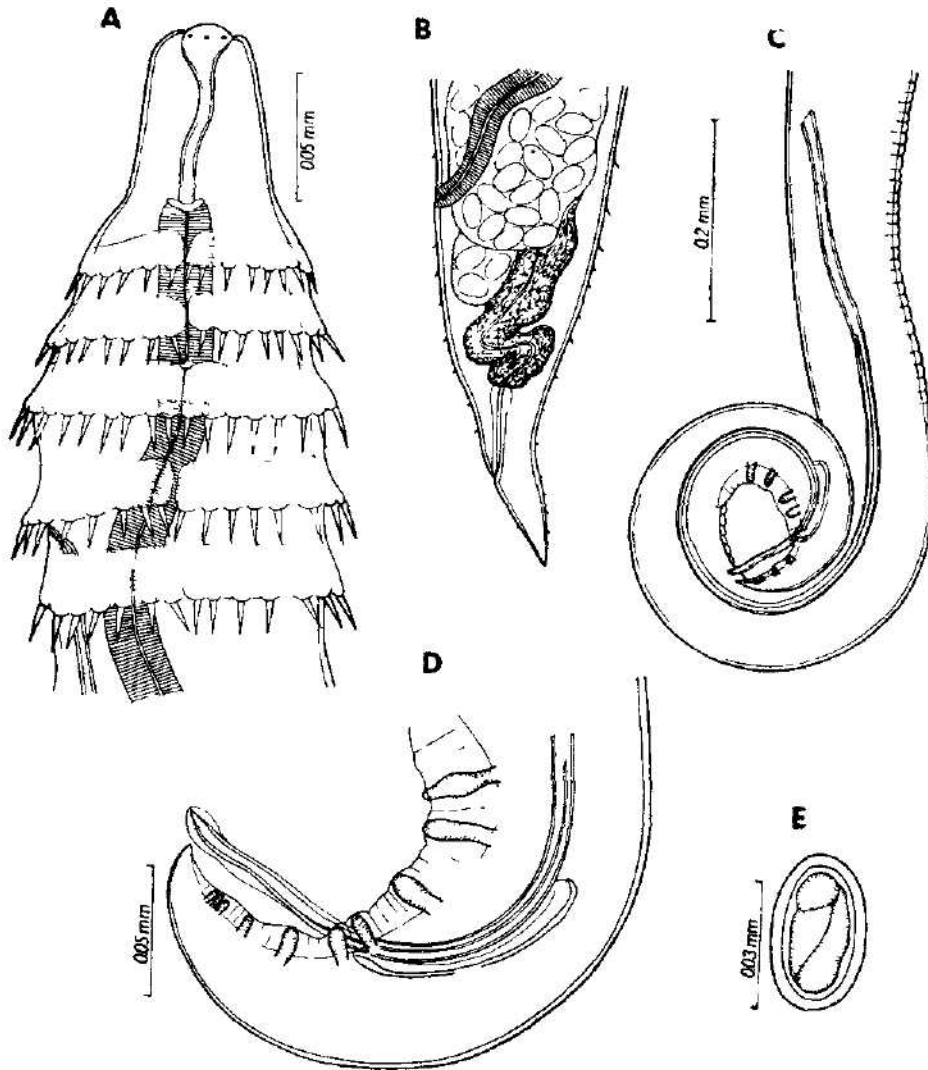


Fig. 7. *Spinitectus ranae* Morishita, 1926 from *Hemibagrus elongatus*. A — anterior end of gravid female; B — posterior end of female; C — posterior end of male; D — tail of male; E — mature egg.

rings. Larger spines present in anterior 5–6 rings; spines gradually diminishing posteriorly. Female body annulated up to posterior extremity, annulation of male ending just in front of area rugosa. Two small lateral pseudolabia present, each bearing two minute mouth papillae and amphid. Annulation of specimens with properly extended anterior end starting slightly in front of anterior end of muscular oesophagus. Vestibule straight, thin-walled, with anterior end distinctly distended to form funnel-shaped prostom in lateral view. Oesophagus divided into anterior muscular section and longer posterior glandular one. Nerve ring encircling oesophagus approximately between second and third rings of cuticular spines, excretory pore situated below fourth ring.

Male (1 specimen): Length of body 3.47, maximum width 0.150. Body bearing 63 rings of cuticular spines, maximum length of spines 0.012; first ring, containing some 30 spines, 0.042 from anterior extremity. Length of whole vestibule including prostom 0.060, length of prostom 0.015, its width 0.018. Muscular oesophagus measuring 0.180, glandular oesophagus 0.810. Nerve ring and excretory pore 0.111 and 0.114, respectively from anterior extremity. Posterior end of body spirally coiled, provided with narrow subventral alae. Tail conical, 0.105 long, ending in sharp point. Area rugosa well developed. Caudal papillae: 4 pairs preanal and 6 pairs post-anal pedunculate papillae present; last three pairs of post-anals close together, last but one pair of papillae shifted ventrally. Left (larger) spicule slender, 1.09 long; its conical distal tip slightly bent, provided with membranous cover; shaft of this spicule 0.240 long representing 22% of whole spicule length. Right (smaller) spicule 0.105 long. Length ratio of both spicules 1:10.4.

Female (1 specimen): Length of body of gravid female 5.22, maximum width 0.218. Total number of rings of cuticular spines 141, maximum length of spines 0.018, first ring, containing about 36 spines, 0.105 from anterior extremity. Length of vestibule including prostom 0.075, prostom not measured. Length of muscular oesophagus 0.231, of glandular oesophagus 0.900. Nerve ring and excretory pore 0.144 and 0.222, respectively, from anterior extremity. Vulva situated in posterior part of body, 0.408 from posterior extremity and 0.309 from anal opening. Vagina muscular, directed anteriorly. Uterus opposed; uterine loops reaching posteriorly nearly to rectum anteriorly not reaching posterior end of oesophagus. Mature eggs oval, thick-walled, larvated, with smooth surface; their size 0.042–0.045 × 0.024 to 0.027. Tail conical 0.090 long, bearing 6 rings of tiny cuticular spines.

Comments. — The morphology and measurements of our specimens from *H. elongatus* correspond to the species *S. ranae* Morishita, 1926, known as a parasite of frogs and toads (*Rana*, *Bufo*) from Japan and China (see Morishita 1926, Yamaguti 1941b, Yamaguti and Mitunaga 1943, Hasegawa and Otsuru 1977, Wang et al. 1978); recently this species has been recorded in *Rana rugulosa* from North Vietnam (Moravec and Sey 1985). The only difference against the existing descriptions of *S. ranae* is that the two anterior rings of cuticular spines in our specimens are not close to each other; however, this may be associated with the contraction of their body. Morphologically this species resembles *S. gigi* and *S. ophicephali*, but in contrast to them, it possesses a greater number (30–36) of cuticular spines in the first ring; as we found, the shaft represented only 22% of the whole length of the left spicule in *S. ranae*, whereas 38–41% in *S. ophicephali*.

As to the fact that, in this case, *S. ranae* was recorded from a different host type, it is necessary to realize that many species of the genus *Spinitectus* exhibit only a low degree of host specificity and they may parasitize, for example, fishes belonging to different orders; some species parasitizing currently freshwater fishes (e.g.

S. carolini, *S. gracilis*) were also recorded from amphibians (Trowbridge and Haffey 1934, Jilek and Wolff 1978). It is probable that some predators (e.g. fishes or amphibians) may play, in such cases, a role of the so called postcyclic hosts for these nematodes.

A *Spinitectus* specimen (gravid female) morphologically similar to those from *H. elongatus* was recorded also from *Cirrhina molitorella*, but its conspecificity with *S. ranae* could not be determined.

8. *Spinitectus* spp. — juv.

Hosts: *Bogarus bogarius* (fam. Sisoridae) and *Acanthorhodeus fortunensis* (fam. Cyprinidae).
Localization: intestine and stomach.

Comments: — In the digestive tract of the above mentioned host species, juvenile *Spinitectus* females were found the identification of which was not possible due to their immaturity. A single specimen from *B. bogarius*, with the body length 2.49 mm, width 0.095 mm, was noted for the presence of 26 cuticular spines in the first ring; its first two rings were close together; the morphology of this specimen reminded *S. ophicephali*. Three specimens from *A. fortunensis* were 1.63–2.16 mm long and 0.082 mm wide, their first two rings of cuticular spines were not close to each other and the general morphology of these nematodes reminded rather the species *S. ranae*.

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**PROBLEMS OF BATHYPHANTES EUMENIS AND ITS OCCURRENCE
IN CZECHOSLOVAKIA (ARANEAE, LINYPHIDAE)**

Vlastimil RŮŽIČKA

Czechoslovak Academy of Sciences, Institute of Landscape Ecology,
Na sádkách 7, 370 05 České Budějovice

In memory of Docent RNDr. Miroslav Kunst, CSc.

Abstract. Both sexes of the new subspecies *Bathyphanes eumenis buchari*, which occurs in the rock debris of the Bohemian frontier mountain ranges Šumava and Krkonoše, are described. Furthermore, the finds of the subspecies *Bathyphanes eumenis eumenis* in northwestern Bohemia are described. The new subspecies is compared with the nominate subspecies as well as with the species *Bathyphanes humilis* and *Bathyphanes jenseicus*.

In the course of the years 1983—84 we collected spiders in the rock debris on the mountain Luč in the Šumava Mountains (= the Bohemian Forest, in German, Böhmerwald). These rock debris lie at the altitude of about 750 m. They are of a very elastic character. They are formed mainly by huge fallen rock boulders, often up to 5 m in size. Among these boulders there are places filled with smaller, transportable stones (size up to 30 cm). The stones are luxuriantly overgrown with mosses and lichens. Trees and shrubs grow sparsely in the whole area of rock debris. To collect the material, we used the modified pitfalls for coarse rock debris (Růžička, 1982). One pitfall was placed at a depth of about 50 cm in a small, dark, against rain and fallen leaves protected cave below a big rock boulder. Into this pitfall no other material than two females of some species of the genus *Bathyphanes* fell in the course of the whole year.

This species, however, had been ascertained in the territory of Bohemia before. Buchar (1987) found it in the rock debris of the Krkonoše (= Giant Mountains) and recorded it under the name *Bathyphanes humilis* (L. Koch, 1879). He made the determination using the paper by Kulezyński (1916) who, however, gives under the name *B. humilis* the female of another *Bathyphanes* species from Siberia. Kulezyński apparently made this female identical with *B. humilis*, because he interpreted the prominent parmula in Koch's original picture as an extended tip of the scapus. Holm (1973) pointed to these errors of Kulezyński and Buchar, but he himself informed erroneously that Buchar had found his specimen in Bulgaria. Both Kulezyński's and Buchar's specimens differ considerably from *B. humilis* (see Figs 1F and 2A).

To obtain also the males of the problematic species, we placed in the course of the years 1984—85 further modified pitfalls quite purposely into the rock debris overgrown with forest in the Vydra river valley. In the pitfalls in which the lowest temperatures were measured in summer, two males and four females of the mentioned species were caught. The new species appeared to be closely related to *B. eumenis* (L. Koch, 1879), *B. similimus* (L. Koch, 1879), and *B. eumenoides* Holm,

1967. These species are known from the northern regions of Europe, Asia and America. Wozny & Czajka (1985), basing on their finds in Poland, made a revision of the types as well as of other specimens and came to the conclusion that all specimens belonged to only one species, viz., *Bathypantes eumenis* (L. Koch, 1879). The Bohemian specimens belong to this species, too.

After a consultation with Dr. Czajka at the First Czechoslovak-Polish Arachnological Symposium at Ostrava in 1986 we set off to the rock towns in the vicinity of the north-eastern frontier of Bohemia. They link up to the mountains Góry Stolowe in Poland, where *B. eumenis* was found. Following exactly the instructions given us by Dr. Czajka, we also found *B. eumenis* here.

The description of *B. eumenis* was based originally on a female only, and that of *B. simillimus* on a male only. However, the specimens described belong to one species. *B. eumenooides* was described by Holm on the basis of a female only, but its epigyne falls into the variation range of the epigyne of *B. eumenis*. Wozny & Czajka (1985) present the synonymy of this species. To *B. eumenis* probably belongs also the specimen described and pictured by Kulezyński (1916). On the contrary, the specimen described by Palmgren (1975) as *B. eumenis*, which we had the opportunity to examine, belongs probably to *B. jeniseicus* Jeskov, 1979.

The specimens found in the rock towns of Bohemia conform to the specimens from Poland and belong to *B. eumenis*. The specimens from the rock debris belong in view of the structure of copulation organs, univocally to this species, too; in other respects, however, they are rather different and can be designated as an independent subspecies.

Bathypantes eumenis buchari ssp. n. (Fig. 1A—G)

Holotypus: ♀ Czechoslovakia, Šumava Mountains, boulder rock debris on the slope of the mountain Luč (750 m a. s. l.), caught in a pitfall trap between 3 to 30 May, 1983, lgt. V. Ružička.

Paratypes: 1 ♂ at the same locality, between 17 June and 28 July, 1983; 2 ♂ 4 ♀ Czechoslovakia, Šumava Mountains, rock debris in the Vydra river valley (900 m a. s. l.), material gathered in a pitfall trap between 4 August, 1984, and 27 July, 1985, lgt. V. Ružička; 1 ♀ Czechoslovakia, Krkonoše Mountains, boulder rock debris on the slope of the mountain Vysoké Kolo 1,450 m a. s. l., material gathered in a pitfall trap placed at the border of a rock debris field from 29 September till 23 October, 1962, lgt. J. Buchar.

Other material: 1 ♂ 4 ♀ Czechoslovakia, Šumava Mountains, rock debris on the slope of the mountain Obří hrad (850 m a. s. l.), material gathered in a ground pitfall from 26 October, 1985, till 4 October, 1986, lgt. V. Ružička.

Deposition: The holotype and one male of paratype are deposited in the collections of the National Museum in Prague (No. P 6 r — 18/86). The paratypes from the Šumava Mountains are deposited in the author's collection, the paratype from the Krkonoše Mountains is preserved in the collection of Docent Dr. J. Buchar at the Faculty of Science of the Charles University in Prague.

Derivatio nominis

I named the subspecies in honour of my teacher, Docent Dr. J. Buchar, CSc., who found it for the first time.

Description

Female (holotype): Total length 2.6 mm. Cephalothorax length 1.08 mm, width 0.83 mm. Cephalothorax brownish-yellow, around the eyes black spots. Both eye rows straight, both the anterior and the posterior middle eyes about half of their diameter distant from each other. Sternum 1.1 times longer than wide, between

Lengths of leg joints (mm)

	fe	pt	ti	mt	ta	total
I	1.72	0.33	1.68	1.63	0.96	6.32
II	1.70	0.33	1.55	1.51	0.86	5.95
III	1.40	0.27	1.06	1.16	0.69	4.58
IV	1.77	0.29	1.53	1.55	0.86	6.00

coxae IV it penetrates by a wide projection. The chelicer groove at the anterior edge with three teeth, at the posterior edge with three denticles.

Legs light brownish-yellow. Fe I–IV with one dorsal spine respectively. Fe I prolaterally on the left leg with 4 spines, on the right leg with 2 spines (in the paratypes always with 2 prolateral spines). Ti I–IV dorsally with two and retrolaterally with one spine respectively. Ti I with two prolateral spines, Ti II–IV with one prolateral spine respectively. Metatarsi without spines.

Epigyne: Epigyne with a large circular pit which is in perpendicular view on the lower side of abdomen almost totally covered with the projecting anterior edge, from which an elongated scapus protrudes backwards (Fig. 1F). The scapus is overgrown with long hairs, 2.5 times longer than wide, reaching behind the epigastral groove. The width of the scapus is equal to half a width of the epigyne pit. In side view the scapus passes continuously into the convex anterior outline of the abdomen; the whole length of it is convex (Fig. 1E). From the posterior edge of epigyne the parmula projects behind the epigastral groove. The scapus and parmula tips touch each other. The lateral sclerites of the posterior edge of epigyne, well visible in the oblique view from behind, are as wide as the half of the middle sclerite (Fig. 1G).

Abdomen very pale, beige, totally without pattern.

Male (paratype): Total length 2.5 mm. Cephalothorax length 1.15 mm, width 0.88 mm. Coloration, dimensions of sternum and distribution of spines on legs the same as in the female.

Lengths of leg joints (mm)

	fe	pt	ti	mt	ta	total
I	1.72	0.33	1.67	1.69	1.08	6.49
II	1.67	0.33	1.55	1.53	0.96	6.06
III	1.36	0.28	1.07	1.17	0.71	4.59
IV	1.75	0.30	1.57	1.63	0.92	6.17

Palpus: Paracymbium overgrown with long bristles. Embolus at the tip wound in a loop. A characteristic lamella along the side (Fig. 1A–D).

Materials for comparison

Bathypantes rumenis (L. Koch, 1879): 35 ♂ 57 ♀ Czechoslovakia, rock town Teplicko-Adri-pašské skály, 13–14 July, 1986. lgt. A. et V. Růžička; 1 ♀ 23 August, 1986. lgt. J. Kopecký; 2 ♂ 5 ♀ Czechoslovakia, rock town Broumovské stěny, 15 July, 1986. lgt. A. et V. Růžička; 1 ♂, Czechoslovakia, Besedice, rocks, 23 April, 1975. lgt. P. Bílek; 2 ♂ 4 ♀ Poland, Góry Sto-

lowe, 27 June, 1985, lgt. M. Czajka, M. Wozny, J. Buchar; 2 ♀ Poland, Góry Stołowe, September 1984, lgt. M. Czajka, M. Wozny; 2 ♂ 2 ♀ Canada, Kuujuaapik bog, 20 June till 28 August, 1985, lgt. S. Koponen.
Bathyphantes humilis (L. Koch, 1879): 2 ♀ USSR, Mirnoje, Yenisei river bank, 23 June, 1970, lgt. K. Jeskov.
Bathyphantes jenseicus Jeskov, 1979: 2 ♂ 2 ♀ USSR, Mirnoje, Yenisei river bank, 28 July, 1979, lgt. K. Jeskov; 1 ♀ Finland, Lkem Muonio (Muonionniska), June, 1867, lgt. Palmén et Sahlberg.

Relations to the species *Bathyphantes jenseicus*

B. jenseicus is related to the North American species *B. orica* and *B. alameda* (see Jeskov, 1979). For these species the hook-like outgrowth on the lamela of the male palpus is characteristic, but it does not occur in *B. eumenis* (cf. Figs 1A, B and 2D)*. The females of *B. eumenis* and *B. jenseicus* are rather alike, however,

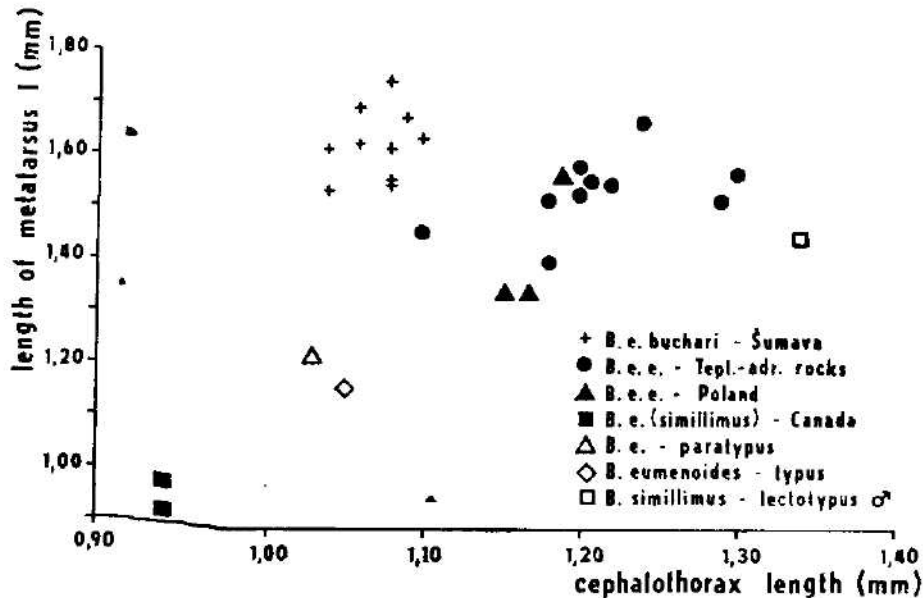


Fig. 3. Relation between the length of metatarsus I and the cephalothorax length in females within the limits of *B. eumenis*. The black symbols indicate the values acquired by the author's own measurements, the white ones indicate the data taken over from the literature.

certain differences are to be found in the structure of epigyne. The lateral epigyne sclerites in *B. jenseicus* are wider than the middle sclerite and are elongated into tips (Fig. 2B, C)*. The lateral epigyne sclerites in *B. eumenis* are narrower than the middle sclerite.

Intraspecific relations

B. eumenis is a rather variable species. Already Holm (1973) pointed to considerable differences in the size of the North American and Siberian specimens. The cephalothorax of the males from Siberia is 1.26–1.34 mm long, while in the males from the USA (New York State) its length is only 1.08–1.17 mm. In the males

* The figures 1 and 2 will be found at the end of issue.

from Quebec (measured by us) the cephalothorax length was 1.13–1.16 mm. *B. simillimus* was differentiated from *B. eumenis* and *B. eumenoides* mainly by the dark coloration of the abdomen (Holm, 1973, Ivie, 1969). Wozny & Czajka (1985), however, have concluded, basing on the evaluation of an extensive material, that the coloration of abdomen is not a taxonomically usable character in the case of *B. eumenis*. Our observations have confirmed a great variability of this species.

The specimens of the nominate subspecies, though rather different as regards their absolute size, show approximately the same body proportions. The literature data are also in a good coincidence with the dependence ascertained in the set of specimens from the rock town Toplicko-Adršpašské skály (Fig. 3). The specimens of *B. eumenis buchari* possess relatively longer extremities. The ratio of the length of metatarsus I to the cephalothorax length can be used as the diacritical character. In *B. eumenis eumenis* this value amounts in average 1.28 (variation range 1.19 to 1.35, interval $\bar{x} \pm 2s$: 1.16–1.40). In *B. eumenis buchari* this value is in average 1.53 (variation range 1.44–1.63, interval $\bar{x} \pm 2s$: 1.41–1.65).

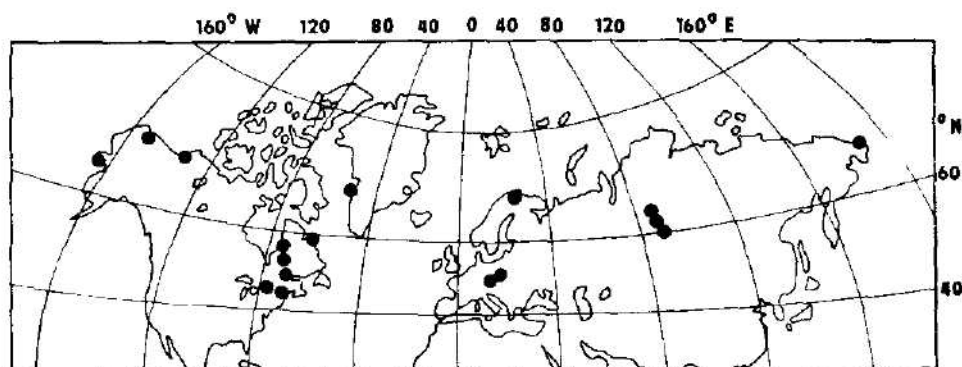


Fig. 4. Worldwide distribution of *B. eumenis*. According to the data given by Holm (1967, 1970, 1973), Ivie (1969), Koponen (1976, unpublished), Wozny & Czajka (1985). The datum from northern Sweden (Koponen, 1974) is erroneous (Koponen, intonation by letter).

Even if the sets of only ten specimens measured are taken for comparison, *B. eumenis eumenis* shows greater dispersion variance in most parameters than *B. eumenis buchari*. The abdomen of *B. eumenis eumenis* is always grey to blackish, sometimes with a developed light pattern. The abdomen of *B. eumenis buchari* is quite lacking in pigment, its colour is light beige. This all is apparently connected with a greater variability of light, temperature and humidity conditions under which *B. eumenis eumenis* occurs in the rock towns. On the contrary, the constant environmental conditions in the depth of mountain rock debris doubtlessly support the uniformity of the populations of *B. eumenis buchari*.

The markedly elongated extremities, elongated spines on extremities, loss of pigmentation in the subspecies *B. eumenis buchari* are the results of adaptation to the cavernicolous way of life. Zacharda (1979) terms these adaptations the troglomorphisms.

The shape of scapus in side view does not present any decisive character. In both subspecies the specimens with arched as well as with sagged scapus are to be found.

A more complex evaluation of variability of the species *B. eumenis* will require further investigations, especially as regards the evaluation of morphology and eco-

logical demands of the North American and Siberian populations. It is not impossible that some of these populations form separate subspecies.

Occurrence

Wozny & Czajka (1985) found *B. eumenis eumenis* in the central parts of the sandstone rock towns. At those localities there are rock fissures which are often tens of meters high and only tens of centimeters wide. In such dark, moist and cold holes lives *B. eumenis eumenis* in masses. The same intensity of occurrence we found in the rock towns Teplicko-Adršpašské skály. Less frequently we met with *B. eu-*

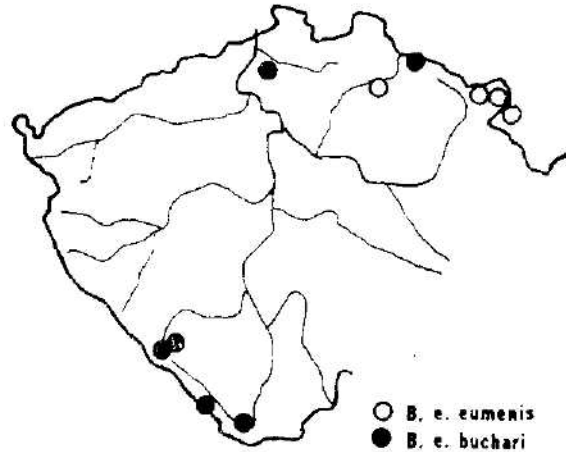


Fig. 5. Distribution of the subspecies *B. e. eumenis* and *B. e. buchari* in the territory of Bohemia and Poland. According to data given by Bílek (unpublished), Buchar (1967), Wozny & Czajka (1985), and according to author's own finds.

menis eumenis in the other rock parts, on the moist rock only several meters high and shaded by forest. An other site of abundant occurrence we found in the underground. Both in the Teplicko-Adršpašské skály and in the rock walls Broumovské stěny there are ravines filled with the material of collapsed rock towers. The boulders accumulated in this way are overgrown with mosses, shrubs and trees. Among the boulders there are hollows often of five or more meters in depth, a kind of pseudo-caves (Vitek, 1979). In these hollows *B. eumenis eumenis* occurs in masses as well.

As regards the environment in which *B. eumenis* occurs in the other regions of its distribution, we have found only one piece of information in the literature: in the northernmost parts of Finland it lives on stone belts and cliffs (Koponen, 1976).

B. eumenis buchari occurs in the depths of the cold mountain rock debris. The finds in the Šumava Mountains, from the mountain Luč and from the Vydra river valley, come from the pitfalls placed in the depth of rock debris in small cave-like hollows below the big rock blocks. Into those places no visible detritus penetrated any more. The stones are clean, and all-year-round darkness, humid air and relatively constant, low temperature rule there. The third find originated from the depth of rock debris on the slope of the mountain Obří hrad. These rock debris lie in the Losenice river valley and, owing to low temperature and high air humidity, they are overgrown with sphagnum without being filled with detritus. In the depths of the rock debris in the Vydra valley in July, at the external temperature of 25° C,

the temperature of only 9° C was measured, i.e. the same temperature which existed in our territory during the summer seasons in the Ice Age (Ložek, 1972).

Distribution

B. eumenis is distributed in Europe, Asia, and America between 40 and 70° N (Fig. 4). In Central Europe it is limited to very few regions with all-year-round low temperatures. This fact indicates that *B. eumenis* is a glacial relict in Central Europe. The occurrence of the nominate subspecies *B. eumenis eumenis* is, according to recent knowledge, known from a small region of sandstone rock towns in Bohemia and Poland. The occurrence of *B. eumenis buchari* is for the present time known from the rock debris of the Bohemian mountain ranges Šumava and Krkonoše (Fig. 5).

Acknowledgements

I am obliged very much to Dr. S. Koponen for his kind consultations covering the whole scope of problems, for his solution of problems regarding the data on the occurrence of the species in the northern parts of Europe and for his loan of material for comparison. Dr. K. Jeskov and Dr. M. Czajka I wish to thank for the kind loan of materials for comparison, and Dr. M. Czajka, in addition, for a detailed mitigation to the ecology of the species under study. To Dr. A. Holm, Docent Dr. K. Thaler, Professor Dr. P. Brignoli and Dr. E. Hauge I wish to express my thanks for their consultation of problems and for data on some relative species. To Docent Dr. J. Buchar I am indebted for his all-round help in the solving process of the problems. Ing. F. Kubík I thank for exact revealing us the promising sites in the Tephicko-Adršpašské skály, where we then really found the species we were looking for. Last but not least, I owe my sincere thanks also to my wife Alena, who accompanies me devotedly on the arachnological field trips and helps me to collect spiders.

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IN MEMORY OF DOCENT RNDr MIROSLAV KUNST CSc.

Docent RNDr Miroslav Kunst CSc., a distinguished Czechoslovak zoologist, internationally renowned acarologist and well-liked teacher, died after a long painful illness on 21 June 1987 at the age of sixty-three.



He joined the staff of the Faculty of Natural History, Charles University, Prague in 1949, and was Head of the Department of Systematic Zoology and a member of the Faculty's Scientific Board from 1967 to 1986. He was very active in reforming the curriculum and in editing *Acta Universitatis Carolinae — biologica*. During his term in office as Head of the Department he brought the basic course of zoology, including laboratory and field courses, to an unprecedented standard. Progress was made in the various fields of research conducted in the Department — ichthyology, chiropterology, ecological ethology of insectivores, entomology and arachnology. Students of acarology and soil biology in general had excellent working conditions owing to Dr Kunst's enthusiasm for these fields. Many young as well as senior acarologists worked in the Department of Systematic Zoology for various periods of time under his leadership: RNDr F. Lešáková CSc. (Bdellidae), RNDr V. Halašková CSc. (Gamasidae, Zerconidae and others), RNDr P. Pecma CSc. (Uropodidae), RNDr M. Zacharda CSc. (Rhagidiidae and Strandmaniidae), and finally RNDr V. Bukva CSc., Ing. M. Trávníček CSc., RNDr J. Smrž CSc. and RNDr J. Starý, who studied his favourite group, the Oribatei. Three these scientists have remained at the Department and continue the interrupted research of their tutor. Most of the

others now work at the institutes of the South Bohemian Biological Centre of the Czechoslovak Academy of Sciences at České Budějovice, which includes the Institute of Soil Biology.

The untimely death of Dr Kunst prevented his completing an extensive manual for the identification of the oribatids of Central Europe. Five volumes of his second doctoral thesis, defended in 1968, contain solid foundations of this manual. Over 400 species of Czechoslovak oribatid mites have been treated in the thesis, 21 of them being new for science (as well as 5 subgenera, 10 genera and 3 families). These data have not yet been published excepting a key to families and genera of the year 1971 (see the list of publications).

The manuscript of a modern textbook of invertebrate zoology also remained unfinished. Dr Kunst's lectures on this subject were appreciated by students for their logical structure which was so much in keeping with the discussed matter.

Dr Kunst was an erudite and hard-working man, fluent in Russian, English, French and German. He was an exacting superior, requiring of others as much discipline as of himself. His dedication to work set the best example to his co-workers and students. He regularly came to his laboratory even during his incurable illness, never letting us notice how much the journeys exhausted him. At the beginning of April he still lectured on invertebrate zoology.

All of us who knew him remember the pleasant hours of rest after a good day in the field students (Dr Kunst's knowledge of Czechoslovak invertebrate fauna was phenomenal), or parties where for a while he became a fascinating narrator, entertaining us with his reminiscences of the postwar history of zoology at the Faculty.

Dr Kunst was awarded both Silver and Gold Medals of the Faculty of Natural History, a Charles University Bronze Medal, and received an honourable mention at the VIIth Congress of Czechoslovak Zoologists (1986) for many years of service on the board of the Czechoslovak Zoological Society sponsored by the Czechoslovak Academy of Sciences and for his work as editor of the *Věstník Československé společnosti zoologické*.

More information about the life and work of Dr Kunst can be found in an article published on the occasion of his sixtieth birthday (Buchar, 1985, *Acta ent. bohemoslov.*, 82: 155–158) and in others that appeared in the journal *Živa* (Buchar and Lelláková, 1974: 141; Buchar, 1984: 180; Buchar, 1988: 45, in Czech).

As a tutor, administrator and author, Dr Kunst substantially helped to lay the foundations of Czechoslovak soil biology; however, he was one of the prominent figures of Czechoslovak zoology as a whole and will be long remembered by two generations of his students. Also the coming generations of zoologists will appreciate his Atlas of Invertebrates.

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J. Buchar

REVIEWS

Bolotnikov, A. M., Šurakov, A. I., Kamenskij, N. Ju., Dobrinskij, L. N., 1985: *Ekologija rannego ontogeneza ptic* [Ecology of the early ontogenesis of birds]. Sverdlovsk: UNC AN SSSR, 228 pp., 2.70 Rubles.

Ecology of the early ontogenesis of birds belongs to the relatively less studied aspects of the avian reproduction. It is thus much welcome that a monograph on this topic appeared. It is divided into 9 chapters. Whereas the first of them is devoted to selected methodical aspects of the research of the early ontogenesis of birds, the following chapters consider: (1) Heterogeneity of eggs in a clutch; (2) Thermophysical characteristics of eggs; (3) Breeding and incubation; (4) The factors of incubation; (5) The types of incubation and the heterogeneity in the development of bird embryos; (6) Periodization and the tempo of the avian embryogenesis; (7) Characteristics of the gas exchange in bird embryos; and, finally, (8) Morphophysiological characteristics of embryos and nestlings.

The book contains a large amount of original information highly interesting to all workers studying avian early development. On the other hand, its main limitation consists in that it summarizes only the work of the Perm' school of ornithologists (to which the authors belong), while other Soviet relevant literature is covered insufficiently and it is apparent that the authors are practically unaware of the foreign literature relevant to the subject, especially of the modern one. Only 48 titles of the non-Soviet literature are cited (from the total of 294 references) and only 5 of them appeared after 1970, the latest in 1977.

The book remains thus a highly useful summary of the work of the Perm' ornithological school which undoubtedly leads the research under discussion in the Soviet Union, but it does not reflect our actual present knowledge of the ecological aspects of the early ontogenesis of birds.

J. Mlikovský

The Freshwater Fishes of Europe. Vol. 9. Threatened Fishes of Europe, by Anton Lelek, 1987. Aula-Verlag Wiesbaden, 343 pages, with 85 figures. Edited by the European Committee for Conservation of Nature and Natural Resources - Council of Europe. Price: DM 236,-.

The book forms a part of an extraordinarily important project to collect systematically information concerning the European fish fauna. The first volume, comprising lampreys, was edited by the well-known Slovak ichthyologist Juraj Holčík.

The aim of the present volume is most topical to summarize basic knowledge of European fish fauna, without entering into much detail but at the same time, offering such an amount of information that would be sufficient to specify dangers for their survival. The author presents a short, but precise outline of the European fish fauna, summarizes the development of individual faunistic areas, and brings a provisional list of European cyclostomes and fishes. The systematic part of the book is devoted to the review of all species classified according to the degree of status (endangered, vulnerable, rare, intermediate) and equipped with selected data in paragraphs headed as Distinguishing characteristics, Worldwide distribution, Distribution in Europe, Ecology, Population in Europe, Results for decline, Conservation measures taken and Conservation measures proposed (the information in the last three being most important). All lamprey and fish species known from freshwaters of Europe are discussed and characterized in this way. The distribution of some species according to the latest knowledge is demonstrated in maps. The final (4th) chapter is devoted to general conservation proposals. Acknowledgements, biography and the index of common names close the book. The book was published at the right moment. The interest in European freshwater fish fauna and its conservation has increased considerably and can be noted in whole Europe at present, especially in industrialized countries where fish fauna is important as an object of angling and aquaristics. While in aquaristics, the interest in native fishes is falling down and exotic species prevail, angling, fishing industry and controlled fish management in tap water riverine lakes are highly topical and their value tends to increase.

The data summarized in this book offer excellent material for further research in the European fish fauna, because they are not limited only to the so called economically important species, but cover the native fish fauna in general; they do not camouflage insufficient knowledge where more reliable information is lacking and thus the text provokes to new research in a very important branch of biological sciences.

O. Oliva

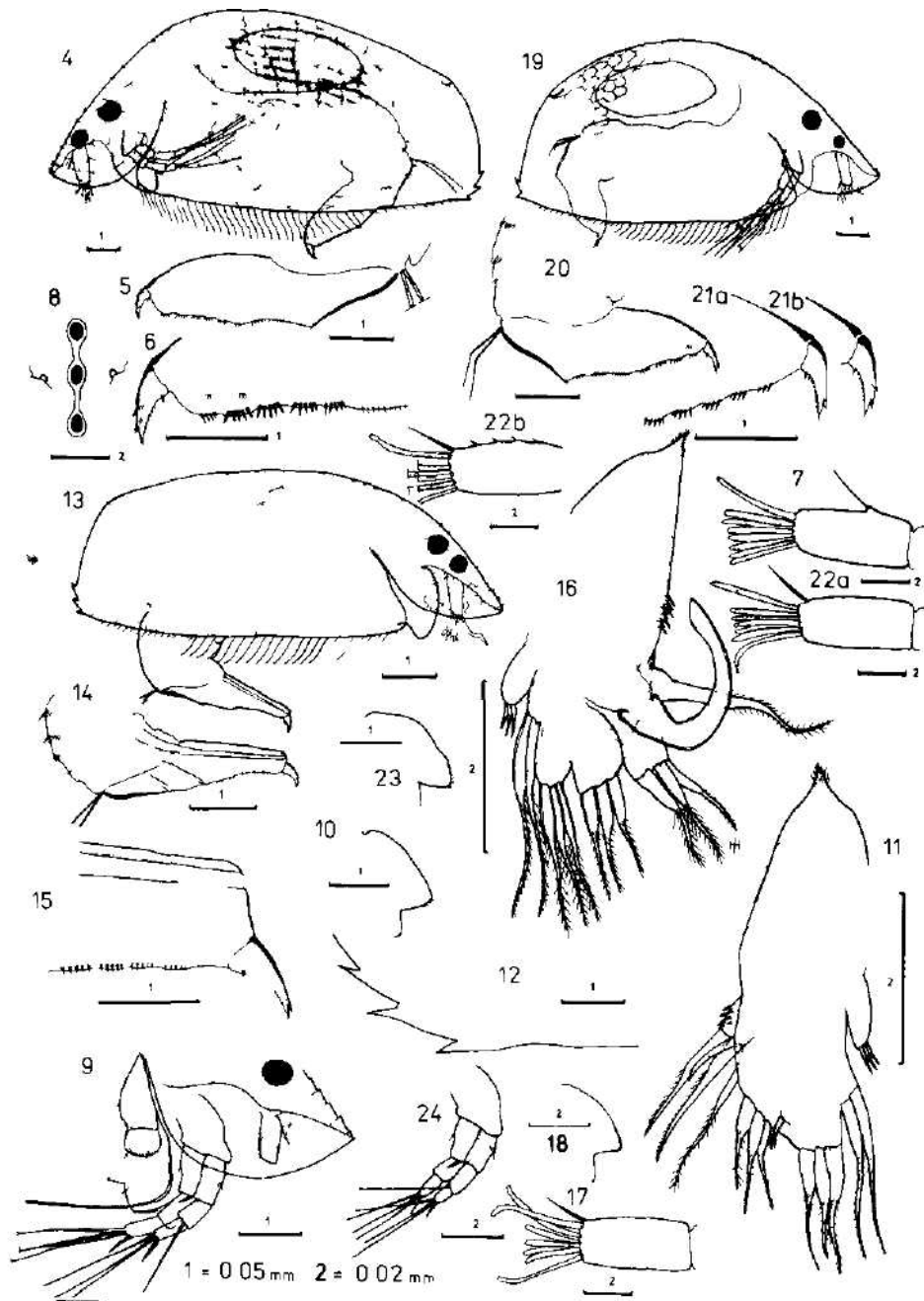
Tichonov, A. V., 1986 *Akustičeskaja signalizacija i ekologija povedenija ptic* (Acoustic signalisation and the ecology of avian behavior). Moskva: Izdatel'stvo Moskovskogo Universiteta, 239 pp., 2.80 Rubles.

Tichonov's book appears to be the first monograph on the acoustic behavior of bird embryos and nestlings (its title being thus a bit misleading). In the first part of the book ('Acoustic signalisation and behavior of birds in their early ontogenesis') its author investigates in seven chapters: (1) Prenatal stages of the voice development in birds, (2) Acoustic signalisation as a factor of acceleration of embryogenesis and synchronisation of hatching, (3) The effect of syrinx denervation on the spectral time structure of uttered signals, (4) Spectral time structure of acoustic signals as an indicator of sexual differences between one day old nestlings (Galliformes and Laridae are discussed), (5) Acoustic signalisation system and behavior of nestlings, (6) Ecological aspects of releasing afferentation in the ontogenesis of the functional feeding system of birds, and (7) Ontogenesis of acoustic signalisation and the evolution of avian ontogenesis.

The second part of the book ('Acoustic signalisation and behavior of birds in the breeding period') includes five chapters, regarding: (1-2) Voice reactions of Procellariiformes, Charadriiformes, Galliformes and Anseriformes, (3) Ecology of breeding and defense reaction of birds, (4) Spectral time structure of alarm signals, and (5) Mechanisms of the acoustic communication of birds.

In the whole the book is a good and usable summary of our present knowledge of the acoustic signalisation of avian embryos and nestlings. The author's own extensive experimental data are adequately supplemented by the results of other, both Soviet and foreign workers. Overall 251 Soviet and 258 foreign publications are cited. The book is a must for all workers interested in the acoustic signalisation of bird embryos and nestlings and should be, especially its first part, translated into English. But even this book has its weak point. Its English summary is full of misprints and translator's errors and will discourage the interested worker rather than attract him to read the book.

Jiří Mlíkovský



Figs 4-12 *Graptoleberis testudinaria pannonica* (female) 4 - female with epippium 5 - postabdomen 6 - detail of postabdomen and terminal claw 7 - antennule 8 - head pores, 9 - detail of head with antennae 10 - labrum 11 - first thoracic limb 12 - denticles on posteroventral corner
 Figs 13-18 *Graptoleberis testularia pannonica* (male) 13 - male 14 - postabdomen, 15 - detail of postabdomen and terminal claw 16 - first thoracic limb 17 - antennule 18 - labrum
 Figs 19-22 *Graptoleberis testudinaria testularia* (female) 19 - female with epippium 20 - postabdomen 21a, b - different terminal claw (the same locality 18.5.H) a, b - antennulae

Hudec 1 Graptoleberis testudinaria (Cladocera: Chydoridae) in Slovakia

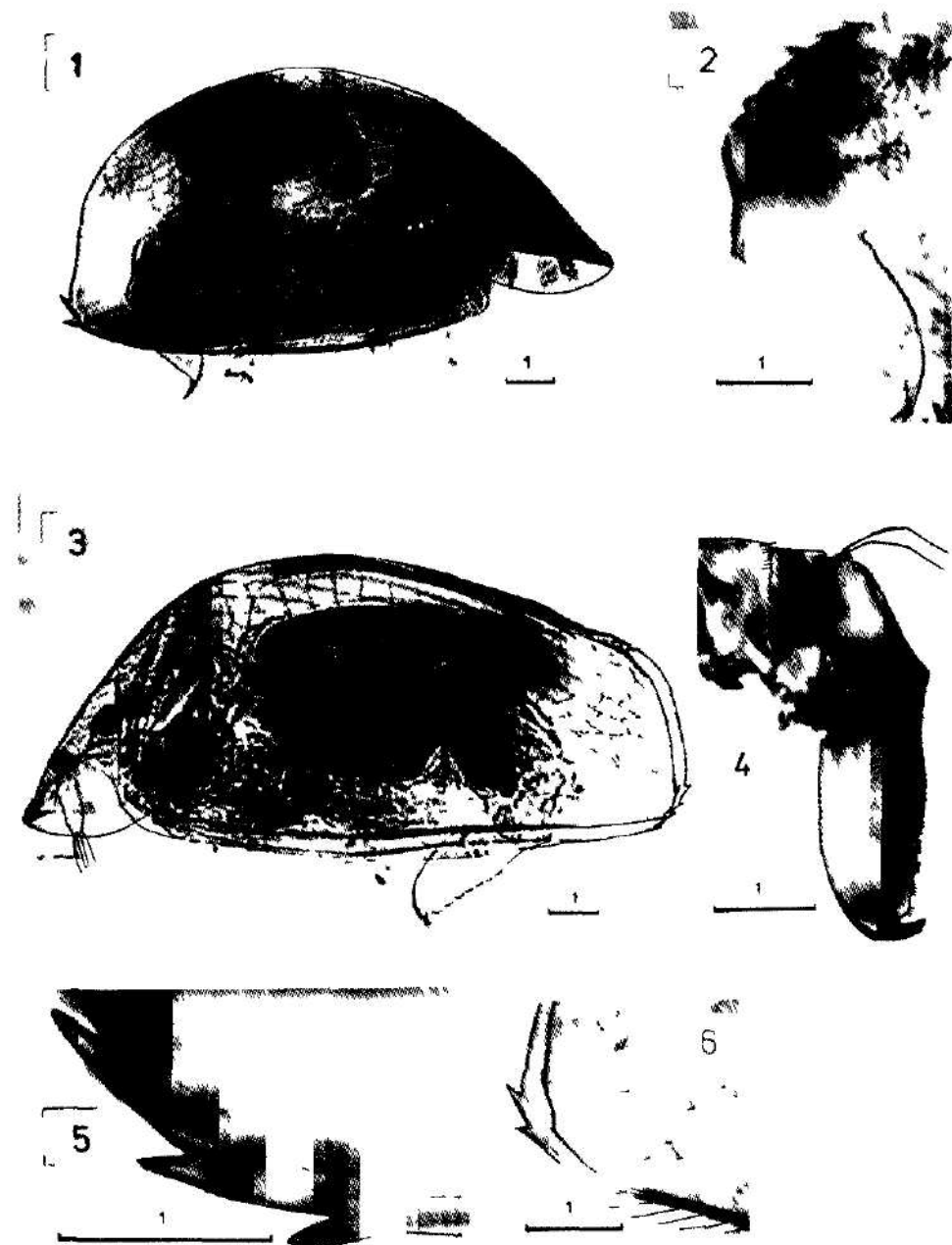


Plate 1
 Fig. 1-2 *Graptoleberis testudinaria testudinaria*: 1 - female with ephippium, 2 - postabdomen; 6 - posterior ventral corner. Figs. 3-5 *Graptoleberis testudinaria panicea*: 3 - female with ephippium, 4 - postabdomen, 5 - posterior ventral corner. Scale's represent 0.05 mm.

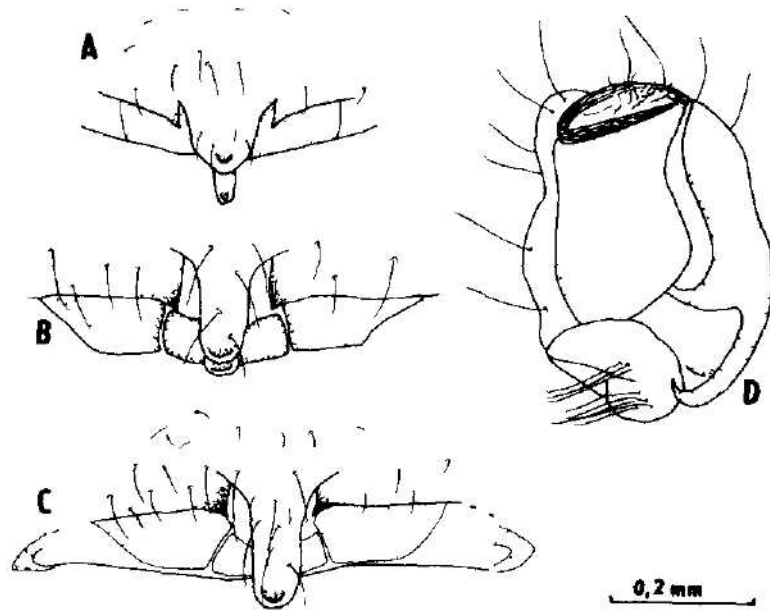


Fig. 2. A — *Bathypantes humilis* epigyne. B — *Bathypantes jenseicus* (Finland) epigyne in oblique view from behind. C — *Bathypantes jenseicus* (USSR), epigyne in oblique view from behind. D — *Bathypantes jenseicus* (USSR) palp.

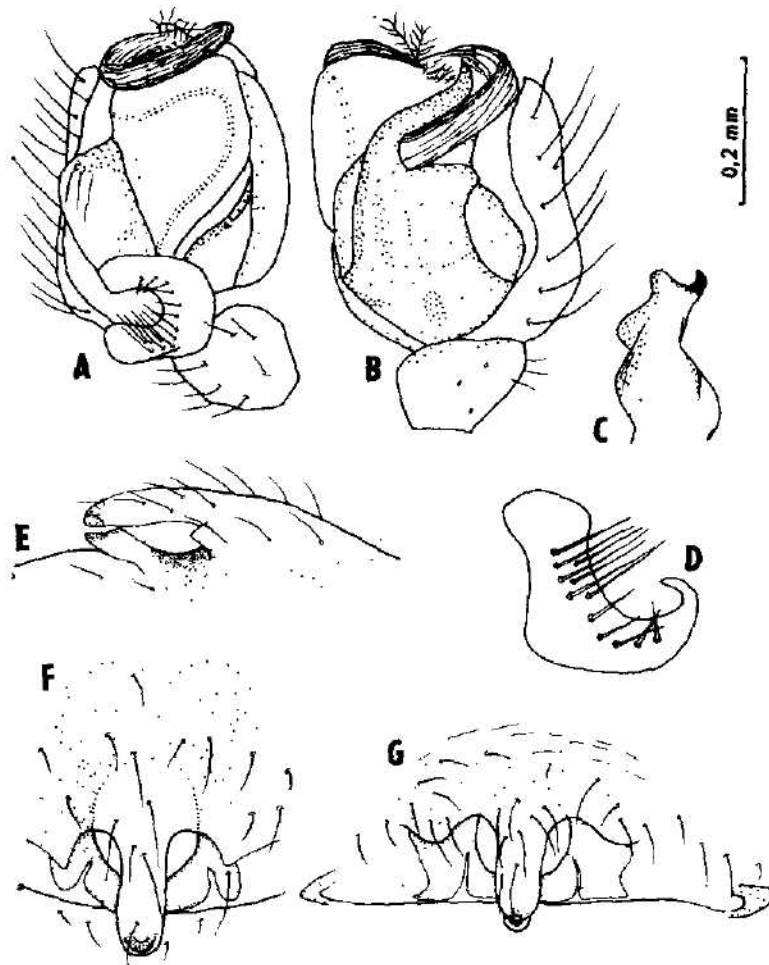


Fig. 1. *Bathypantes eumenis buchari* ssp. n. A, B — palpus (paratype 1), C — median apophysis (paratype 2), D — paracymbium (paratype 1), E — epigyne, lateral view, F — epigyne, G — epigyne, oblique view from behind (E—G — holotype).

POKYNY PRO AUTORY

Věstník Československé společnosti zoologické uveřejňuje původní vědecké práce členů společnosti v rozsahu nejvýše 30 stran rukopisu, napsané v některé z kongresových řečí, a dále články, hodnotící životní dílo našich zoologů, vyžádané redakcí. Práce autorů, kteří nejsou členy společnosti, budou přijímány jen výjimečně.

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Rukopis (originál a 1 kopie) musí být psán na stroji s většimi typy obřádek, na stránce 30 řádek, řádky po 60 úhzech, bez větších oprav. Rukopisy, které by neodpovídaly těmto formálním požadavkům, budou vráceny k přepsání.

Hlavička práce. 1. Název práce (u prací taxonomických v závorce za názvem systematické zařízení druhu nebo skupiny – např. Ostracoda: Cyprinidae), obojí v řeči, v níž je práce psána. 2. Jméno a příjmení autora. 3. Název pracoviště a adresa.

Vlastní práce: 1. Velmi stručný abstrakt, v rozsahu nejvýše 15 řádek, v angličtině. 2. Úvod do problematiky (stručně). 3. Materiál a metodika (u známých metod pouze odkaz). 4. Vlastní část experimentální nebo popisná. 5. Diskuse. 6. Závěr. 7. Seznam citované literatury (nikoliv bibliografie!). 8. Tabulky, texty k obrázkům a grafům. Celý rukopis je průběžně stránkovan.

Citace prací proveďte podle jednotného vzoru: autor, rok, název, časopis (mezinárodními bibliografickými zkratkami), ročník, sešit pouze v případě, že ročník není průběžně stránkovaný, stránky. U knižních titulů nakladatel a místo vydání. Např.: Hrabě, S., 1975: Second contribution to the knowledge of marine Tubificidae (Oligochaeta) from the Adriatic Sea. *Věst. čs. Společ. zool.*, 39: 111–119.

Přepis cyrilice proveďte podle mezinárodních pravidel transliterace (nikoliv fonetické transkripcie – viz ISO Recommendation R 9, International system for the transliteration of cyrilic characters I. Ed. October 1955, nebo Zekalle, R., 1964: *Pedobiologia*, 4: 88–91, Jena.

Obrázky a grafy kreslete černou tuší na kladívkový nebo pausovací papír v poměru 1 : 1 až maximálně 1 : 2, u taxonomických prací musí mít obrázky měřítko. Obrázky kreslete pokud možno tak, aby mohly být všechny stejným způsobem zmenšeny. Fotografie musí být ostré, kontrastní, na lesklém papíře. Obrázky sestavte do tabulí, které by bylo možno reprodukovat na šíři strany (126 mm), nebo s textem na celé zrcadlo (126 × 188 mm). Obrázky nebo obrazové tabule průběžně číslujte a v rukopise vyznačte místo, kam mají být zalomeny.

Tabulky jsou tištěny jako otevřené, tj. bez svislých linek. V tabulkách oddělte vodorovnými linkami jen záhlaví tabulky a dolní okraj. Tabulky protokolárního charakteru nebo opakující údaje z textu, případně tak velké, že by je nebylo možné vytisknout na dvě protilehlé strany nebudou přijímány.

V taxonomických pracích dodržujte zásady, ustanovení a doporučení mezinárodních pravidel zoologické nomenklatury.

V rukopisu nepředpisujte zásadně žádné typy písma, označte pouze tužkou po straně části, které mají být vysazeny petitem.

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