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SOME FINS AND VERTEBRAL ANOMALIES IN FISHES FROM THE VALLEY WATER RESERVOIR SLAPY BASIN (CZECHOSLOVAKIA)

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Abstract. Vertebral anomaly in the roach (*Rutilus rutilus*) and fins anomalies in the chub (*Leuciscus cephalus*), the dace (*Leuciscus leuciscus*) (family Cyprinidae) and the perch (*Perca fluviatilis*) (family Percidae) from the reservoir Slapy and its tributary the brook Mastník Central Bohemia) are described. The influence of the anomalies described on the growth of examined fishes is discussed.

MATERIAL AND METHODS

During field operations on May, 1985, performed in the reservoir Slapy, locality Stará Živohošť, the roach *(Rutilus rutilus)* with vertebral anomaly was caught in the net. During electrofishing in the brook Mastník (the tributary of the reservoir Slapy) on October 20, 1985, were found three specimens of the chub (*Leuciscus cephalus*) without ventral fins and one specimen of the dace *(Leuciscus leuciscus)* with absence of the left ventral fin. During field operations on October, 11, 1986 in the reservoir Slapy (locality Nová Živohošť) were found four specimens of the perch *(Perca fluviatilis)* with anomalies of dorsal and ventral fins.

For detailed study, binocular microscope and radiograph was used and for the study of the length growth was used the scale method with a correction (according R. Lee, 1920) in the roach 17 mm (Černý, 1980), in the chub 18 mm (Hanel, 1982), in the dace 17 mm (Kennedy, 1969) and in the perch 16 mm (Lohniský, 1960). Measurements in fishes were made by Oliva (1953) and Holčík, Hensel (1972).

INTRODUCTION

Vertebral anomalies have been reported in many fishes (some literary sources see e. g. Coad, Rubec. Quadri, 1974; Manning, 1980; Komada, 1982). Concerning fish species living in Czechoslovakian waters vertebral anomalies were described in following species: *Salmo trutta* m. *fario* (Plehn, 1924: Schäferna, 1938; Dyk, 1952; Průcha, 1967; Havelka, Peyerl, Volf, 1971), *Salmo gairdneri irideus* (Plehn, 1924; Volf, Havelka, 1958), *Salvelinus fontinalis* (?) (Plehn, 1924); *Coregonus lavaretus maraena* (Volf, Havelka, 1958), *Thymallus thymallus* (Schäferna, 1939 b), *Esox lucius* (Plehn, 1924; Schäferna, 1926 b, 1944; Dyk, 1941, 1952; Onderka, 1976), *Leuciscus cephalus* (Šimek, 1978), *Tinca tinca* (Dyk, 1952), *Barbus barbus* (Volf, Havelka, 1958). *Cyprinus carpio* (Plehn, 1924; Dyk, 1952, 1975; Hanzal, 1957; Volf, Havelka, 1958: Havelka, Peyerl, Volf, 1971; *Silurus glanis* (Dyk, 1958) and *Ictalurus nebulosus* (Coad, Rubec, Quadri, 1974).

Concerning fins anomalies absence of ventral fins was found in some species: *Rutilus rutilus* (Dyk. 1935 a. b), *Leuciscus cephalus* (Oliva, 1950; Libosvárský, 1956; Anonymus, 1977), *Abramis brama* (Novák, 1984), *Cyprinus carpio* (Anonymus (V. D.), 1980) and concerning foreign fishes e. g. in *Lutjanus argentiventris* (Álvarez-León, 1980) from the family Lutjanidae. Tandon (1964) found in the

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Asiatic fish *Channa punctatus* the absence of the right ventral fin. Dwarfed ventrals were described in the female of *Cyprinus carpio* (Dyk, 1952) and in *Hucho hucho* (Kirka, 1958). Different anomalies of ventrals in *Cyprinus carpio* from ponds were described by Dyk (1975). In the fry of *Hucho hucho* the occurrence of double ventrals was found by Kirka (1958). False ventrals had 2—3 rays. Concerning anomalies of the dorsal fin Schäferna (1939 c) described in detail 10 specimens of *Cyprinus carpio* with the double dorsal fin. Further anomalies of this fin found Plehn (1924) and Dyk (1975) in *Cyprinus carpio*. Dyk (1951, 1952) described some anomalies of the dorsal fin in *Perca fluviatilis*. Absence of the anal fin was ascertained by Schäferna (1939 a) in *Salmo trutta* m. *fario* and Kirka (1958) in *Hucho hucho*, dwarfed anal fin in *Cyprinus carpio* described Dyk (1975). The absence of the caudal fin is described in *Esox lucius* (Anonymus, 1933), in the same species was found also deformed caudal fin (Plehn, 1924). Dyk (1975) described dwarfed caudal fin, too.

Prolonged fins in fishes living in natural conditions were found by Jirásek (1958) in *Leuciscus cephalus*, Frič (1908) in *Leuciscus leuciscus*, Dyk (1942) in *Tinca tinca*, Schäferna (1926 a, 1933/34, 1934) in *Cyprinus carpio* and *Perca fluviatilis* and Plehn (1924) in *Salvelinus fontinalis* (?).

RESULTS AND DISCUSSION

Concerning the specimen of the roach (Rutilus rutilus) studied, its description is as follows:

The total length 275 mm, the standard length 215 mm, the weight 210 g, male. In % of the standard length: the head length 23, the head depth 18, the eye diameter 5, the preorbital distance 9, the postorbital distance 12, the preventral distance 51, the predorsal distance 55, the postdorsal distance 25, the length of the caudal peduncle 11, the depth of the caudal peduncle 11, the minimal depth of the caudal peduncle 10, the depth of the body 33, the maximal width of the body 14, the length of the pectoral fin 18, the depth of the anal fin 15, the depth of the dorsal fin 23, the length of the base of the anal fin 12 and dorsal fin 16. Counts of meristic characters: D 1/11, A 2/11, V 1/8, C 21, P 1 16, l.l. on the right side 45, on the left one 43, above 8 1/2, below 4 scales, around the caudal peduncle 15 scales, on the predorsal distance 18 and postdorsal distance 14 scales. Radiograph of examined roach show lordosis and kyphosis of vertebrae in the caudal peduncle. The back calculated length growth was found as (SL/TL): $l_1 = 42/54$, $l_2 = 68/87$, $l_3 = 99/127$, $l_4 = 143/183$, $l_5 = 161/206$, $l_6 = 176/225$, $l_7 = 196/251$ mm (age 7+).

Comparising the author's growth data with values by Holčík (1961) it is evident that the examined roach grew very rapidly. This fact documented the vertebral *anomaly in the examined specimen had no considerable influence on the growth rate.*

Descriptions of three specimens of the chub (*Leuciscus cephalus*) examined by me are as follows:

Total lengths 175—245 (ave. 204.3) mm, standard lengths 160—207 (ave. 189.0) mm, weights 75—145 (ave. 104.7) g, males. In % of the standard length: the head length 24—25 (ave. 24.5), the preorbital distance 7—8 (ave. 7.7), the postorbital distance 12—13 (ave. 12.3), the eye diameter 5—6 (ave. 5.3), the head depth 16, the head width 13—14 (ave. 13.3), the maximal body depth 25—26 (ave. 25.3), the predorsal distance 51—56 (ave. 54.3), the postdorsal distance 31—38 (ave. 36.3), the preanal distance 68—73 (ave. 71.0), the depth of the caudal peduncle 13—15 (ave. 14.3), the width of the caudal peduncle 8, the length of the caudal peduncle 19—23 (ave. 20.3), the maximum body width 14, the depth of the dorsal fin 19, the depth of the anal fin 15—17 (ave. 16.3), the length of the pectoral fin 18—19 (ave. 18.3), the length of the base of the dorsal fin 10—12 (ave. 10.7), the length of the base of the anal fin 9—11 (ave. 10.3), the interorbital distance 10, the minimum depth of the caudal peduncle 10—11 (ave 10.3). Counts of meristic characters: D 2 9, A 2 9, P 1/13—15 (ave. 13.7), l.l. 45, above 8, below 5. The length growth was found as follows: $l_1 = 35-66$ (ave. 46), $l_2 = 82-92$ (ave. 88), $l_3 = 106-128$ (ave. 116), $l_4 = 139-179$ (ave. 155), $l_5 = 194$ mm of the standard length. This length growth in comparison with the data by Hanel (1982) can be evaluated as the average one. In all specimens examined no basipterygia of ventrals were found.

Description of the dace (*Leuciscus leuciscus*) with one (right) ventral fin is as follows: the total length 194 mm, the standard length 160 mm, the weight 67 g, male. In % of the standard length; the head length 24, the preorbital distance 8, postorbital length 11, the eye diameter 5, the head depth 16, the head width 13, the body depth 24, the predorsal distance 51, the preanal distance 71, the depth of the caudal peduncle 14, the width of the caudal peduncle 7, the length of the caudal peduncle 20, the maximum body width 15, depth of the dorsal fin 19, the depth of the anal fin 18, the length of the pectoral fin 20, length of the ventral fin 12, the length of the base of the dorsal fin 10, the length of the base of the anal fin 10, the interorbital distance 10, the minimal depth of the caudal peduncle 11. Counts of meristic characters: D 3/9, A 2/8, V 1 7, P 1/12, l.l. 46, above 9, below 5. The length growth: $l_1 = 42$, $l_2 = 61$, $l_3 = 126$, $l_4 = 147$ of the standard length. Length growth compared with the data by Hanel (1984) can be evaluated as better than the average ones.

I found small fin anomalies in the perch (*Perca fluviatilis*). In one specimen (the total length 162, the standard length 138 mm, the weight 48 g, female) I found very short second dorsal fin with the formula 1,6 (further specimens caught in the same locality and date had this formula as 1 12—15. In further specimen (the total length 191, the standard length 159 mm, the weight 86 g, male) I found the formula 1/4 in the right ventral fin. In all further specimens examined from the reservoir Slapy this formula was found as 1/5 (see Oliva, Hanel, Šafránek, in print).

In two specimens (total lengths 122—162, standard lengths 102—135 mm, weights 30—44, male and female) I found different lengths of the right and left ventral fin. In the smaller specimen it was 10 and 19%, in the bigger specimen 16 and 19% from standard lengths. All fins were without damage. Average length growth of examined four specimens of the perch was: $l_1 = 41-63$ (ave. 53), $l_2 = 59-79$ (ave 70), $l_3 = 85-105$ (ave. 97), $l_4 = 130-140$ (ave. 135) mm of the standard length. Average length growth compared with the data by Lohniský (1960) and Čihař (1961) was found as worse, but this fact is most likely influenced by the different ecological conditions in the reservoir Slapy.

SUMMARY

Vertebral and fin anomalies in 9 specimens of the roach (*Rutilus rutilus*), the chub (*Leuciscus cephalus*), the dace (*Leuciscus leuciscus*) and the perch (*Perca fluviatilis*) from the reservoir Slapy and its tributary the brook Mastník are described and documented by photos and radiograph. Evident decrease of the length growth in examined cyprinid fishes has not been found, but it appeared in the perch.

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GROWTH OF THE RUFFE (ACERINA CERNUA, PISCES: PERCIFORMES) IN THE ORLÍK RIVERINE LAKE

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Abstract. The first data concerning the growth of the ruffe (*Acerina cernua*) in the riverine lake Orlík 1981 – 1983 are presented. In 1981 139 specimens (I – III age class), in 1982 54 specimens (0 – III age class), in 1983 125 specimens (I – IV age class) were studied, in total, 318 specimens. The weight growth was ascertained in 155 specimens. The value of the so-called Bank's start was 38 mm. For separate age classes the Fulton's index was calculated. The growth rate was compared on the basis of the index of the population growth rate and the population growth intensity. The exponential character of the length growth was confirmed by the Bertalanffy's growth equation.

INTRODUCTION

The ruffe, *Acerina cernua* (Linnaeus, 1758) is a short-aged fish, generally enlisted among the so-called scrab fishes. It does not attain larger sizes, and it is far from being popular among sport anglers. However, it is a sought-for delicacy in the USSR. The growth of the ruffe in the riverine lake Orlík has not yet been studied, but there are data on it from several other localities in Czechoslovakia. In the Pastviny and Slapy valley water reservoirs the growth of the ruffe was studied by Oliva and Vostradovský (1960) and Johal (1980). In another reservoir, Vranov, also by Johal (1980); in the Klíčava by Sanjosé (1984); in the Orava reservoir by Bastl (1965). The growth of the ruffe was studied also in specimens from the South Bohemia artificial ponds (Johal, 1980; Sanjosé, 1984). The same authors studied it also in the rivers Berounka, Dyje (Johal, 1980) and Vltava (Sanjosé, 1984).

Outside Czechoslovakia, data are known from the GDR (lakes in the northern part of the country, Bauch (1953)), from the USSR Svetovidova (1947): the Učinsk reservoir; Vasnecov (1950): Rybinsk reservoir; Tolčanov (1951): the river Kama; Gorjunova (1956): Džezkazgan reservoir; Žukov (1965): the Neman river; the drainage of the Dnieper; Rudenko (1971): lake Demenec; Fedorova and Vetkasov (1974): lake Ilmen; Kolomin (1977): the Nadym river; the Bratsk reservoir, Mamontov (1977). Further data on the ecology of the ruffe are presented in Nikolskij (1954), Pisanko (1964, 1966, 1967), Kobalev (1973), Alexandrova (1974), Buckaja (1976), Kozlova and Panasenko (1977).

MATERIAL AMD METHODS

Specimens for study were seined in the Orlík riverine lake situated on the river Vltava, near the village of Zvíkovské Podhradí in the district of Štědronín, between the 4th and 7th river km of the river Otava. Further data see Závěta (1981).

The hauls were performed during the day, but chiefly in the night, in May and August, 1981, in June and August, 1982, in May and June, 1983. Two hauling nets were used, tow of the length 50 m with meshes of 0.8 × 0.8 cm and 2.0 × 2.0 cm, the depth of the seine being 4 and 6 m, respectively, and another net 100 m long, 6 m deep, with meshes of 1.0 × 1.0 cm.

In 1981 139 specimens, in 1982, 54, in 1983, 125 were seined. In all specimens the length of the body was measured up to the end of the scale cover of the body (longitudo corporis, SL), and scales for age determination were sampled. The total weight was ascertained in a part of the sample. One part of the sample was conserved using 4% formaline solution and the weight of single specimens was ascertained using the correction factor plus 7% according to Lusk and Pokorný (1964).

The age and length growth was determined using the method of Rosa Lee with the correction factor of 19 mm. The weight growth was ascertained according to the method published by Rounsefell and Everhart (1960). The relation between the body length and the weight was evaluated by Fulton's index (K). The length and weight growth was later evaluated by means of the index of the population growth rate and the population growth intensity (Balon, 1964).

RESULTS AND DISCUSSION

The length growth

In 1981, 139 specimens of three age classes were studied. The 1st age class (48.9%) was the most frequent: then followed the second (41%), and the smallest was the third age class (10.1%). The smallest specimen from the first age class measured 75 mm, the longest (110 mm) was enlisted into the third age class.

Results of the length growth are summarized in Table 1. From the results of the back-calculated body lengths in individual years and individual age classes the influence of the Rosa Lee phenomenon is evident. The difference between the value in the first age class and that in the third age class is 8 mm for first years of life. The same phenomenon appears also in the second year of life in the back-calculated values for the length growth.

In 1982, 54 specimens were examined, which belonged to the 0-III age class. The most numerous was the third age class (37%): then followed the second (31.5%), third (22.6%), and the least numerous was the zero age class (9.3%). The smallest specimen in the zero class measured 39 mm, the largest in the third age class 115 mm. Results of the back-calculated length growth are summarized in Table 2.

In 1983, the object of study were 125 specimens of the ruffe, belonging to the 1st to 4th age classes. The most frequent in this sample was the first class (63.2%), followed by the second (28.8%), third (6.4%) and fourth (1.6%). The smallest specimen from the first age class measured 57 mm, the largest from the fourth age class 114 mm. Results of the back-calculated length growth in the year 1983 are given in Table 3. Again, the influence the Rosa Lee phenomenon is evident.

Table 1. The length growth of the ruffe in the Orlík reservoir in 1981

Age class	No.	Body length at the time of capture in mm		Back calculated body lengths in mm		
		average	ranges	l_1	l_2	l_3
I	68	83	75 - 102	55 45 – 70		
II	57	86	75 – 100	54 36 – 76	74 54 – 85	
III	14	93	78 – 110	47 40 – 64	69 52 – 86	83 74 – 103
	139		average	52 36 – 76	72 52 - 86	83 74 – 103

Table 2. The length growth of the ruffe in the Orlik reservoir in 1982

Age class	No.	Body length at the time of capture in mm		Back calculated body lengths in mm		
		average	ranges	l_1	l_2	l_3
0	5	40	39 – 40			
I	12	73	66 – 80	47 43 – 60		
II	17	80	70 – 87	50 43 – 57	72 63 – 82	
III	20	92	80 – 115	49 42 – 59	74 62 – 90	85 73 – 107
	54		average	49 42 – 60	73 62 – 90	85 73 – 107

The comparison of the results of the length growth from back-calculated values is presented in Table 4.

It is evident that in individual years the length growth was fairly stable. This is also confirmed by the values of ranges in the length growth. Out of the three years studied, the largest range at $l_1 = 36$ mm as well as at $l_2 = 34$ mm, appears in 1981. As regards the values for l_3, the largest value of the range is cited for the year 1982, the smallest for 1983. As for l_4 a remarkably small values of the range appears in 1983, only 10 mm; this, among others, confirms the reliability of the method used.

The largest average year increments in the first year of life were found in samples from 1981 and 1983 – 52 mm. In the second year of life the specimens from the year 1982 reached a large increment (24 mm). The smallest increments were observed in specimens from the year 1983 in the second year of life.

Table 3. The length growth of the ruffe in the Orlik reservoir in 1983

Age class	No.	Body length at the time of capture in mm		Back calculated body lengths in mm			
		average	ranges	l_1	l_2	l_3	l_4
I	79	74	57 – 88	57 46 – 71			
II	36	89	75 – 100	51 43 – 67	76 62 – 84		
III	8	100	93 – 106	48 43 – 57	69 61 – 73	89 81 – 95	
IV	2	112	110 – 114	51 46 – 55	63 59 – 67	83 82 – 83	101 96 – 106
	125		average	52 43 – 71	69 59 – 84	86 81 – 95	101 96 – 106

Table 4. The length growth of the ruffe in the Orlík reservoir in 1981 – 1983

Year	No.	Back calculated body lengths in mm			
		l_1	l_2	l_3	l_4
1981	139	52 36 – 76	72 52 – 86	83 74 – 103	
1982	54	49 42 – 60	73 62 – 90	85 73 – 107	
1983	125	52 43 – 71	69 59 – 84	86 81 – 95	101 96 – 106
1981 – 83	318	51 36 – 76	71 52 – 90	85 73 – 107	101 96 – 106

The back-calculated body lengths were used for the construction of the growth equation according to Bertalanffy (Ricker, 1975). According to our data individual parameters of the growth equation were calculated:

$$l_t = L_\infty(1 - e^{-K(t-t_0)})$$

The following coefficients were calculated: t_0 = the hypothetical starting age, K = the growth coefficient, L_∞ = the theoretically attainable maximum length. The back-calculated standard lengths were represented graphically and numerically (from the functional GM regression line of l_{t+1} on l_t using Ford–Walford's methods). Plotting the lengths in t-time (l_t) in the function for one year later (l_{t+1}), the straight line of the intercept by the diagonal line passing through the origin at the angle of 45° gives the theoretically attainable maximum length (L_∞). From our data other parameters of Bertalanffy's growth-model were also determined as well as the starting point of the exponential curve (t_0) and the growth coefficient (K). Re-

Table 5. The weight growth of the ruffe in the Orlík reservoir in 1981 – 1983

Age class.	No.	Body length in mm	Weight at the time of capture in g	Back-calculated body weight in g			
				w_1	w_2	w_3	w_4
0	5	40 39 – 40	1 0.5 – 1.4				
I	85	80 57 – 102	8 4 – 14	3 1 – 7			
II	46	83 66 – 100	11 8 – 19.5	3 1 – 6	7 4 – 11		
III	17	97 78 – 115	14 9 – 25	2 1 – 4	7 4 – 13	12 7 – 23	
IV	2	112 110 – 114	27 25 – 29	2 2 – 3	5 4 – 6	11 10 – 11	19 16 – 22
	155		average	2.5 1 – 7	6.3 4 – 13	11.5 7 – 23	19 16 – 22

Table 6. Comparison of the K values of the ruffe in various localities

Locality	Author	Age groups				
		0	I	II	III	IV
Orlík 1981–83	The author's own data	1.56	1.56	1.92	1.53	1.92
Lake Ubinsk females	Berg, 1949	—	-	1.87	2.01	1.99
males		—	-	1.69	1.86	1.45
23 German lakes	Bauch, 1953	—	2.09	2.62	3.00	1.74
Dnieper river basin	Žukov, 1965	—	2.01	2.09	1.85	1.92
Western Dvina	Penjaz, 1956	—	2.23	2.26	2.28	2.29
Lake Demenee	Rudenko, 1971	—	1.20	1.43	1.57	1.50
Lake Ilmen V. 1972	Fedorova et al., 1974	—	2.07	2.23	1.98	1.97
IX. 1972		—	2.42	2.10	1.94	1.91
Nadym river basin	Kolomin, 1977	—	—	1.86	1.69	2.03
Bratsk reservoir females in 1965	Mamontov, 1977	—	—	1.55	1.74	1.51
males		—	—	1.33	1.58	1.23
Bratsk reservoir females in 1966	Mamontov, 1977	—	—	2.45	2.17	2.39
males		—	—	2.49	2.10	2.14

presenting the exponential growth by the parameters obtained, we got a curve the numerical equations being as follows:

$$\begin{array}{ll} 1981 & l_t = 96\,(1 - e^{-0.598(t + 0.096)}) \\ 1982 & l_t = 97\,(1 - e^{-0.69(t + 0.015)}) \\ 1983 & l_t = 350\,(1 - e^{-0.060(t + 1.669)}) \\ 1981-83 & l_t = 206\,(1 - e^{-0.128(t + 1.243)}) \end{array}$$

The comparison of the values back-calculated from scales and those obtained according to Bertalanffy's model shows deviations of 1–2 mm in different age groups.

The weight growth

In 1981 the weight was ascertained only in 15 specimens. They belonged to the 2nd and 3rd age classes. The minimum weight was found at a ruffe of 75 mm in length in the second age class: 8 grams. The maximum weight was found in a specimen of 95 mm SL — 16 grams; the specimen belonged to the third age class.

In 1982 again only 15 specimens were weighed (age class 0, I, III). The minimum weight (0.5 g) was found in 3 specimens of 39 mm SL, 0 age class. The maximum weight (25 g) in a ruffe of 115 mm SL from the third age class.

In 1983, 125 specimens were weighed (I—IV age class). The minimum weight found was 4 g (57 mm SL, I age class), the maximum weight — 25 g — in a ruffe of 114 mm SL, IV age class.

In 1981—1983, weight was ascertained in 155 specimens. This summarized material included 5 age classes (0-IV). The most numerous was the first age class (85 sp.), then followed the second (46 sp.), the third (17 sp.), the zero age class (with 5 specimens) and, finally, the fourth age class with only 2 specimens. With regard to small numbers of fish in individual years the material was summed up in order to get a clearer idea of the weight growth

The weights of specimens were calculated on the basis of the length-weight relation ascertained for 1980—1983:

$$\log w = -4.74795 + 3.00782 \log l$$

with the value of the correlation coefficient $r = 0.975$.

Table 7. Comparison of the length growth of the ruffe from Czech and foreign localities based on the indexes of the population growth rate and population growth intensity

Locality — autor	φC_{lh1-3}	φC_{lh1-4}	φC_{l1-3}	φC_{l1-4}
Orlík 1981 (the present authors)	13.6	—	26.5	—
Orlík 1982 (the present authors)	15.3	—	32.5	—
Orlík 1983 (the present authors)	15.0	14.6	28.7	25.0
Orlík 1981—1983 (the present authors)	14.9	14.8	29.3	26.0
Slapy near Bučily, 1957 (Oliva and Vostradovský, 1960)	18.8	—	33.5	—
Slapy 1957—58 (Oliva and Vostradovský, 1960)	17.4	11.9	31.9	21.6
Orava reservoir 1964 (Bastl, 1965)	16.4	14.7	44.5	34.7
Vranov reservoir 1957 (Johal, 1980)	15.2	—	29.1	—
Pastviny reservoir 1957 (Oliva and Vostradovský, 1960)	14.8	14.5	29.4	26.7
Klíčava reservoir 1982 (Sanjosé, 1984)	11.1	13.2	20.8	23.4
Pond Máchovo jezero 1951 (Johal, 1980)	16.0	15.6	30.1	25.8
Backwater *Hrad* 1949 (*Johal*, 1980)	14.5	13.1	28.1	23.0
River Berounka near Řevnice 1949 (Johal, 1980)	16.8		31.3	—
River Vltava near Prague 1982 (Sanjosé, 1984)	15.2	14.7	31.6	27.1
River Dyje near Znojmo 1957 (Johal, 1980)	13.7	12.9	25.1	21.4
Bratsk reservoir 1967 females (Mamontov, 1977)	25.2	21.9	79.5	58.7
males	23.2	19.2	66.0	48.5
Džezkazgan reservoir (Gorjunova, 1956)	21.7	17.0	55.0	39.0
Rybinsk reservoir (Vasnecov, 1950)	20.6	21.8	55.5	47.3
Učinsk reservoir (Svetovidova, 1947)	15.6	13.2	39.5	30.3
Lake Sarkomer (Bauch, 1953)	17.3	19.0	33.4	30.6
Average from 23 German lakes (Bauch, 1953)	16.8	18.6	27.0	26.3
Lake Ilmen (Fedorova and Vetkasov, 1974)	15.4	12.9	31.5	24.3
Lake Demenec (Rudenko, 1971)	14.7	13.5	26.5	22.3
River Neman (*Žukov*, 1965)	31.1	—	62.5	—
River Dnieper (Kostjučenko, 1962)	25.5	23.4	71.0	54.0
Dnieper drainage (Žukov, 1965)	25.5	19.2	62.0	44.7
River Western Dvina (Penjaz, 1956)	24.5	25.0	74.5	60.0
River Kama (Tolčanov, 1951)	16.6	—	40.7	—
Odra Estuary (Bauch, 1953)	14.7	12.7	25.3	20.2

The results of the weight growth calculated for the years elapsed are summarized in Table 5. *The value of* Bank's *start is* 38 *mm at the weight* 1 *g* (Bank, 1940).

From the results of the weight and length growths also Fulton's coefficient (K) was ascertained. Its value for single age classes are as follows: 0 = 1.56, I = 1.56, II = 1.92, III = 1.53, IV = 1.92. Values of K fluctuate in relation to age classes. The smallest were observed in the third age class, the largest in the fourth age class.

When we compare the K values with the data of other authors (or with our data compiled from their data on growth and weight) summarized in Table 6, we see that there are *no data given for the 0 age class. In the first age class the largest values* were found in specimens of the ruffe from lake Ilmen (**Fedorova** et al., 1974), the smallest values are from lake Demenec (**Rudenko**, 1971). The values from the Orlík riverine lake can be characterized as average ones.

A similar situation can be registered in other age classes. K values are always higher in females, as it was found by **Mamontov** (1977) and calculated according to the data of **Berg** (1949). The fluctuation of K values is noticeable in all localities cited.

When we evaluate the length growth of the ruffe from the Czechoslovak water bodies, we see that these speciemens reach maximum increments in the Slapy reservoir near Bučily (**Oliva** et **Vostradovský**, 1960), then follows the Orava

Table 8. Comparison of the weight growth of the ruffe according to the index of the population growth rate and the population growth intensity

Locality -- author	φC_{wh1-4}	φC_{w1-4}
Orlík 1981 - 83 (the present authors)	3.96	100.0
Average from 23 German lakes (Bauch, 1953)	6.55	103.7
Lake Demenec (Rudenko, 1971)	3.88	101.1
Lake Ilmen (Fedorova and Vetkasov, 1974)	3.19	82.3
Western Dvina (Penjaz, 1956)	8.94	344.8
Dnieper river basin (Žukov, 1965)	5.63	258.3

riverine lake (Johal, 1980) and the riverine lakes Orlík and Pastviny. The smallest increments in the first year of life were found in the riverine lakes Orava (Bastl, 1965) and Klíčava (Sanjosé, 1984). The maximum increments in the first year of life were attained in the South Bohemian ponds Kaňov, Ženich (Johal, 1980; Sanjosé, 1984). The values of increments range between 51—55 mm. The ruffe grows well also in the rivers Berounka and Dyje, the increments reaching 55 mm (Johal, 1980). In the river Vltava the growth is somewhat slower, in the first year of life, the increment is 48 mm (Sanjosé, 1984).

When we compare the length increments in the first year of life with the data from abroad, the growth in the Orlík riverine lake appears to be quick. The data from the riverine lakes Džezkazgan (Gorjunova, 1956), Bratsk (Mamontov, 1977), Učinsk and Rybinsk (Svetovidova, 1947; Vasnecov, 1950) are always lower. A faster growth is evident only in the North German lakes (Bauch, 1953). Almost the same was found in lake Demenec (Rudenko, 1971) and in lake Ilmen (Fedorova and Vetkasov, 1974).

As regards rivers, the growth in Orlík is comparable with the river Neman (Žukov, 1965), but a slower growth was reported from the river Kama (Tolčanov, 1951) and Dnieper (Kostjučenko, 1962).

The weight growth could be compared only with the data from abroad, because those from the Czech localities are still lacking. A faster growth than in the Orlík riverine lake can be noticed from the Bratsk reservoir, although no data are known from the first years of life (Mamontov, 1977). Similarly a faster weight growth is reported from the North German lakes (Bauch, 1953) and from lake Demenec (Rudenko, 1971). A smaller weight growth in the first year of life is reported only by Žukov (1965), but in the subsequent years the growth is faster than in the Orlík riverine lake.

The growth rate and the size of the upgrowth of the length increments were also evaluated by means of the index of the population growth rate and the population growth intensity. From the indexes cited in Table 7 it is evident, that the largest growth rate in riverine lakes was reported from the Bratsk reservoir, followed by other Soviet reservoirs as cited by Gorjunova (1956) (Džezkazgan), Vasnecov (1950) (Rybinsk). From the reservoirs studied in Czechoslovakia according to this index the fastest growth was found in the Slapy reservoir (Oliva et Vostradovský, 1960), followed by Orava (Bastl, 1965) and Vranov (Johal, 1980). The average growth rate in the Orlík reservoir can be estimated as medium fast as compared with other native localities. The slowest growth according to the index $\varphi C_{lh1-3} = 11.1$ was found in the Klíčava reservoir (Sanjosé, 1984).

From the data of the index of the population growth rate in four years of observation (φC_{lh1-4}) it is evident that the upgrowth of the body length in the last year considered can be recorded also in the values of the index cited. A slow-down of the growth rate was observed in the Slapy reservoir in 1957—1958, but on the contrary, a certain acceleration was noted in the Klíčava reservoir. A relatively fast growth was also found in the artificial pond Máchovo jezero (Johal, 1980) and, similarly, in the natural pond Hrad in Central Bohemia (Johal, l.c.).

From the data of growth in lakes the fast growth in lake Sarkomer (Bauch, 1953) and a relatively slow growth rate in the lake Demenec (Rudenko, 1971) are remarkable. According to calculated indexes a very fast growth can be stated in the river Neman (Žukov, 1965). The growth rate in Czech rivers is comparable with the Kama (Tolčanov, 1951). As to our rivers, the slowest growth was found in the Moravian river Dyje (Johal, 1980).

The index of the population growth intensity also confirms the results discussed above. Again the fastest upgrowth of the body length is reported in females from the Bratsk reservoir (Mamontov, 1977). The growth rate in the Orlík riverine lake 1981—1983 can be evaluated as an average one. A higher intensity of increments is expressed by the size of the index at the Orava reservoir (Bastl, 1965). According to the index cited the growth in the Dnieper (Žukov, 1965) and the Western Dvina is twice as fast as in the Czech and Moravian rivers.

The evaluation of the weight growth was again performed by means of the indexes cited. From the data in Table 8 the growth in the Orlík riverine lake may be evaluated as a medium one. Large values of this index are achieved by the ruffe from the rivers Western Dvina and Dnieper.

Apparently, growth rate of the ruffe is influenced by sufficient food supply and by temperature. From the literature data, however, specification of these factors and their broader evaluation are not feasible.

CONCLUSIONS

1. In the Orlík riverine lake the growth of the ruffe was studied by means of the scale method. The correction for back-calculated body lengths was 19 mm.
2. In 1981, 139 specimens of the I-IIIrd age class, in 1982, 54 specimens from the 0-IIIrd age class, and in 1983, 125 specimens from the I-IVth age class were sampled and their scale structures studied.
3. Results in the length growth show the same growth intensity in the years 1981—1983.
4. The weight growth was studied in 155 specimens of the 0-IVth age class. The results obtained show a stability of the growth. The value of Bank's start is 38 mm at the weight of 1 g.
5. For individual age classes the coefficient of condition (K) was calculated. Its values fluctuated in individual age classes.
6. For the comparison of the rate of the length and weight growths the indexes of the population growth rate and the population growth intensity were used. The above mentioned indexes were calculated for the extend of 1—3 and 1—4 years of the life span of the ruffe.
7. According to the results of both the length growth and the growth of the weight and the indexes evaluating the growth rate, growth of the ruffe from the Orlík reservoir may be evaluated as medium fast.
8. The exponential character of the length growth ascertained according to the body length growth was expressed by Bertalanffy's growth equation.

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NEMATODES OF FRESHWATER FISHES FROM NORTH VIETNAM. PART 2. THELAZIOIDEA, PHYSALOPTEROIDEA AND GNATHOSTOMATOIDEA

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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. Of them, members of the superfamilies Thelazioidea, Physalopteroidea and Gnathostomatoidea are dealt with in the present paper. These include: *Rhabdochona (Rhabdochona) jiangxiensis*, *R. (R.) vietnamensis* sp. n., *R. (R.) hakyi* sp. n., *Rhabdochona (R.)* sp. 1, *Rhabdochona (R.)* sp. 2 juv., *Rhabdochona (Globochonoides) squaliobarbi* sp. n., *R. (G.)* sp. 3 juv., Proleptinae gen. sp. larvae, and *Gnathostoma hispidum* larva. *Rhabdochona vietnamensis* sp. n. from *Cranoglanis sinensis* (type host) and *Rhinogobius hadropterus* is characterized mainly by the presence of basal teeth in the prostom, length of the left spicule (0.405 – 0.450 mm) and shape of its distal tip, number of caudal papillae and by nonfilamented mature eggs in females. *R. (R.) hakyi* sp. n. from *Cranoglanis sinensis* (type host), *Hemibagrus elongatus* and *Gymnostomus lepturus* (young specimens were also recorded from other fish species) is noted for the structure of the prostom, length of the left spicule (0.609 – 0.654 mm) and its character and presence of the fine flock-like coating on mature eggs. *R. (G.) squaliobarbi* sp. n. from *Squaliobarbus curriculus* differs from the only other member of the subgenus in having 6 anterior teeth in the prostom, longer left spicule (0.462 – 0.561 mm) and by the absence of a crown-like formation on the female tail tip. The subgenus *Globochonoides* Moravec, 1975 is newly diagnosed. All the nematodes recorded are briefly described and illustrated and some problems concerning their taxonomy and geographical distribution are discussed.

This paper is a continuation of the authors' earlier work (Moravec and Sey 1988) presenting the results of the systematic evaluation of nematodes obtained by the second author (O. Sey) from 22 fish species during his visit to North Vietnam in 1984. The fishes examined originated from the Red River near Hanoi and were collected in 1960 — 1975. While the first paper (Moravec and Sey 1988) treated the nematodes of the superfamilies Camallanoidea and Habronematoidea, the present paper deals with members of the Thelazioidea, Physalopteroidea and Gnathostomatoidea.

REVIEW OF SPECIES

Fam. Rhabdochonidae (Travassos, Artigas et Pereira, 1928, subfam.)

1. *Rhabdochona (Rhabdochona) jiangxiensis* Wang, Zhao, Wang et Zhang, 1979 (Fig. 1)

Host: *Hemiculter leucisculus* (fam. Cyprinidae)
Localization: intestine.

Description: Medium-sized nematodes with smooth cuticle. Mouth roughly hexagonal. Two fairly large lateral amphids and four small, submedian cephalic papillae present. Prostom funnel-shaped, without basal teeth; anterior margin of prostom armed with 14 teeth. Wall of vestibule including prostom with fine transverse striation. Glandular oesophagus wide, occupying almost whole width of body.

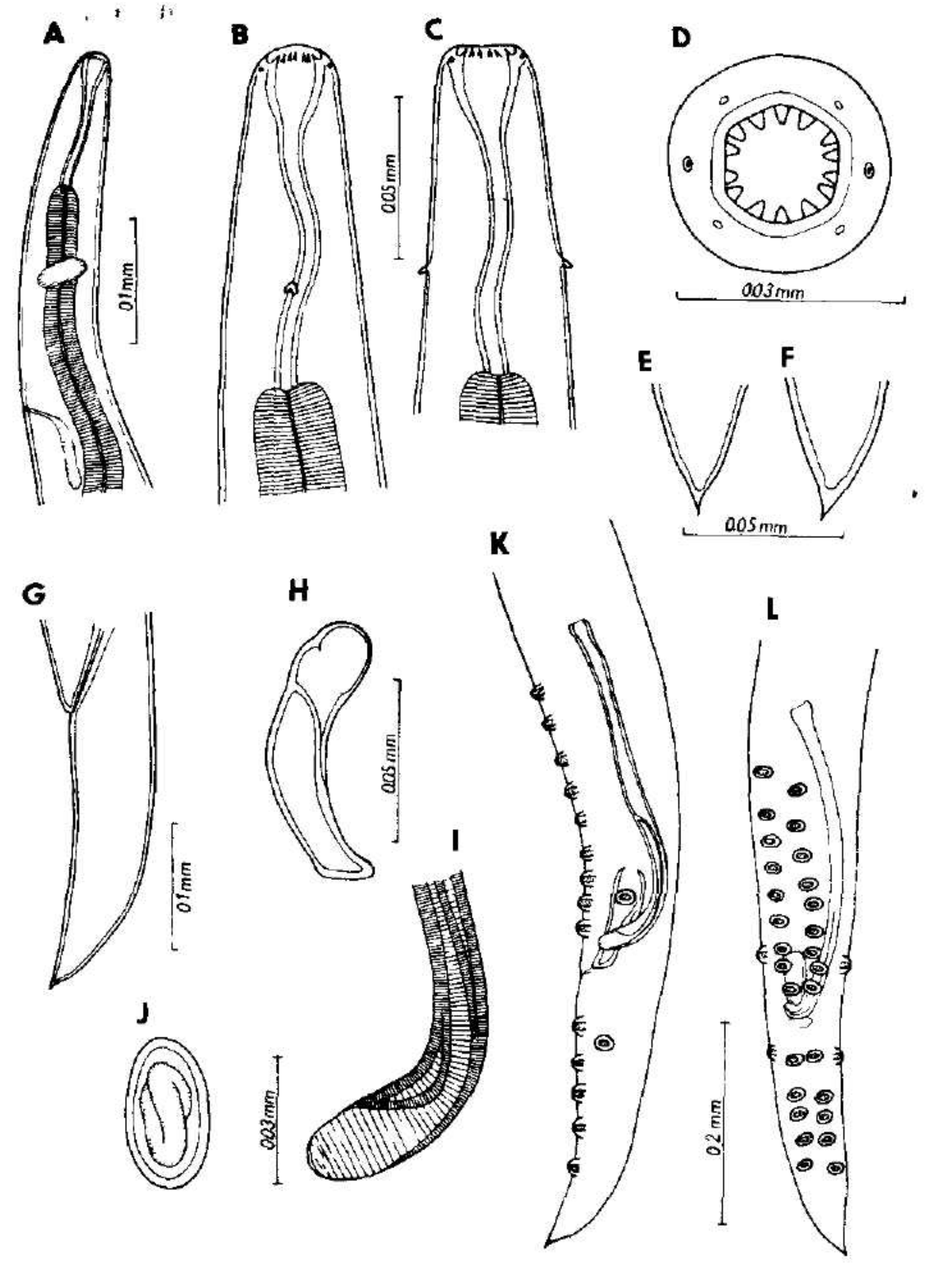


Fig. 1. *Rhabdochona (Rhabdochona) jiangxiensis* Wang, Zhao, Wang et Zhang, 1979. A – anterior end of gravid female; B – D – head end of gravid female, lateral, dorsoventral and apical views; E – tip of male tail; F – tip of female tail; G – female tail. H – small spicule; I – distal tip of large spicule; J – mature egg. K, L – tail of male lateral and ventral views.

medium-sized deirids bifurcate, situated slightly posterior to mid-length of vestibule. Tail of both sexes ending in sharp cuticular spike.

Male (3 specimens): Length of body 3.81—5.89, maximum width 0.150—0.177. Prostom 0.021—0.024 long and 0.015—0.018 wide. Length of vestibule including prostom 0.099—0.123, of muscular oesophagus 0.240—0.318, of glandular oesophagus 1.12—1.93. Nerve ring 0.147—0.183, excretory pore 0.216—0.294, and deirids 0.066—0.075 from anterior extremity. Subventral preanal papillae occurred in following combinations: 8 + 8, 9 + 9, and 9 + 10. Additional pair of lateral preanal papillae situated between second and third (counting from cloacal opening) subventral pairs. Postanal papillae: 6 pairs present, second pair lateral, remaining subventral. Left (large) spicule 0.360—0.399 long, length of its shaft 0.195—0.225, representing 54% of whole spicule length; distal tip provided with wide, rounded cuticular membrane. Right (small) spicule 0.111—0.117 long, with dorsal barb only slightly outlined. Length ratio of spicules 1 : 3.08—3.59. Tail conical, 0.267—0.348 long, with sharp cuticular spike at tip.

Female (10 specimens): Length of body of gravid females 4.83—7.93, width 0.190—0.204. Prostom 0.024 long and 0.018 wide. Length of vestibule including prostom 0.102—0.117, of muscular oesophagus 0.180—0.375, of glandular oesophagus 1.63—1.84. Distance of nerve ring 0.120—0.186, of excretory pore 0.180—0.306, of deirids 0.078—0.081. Tail conical, 0.150—0.231 long, with sharp terminal cuticular spike. Vulva postequatorial, 2.00—3.94 from posterior end of body. Muscular vagina directed posteriorly. Uterus reaching anteriorly to end of glandular oesophagus, posteriorly nearly to rectum. Size of mature (larvated) eggs 0.039—0.045 × 0.021—0.024; surface of these eggs smooth.

Comments: — In 1979, Wang et al. (1979) described a new species, *R. jiangxiensis* from *Hemiculter leucisculus* from China; the original description is rather incomplete. Our specimens are noted for somewhat smaller measurements, but in all main features they are in accordance with the description of this species. Since our specimens have originated from the same host species from the near-by geographical region, we consider them to be conspecific with *R. jiangxiensis*.

The morphology of *R. jiangxiensis* is very close to that of *R. longispicula* Belouss, 1965 (see Moravec 1975); but in contrast to the latter, *R. jiangxiensis* is characterized by the substantially smaller length of the left spicule (0.28—0.40 mm versus 0.56—0.80 mm), somewhat different structure of the distal tip of this spicule, length of the shaft exceeding a half of the left spicule length, by different length ratio of spicules (1 : 3.1—3.6 against 1 : 3.7—5.1 in *R. longispicula*) and usually by a somewhat greater number of subventral preanal papillae in the male (8—10 pairs versus 6—8 pairs).

R. longispicula is reported by Belouss (1952, 1965) and Roytman (1963) from several fish species, including *Hemiculter leucisculus*, from the Soviet Far East; but it cannot be excluded that the nematodes from *H. leucisculus* belonged, in the fact, to *R. jiangxiensis*. According to Moravec (1975), *R. longispicula* is largely bound on fishes of the genus *Erythroculter*, this being also confirmed by the records of this species from China (Wang et al. 1979). In the literature, another species, *R. denudata* (Dujardin, 1845), has also been reported from *Hemiculter leucisculus* from the Far East (see Dogel and Akhmerov 1959, Wang 1976) but these records need verification.

2. *Rhabdochona (Rhabdochona) vietnamensis* sp. n. (Fig. 2)

Hosts: *Cranoglanis sinensis* (type host) (fam. Bagridae) and *Rhinogobius hadropterus* (fam. Gobiidae).

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 N — 204 (holotype, allotype and paratypes).

Description: Medium-sized nematodes with smooth cuticle. Prostom funnel-shaped, thick-walled, with distinct basal teeth; anterior margin of prostom armed with 14 teeth. Wall of vestibule including prostom with dense fine transverse striation. Glandular oesophagus wide, occupying almost whole width of body. Medium-sized

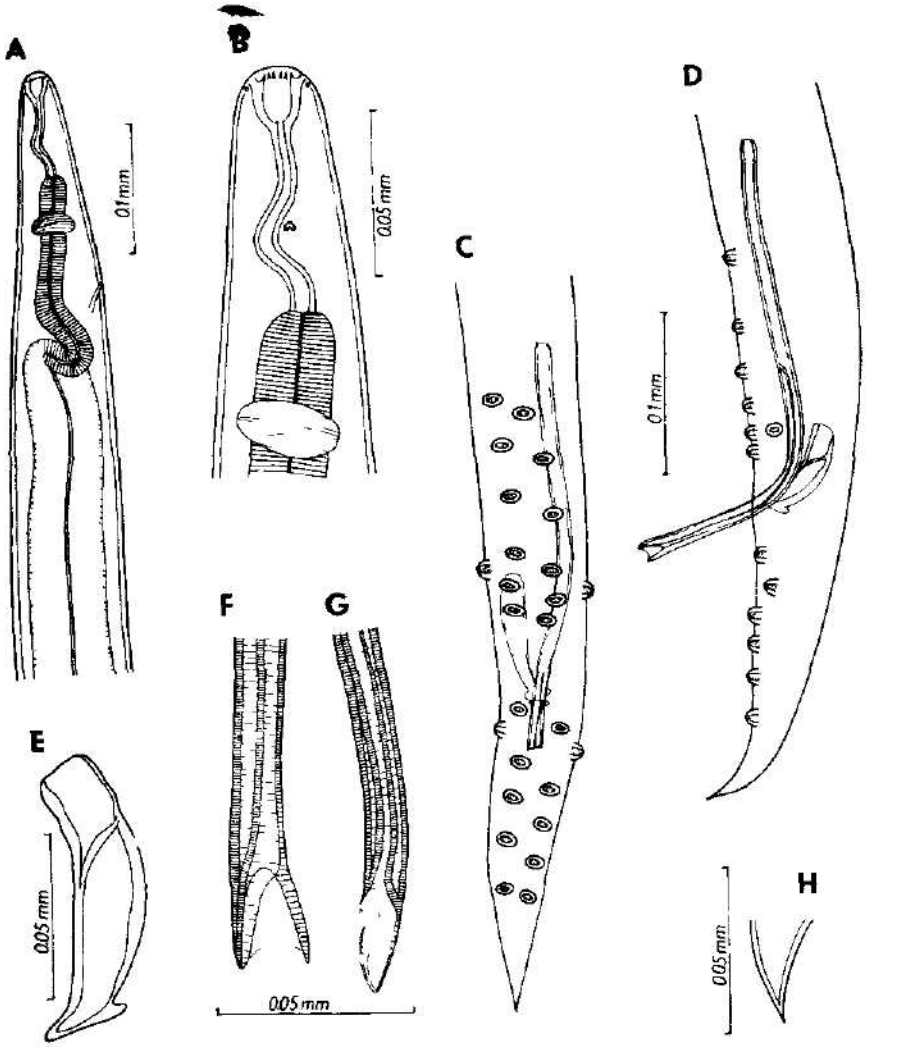


Fig. 2. *Rhabdochona (Rhabdochona) vietnamensis* sp. n. from *Cranoglanis sinensis*. A — anterior end of male; B — head end of male; C, D — tail of male, ventral and lateral views; E — small spicule; F, G — distal tip of large spicule, H — tail tip of male.

deirids bifurcate, situated slightly posterior to mid-length of vestibule. Tail of both sexes ending in sharp cuticular spike.

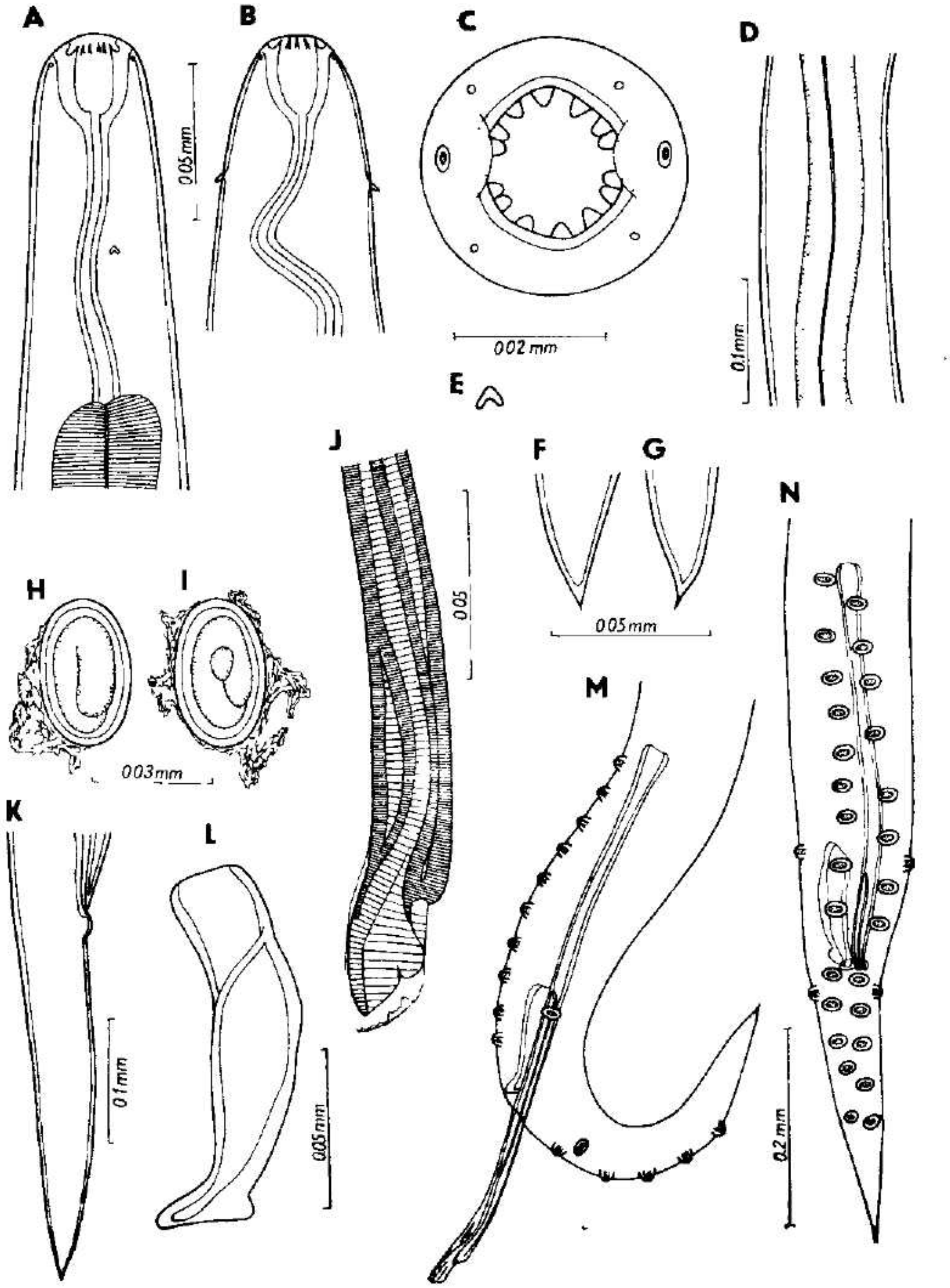
Male (4 specimens from *C. sinensis*; measurements of holotype in brackets): Length of body 3.40—5.22 (5.22), maximum width 0.082—0.136 (0.136). Prostom 0.021—0.024 (0.024) long and 0.018 (0.018) wide. Length of vestibule including prostom 0.054—0.084 (0.082), of muscular oesophagus 0.132—0.240 (0.219), of glandular oesophagus 0.99—1.43 (1.43); width of glandular oesophagus 0.069—0.096 (0.090). Nerve ring 0.093—0.147 (0.141), excretory pore 0.129—0.180 (0.180), and deirids 0.030—0.060 (0.042). Subventral preanal papillae occurred in combinations 5 + 6 or 6 + 6 (6 + 6). Additional pair of lateral preanal papillae situated between second and third (counting from cloacal opening) subventral pairs. Postanal papillae 6 (6) pairs present, second pair lateral, remaining subventral. Left (large) spicule 0.405—0.450 (0.450) long, length of its shaft 0.165—0.210, representing 41—47% of whole spicule length; distal tip provided with marked spicular cover with cuticular membrane; spicule tip appearing sometimes as being bifurcated. Right (small) spicule 0.084—0.099 (0.099) long, with well developed dorsal barb. Length ratio of spicules 1 : 4.1—4.8 (1 : 4.6). Tail conical, 0.252—0.291 (0.291) long, with sharp cuticular spike at tip

Female (9 specimens from *R. hadropterus*; measurements of allotype in brackets): Length of body of gravid females 6.53—10.20 (10.20), width 0.109—0.150 (0.150). Prostom 0.024—0.027 (0.027) long and 0.021—0.024 (0.024) wide. Length of vestibule including prostom 0.111—0.114 (0.111), of muscular oesophagus 0.324—0.345 (0.345), of glandular oesophagus 1.33—1.63 (1.63); width of glandular oesophagus 0.087—0.090 (0.090). Distance of nerve ring 0.168—0.180 (0.180), of excretory pore 0.228—0.324 (0.324), of deirids 0.087 (0.087). Tail conical, 0.240—0.279 (0.279) long, with sharp terminal cuticular spike. Vulva postequatorial, 2.34—4.83 (4.83) from posterior end of body. Muscular vagina directed anteriorly. Size of mature (larvated) eggs 0.039—0.042 × 0.021—0.024 (0.039—0.042 × 0.024), width of their wall 0.003; surface of these eggs smooth

Comments: Altogether 5 males and 49 juvenile females from *C. sinensis* and male, 9 gravid females and 30 juvenile females from *R. hadropterus* were obtained. The single male from the latter host species was 5.48 mm long and its left and right spicules measured 0.399 mm (shaft 0.201 mm) and 0.090 mm, respectively; in contrast to the males from *C. sinensis*, this specimen possessed 7 subventral preanal papillae on one side and 8 papillae on the other side of body which can be considered as intraspecific variability.

At present the genus *Rhabdochona* includes a total of 81 species (see Moravec and Coy Otero 1987 and Wang 1986). If the species belonging to the subgenus *Rhabdochona* in the conception of Moravec (1975) are taken into account, and namely the species of the morphological group noted for the presence of nonfilamented eggs, then *R. vietnamensis* sp. n. appears to be most similar to the palaearctic species *R. denudata* (Dujardin, 1845), *R. longispicula* Belouss, 1965, *R. phoxini* Moravec, 1968, *R. synechogobii* Wang, 1976, *R. jiangxiensis* Wang, Zhao, Wang et Zhang, 1979, *R. nemacheili* Wang, 1986, and *R. fujianensis* Wang, 1986; other species belonging

Fig. 3 *Rhabdochona (Rhabdochona) hakyi* sp. n. from *Cranoglanis sinensis*. A—C — head end of gravid female, lateral, dorsoventral and apical views; D — region of glandular oesophagus of young female; E — deirid; F — tail tip of female, G — tail tip of male H, I — mature egg, J — distal tip of large spicule, K — tail of female, L — small spicule, M, N — posterior end of male, lateral and ventral views.


A
B
C
D
0.05 mm
0.02 mm
0.1 mm
E
J
F
G
N
0.05
0.05 mm
H
I
M
0.03 mm
K
L
0.1 mm
0.05 mm
0.2 mm

to this morphological group differ markedly in the size of the left spicule, number of anterior teeth in the prostom, conspicuously large deirids and some other features. From *R. denudata* and *R. phoxini R. vietnamensis* sp. n. markedly differs in the shape of the distal tip of the left spicule, absence of the gelatinous coating on eggs, and in the shape of the prostom which is distincly more elongate in the two first named species. From *R. synechogobii* it can be distinguished by the shape of the female tail tip which is rounded, without a cuticular spike, in *R. synechogobii*. *R. longispicula* differs from *R. vietnamensis* sp. n. by the absence of basal teeth in the prostom, by conspicuously longer left spicule and by a different shape of the distal tip of this spicule, whereas *R. jiangxiensis* can be distinguished from *R. vietnamensis* sp. n. by the absence of basal teeth in the prostom, relatively longer shaft of the left spicule exceeding a half of the whole length of this spicule, by the shape of the distal end of the left spicule and usually also by less numerous subventral preanal papillae in the male (5–6 pairs, exceptionally up to 8 pairs, versus 8–10 pairs in *R. jiangxiensis*). In contrast to *R. vietnamensis* sp. n., *R. nemacheili* does not possess basal teeth in the prostom, while *R. fujianensis* can be distinguished mainly by the absence of a dorsal barb on the right spicule.

Cranoglanis sinensis has been established as the type host of this species, because more males were obtained from this host; this new *Rhabdochona* species can be diagnosed on the basis of males. It appears, however, that the primary host of *R. vietnamensis* sp. n. is *Rhinogobius hadropterus* in which also gravid females of this nematode were found, whereas *C. sinensis* is probably only the so called postcyclic host.

3. *Rhabdochona (Rhabdochona) hakyi* sp. n. (Fig. 3)

Hosts: *Cranoglanis sinensis* (type host) (fam. Bagridae), *Hemibagrus elongatus* (Bagridae) and *Gymnostomus lepturus* (Cyprinidae); nongravid and juvenile females also in *Arius sinensis* (Ariidae), *Bagarius bagarius* (Sisoridae), and *Rhinogobius hadropterus* (Gobiidae).

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. N – 203 (holotype, allotype and paratypes).

Description: Medium-sized nematodes with smooth cuticle. Mouth roughly hexagonal. Two fairly large lateral amphids and four small, submedian cephalic papillae present. Prostom oval-shaped, thick-walled, with distinct basal teeth; anterior margin of prostom armed with 14 teeth. Wall of vestibule including prostom with fine transverse striation. Medium-sized deirids bifurcate, located near mid-length of vestibule or anterior to it. Tail of both sexes ending in sharp cuticular spike.

Male (5 specimens; measurements of holotype in brackets): Length of body 6.66–9.79 (9.79), maximum width 0.109–0.163 (0.163). Prostom 0.024–0.030 (0.030) long and 0.021–0.027 (0.024) wide. Length of vestibule including prostom 0.126–0.156 (0.153), of muscular oesophagus 0.294–0.465 (0.438), of glandular oesophagus 1.33–2.08 (1.79); width of glandular oesophagus 0.045–0.054 (0.054). Nerve ring 0.174–0.233 (0.201), excretory pore 0.225–0.285 (0.273) from anterior extremity. Subventral preanal papillae occurred in following combinations: 8 + 9 and 9 + 10 (9 + 10). Additional pair of lateral preanal papillae situated between second and third (counting from cloacal opening) subventral pairs. Postanal papillae: 6 (6) pairs present, second pair lateral, remaining subventral. Left (large) spicule 0.609–0.654 (0.654) long, length of its shaft 0.300–0.345 (0.300), representing

Table 1. Comparison of measurements of ***Rhabdochona hakyi*** sp. n. **from five species of host fishes**

	Cranoglanis sinensis		*Hemibagrus elongatus*		*Gymnostomus lepturus*		*Arius arius*	*Bagarius bagarius*
	♂♂	♀♀	♂	♀	♂♂	♀♀	♀♀ nongr.	♀ nongr.
Length of body	9.41 – 9.79	8.75 – 16.02	6.66	13.17	8.05 – 8.73	11.48 – 17.97	8.70 – 9.38	9.97
Width of body	0.163	0.163 – 0.245	0.136	0.177	0.109 – 0.122	0.150 – 0.177	0.150 – 0.177	0.163
Length of prostom	0.030	0.030 – 0.033	0.027	0.033	0.024 – 0.027	0.030 – 0.036	0.024 – 0.027	0.024
Width of prostom	0.027	0.021 – 0.027	0.024	0.030	0.021 – 0.024	0.024 – 0.027	0.018 – 0.021	0.021
Length of vestibule including prostom	0.126 – 0.153	0.099 – 0.180	0.150	0.153	0.138 – 0.156	0.147 – 0.186	0.171	0.168
Muscular eosophagus	0.351 – 0.438	0.300 – 0.555	0.294	0.462	0.375 – 0.465	0.513 – 0.525	0.471	0.567
Glandular oesophagus	1.47 – 1.80	1.22 – 2.15	1.33	1.50	1.66 – 2.08	1.67 – 2.11	1.5	1.92
Distance of nerve ring	0.174 – 0.201	0.183 – 0.252	0.233	0.210	0.180 – 0.201	0.210 – 0.233	0.261	0.231
Distance of exer. pore	0.243 – 0.273	0.231 – 0.300	?	?	0.225 – 0.285	0.312 – 0.330	0.390	0.360
Distance of deirids	0.666	0.075 – 0.087	0.066	0.069	0.069 – 0.087	0.081 – 0.087	?	?
Length of tail	0.339 – 0.360	0.231 – 0.285	0.315	0.270	0.396 – 0.450	0.204 – 0.381	0.189 – 0.231	0.219
Left spicule	0.654		0.420 (fragment)	—	0.606	—	—	—
Right spicule	0.132 – 0.135	—	0.150	—	0.129 – 0.135	—	—	—
Length of eggs	—	0.039 – 0.042	—	immature	—	0.036 – 0.042	—	—
Width of eggs	—	0.021 – 0.024	—	—	—	0.021 – 0.24	—	—
Distance of vulva from posterior end	—	4.26 – 6.87	—	5.49	—	4.68 – 8.02	2.99 – 4.01	3.73

46–49 (46) % of whole spicule length; distal tip lanceolate, of rather complicated structure, provided with small cuticular membrane. Right (small) spicule 0.129–0.150 (0.132) long, with well developed dorsal barb. Length ratio of spicules 1 : 4.5–5.0 (1 : 5.0). Tail conical, 0.315–0.450 (0.339) long, with sharp cuticular spike at tip.

Female (9 specimens; measurements of allotype in brackets): Length of gravid female 8.75–17.97 (8.75), maximum width 0.163–0.245 (0.163). Prostom 0.030–0.036 (0.030) long and 0.021–0.030 (0.024) wide. Length of vestibule including prostom 0.099–0.186 (0.132), of muscular oesophagus 0.300–0.525 (0.300), of glandular oesophagus 1.22–2.15 (1.22); width of glandular oesophagus 0.063–0.075 (0.063). Distance of nerve ring 0.195–0.252 (0.195), of excretory pore 0.210–0.300 (0.261), of deirids 0.069–0.087 (0.075). Tail conical, 0.204–0.381 (0.231) long, with sharp terminal cuticular spike. Vulva postequatorial, 4.26–8.02 from posterior end of body. Muscular vagina directed posteriorly. Size of mature (larvated) eggs 0.036–0.042 × 0.021–0.024 (0.039–0.042 × 0.021–0.024), their wall 0.003 (0.003) thick; surface of mature eggs provided with very fine, irregular, flock-like coating.

Comments: — Altogether 3 mature males and 3 juvenile males undergoing the last moult (body length 4.86–8.70 mm, width 0.082–0.150 mm, length of left spicule 0.525–0.609 mm, of right spicule 0.120–0.126 mm), and 8 gravid and 28 juvenile females were obtained from *C. sinensis*, 1 male and 13 young females (one of them with immature eggs) from *H. elongatus*, 25 nongravid and juvenile females from *A. sinensis*, 1 nongravid female from *B. bagarius*, 2 mature and 4 immature males and 2 gravid and 7 juvenile females from *C. lepturus*, and 10 juvenile females from *R. hadropterus*. A relatively high percentage of juvenile forms from siluriform fishes suggests that the cyprinid *Gymnostomus lepturus* is probably the obligate host for this nematode species, whereas the catfishes and other fish species are only its facultative (paradefinitive or postcyclic) hosts.

It has been mentioned with the feroging species that the genus *Rhabdochona* includes 81 species at the present time. Of them, by the size of spicules, structure of the head end, shape of the tail and the character of eggs, *R. hakyi* sp. n. is most similar to the palaearctic species *R. oreini* Hsü, 1933, *R. tridentigeris* Yamaguti, 1941, *R. longispicula* Bellous, 1965, *R. wuyensis* Wang, 1981, and *R. fujianensis* Wang, 1986, all these being described from freshwater fishes from eastern Asia (Japan, China, USSR). In contrast to *R. hakyi* sp. n., *R. oreini* and *R. tridentigeris* are characterized by more numerous lateral preanal papillae in the male (2–3 pairs versus 1 pair in *R. hakyi* sp. n.) and different numbers (8 or 12 against 14) of anterior teeth in the prostom. *R. hakyi* sp. n. differs from *R. longispicula* mainly in the presence of basal teeth in the prostom, a distinctly shorter glandular oesophagus (1.2–2.2 mm against 3.1–5.2 mm) and by the shape of the distal tip of the left spicule (see Moravec 1975); from *R. fujianensis* it differs in possessing a dorsal barb on the right spicule. In none of the four named species the mature eggs are provided with irregular gelatinous coatings as in *R. hakyi* sp. n.

Due to the insufficient description of *R. wuyensis* and because the type specimens of this species were not provided to study, a comparison of this species with *R. hakyi* sp. n. is rather problematic. In comparison with *R. hakyi* sp. n., *R. wuyensis* is characterized by smaller body measurements (length of males 5.3 mm, that of nongravid females 4.0–4.2 mm) and, according to the original drawing of the male, by a relatively longer shaft of the left spicule, representing 59% of the whole spicule length, this being only 46–49% in *R. hakyi* sp. n. A dorsal barb is lacking on the right spicule of *R. wuyensis*, while it is well developed on that of *R. hakyi* sp. n. From both the foregoing species (*R. jiangxiensis* and *R. vietnamensis* sp. n.), *R. hakyi* sp. n.

distincly differs in possessing a conspicuously longer left spicule with different structure of its distal tip, by the narrower glandular oesophagus, by far not filling up the whole width of the body as in these two species, by greater body measurements, and from *R. jiangxiensis* also by the presence of basal teeth in the prostom.
Etymology: This species has been named in honour of Dr. Ha Ky, Hanoi, Vietnam, who contributed greatly to the knowledge of helminths parasitizing North Vietnamese freshwater fishes.

4. *Rhabdochona (Rhabdochona)* sp. 1

Host: *Squaliobarbus curriculus* (fam. Cyprinidae).
Localization: intestine.

Description of female (2 specimens): Body length of gravid females 5.06—5.80, width 0.109—0.190. Prostom funnel-shaped, 0.018—0.027 long and 0.012—0.021 wide, without basal teeth; anterior teeth 14 in number. Vestibule including prostom 0.081—0.105 long; length of muscular oesophagus 0.147—0.270, of glandular oesophagus 1.42—2.11; width of latter 0.069—0.150. Nerve ring 0.120—0.165, excretory pore 0.192—0.240, and bifurcate deirids 0.039 from anterior end of body. Tail conical, 0.150—0.324 long, with sharp cuticular spike at tip. Vulva 2.11—2.72 from posterior extremity. Mature eggs smooth, size 0.039—0.042 × 0.021—0.024.
Comments: By their morphology, these nematodes are very similar to *R. jiangxiensis* and probably belong to this species. However, since no males were available in our material, we are designating them as *Rhabdochona* sp. only.

5. *Rhabdochona (Rhabdochona)* sp. 2 juv.

Host: *Megalobrama terminalis* and *Cirrhina molitorella* (fam. Cyprinidae).
Localization: intestine.

Comments: Forty juvenile nematode specimens, representing probably the fourth-stage larvae and very young females, were recovered from this fish host. The length of the body of these nematodes was 3.71—5.78 mm, their maximum width 0.122—0.176 mm; their prostom was always with basal teeth, the glandular oesophagus occupied the whole width of the body and the tail was conical, with a sharp cuticular spike at its tip.

These nematodes are probably conspecific with *R. vietnamensis* sp. n. or *R. jiangxiensis*. It may well be that *Megalobrama terminalis* is an unsuitable host for these nematodes in which they cannot attain maturity. Additional two specimens (gravid female and male fourth — stage larva) of same type were recorded from *C. molitorella*.

6. *Rhabdochona (Globochonoides) squaliobarbus* sp. n. (Fig. 4)

Host: *Squaliobarbus curriculus* (fam. Cyprinidae).
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. N - 205 (holotype, allotype and paratypes).

Description: Medium-sized nematodes with fine transverse striation of cuticle. Wide lateral alae present, extending approximately from nerve ring level up to anterior part of tail in females and to preanal papillae level in males, being widest in postoesophageal region. Mounth approximately of hexagonal shape. Two fairly large lateral amphids and four small, submedian cephalic papillae present. Rim of oral opening appearing to bear additional six minute papillae. Prostom small, barrel-

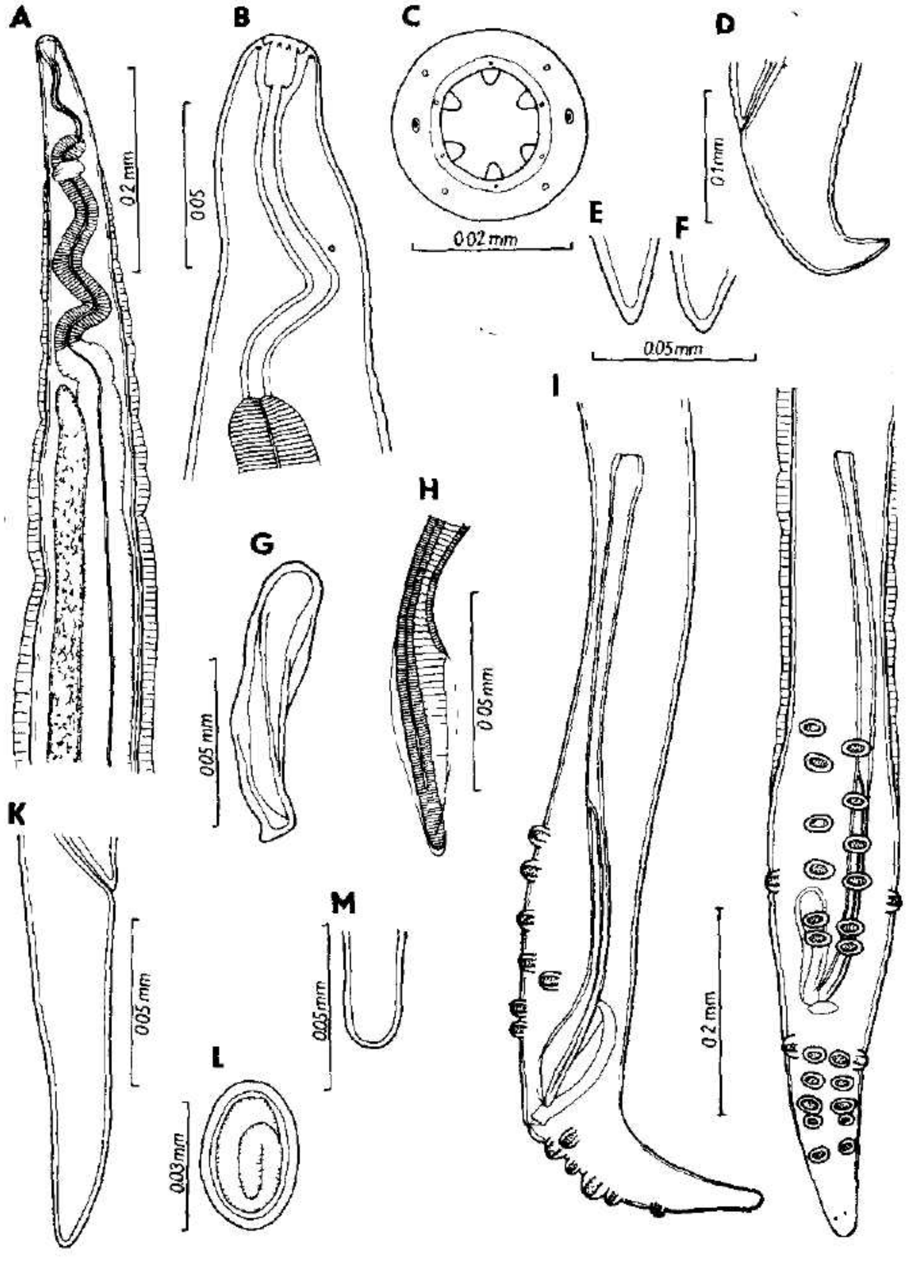


Fig. 4. *Rhabdochona (Globochonoides) squaliobarbi* sp. n. A — anterior end of gravid female, dorsal view, B, C — head end of female, lateral and apical view; D — tail of gravid female, E, F — tail tip of female; G — small spicule; H — distal tip of large spicule, I, J — posterior end of male, lateral and ventral views; K — tail of young female; L — mature egg; M — tail tip of male.

-shaped, with distinct basal teeth; 6 anterior teeth of equal size present, of which 4 (2 + 2) lateral, 1 dorsal, and 1 ventral. Vestibule relatively long. Minute deirids simple, located approximately at mid-length of vestibule.

Male (5 specimens; measurements of holotype in brackets): Length of body 3.40—5.20 (5.07), maximum width 0.068—0.122 (0.109). Maximum width of lateral allae 0.016—0.024 (0.021). Prostom measuring 0.015—0.018 (0.018) in length and 0.009—0.015 (0.012) in width. Vestibule including prostom 0.087—0.132 (0.099) long, muscular oesophagus 0.147—0.201 (0.189), glandular oesophagus 0.467—0.748 (0.721). Distance of deirids from anterior extremity 0.060—0.087 (0.072), of nerve ring 0.108—0.168 (0.147), of excretory pore 0.186—0.233 (0.201). Preanal papillae: 6 pairs of subventral and 1 pair of lateral papillae; latter papillae located between second and third subventral pairs (counting from cloaca). Of 6 pairs of postanal papillae, 5 pairs subventral and 1 pair lateral located at level of first subventral pair; third subventral pair distinctly larger than those of remaining pairs. Area rugosa absent. Left (large) spicule 0.462—0.561 (0.543) long, length of its shaft 0.240—0.291 (0.279), representing 49—57 (51) % of whole spicule length; distal tip of this spicule ventrally distended. Right (small) spicule measuring 0.090—0.114 (0.114), with barbed distal end. Length ratio of spicules 1 : 4.8—6.2 (1:4.8). Tail conical, 0.114—0.195 (0.135) long, with rounded tip.

Female (6 specimens; measurements of allotype in brackets). Body of gravid female 5.26—10.91 (10.91), maximum width 0.082—0.177 (0.177). Maximum width of lateral alla 0.018—0.033 (0.030). Prostom 0.018—0.021 (0.021) long and 0.015—0.018 (0.018) wide. Length of vestibule including prostom 0.096—0.120 (0.114), of muscular oesophagus 0.159—0.213 (0.213), of glandular oesophagus in allotype (0.748); major part of glandular oesophagus overlapped by greatly developed anterior ovary and, therefore, ill-visible. Deirids situated 0.057—0.069 (0.069) from anterior extremity, distance of nerve ring 0.141—0.177 (0.177), of excretory pore 0.201 (—) in specimen with body length 9.17. Tail conical, 0.105—0.171 (0.171) long, its tip bluntly conical, without any processes. Vulva postequatorial, 2.46—5.77 (5.77) from posterior extremity. Vagina muscular, directed posteriorly, forming distinct ovijector. Uterus amphidelphic, containing very numerous eggs, occupying mostly whole width of body. Anterior ovary reaching level of anterior end of glandular oesophagus. Mature (larvated) eggs oval, smooth, without filaments or floats; their size 0.039—0.045 × × 0.021—0.029 (0.039—0.042 × 0.024—0.029); egg wall 0.003 (0.003) thick.

Comments: — The morphology of this species is very similar to that of *R. coronacauda* Belouss, 1965, which was the only member of the subgenus *Globochonoides* Moravec, 1975. *R. coronacauda* was originally described by Belouss (1965) from several species of cyprinids and some other fish species (*Erythroculter, Culter, Parabramis, Hemibarbus, Leuciscus, Salmo, Hypomesus, Esox*) from the Soviet Far East (Primorsk Territory); later Moravec et al. (1981) found this species in *Opsariichthys uncirostris* in Japan (Honshu) and carried out its redescription based on this new material. Undoubtedly, also the nematodes from *Erythroculter mongolicus, Parabramis pekinensis* and *Culter erythropterus* reported erroneously as *R. chodukini* Osmanov, 1957 from China (see Chen 1973) belonged to *R. coronacauda*; it is indicated by both the morphology and measurements of these nematodes (*R. chodukini* differs from *R. coronacauda* in many important features — see Moravec 1975) and their hosts, because all the three named species of fishes are known to be the hosts of *R. coronacauda* in the USSR (Belouss 1965).

In spite of a considerable similarity of *R. squaliobarbi* sp. n. to *R. coronacauda*, particularly as to the structure of the head end of body, presence of lateral allae, structure of spicules and the number, type and distribution of caudal papillae in the male, there are striking differences between them, making it necessary to consider the nematodes from *Squaliobarbus curriculus* an independent species. *R. squaliobarbi* sp. n. markedly differs from *R. coronacauda* in the absence of a crown-like formation at the female tail tip, the substantially longer left spicule (0.46—0.56 mm versus 0.30—0.32 mm), and the greater size of the body, this being remarkable especially in gravid females (5.3—10.9 mm versus 5.6—6.0 mm in *R. coronacauda*). Interspecific differences probably exist also in the numbers of anterior teeth in the prostom: Moravec et al. (1981) reported 8 teeth in the Japanese specimens of *R. coronacauda*, whereas there are 6 teeth present in *R. squaliobarbi* sp. n.; but only 6 teeth were also found in the prostom of the *R. coronacauda* specimens from China (erroneously assigned to *R. chodukini* — see the foregoing text) (see Chen 1973, Pl. CX, Fig. 19). Therefore in order that the significance of this feature might be judged, it would be desirable to study up more numerous materials of both these species, preferably with the use of the scanning electron microscopy.

Etymology. The specific name of *R. squaliobarbi* sp. n. is derived from the generic name of its fish host (*Squaliobarbus*).

The general morphology of *R. squaliobarbi* sp. n. corresponds to the diagnosis of the subgenus *Globochonoides* Moravec, 1975, the only exception being a somewhat smaller number of anterior teeth in the prostom. From these reason we suggest to modify the subgeneric diagnosis as follows:

Subgenus *Globochonoides* Moravec, 1975

Diagnosis: *Rhabdochona*; prostom provided with 6 or 8 anterior teeth; basal teeth present; wide lateral allae starting below deirids and extending along almost whole body length; deirids simple, weakly developed; female tail tip bluntly conical to rounded, with or without a crown of minute tooth-like processes; male tail rounded; mature eggs smooth.

Type species: *R. (G.) coronacauda* Belouss, 1965

7. *Rhabdochona (Globochonoides)* sp. 3 juv.

Host: *Megalobrama terminalis* (fam. Cyprinidae).
Localization: intestine.

Comments: — Six juvenile specimens of this subgenus were found in *M. terminalis* in a mixed infection with *Rhabdochona* sp. 2; their morphology was distinctly different from that of the latter species. Their body was only 1.84—2.01 mm long and 0.054 mm wide. Two very narrow lateral allae extended along the body. The prostom was indistinct. The tail tip was rounded, only in one specimen (probably the third-stage larva) it was provided by several minute mucrons.

It is possible that these nematodes belong to *R. squaliobarbi* sp. n. *M. terminalis* is apparently an unsuitable host for this species and, therefore, the nematodes cannot mature in it.

Fam. Physalopteridae (Railliet, 1893, subfam.) Leiper, 1908

8. Proleptinae gen. sp. — larvae (Fig. 5 A—E)

Hosts: *Clarias fuscus* (fam. Clariidae), *Ophicephalus maculatus* (fam. Channidae), *Megalobrama hoffmani* (Cyprinidae), and a "silurid fish".
Localization: abdominal cavity.

Description (10 specimens): Larvae encapsulated by connective tissue. Body whitish, 7.36—10.19 long and 0.340—0.394 wide. Cuticle with fine longitudinal striation. Head end rounded, with two feebly outlined lips, each of them being provided with terminal tooth and two mouth papillae; four cephalic papillae present. Oesophagus distinctly divided into anterior muscular and posterior glandular parts; length of muscular oesophagus 0.216—0.264, width 0.036—0.042; length of glandular oesophagus 1.09—1.54, width 0.114—0.162. Intestine straight. Nerve ring encircling muscular oesophagus at its posterior end, 0.222—0.243 from anterior extremity. Deirids small, located 0.330—0.394 from anterior extremity; excretory pore situated approximately at level of deirids, 0.367—0.392 from anterior end. Rectum transparent tube, small unicellular rectal glands present. Tail conical, 0.204—0.261 long, with pointed tip.

Comments: — Since the various genera of the subfamily Proleptinae differ from one another mostly in characters which are found in adults only (situation of the

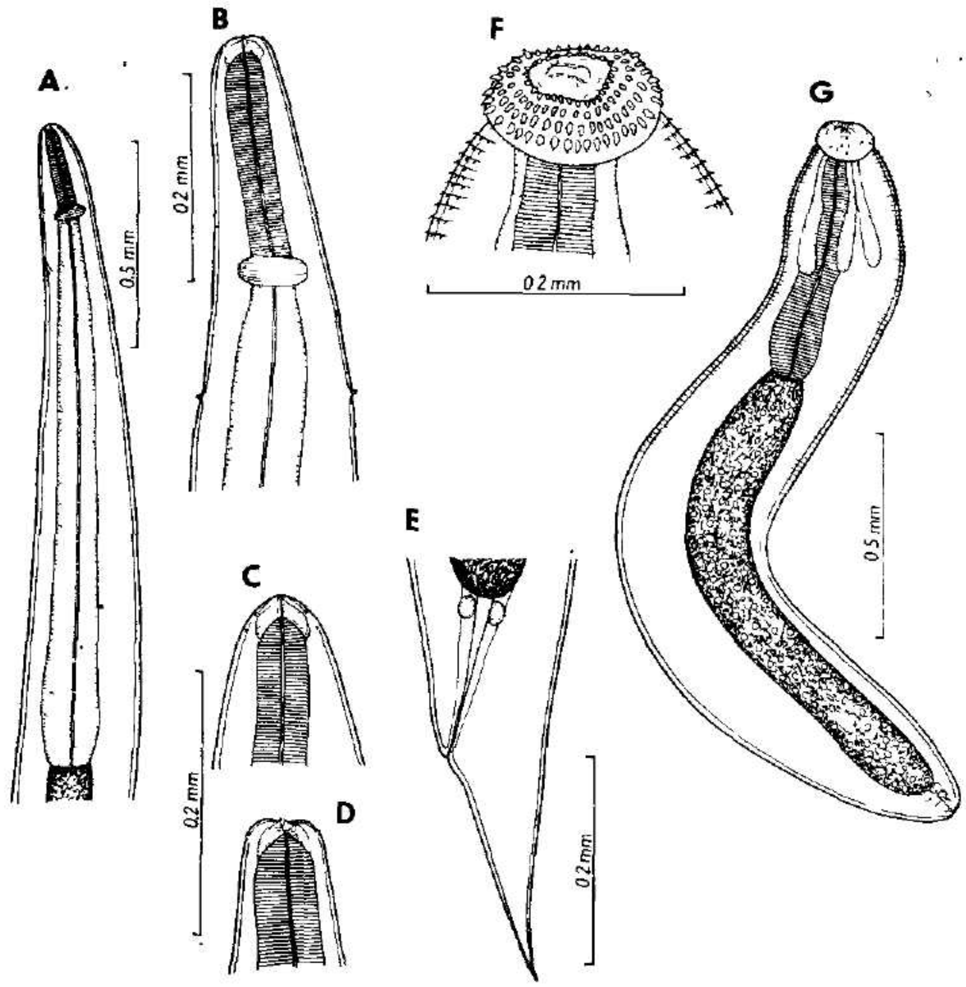


Fig. 5. A—E — Proleptinae gen. sp. — larv. (A, B — anterior end of body, lateral and dorsoventral views; C, D — head end, lateral and dorsoventral views; E — tail); F—G — *Gnathostoma hispidum* Fedtschenko, 1872 — larva (F — head end, G — general view).

vulva, type of spicules) (see Chabaud 1975), the generic identification of these larvae could not be established. Morphologically they may belong to the genera *Proleptus* Dujardin, 1845, *Paraleptus* Wu, 1927 or *Heliconema* Travassos, 1919; freshwater members of these are known largely from fishes of the Oriental Region. Similar larvae were described by Moravec and Amin (1978) from the abdominal cavity of *Barilius vagra* from Afghanistan (R. Indus basin). Adults are probably parasitic in some predatory fishes (e. g. *Ophicephalus*, *Mastacembelus*).

Fam. Gnathostomatidae Railliet, 1895

9. *Gnathostoma hispidum* Fedtschenko, 1872 — larva (Fig. 5 F,G)

Host: *Ophicephalus maculatus* (fam. Channidae).
Localization: not determined.

Description (1 stained specimen): Body plump, 2.31 long and 0.394 wide. Length of head bulb 0.084, its width 0.150, this being armed with four transverse rows of hooks; each row consisting of 32—37 hooks increasing gradually in size posteriorly. Length of hooks including their broad basal parts 0.006 in first row, 0.009 in second row, 0.012 in third row, and 0.015 in fourth row; conical part of hook in last row 0.003 long. Cuticle on anterior half of body finely striated, bearing numerous transverse rows of tiny spines diminishing gradually in posterior direction. Oesophagus 0.612 long and 0.150 wide. Four lemniscus-like organs, 0.354 long and 0.060 wide, extending along anterior half of oesophagus. Intestine straight, wide. Anal opening terminal. Length of rectum 0.084; rectal glands present.

Comments: The morphology of the only available larva, particularly the character and the number of hooks on its head bulb, corresponds to the description of the larvae of *G. hispidum* (see Ivashkin and Khromova 1976). The adults of this species are parasitic mainly in the stomach of wild boars and domestic pigs. The intermediate hosts of *G. hispidum* are copepods, while various species of fishes, amphibians, reptiles, birds and mammals serve as its paratenic hosts. This species has been reported from Vietnam e. g. by Le-Van-Hoa et al. (1965) from pigs.

Larvae of another congeneric species, *G. spinigerum* Owen, 1836, have often been reported from fishes of the genus *Ophicephalus* from Thailand, China and Japan; it parasitizes as adults mainly beasts of prey, sometimes it is recorded even from man. However, the larvae of *G. spinigerum* differ from those of *G. hispidum* in a greater number (more than 40) of hooks in the transverse rows on the head bulb (see Ivashkin and Khromova 1976).

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WEIGHT STRUCTURE IN A POPULATION OF MICROTUS ARVALIS DURING THE POPULATION CYCLE (MAMMALIA, RODENTIA)

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In memory of Docent RNDr. Miroslav Kunst, CSc.

Abstract. Average body weght of adult females of Microtus arvalis (Pall.) of unidentified age was 18.2% higher at the time of the spring- and summer peak of the population cycle than it was at the start of the increase phase; the increase in average body weight of the male was within the range of 38.8 and 39.2%. However, these changes in body weight could be confirmed for the current year and the overwintered males only when we analyzed the weight of individuals of a known age. We discussed distortions of an evaluation of cumulative samples made without knowledge of age structure etc., and described seasonal changes in the weight of the individual cohorts.

INTRODUCTION

The relationship between an increase in both body weight and length of Arvicolidae and an increase in their population density was first pointed out by Chitty (1952) in his study on *Microtus agrestis*. Later, the phenomenon was observed and described by many authors for species in which cyclic changes occur in their population density, for example by Zimmermann (1955), Stein (1957) and Pykal (1981) for *M. arvalis*, Chitty et Chitty (1962) and Newson et Chitty (1962) for *M. agrestis*, Kalela (1957) for *Clethrionomys rufocanus*, Krebs (1966, 1979), Krebs et al. (1973, 1976), Boonstra et Krebs (1979), Keller et Krebs (1970) and Beacham (1980) for American species of the genus *Microtus*. Krebs et Myers (1974) regarded the phenomenon as on of the most definitely formed phenomena in cyclically changing populations of voles and lemmings.

It also became known that changes in body weight due to growth was greatly influenced by the date of birth of the animal and thus also by the different conditions of life during the individual seasons. This explained a clearly seasonal oscillation in the body weight of Arvicolidae within the framework of the individual cohortes (see e.g detailed reports by Schwartz et al. 1964, Zejda 1971, laboratory results by Pokrovskiy et Bolshakov 1979, a.o.).

The present study presents the result of an analysis of the mentioned changes in body weight within the course of a three-year population cycle of *M. arvalis* in the area of S-Bohemia (at about 49°06′15″–49°03′45″ northern latitude, 14°18′45″ to 14°20′45″ eastern longitude) based on knowledge of its reproduction dynamics and age structure. The study was designed to obtain complementary data on the changes in body weight of Arvicolidae from the mid-geographical latitudes of its area of distribution in which cyclic changes occur in their population density.

MATERIALS AND METHODS

Weight changes were evaluated in 2168 specimens out of a total of 2697 specimens captured with snap-traps from which all damaged specimens had been removed. Of these, their approximate age could be established for 887 specimens using Hlaváč's (1979) modification of a method suggested by Lord (1959).

The animals were trapped in intervals of about one month from 1979–1981 in the area of the Zbudovská blata at 15 km NW of České Budějovice in S-Bohemia, using the common type of snap-traps in grassland areas. Information on the origin of the material, trapping and treatment is available from earlier papers (Moravec 1982, 1985). The weight of *M. arvalis* was determined to an accuracy of 0.5 g, that of gravid females was conditioned as suggested by Zejda (1968) with knowledge of a certain inaccuracy. The changes in the weight of the adults of both sexes were evaluated on the level of the population during the population cycles. Adult animals were determined by means of standard criteria which means that as adults were rearded all overwintered specimens, all sexually mature specimens during the reproductive period (all males with testes bigger than 8.4 × 6.0 mm (Pelikán 1959), all evidently gravid or postpartum females), and after the reproductive period all males with regressed testes, all females with uterine spots and an open symphysis.

In order to evaluate seasonal changes in body weight, animals of a known age were arranged each year to five age groups (cohorts C1–C5) on the basis of their approximate date of birth.
Spring cohort – C1 (born in March and April)
Early summer cohort – C2 (May and June)
Summer cohort – C3 (July and August)
Autumn cohort – C4 (September, October, first half of November)
Winter cohort – C5 (second half of November to end of February).
We obtained larger samples by joining the two sexes in all cohorts.

RESULTS

Common trends in weight changes during the population cycle

Basing on the calculated hectare density, the individual phases of the population cycle of *M. arvalis* could be determined:

Phase of low density – 1979
Increase phase – 1980
Peak phase – 1981.

Table 1 surveys average body weight of both adult and subadult specimens of *M. arvalis*. In 1979, body weight of the animals was in general remarkably low in spite of the small number of trapped specimens (n = 21). The situation during the following two phases (increase- and peak phase) was clearly illustrated by a large number of specimens captured in June and October 1980 and 1981 (Table 1, Fig. 1).

In June 1981, the adult female, regardless of age, was on the average 5.3 g heavier (34.6 g, n = 351) than in June 1980 (29.3 g, n = 28), i.e., an increase of 18.2% ($P \ll 0.01$), and 4.6 g heavier than in October 1980 (30.0 g, n = 89), i.e. an increase of 15.3% ($P \ll 0.01$). However, differences in average values for June 1980 and October 1980 were not significant, and hardly no difference occurred between October values for 1980 and 1981 (1.0%).

The increase in average body weight of a cumulative sample of adult males was more marked in the peak phase. In May and June 1981, the weight of the animals was 36.5 (n = 7) and 41.9 g (n = 66) respectively, i.e., 10.2 and 11.8 g (38.8 and 39.2%) higher than in May and June 1980 (26.3 g, n = 8 and 30.1 g, n = 14) ($P \ll 0.01$). When compared with October 1980 (31.5 g, n = 21), the June males (1981) weighed 6.8 g (22.6%) more ($P \ll 0.01$). However, a statistically significant difference was found between average weight for June 1980 and October 1980 ($P < 0.01$). In 1981, weight declined between June and October, similar to that of the females; this was attributable mainly to an early termination of the reprodduction period (about July 1981).

Data on subadult specimens (Table 1, Fig. 1) were intended to illustrate the situation which reflected more or less the momentary state influenced by the age composition.

The weight of the males differed greatly from that of the females during the time of our study. For example, the weight of a male from a sample from October 1980 surpassed the average female weight by 16.7%, in June 1981 by 21.4%, in October by 7.9%. The same occurred with the subadults. In a sample from October 1980 subadult males weighed 17.5% more than subadult females, in June 1981 1.2% in October 1981 6.8%.

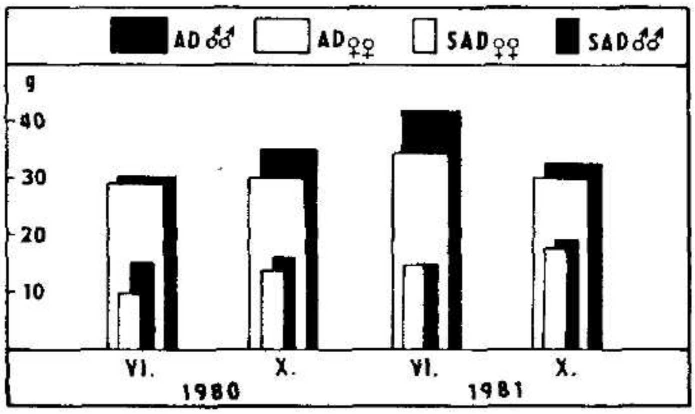

Fig. 1. Average weight of adult (AD) and subadult (SAD) specimens of *Microtus arvalis* of June and October samples in 1980 and 1981.

Changes in weight of the individual cohorts during the population cycle

Data on average body weight of the individual cohorts of *M. arvalis*, and their relative representation in the population during the study period, are shown in Table 2a, b. Because we divided our material of specimens of a known age into cohorts and arranged these in accord with the individual trapping dates. the samples were not large enough for an in-depth analysis and could be used in some cases only with the knowledge that inaccuracies may occur.

When *comparing average weight of members of the individual cohorts in the* first year of life, a statistical difference between the increase- and the peak phase of the population cycle could not be confirmed. Even when analyzing adult specimens only (in 1980, reproduction started at about the end of February, in 1981 in mid-March), average weight values for cohort Cl 1980 and cohort Cl 1981 determined *in* June samples were not significantly different (33.2 g, n = 7. 34.9 g, n = = 42; $P \gg 0.05$). The weight of members of the younger cohorts (C2—C5) for which a large material was available, could not be compared for their low age. and the absence of material for a period between July and August 1981. Similar to this situation was that observed in a sample of adult females of cohort Cl from June 1980, 1981 (1980: x—X 33.5 g, n = 6; 1981: x = 33.7 g, n = 38; $P \gg 0.05$). An unremarkable, but statistically significant difference was reported for males of identical cohorts from May and June (1980: x = 24.9 g, n = 6; 1981: $\bar{x}$ = 36.5 g, n = 6; $P < 0.01$).

The considerable reduction in the weight of specimens of the individual cohorts in the October sample 1981 could be used only in a comparison of the rate of weight

Tab. 1. Total absolute weights (W) and average weight ($\bar{x}$ = g) of adult (AD) and subadult (SAD) specimens of *Microtus arvalis* in the years 1979–1981

MONTH		AD ♀♀			AD ♂♂			SAD ♀♀			SAD ♂♂		
		N	W	$\bar{x}$	N	W	$\bar{x}$	N	W	$\bar{x}$	N	W	$\bar{x}$
1979	III.	0	0	0	1	13.6	13.6	0	0	0	0	0	0
	IV.	2	31.0	15.5	1	19.0	19.0	0	0	0	0	0	0
	V.	1	17.5	17.5	0	0	0	0	0	0	0	0	0
	VIII.	1	15.1	15.1	0	0	0	0	0	0	0	0	0
	X.	1	20.9	20.9	0	0	0	0	0	0	2	28.9	14.5
	XI.	1	17.7	17.7	1	19.0	19.0	1	14.0	14.0	0	0	0
	XII.	4	82.9	20.7	2	43.9	21.9	2	34.6	17.3	1	17.7	17.7
1980	II.	3	53.3	17.9	2	38.0	19.0	0	0	0	0	0	0
	IV.	0	0	0	2	50.3	25.2	0	0	0	0	0	0
	V.	4	94.4	26.3	8	210.2	26.3	2	20.2	10.1	1	10.0	10.0
	VI.	28	819.2	29.3	14	421.6	30.1	7	67.6	9.7	10	154.5	15.4
	VII.	6	141.5	23.6	4	146.2	36.6	1	9.2	9.2	4	58.3	14.6
	VIII.	30	903.3	30.1	2	63.9	32.0	14	168.4	12.0	29	432.8	14.9
	IX.	25	753.7	30.1	7	219.1	31.3	11	160.7	14.6	30	495.7	16.5
	X.	89	2673.3	30.0	21	736.3	35.1	76	1047.6	13.8	117	1894.0	16.2
	XI.	4	112.1	28.8	0	0	0	17	286.5	16.9	15	249.7	16.6
	XII.	8	166.8	20.9	4	106.6	26.7	22	340.3	15.5	23	375.5	16.3
1981	II.	22	411.5	18.7	35	732.0	20.9	0	0	0	0	0	0
	III.	23	443.7	19.3	36	853.0	23.7	0	0	0	0	0	0
	IV.	12	287.7	24.0	7	255.5	36.5	6	75.3	12.6	12	186.0	15.5
	V.	8	238.6	29.8	7	255.5	36.5	5	85.0	17.0	1	11.5	11.5
	VI.	351	12133.8	34.6	66	2765.5	41.9	73	1116.5	15.3	87	1346.5	15.5
	VII.	12	326.5	27.2	2	62.5	31.3	14	208.5	14.9	14	212.5	15.2
	X.	150	4556.5	30.4	19	623.0	32.8	233	4124.5	17.7	312	5899.0	18.9

loss with that of the pertinent cohorts sampled in October 1980. The loss of weight of C1 1981 in the first year of life (24.1 g, n = 67) was 28.5% (C1 1980: 33.7 g, n = 5; $P \leqslant 0.01$), C2 1981 (20.4 g, n = 89) 36.3% (C2 1980: 32.0 g, n = 24; $P \leqslant 0.01$), C3 1981 (17.7 g, n = 71) 14.5% (C3 1980: 20.7 g, n = 20.7 g, n = 69; $P \leqslant 0.01$). A *statistically not significant* difference occurred between cohorts C4 1981 and C4 1980 (16.6 g, n = 18; 14.5 g, n = 35). In this connection, we should be to point out a sample from October 1981 with a remarkable difference between cohorts C1 1981 and even C2 1981, of which several females only had just become sexually mature, and overwintered cohorts C1–C5 1980 (see changes in weight from July to October, Table 2b). Although the reproduction period terminated for all cohorts in July 1981, there was a relatively smaller loss of weight in C1–C5 1980.

Seasonal changes in weight in terms of age groups

The most complete results were obtained from materials collected in 1980, 1981 (Table 2, Fig. 2). Owing to a low density, the first members of cohort C1 1980 were recovered from the samples at the beginning of May, when the age of the specimens was two months which accounted for their high average weight (21.4 g, n = 9). In the following sample, their weight was 32.2 g (n = 8). Data on weight values obtained either from a small material or from the net weight of occasionally trapped individuals (not joined in Fig. 2) suggested that the changes were similar to those recorded for the early summer cohort C2 1980 composed a sufficiently large number of specimens. As the members of cohort C2 1980 matured sexually (Table 3), their average body weight increased from June 1980 (13.1 g, n = 3) to the end of August 1980 (Maximum weight 33.5 g, n = 7). A decline in average weight of this cohort occurred gradually from August to October (32.0 g, n = 24). The rate of decrease in weight increased greatly in the following months. Members of C2 1980 attained their minimum weight in February 1981 (19.6 g, n = 11). When compared with

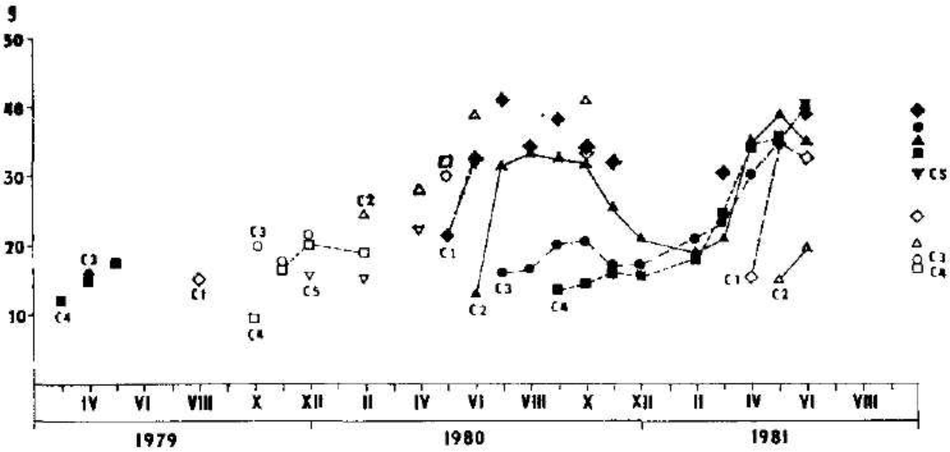

Fig. 2. Average weight of individual cohorts (C1—C5) of *Microtus arvalis* in the years 1979—1981.

Tab. 2a, b. Average weight ($\bar{x}$ = g) of individual cohorts (C1—C5; ♂♂ + ♀♀) in population of *Microtus arvalis* in the years 1979—1981

MONTH		ΣN	1978 COHORTS				1979 COHORTS									
			$\bar{x}$ C3	N	$\bar{x}$ C4	N	$\bar{x}$ C1	N	$\bar{x}$ C2	N	$\bar{x}$ C3	N	$\bar{x}$ C4	N	$\bar{x}$ C5	N
1979	III.	1	—		13.6	1	—		—		—		—		—	
	IV.	2	15.8	1	14.8	1	—		—		—		—		—	
	V.	1	—		17.5	1	—		—		—		—		—	
	VIII.	1	—		—		15.0	1	—		—		—		—	
	X.	3	—		—		—		—		20.2	2	9.4	1	—	
	XI.	7	—		—		—		—		17.7	1	20.0	6	—	
	XII.	3	—		—		—		—		21.9	2	—		15.5	1
1980	II.	3	—		—		—		—		—		18.7	2	15.0	1
	IV.	2	—		—		—		28.0	1	—		—		22.3	1
	V.	11	—		—		—		—		30.0	1	32.2	1	—	
	VI.	13	—		—		—		38.9	1	—		—		31.8	1
	VII.	13	—		—		—		—		—		—		—	
	VIII.	44	—		—		—		—		—		—		—	
	IX.	59	—		—		—		—		—		—		—	
	X.	135	—		—		33.0	1	41.0	1	—		—		—	
	XI.	30	—		—		—		—		—		—		—	
	XII.	48	—		—		—		—		—		—		—	

Tab. 2b

MONTH		ΣN	1980 COHORTS x̄ C1	N	[redacted] C2	N	x̄ C3	N	x̄ C4	N	x̄ C5	N	1981 COHORTS x̄ C1	N	x̄ C2	N	x̄ C3	N	x̄ C4	N
1980	II.	3	—		—		—		—		—		—		—		—		—	
	IV.	2	—		—		—		—		—		—		—		—		—	
	V.	11	21.4	9	—		—		—		—		—		—		—		—	
	VI.	13	32.2	8	13.1	3	—		—		—		—		—		—		—	
	VII.	13	40.1	1	31.9	5	15.8	7	—		—		—		—		—		—	
	VIII.	44	34.1	2	33.5	7	16.6	35	—		—		—		—		—		—	
	IX.	59	38.2	1	32.8	14	19.9	38	13.5	6	—		—		—		—		—	
	X.	135	33.7	5	32.0	24	20.7	69	14.5	35	—		—		—		—		—	
	XI.	30	32.1	1	26.1	3	17.1	11	16.0	15	—		—		—		—		—	
	XII.	48	—		21.0	11	17.3	12	15.6	25	—		—		—		—		—	
1981	II.	35	—		19.6	11	20.7	13	18.2	11	—		—		—		—		—	
	III.	32	30.5	1	22.1	10	23.3	10	24.6	11	—		—		—		—		—	
	IV.	27	—		35.1	4	30.3	2	34.6	3	—		15.6	18	—		—		—	
	V.	12	—		39.0	1	35.3	2	35.5	2	—		34.8	3	14.8	4	—		—	
	VI.	112	44.5	2	35.0	13	39.0	1	39.5	5	40.0	4	32.9	47	19.4	40	—		—	
	X.	293	39.5	3	35.4	8	30.2	3	33.2	11	29.8	23	24.1	67	20.4	89	17.7	71	16.6	18

Tab. 3. Sexual maturation (%) of individual cohorts (C1—C4) in the first year of their life

MONTH	COHORTS	C1		C2		C3		C4	
		♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
1980	V.	83	67	—	—	—	—	—	—
	VI.	50	100	0	50	—	—	—	—
	VII.	100	—	100	100	0	83	—	—
	VIII.	—	100	100	100	0	44	—	—
	IX.	100	—	100	100	0	53	0	0
	X.	100	100	67	100	7	61	0	0
1981	IV.	—	50	—	—	—	—	—	—
	V.	100	100	0	0	—	—	—	—
	VI.	60	96	0	45	—	—	—	—
	X.	11	64	11	23	0	0	0	0

the maximum weight in August 1980, the loss of weight was 13.9 g (41.5%). An increase in weight started in February 1981 and surpassed, as early as in April 1981, the highest value of 1980 (March 1981: 22.1 g, n = 10; April 1981: 35.1 g, n = 4; May 1981: 39.0 g, n = 1; June 1981: 35.0 g, n = 13). No material was o-tained during the following months, but according to values for October 1981 (35.4 g, n = 8), the weight oscillated roughly around the June value.

The increase in weight of cohorte C3 1980 was less marked before the onset of winter, although a substantial portion of females of this age group succeeded to become sexually mature (July 1980 — 15.8 g, n = 7, August 1980 — 16.6 g, n = = 35; September 1980 — 19.9 g, n = 38; October 1980 — 20.7 g, n = 69) (Table 2, 3). The winter depression seemed to have started later than with C2 (November 1980 — 17.1 g, n = 11; December 1980 — 17.3 g, n = 12), and was less high (about 25%). In February 1981, the weight was again higher (20.7 g, n = 13), and continued to increase (May 1981 — 35.3 g, n = 2). One specimen weighed 39.0 g in June, 1981, three specimens attained an average weight of 30.3 g in October 1981. Thus, the increase in average weight of members of cohort C3 was 15 g (75.0%) *after the loss* of weight in winter.

The winter depression of weight was indistinct in the autumn cohorte C4 1980, in this case it was rather a low rate and arrestment of growth (September 1980 — 13.5 g, n = 6; October 1980 — 14.5 g, n = 35, November 1980 — 16.0 g, n = 15; December 1980 — 15.6 g, n = 25). From February 1981 onwards, the average weight of the cohort started to increase and came into balance with the weights of C2 1980 and C3 1980.

DISCUSSION

Changes in body weight of Arvicolidae during the course of their population cycle are associated with changes in population density (Chitty phenomenon). It our cumulative samples not separated into age groups, the spring increase in weight of adult specimens of *M. arvalis* was most remarkable. The weight of the male surpassed the customary range of increase (20—30%) common to cyclically oscillating populations of voles and lemmings during the increase- and peak phase (Boonstra et Krebs 1979, Krebs 1979). Our results were comparable with those obtained by Pykal (1981) for an identical period. In overwintered males of *M. ar-*

valis from South Bohemia, the increase in the average April weight between the increase- and peak phase was 32.2% Pykal (above). Stein (1957) gave a much lower value (8.0%) for a weight increase in males of *M. arvalis* during the spring months of the two mentioned phases. A similar trend in weight changes we found by adult females — increase 18.2%. However, our values did not reach those reported by Beacham (1980) for females of *Microtus townsendii* (46.4%).

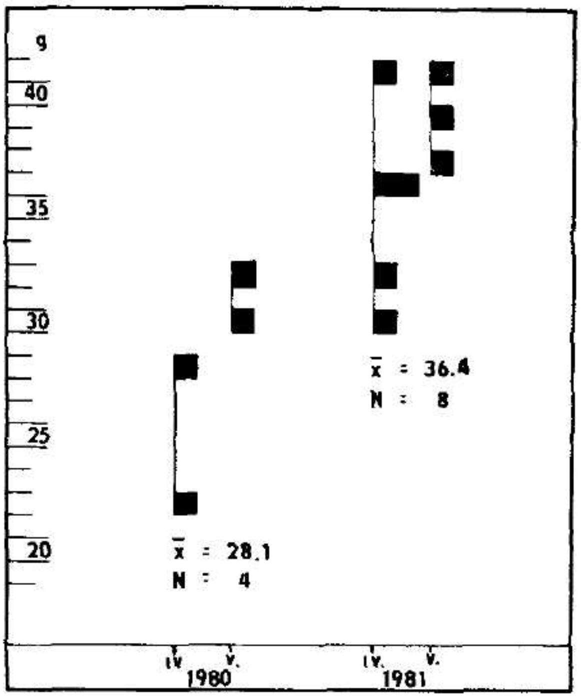

Fig. 3. Comparison of spring weight of overwintering males of *Microtus arvalis* in the years 1980 and 1981.

All changes in the weight of Arvicolidae occurring during their population cycle were described on the basis of average weights of cumulative samples of adult specimens, mostly males. However, a different aspect of the problem was offered by an analysis of changes in body weight of individuals of a known age. Most surprising were the result of a comparison of average June weight in adult females of the current year of cohort C1 1980 and C1 1981. Changes in weight occurring in between the increase- and peak phase were not assessed in this case. The problem that needs to be elucidated is the reason for an increase in the weight of adult females in cumulative samples (Fig. 1). In our opinion, the difference in weight could have been caused:

1) By *an almost zero representation of overwintered females in the sample from* June 1980. In 1981, the proportion of overwinter females was 21%, their weight was moderately, but significantly higher than that of cohort C1 and C2 1981 (C1 + + C2: $\bar{x} = 33.5$ g, n = 50; overwintered: x = 36.1 g, n = 13; $P < 0.05$).

2) A contribution to the difference may be the presence of very light females in the cumulative sample of June 1980 (21—24 g; 27%), the weight of which was identical to that of individuals of the current year cohort C2. However, with regard to the very early onset of their first gestation, they may be regarded as cohort C2.

We have been unable to evaluate changes in the weight of overwintered females occurring between the increase- and the peak phase of the population cycle. However, as indicated by the weight of one female in June 1980 (38.9 g), their weigh may have reached equally high values to those of the peak phase during the increase phase (30.5—48.0 g, average 36.1 g, n = 13).

An evaluation of weight changes on the level of cohorts of adult males was more difficult owing to the small numbers of overwintered individuals and an ununiform representation of the cohort C1 in 1980 and 1981. A considerable difference in average weight (46.6%) was determined for cumulative samples of cohort C1 in the years 1980 and 1981, but in 1980, the majority of our material was obtained in May, while in 1981, the situation was reversed. And now, what was the situation with overwintered males? The difference between cumulative samples of April and May 1980 and 1981 was statistically significant (1980: $\bar{x} = 28.1$ g, n = 4; 1981: $x = 36.4$ g, n = 8; $P < 0.005$) (Fig. 3). This finding was supported by the body weight of males of unknown age which remained within the range of values given in Fig. 3.

According to our results, the females of a known age did not change their weight between the increase- and peak phase of the population cycle, which leaves no doubt about the possibility of a distortion in an evaluation of cumulative samples (Fig. 1) in which the age structure or the intensity and the start of reproduction have been disregarded. So far, we know nothing of the character of weight changes between the low density phase and that of a peak density which could not be evaluated on the basis of our material. On the other hand, the situation reported for the male is the only one that is in agreement with the commonly reported trend toward cyclic changes in weight.

A sudden weight loss during the peak phase in adults of the current year which started in 1981 as early as the end of June, may perhaps be attributed to a premature termination of sexual activity (Moravec 1982). It would not do to ascribe this weight loss to the mortality of older animals (see Moravec 1982, 1985). At that time, the average age of the population was higher than in 1980 because cohorts C1 1981 and C2 1981 were predominant. Moreover, the compared samples (June 1981 and October 1981) consisted of adult members of cohorts C1, C2 1981 because no other age group matured sexually in this year. By using adult specimens only, we excluded the possibility of an influence of young animals entering the population which may have distorted the picture of the finite value of average weight (Rose et Gaines 1978).

Changes in spring and summer weight of the body of adult voles in the course of the population cycle were not reflected in their weight in the winter months which remained more or less stable in the individual years (see Table 1, 2, Fig. 2). Similar conclusions were made by Fuller (1985) who examined the species *Clethrionomys gapperi*.

According to our results, changes in the weight of adults of *M. arvalis* occurring in the course of its population cycle were influenced mainly by the duration of the reproduction season, the intensity of reproduction and the age structure. A different age structure was not of secondary importance, at least for the adult female, as suggested by Krebs et Myers (1974), Rose et Gaines (1978) and Pelikán (1981).

Seasonal changes in the weight of the population ought to regarded as the outcome of changes in weight of the individual generations (Pokrovskiy et Bolshakov 1979) which differed in the various cohorts. Consequently, these cohorts ought to be regarded as physiologically different groups of animals (Schwartz et al. 1964). Our results were in agreement with those obtained by Zejda (1971) for *Clethrionomys glareolus*, and Pykal (1981) for *M. arvalis* and *M. agrestis*.

Body weight increased most during the increase phase of the population cycle approximately in the first two months of their life (cohorts C1 1980 and C2 1980). Similar results were obtained by Zejda (1971). Pykal (1981) reported for *M. arvalis* that this period was prolonged for another three months. The character of a weight depression in winter was conform to the general trend. For example, Koshkina (1955) and Bergstedt (1965) did not observe an increase in the weight of *C. glareolus* in the winter months. Zejda (1971) reported that specimens of *C. glareolus* born between March and May decreased their weight during the winter; a similar situation was described for other species by Fuller et al. (1969) and by Pokrovskiy et Bolshakov (1979) (laboratory experiment). Pykal (1981) having exactly determined the age groups, observed that the winter depression in the relevant cohorts was smaller by one half, but this may have been due to a number of reasons such as the size of the population and the quantity of available food (Tast 1972, 1981), the temperature regime of the locality under consideration (Huminski et Krajewski 1977) or both temperature and nutritional conditions of the locality (Wunder et al. 1977). Our results were in agreement with those obtained by Iverson et Turner (1974) who found that weight loss of a population of *M. pennsylvanicus* in winter was 30–40%. The authors refused the possibility of a selective mortality of the heavier animals during this period and suggested that apart from a decrease in weight of the older specimens, this may have been caused by immigrating small animals into the population. Because smaller specimens belong clearly to young cohorts, this situation could not have occurred in our population.

The smaller increase in weight of cohort C3 1980 than that of C1 and C2 was in agreement with the data by Reichstein (1964) on *M. arvalis*. According to this author, a group of animals born between March and June gained as much as 47 g of weight and matured sexually while those born between July and October, gained not more than 15–22 g. The lower decrease in weight of C3 in winter (25%) as well as a short-term arrestment of growth of C4 were conform to the results obtained by Zejda (1971) for groups of *C. glareolus* of an adequate age. Slight differences occuring in our cohort C3 may have been due to their reproduction during the increase phase.

SUMMARY

1) By analyzing 2 168 undamaged specimens of *Microtus arvalis* out of a total of 2 697 specimens trapped in grassland habitats of South Bohemia between 1979 and 1981, we determined changes in weight.

2) We determined the approximate age of 887 specimens on the basis of the dry matter weight of eye lenses, we divided them into cohorts (C1–C5).

3) In 1979, the population of *M. arvalis* was at a phase at which its numbers were lowest; the increase phase occurred in 1980, the peak phase in 1981.

4) An increase in average spring- and summer body weight in cumulative samples of adult *M. arvalis* of unidentified age was high during the period of its population

cycle starting with the onset of the increase phase (June 1980) and ending with the peak phase (May, June 1981). The females increased their weight by 18.2%, the males between 38.8 and 39.2% surpassing the average weight increase (20 to 30%) common to cyclically changing populations of voles and lemmings.

5) The analysis of average weight of adult specimens of a known age did not fully confirm the findings reported under 4). An increase in average weight occurring between the increase- and the peak phase of the population cycle was not confirmed for the current-year-females and was neither expected to occur in overwintered females. On the other hand, changes were confirmed for both categories of males. Cyclic changes in body weight in winter did not occur in our material. The different character of changes in body weight of subadult specimens was due to their sexual activity.

6) Our observation under 5) showed how distortional could be an evaluation of cumulative samples in which both the age structure and the intensity or onset of reproduction had been disregarded.

7) Seasonal changes in body weight differed in the given cohorts in connection with their sexual maturation. In the birth year, cohorts C1 and C2 1980 increased greatly in weight during the increase phase (32.0—33.5%), in the winter months they lost about 40% of body weight. Cohort C3 increased less in weight during the same period, and also lost less in winter (25%); in addition weight loss started two months later. Cohort C4 increased steadily in weight except for one month in winter. The weight of all cohorts was balanced just before the start of the reproduction period.

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ON THE BULGARIAN BLEAK, ALBURNUS ALBURNUS (PISCES: CYPRINIDAE)

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Abstract. The sample of 72 specimens of the common bleak, *Alburnus alburnus* (Linnaeus, 1758), collected in the river Varbica, southern affluent of the Arda, tributary of the Marica, southern Bulgaria, drainage of the Aegean Sea, and the sample of 52 specimens, collected in the riverine lake Slapy, central Bohemia, drainage of the North Sea, was studied. 23 plastic and 3 meristic characters were proofed. Sexual differences in the material from the riverine lake Slapy are discussed. In several plastic and meristic characters differences between nominal form and other Balkans subspecies of the bleak were found. Most probably the form of the bleak from the river Varbica represents a separate natio.

INTRODUCTION

The taxonomical reviews of the European forms of *A. alburnus* were published by Berg (1932, 1933. 1949), Banarescu (1960). Ladiges and Vogt (1965). The three latter authors recognized only 2 subspecies of the common bleak, namely *A. alburnus macedonicus* Karaman, 1929 (only in the Vardar). and *A. alburnus strumicae* Karaman. 1955 (in the Struma drainage). Probably, this form inhabits also rivers Mesta and Marica, all amouthing into the Aegean Sea. Economidis (1973) recognized 3 subspecies of the bleak from the Greek terriotory, namely *A. alburnus macedonicus* Karaman, 1929, *A. alburnus thessalicus* Stephanidis, 1930 and *A. alburnus strumicae* Karaman, 1955.

From our view following facts are interesting. Michajlowa (1965) testified *A. alburnus* only from the Bulgarian Thrakia) in the drainage of the rives Marica), adding to it not subspecific rank. She had samples containing 102 specimens. She pointed only to the differences among populations from the stagnant water (elevated specimens) and those from the running water (elongated specimens). Karaman (1955) described the new subspecies of the bleak *A. alburnus strumicae* from the drainage of the Strumica. According to his viewpoint this subspecies inhabits also other tributaries of the Aegean Sea estwards, namely the river Mesta and the Marica. Karaman (1955) rightly questioned the problem of the possible identity of *A. alburnus strumicae* with "*Alburnus lucidus*" from Thessalia and the "Greek Macedonia", but the lack of material did not allow to him to solve this problem. Comparing morphometrical characters of the bleak from various localities we presume the differences between sexes are negligible.

MATERIAL AND METHODS

RNDr J. Křížek has very kindly given to our disposal the sample of 72 specimens of the bleak, collected by him June 22nd, 1977 in the river Varbica, near the town Momchilgrad, southern Bulgaria (41°20′ NLat., 25°20′ELength).

The sample of 52 specimens of the bleak from the riverine lake Slapy was collected using seining, July 21st, 1986 locality Nová Živohošť.

The whole material was measured by the use of technics described by Oliva (1952).

Table 1. Plastic characters of the bleak from different localities

	The river Varbica (own values)			The lake Pskov (Berg, 1933)		Romania (Banarescu, 1964)
body length (mm)	70 – 102		82.8			
in % of the vody length						
head length	26	28	25.0	19.5 – 22.5	(21)	19.6 – 23.1
predorsal distance	54 –	57	55.0	53.4 – 60.1	(56,7)	52.9 – 57.6
preventral distance	45	47	46.3	—		—
preanal distance	58 –	65	64.7	—		—
body depth	14 –	22	20.5	19.2 – 24.0	(21.3(	
body width	10 –	11	10.0			—
length of the caudal peduncle	17 –	21	19.3	17.5 – 23.6	(20,7)	17.9 – 21.7
length of D	11 –	12	11.6	—		—
length of A	17	19	18.6	—		—
length of P	21	22	21.1	—		18.6 – 21.4
length of V	14	16	15.4	—		12.7 – 15.2
depth of D	13	21	19.0	—		—
depth of A	14 –	17	15.2	—		—
in % of the head length						
preorbital distance	22 –	29	25.2	—		—
eye diameter	28 –	32	29.5	—		23.8 – 31.2
interorbital distance	28 –	32	30.4	—		—
postorbital distance	45 –	54	50.5	—		—
head depth	67 –	68	67.1	—		—
in % of the length of the caudal peduncle its depth	54 –	59	55	—		—
min. body depth	42 –	45	43.7	—		—
in % of the P — V distance						
length of P	100			—		—
length of V	84 –	85	84	—		—

RESULTS AND DISCUSSION

When we compare our data at first with Oliva (1952), who published data of proportionate measurements of 29 specimens of the bleak from the drainage of the river Elbe (males and females separately), and another 14 specimens from the Czechoslovak part of the Danube drainage (sexes mixed), and with the material from the reservoir Slapy, the Varbica bleak has somewhat larger head, longer preventral distance, lower body depth in ave. 20.5 % of the body length without caudal, in Elbe specimens 24.1 % males, 24.8 % females, 23.6 % specimens from the Czechoslovak part of the Danube drainage, and 25.8 % males, 26.2 % females from the reservoir Slapy, the river Vltava).

In Varbica specimens we have found also the shorter anal fin base, longer P, higher A (A in these specimens in ave. 15.2%, in Elbe sp. 13.0% — males, 12.2% — females, Danube sp., mixed sex, 13.5%, and 13.9% in males and 13.4 % in females from the reservoir Slapy), larger eyes regardless the size, longer postorbital distance (ave. 50.5%, in Elbe sp. 46.7% — males, 45.9% — females, 45.3% in specimens from the reservoir Slapy), but in the Czechoslovak Danube specimens with this value 48.1% of the head length were found.

Table 2. Plastic characters of the bleak from different localities

	The reservoir Slapy (own values)	Poland (Gasowska, 1974) ave. from 7 rivers	Poland (Gasowska, 1974) ave. from 6 lakes
body length (mm)	125 - 193 (154.5)	50 — 148 (100.7)	68 - 146 (105.2)
in % of the body length			
head length	18.6— 21.5 (20.6)	20.0—24.2 (21.8)	18.2—23.2 (23.4)
predorsal distance	50.4 — 58.4 (55.1)	50.6—59.6 (55.3)	50.0—58.6 (54.9)
preventral distance	41.6— 48.6 (44.9)	—	—
preanal distance	59.1— 70.0 (63.9)	—	—
body depth	23.4— 29.6 (26.0)	18.2—26.2 (22.3)	17.1—23.8 (20.3)
body width	10.2— 14.7 (12.5)	—	—
length of the caudal peduncle	16.0— 20.7 (18.7)	14.6—23.6 (19.8)	17.5—24.4 (20.8)
length of D	7.0 — 12.9 (10.6)	8.0—12.5 (10.2)	7.0—11.2 (9.4)
length of A	16.0— 22.9 (19.5)	15.2—22.6 (19.0)	15.0—21.1 (17.8)
length of P	16.6— 20.9 (16.9)	16.3—22.6 (19.3)	15.4—20.9 (18.2)
length of V	12.9— 20.0 (14.7)	11.4—16.8 (14.1)	10.7—14.8 (12.9)
depth of D	16.6— 20.9 (18.9)	13.4—20.0 (16.2)	11.8 -17.9 (14.8)
depth of A	11.4— 15.5 (13.7)	10.1—15.8 (12.4)	8.9 -13.6 (11.2)
in % of the head length			
preorbital distance	25.8— 35.4 (30.1)	—	—
eye diameter	22.9— 31.1 (25.0)	—	—
interorbital distance	27.8— 32.8 (30.3)	—	—
postorbital distance	41.4— 52.3 (45.3)	—	—
head depth	65.2— 79.4 (71.3)	—	—
in % of the lenth of the caudal peduncle depth	52.7— 70.5 (60.9)	—	—
min. body depth	39.4— 56.5 (48.7)	—	—
in % of P — V distance length of P	85.3—120.4 (101.6)	—	—
in % of V — A distance length of V	75.0— 91.5 (82.9)	—	—

In the Varbica bleak the length of pectoral fin (P) in the P-V distance is on the average higher (P in P-V = 100%) than in Elbe males (ave. 93.7%) and females (ave. 93.0%) and in the Danube specimens from Czechoslovakia (ave. 90.8%). Very broad ranges were found in the material from the reservoir Slapy 85.3—120.4%) with the high average of 101.6%. Varbica specimens have also longer ventrals (ave. 84.0% of the V-A distance, in Elbe specimens in ave. 81.9% males, 76.4% females, Czechoslovak Danube specimens in ave. 74.9%, Slapy specimens 82.9%).

The differences of the Varbica bleak compared with the bleak examined by Pravdin (1948), which are almost topotypic with Swedish ones (Linnaeus, 1758: *Cyprinus Alburnus* — in Europae aquis dulcibus, terra typica restricta: Sweden), ar summarized in our Table 1.

Unfortunately several serious typographical mistakes in Pravdin's contribution make comparisons impossible, but from several characters, which can be compared with ours, such differences appeared (e. g. in pectorals and vetrals length, dorsal fin depth, eye diameter) that the synonymization of the South Bulgarian bleak with the typical or nominal form of the bleak is highly improbable.

Table 3. Plastic characters of the bleak from diffetent localities

	Karelia (USSR) (Pravdin. 1948)		Dněpr (Žukov, 1965)		Zap. Dvina (Žukov, 1965)	
body length (mm)	upto 150 mm		80 – 155	110	105 – 135	114.6
in % of body length:						
head length	—		18.6 – 24.6	21.6	20.5 23.5	22.0
predorsal distance	55 – 59	56.6	52 – 59	55	53.5 - 59.5	55.6
preventral distance	—		42 – 49	44.5	31.5 – 47.5	44.3
preanal distance	—		57 – 68	62.9	60.5 – 67.5	63.1
body depth	9 – 19	17.8	18 – 26	22.7	20.5 – 25.5	22.2
body width	—		8 – 13	10.8	8.5 – 13.5	10.8
length of the caudal peduncle	18 – 22	20.5	15 – 24	18.9	16.5 – 22.5	19.5
length of D	8 – 11	8.8	8 – 13	10.4	9.5 – 13.5	10.7
length of A	17 – 20	18.2	16 – 23	19.4	15.5 – 21.5	18.1
length of P	15 – 19	16.8	16. – 22	19.0	16.5 – 24.5	19.0
length of V	11 – 14	12.0	12 – 17	14.8	12.5 – 16.5	14.3
depth of D	8 – 11	-	14 – 21	17.0	13.5 – 18.5	15.7
depth of A	8 – 12	11	10 – 16	13.4	11.5 – 16.5	12.5
in % of the head length:						
preorbital distance	—		20 – 33	28.2	27.5 – 33.5	30.0
eye diameter			22 – 35	26.9	25.5 31.5	28.8
interorbital distance	—		23 – 35	28.9	25.5 35.5	25.3
postorbital distance	—		36 – 52	46.1	38.5 - 46.5	45 9
head depth	—		58 – 79	69.8	6.5 – 75.5	67.9

The same is true when comparing the Varbica bleak with the Struma bleak. In the latter the body depth is greater, being 28.0% of the body length, and the head length is 22.0% of the body length (Karaman 1955); Varbica specimens posses these proportions: 14—22 (ave. 20.5%) or 26—28 (ave. 25.0%) respectively. Varbica specimens showed differences when compared with those from the Pskov Lake, which can be supposed to be almost topotypical with the Swedish ones.

Pskov bleak has smaller head (19.5—22.5, ave. 21.0%) of body length, its body is also low, its depth being 19.2—24.0, ave. 21.3% of body length (Berg 1933). A short head was also shown in the bleak from Romania (19.5—23.1%) of the body length (Banarescu 1964), this character remarkably distinguishing the Varbica bleak from the Danube one.

Very interesting are the data of Drenski (1951), but they present general description of the Bulgarian bleak without regard to different water drainages in Bulgaria. From these results it is clear that the Varbica bleak has larger head (see Table 1), for Bulgarian bleak Drenski (l.c.) gave ranges 20—25% of body length. The minimum body length in % of the length of the caudal peduncle showed, following Drenski (l.c.), broader ranges (38—55%): ranges for limits of dorsal fin depth in % of the body length are also lower (14—19%). Unfortunately, Drenski (7951) has not given a detailed analysis of various proportionate characters as we have done here and therefore only several of his values are comparable with our own.

Very interesting are shorter pectoral and ventral fins in the Danube specimens, which do not reach ventral or anal base (Banarescu 1964), but in Varbica specimens

Table 4. Plastic characters of males and females of the bleak (*Alburnus alburnus*) from the reservoir Slapy

Sex	males		Females	
n	22		30	
body length (mm)	136 – 175	(150.2)	125 – 193	(159.0)
in % of the body length				
head length	19.9 – 21 5	(20.6)	18.6 – 21 5	(20.5)
head width	9.4 – 10.5	(9.9)	6.1 – 10.7	(9.9)
head depth	13.5 – 15.5	(14.7)	13.4 – 15.8	(14.6)
preorbital distance	5.5 – 7.5	(6.2)	5 5 – 6.6	(6.2)
postorbital distance	8.7 10.0	(9.4)	8.4 – 10.8	(9 3)
interorbital distance	5.9 – 6.6	(6.3)	5 8 – 6.8	(9.3)
eye diameter	4.6 – 6.6	(5.3)	4 6 – 5.9	(5.1)
predorsal distance	50.4 – 58.4	(54.7)	52.4 – 58.4	(55 4)
preanal distance	60.7 – 67.4	(63.4)	59.1 – 70.0	(64.3)
preventral distance	41.6 46.9	(44.9)	42.0 48.6	(45.0)
distance between V and A	16.0 – 20.7	(17.9)	16.0 – 22.4	(18.9)
body depth (max.)	24.2 – 29.6	(25.8)	23.4 – 28.4	(26.2)
body width (max.)	10.9 – 13.9	(12.1)	10.2 14.7	(12.9)
length of the caudal peduncle	17.2 – 20.9	(18.5)	16 0 – 20.7	(18.8)
depth of the caudal peduncle	9.8 – 12.9	(11 3)	9.9 – 13.3	(11.4)
depth of the caudal peduncle (min.)	8.6 – 9 9	(9 2)	7 8 – 9.8	(8.9)
depth of the dorsal fin	17.4 20 9	(19.4)	16 6 – 19.7	(18 3)
length of the pectoral fin	16 6 – 20.9	(18 9)	17 1 – 20.3	(18.9)
length of the ventral fin	13.5 – 15.7	(14 9)	12.9 – 20.0	(14.5)
depth of the anal fin	11.4 – 15.5	(13.9)	12.9 – 15.4	(13.4)
length of the base of the dorsal fin	9.5 – 12.9	(11.2)	7.0 – 11.8	(9.9)
length of the base the anal fin	17.8 – 22.9	(21.3)	16.0 – 22 6	(18.)
the distance from the end of the ventral fin to the anal fin	3.7 – 8.1	(5 3)	3 7 – 11.5	(7.1)
length of the pectoral fin in of distance between pectorals and ventrals	93 2 – 109 4	(101.9)	85.3 – 120 4	(101.5)
number of rays in dorsal fin	2/9		2/8 – 9	(2/8.9)
anal fin	3/17 – 21	(3/18.4)	3,17 – 21	(3'18.4)
ventral fin	1/8		1/7 – 8	(1/7 9)
pectoral fin	1/12 – 15	(1/13 7)	1/12 – 15	(1/13 8)
number of scales in the lateral line	47 – 53	(49.2)	46 – 52	(49.3)
above the lateral line	9 – 10	(9.2)	8 – 10	(9 2)
below the lateral line	3 – 4	(3.9)	4	

pectorals reach the ventral base, and the ventral fin. when alleged to the body, reaches the anal base. Simultaneously the length of the paired fins is almost the same when their lengths are calculated in % of the body length.

Notes must be added *concerning the position of the anal* base towards the dorsal base. In the bleak from the Varbica the anal base begins not vertically below the end of the dorsal base as in Upper Italian bleak (see **Tortonese** 1970), but it is slightly shifted towards the head. This base originates on the vertical from the dorsal base at the point of the insertion of the 6th or 7th ramified ray (the same position we have found in the bleak from the Slapy reservoir. This forward shifting of the anal fin was noted also by **Drenski** (1951) in the general description of the Bulgarian bleak. Eyes in Varbica specimens are larger than in all forms of the bleak mentioned by **Karaman** (1924). In Varbica specimens, eyes are always larger than the preorbital distance (see Table 1) a; in forms of the bleak cited by **Karaman** (1924), listed the Heckel-Kner's (1858) *Alburnus breviceps* as a synonym of *A. alburnus*. Žukov's (1965) observations, based on his rich material of the bleak from Belorussia, from both river drainages, namely the river Zapadnaja Dvina (mouthing into the Baltic Sea) and the Dniepr (Black Sea), are similar to those by Siebold (1863). E.g., the maximum body depth in the bleak from Pskov Lake (USSR) is 19.2—24.0, ave. 21.3% of the body length. According to Žukov (1965), ranges concerning body depth in % of the body length are 17.7—26.0, ave. 22.7. Žukov (1965) believes that the lake morpha of the bleak designated by Berg (1949) as "*lacustris*" does not exist, because the values of the body depth which were supposed to be typical can be found within the ranges of the individual variability of the bleak inside the area of distibution in the river Dniper drainage. For a complete review of various forms of the bleak see Berg (1932, 1933).

Siebold (1863) was apparently the first to draw attention to Agassiz's (1828) contribution to the variability in the body depth of the bleak. Siebold (l.c.) added the variability in the position of the mouth as regards its more or less oblique position The eye size and length of the paired fins also show a great variability. The begining of the insertion of the anal fin base is sometimes vertically below the end of the dorsal base, sometimes shifted more in the oral direction (Siebold 1863). As to the difference of plastic characters among sexes it may be stated that in the bleak from the Slapy reservoir they are very small(see Table 4). Similar results were obtained earlier by Oliva (1952), Michailowa (1963) and Gasowska (1974). Only Oliva (1952) found a larger difference among sexes in the bleak from the Elbe drainage (7%) as regards the legth of V in % of the V. A distance However this character has shown very large ranges of values (see also values of the bleak from the Slapy reservoir, Table I).

Meristic characters, when males and females are separated (the case of the sample from the Slapy reservoir), are similar (see Table 4). This fact was also confirmed by Oliva (1952). Michailowa (1963) and Gasowska (1974).

The variability of the lateral line scales is demonstrated in Table 3. Varbica bleak has a considerably smaller number of lateral line scales (ave. 47), as compared with the Russian ones (ave 50.29), the bleak from the Slapy reservoir (ave. 49.39), from the Dniepr drainage in Belorussia (47.96), from the central part of the river Zapadnaya Dvina (48.3). The bleak from Bohemia has almost the same number of lateral line scales as the Varbica bleak (ave. 46.34, Oliva and Šafránek 1962).

The majority of the 43 localities cited by Gasowska (1974) show greater average values than those found by us in the Varbica bleak, but also in the Slapy reservoir bleak Lower values were found only in the bleak from the Odra (46.97), n = 35), the Struma (43.17, n = 100), and from the lower part of the river Ural (46.80, n = 20).

The bleak from Lake Doiran, considered first by Karamana (1924) as the typical subspecies, has 48—52 lateral line scales. This form of the bleak was later described by Karaman (1929) as the separate subspecies *A. alburnus macedonicus*(not "*macedonius*" as erroneously printed in Vuković, Ivanović (1971). The number of lateral line scales was enlarged according to latter authors to 50—52. When we used data of the lateral line scales of the single samples of the bleak from the Baltic Sea drainage following Berg (1933), the number of scales has shown ranges 46—54, ave. 49.0. For the whole material of the bleak from the territory of the European part of the USSR the average is 50.29, ranges 46—55, using all Berg's (1933) data. Therefore it is interesting that Žukov (1965) found the average being 47.96 for the

Karaman (1924)

	Alburnus alburnus the Sava	"*Alburnus alborella*" the Neretva	"*Alburnus scoranza*" Lake Ohrid	"*Alburnus belvica*" Lake Prespa
Total length (mm)	125 — 145	111—113	121 - 147	120 - 148
In % of the body length				
its depth	23 - 27	22— 25	22 - 24	22 — 24
head length	20,5— 23	23— 24	23 25	25,5— 26.5
In of the head length:				
eye diameter	28 — 30	26— 27	24— 29	23 — 25
In % of the preorbital distance:				
eye diameter	100	100	100	100

bleak from the Dniepr drainage (ranges 45—52) and the ave 48.30 (ranges 46—53) from the river Zapadnaya Dvina drainage. Apparently Berg (1933) had for his disposal most of the material examined from the more northern territories of the natural occurrence of the bleak. Therefore it is full of interest that also the bleak from the Danube, in the most southern territory of its natural distibution, possesses a high number of lateral line scales, 47—52, exceptionally only 45 (Banarescu 1964). Therefore, when we evaluate only the number of lateral line scales and not other characters, the Varbica bleak can be listed into the typical subspecies, *A. alburnus alburnus*, the same as the Danubian and Lake Doiran populations (50—52 scales, Karaman 1929). This fact has probably influenced Tortonese (1971) to enlist the Italian bleak "*alborella*" into the subspecies of the nominal form, because "*alborella*" has also 42—51 lateral line scales and in this character does not differ much from the nominal form. Concerning the dorsal soft fin rays, the constant number 8 repeats in most populations, including "*alborella*". Because Manfredi (1916) apparently listed all fin rays altogether (also those in the anal fin), we have substracted 3 from her total number of rays and thus we have received results summarized in Table 3. Very interesting are the specimens of the bleak from the reservoir Slapy with mostly 9 soft rays in anal (in 92 % of all examined specimens; see Table 3 and 4). The average value of 8.92 is the highest when compared with the values mentioned by Gasowska (1974). Also very interesting is the shifting of the number of soft rays in the dorsal fin towards 7, but not in the southern direction, as could be expected, but on the contrary in northern localities Gasowska (1974) assumed that due to the higher average temperature the number of anal rays and vertebrae decreases towards south. A decrease in the number of lateral line scales was not confirmed.

When we return to the number of soft anal rays, the Varbica bleak obviously differs from *A. alburnus macedonicus* Karaman, 1929, having 15 anal rays -if the data of Karaman are correct and if his material was sufficient to embrace the variability. The small number (15) of anal rays was emphasized by Karaman (1929) as compared with the 18 rays in the "typical bleak"; see also Vuković and Ivanović (1971). Oliva and Šafránek (1962), however, found only 16 anal rays

Table 6. Number of lateral line scales

Drainage	Author	n	ranges	M ± m	σ
North Sea					
Labe drainage	(Oliva, Šafránek, 1962)	401	40 – 52	47.39 ± 0.10	2.09*
Baltic Sea					
Zap. Dvina	(Žukov, 1965)	49	46 – 53	48.30 ± 0.34	2.44
ave. from 9 Polish rivers	Gąsowska, 1974)	497	45 – 55	49.31*	—
ave. from 8 Polish rivers	(Gąsowska, 1974)	667	47 – 56	50.54*	—
Odra drainage	(Oliva, Šafránek, 1962	35	40 – 52	46.97 ± 0.50	2.99*
Pskov Lake	(Petrov, 1930)	82	46 – 55	50.62 ± 0.22	1.95*
White Sea					
Syamozero Lake	(Milinskij, 1941 in Gasowska, 1974)	54	44 – 55	51.4 ± 0.16	1.18
Adriatic Lake					
Ohrida Lake	(Oliva, 1950)	10	48 – 52	50.50 ± 0.45	1.43*
Ohrida Lake	(Dimovski et Grupče, 1971 in Gąsowska, 1974)	100	47 – 55	50.68	—
Prespa Lake	(Dimovski et Grupče, 1971 in Gąsowska, 1974	100	47 – 60	53.95	—
Aegean Sea					
Marica	(Michailova, 1963	58	43 – 52	—	—
Marica, Vardar, Struma	(Šiškov, 1941 in Gąsowska, 1974)	92	45 – 53	48.4 ± 0.13	1.25*
Doiran Lake	(Dimowski et Grupče, 1971 in Gąsowska, 1974)	100	47 – 57	50.82 ± 0.21	2.10*
Black Sea					
Dnepr	(Žukov, 1965)	49	45 – 52	47.96 ± 0.26	1.85
Dunaj drainage	(Oliva, Šafránek, 1962)	80	41 – 52	47.49 ± 0.26	2.35*
Tisa drainage	(Vladykov, 1931)	15	47 – 52	49.53 ± 0.34	1.30*
Caspic Sea					
Kura	(Petrov, 1930	76	39 – 46	41.76 ± 0.13	1.16*
Kama	(Kozmin, 1954 in Gąsowska, 1974)	100	45 – 51	48.16	
Ural	(Petrov, 1930)	42	43 – 49	45.93 ± 0.23	1.49*
Volga	(Gąsowska, 1974)	13	46 – 48	47.00	—
Total		2620			

* All these statistical values are calculated by authors of this paper

in most specimens (n = 86) of the bleak from the Cezchoslovak part of the Danube drainage; 18 rays occurred only in 7 % of examined specimens. In the material from the reservoir Slapy, the number of 18 anal rays was found at 52 % of examined specimens (see Table 3,4). Michailowa (1963) found the same average value (16.0, n = 58) of soft anal rays in the bleak from the middle course of the Marica, as we have found in our sample from the Varbica. *A. alburnus macedonicus* sensu Karaman (1929), Sabioncello (1967), Vuković and Ivanović (1971) may occur in Lake Doiran, in the river Vardar and the Strumica. It is interesting that Karaman (1924) heald this form of the bleak as "typical"; later (1929) he created a new subspecies form the bleak from this area. He also found the number of lateral line scales to be greater (in 1924 : l.lat.squ. 48—52, in 1929 : l.lat.squ. 50—52). The bleak may have also somewhat lower and thicker body. The Varbica bleak is not identical with *A. alburnus belvica* Karaman, 1924, from the lake Prespa. Thus subspecies has 12—14 soft anal rays, lateral line scales are more numerous: 50—52. Karaman drew attention to its longer lower jaw than in *A. a. alburnus*; the length of it may

Table 7. Number of ramified rays in the dorsal fin

Drainage	Author	n	ranges	M ± m	σ
North Sea					
Labe drainage	(Oliva, Šafránek, 1962)	509	7–9	7.91 ± 0.02	0.39*
Baltic Sea					
Zap. Dvina	(Žukov, 1965)	49	7–8	7.98 ± 0.02	0.14
ave. from 9 Polish rivers	(Gąsowska, 1974)	497	7–9	8.00*	—
ave. from 8 Polish lakes	(Gąsowska, 1974)	667	7–9	7.98*	—
Odra drainage	(Oliva, Šafránek, 1962)	44	7–9	7.98 ± 0.08	0.51*
Pskov Lake	(Petrov, 1930)	72	7–9	7.90 ± 0.04	0.38*
White Sea					
Syamozero Lake (USSR)	(Milinskij, 1941, in Gąsowska, 1974)	54	7–9	8.00	—
Adriatic Sea					
Ohrida Lake	(Oliva, 1950)	17	8–9	8.88 ± 0.08	0.33*
Ohrida Lake	(Dimovski et Grupče, 1971 in Gąsowska, 1974)	100	7–8	7.97	—
Prespa Lake	(Dimovski et Grupče, 1971 in Gąsowska, 1974)	100	7–10	8.05	—
Aegan Sea					
Marica	(Michailova, 1963)	58	7–9	—	—
Marica, Vardar, Struma	(Šiškov, 1941 in Gąsowska 1974)	92	7–9	8.00	—
Doiran Lake	(Dimowski et Grupče, 1971, in Gąsowska 1974)	100	7–9	8.07	—
Black Sea					
Dnepr	(*Žukov, 1965*)	79	7–9	8.17 ± 0.05	0.46
Dunaj drainage	(Oliva, Šafránek, 1962)	100	7–9	7.89 ± 0.04	0.39*
Tisa drainage	(Vladykov, 1931)	27	8–9	8.11 ± 0.06	0.32*
Rumania	(Banarescu, 1946)	47	7–9	8.06 ± 0.05	0.32*
Caspic Sea					
Kura	(Petrov, 1930)	258	7–9	7.89 ± 0.02	0.36*
Kama	(Kozmin, 1951, in Gąsowska, 1974)	100	7–10	8.18	—
Ural	(Petrov, 1930)	44	7–9	7.91 ± 0.05	0.36*
Volga	(Gąsowska, 1974)	13	7–8	7.85	—
Total		2927			

exceed the same length at *A. a. alburnus* by 25–33%. For the Prespa Lake this subspecies is listed also by otder authors (Sabioncello 1967, Vuković and Ivanović 1971). The large number of lateral line scales and the long lower jaw may suggest that in this case we could deal with some relict lake form of the genus *Chalcalburnus* (about them see Berg 1933). In anal fin this subspecies has only 12–14 soft rays.

For the Yugoslav *A. alburnus*, Vuković and Ivanović (1971) presented a very broad range of the number of lateral line scales (35) 40–52, generally 46–52. The number 35 is apparently low and seems to be improbable in *A. alburnus*. Obviously these broad ranges do not help to solve the problem of geographical variability of the bleak within the territory of Yugoslavia that belongs to three water drainages. The number of scales 46–52 falls exactly into the range) given by Pravdin (1948). Here it is also necessary to note that according to Vuković and Ivanović (1971) the pectoral fins do not reach the ventral ones. Sabioncello (1967) diminished the range of the lateral line scales to 46–53, which is more probable.

However, the Varbica bleak is not identical with *A. alburnus strumicae* Karaman, 1955, either at first, this subspecies may have the elevated body which sometimes occurs also in the typical form, as explicitly stated by Karaman (1955). The body depth is 28% (?) of the body length, head is 22% of the body length. In anal fin has only 14 rays. Unfortunately, no ranges, average, or the number of examined specimens are given. This bleak resembled *A. escherichi* Steindachner, 1897 (sensu Pellegrin, 1928) from Turkey, to Karaman (1955). The same diagnosis as Karaman's (1955) was repeated by Vuković and Ivanović (1971).

From our results it is obvious that we cannot simply proclaim the Bulgarian bleak from Thrakia (= Thessalia) as typical *Alburnus alburnus*, as it was done by Michailowa (1965), but we also cannot confirm Karaman's view (1955) that his *Alburnus alburnus strumicae* inhabits the whole drainage of the Aegean Sea. The Varbica bleak is closer to the typical form of the bleak than to Karaman's subsp. *strumicae*. We do not know the reason for this, Karaman's observations are probably based on a very limited material.

Concerning the "*alborella*" the important and laborious biometrical monograph of Manfredi (1916) is unfortunately based on measurements that are not generally used in ichthyology. Therefore, most of her results cannot be compared with other papers. The view of Tortonese (1971) that the "*alborella*" is only the subspecies of *A. alburnus* living southwards of Alps (l.lat.squ. 42—51, D III 7—8, A III 13—17) seems to be also debatable. Firstly, as shown by Berg (1933) the specific name *alborella* must be replaced due to the rule of priority by *albidus* Costa, 1838. Valenciennes 1844 : 245 cited literally the description of Costa (Fauna Neapol., Poiss., 15, tab. XIV), and he drew attention to an evident typographical error in this passage : in ventral 14 rays.... because in Costa's description "la figure ne represente pas les ventrales plus grandes qu'a l'ordinaire".

Berg (1932) recognized the subspecies *A. alburnus macedonicus* Karaman, 1929 (lake Doiran, the river Vardar between this lake and Skopje). Berg (1932) is not correct in supposing that also the bleak described by Kovačev (1921) as *Alburnus lucidus* from the river Struma and the river Marica belongs to this subspecies ("*macedonicus*"). *Alburnus alborella* (non Filippi) Kovačev, 1921 from the river Osm, tributary of the Bulgarian part of the Danube, is the form of the bleak closely related to *A. alburnus macedonicus* (Berg 1932).

In northern Italy, in the drainage of the river Po, Adige (Etsch), eastwards as far as the Isonzo, a vicariant form, *Alburnus albidus alborella* (Filippi) = *Aspius alborella* Filippi, 1844, occurs, possessing according to Berg (1933), the following formula of fin rays and lateral line scales: A III 13—16(17), regularly III 14—15, l.lat.squ. 44—50, vertebrae: 37—39. According to Tortonese (1970): D III 7—8, A III 13—17, l.lat. squ. 42—51. For further details see Table 3.

The difference between both vicariant species seems to be evident. In southern Italy, the river Sele (40° 30′ of the NLat, drainage of the Tyrrhenean Sea), in the Sinni and the Basento, affluents of the Ionian Sea, the typical *Alburnus albidus* Costa, 1838, occurs (Berg 1932). In this form, following Berg (1932, 1933) the same direction of some characters which are typical for *A. alborella* is expressed more evidently: A III (10) 11—13 (14), lateral line scales 42—48, generally 44—45, the size still smaller. Besides the drainage of the river Po, *Alburnus albidus alborella* occurs also in the streams mouthing into the northern part of the Adriatic Sea (the Isonzo and others) and it also occurs in Dalmacia (Imotski, Vrgorac, Narenta and others). Berg (1933) rightly recognized that *Alburnus scoranza* Heckel (see also Heckel and Kner, 1858) must be synonymous with *alborella*. The same view was published

Table 8. Number of ramified anal rays

Drainage	Author	n	ranges	M ± m	σ
North Sea					
Labe drainage	(Oliva, Šafránek, 1962)	473	14–20	17.22 ± 0.05	1.10*
Baltic Sea					
Zap. Dvina	(Žukov, 1965	49	16–18	17.24 ± 0.09	0.69
ave from 9 Polish rivers	(Gąsowska, 1974)	479	15–21	17.86	—
ave from 8 Polish lakes	(Gąsowka, 1974)	667	15–21	17.36*	—
Odra drainage	(Oliva, Šafránek, 1962)	41	16–20	16.61 ± 0.29	1.86*
Pskov Lake	(Petrov, 1930)	72	14–20	16.75 ± 0.15	1.31*
White Sea					
Syamozero Lake	(Milinskij, 1941 in Gąsowska, 1974)	54	15–22	18.04 ± 0.16	1.18*
Adriatic Sea					
Ohrida Lake	(Oliva, 1950)	17	13–16	14.35 ± 0.19	0.79*
Ohrida Lake	(Dimovski et Grupče, 1971 in Gąsowska, 1974	100	12–15	13.23	—
Prespa Lake	(Dimovski et Grupče, 1971 in Gąsowska, 1974)	100	12–15	13.05	—
Aegan Sea					
Marica	(Michailova, 1963)	58	15–18	16.00	—
Marica, Struma, Vardar	(Šiškov, 1941 in Gąsowska, 1974)	92	14–19	16.72 ± 0.09	0.86*
Doiran Lake	(Dimovski et Grupče, 1971 in Gąsowska, 1974)	100	14–17	15.29 ± 0.06	—
Black Sea					
Dnepr	(Žukov, 1965)	79	15–20	14.47 ± 0.11	1.00
Dunaj drainage	(Oliva, Šafránek, 1962)	86	14–19	16.28 ± 0.10	0.93*
Tisa drainage	(Vladykov, 1931	28	16–19	17.71 ± 0.15	0.81*
Rumania	(Banarescu, 1946)	47	15–20	17.55 ± 0.16	1.12*
Caspic Sea					
Kura	(Petrov, 1930)	268	11–16	12.85 ± 0.05	0.88*
Kama	(Kozmin, 1951 in Gąsowska 1974)	100	17–21	18.55 ± 0.10	1.00*
Ural	(Petrov, 1930)	44	14–18	16.39 ± 0.16	1.06*
Volga	(Gąsowska, 1974)	13	16–19	17.46	—
Total		2967			

also by Sabioncello (1967). The latter author enumerated following localities: the river Soča, Lake Skadar (= Scutari), Lake Ohrid. The same view was expressed earlier by Berg (1933). *Alburnus scoranzoides* Heckel et Kner, 1858 from the Monte Negro resembles *Alburnus albidus* in the number of rays (A III 10—11, l.lat.squ. 41—42). According to Berg (1933) *Alburnus fracchia* Heckel et Kner, 1858, from the Treviso, is *A. albidus alborella* („the alborella"). The Northcaucasian species *Alburnus* *charusini* Herzenstein, is very closely related to *Alburnus albidus alborella* in Berg's view (1933).

It is a well known fact (see e. g. Berg 1932, 1933, 1949, Drenski 1951, Banarescu 1960, 1964, Landiges and Vogt 1965) that the genus *Alburnus* is totally absent on the Iberian peninsula, where it has not penetrated due to the geological history, in spite of the broad distribution of the bleak throughout the Appenine peninsula and the Balkans. Here many endemic subspecies of the bleak were described, perhaps correctly, due to the complicated geological history of the Dinaric water system (details see, e. g., in Komárek, 1953). No intergradation in bleak populations is possible now throughout the distribution of the bleak from Central, Northern and Northeastern Europe. The same is true of the southern slopes of the Alps and the lowlands of Italy, where, additionally, the Appennines make a north-south barrier after the retreat of the last Scandinavian glaciers. The bleak apparently penentrated as the postglacial immigrant into its recent European territory of distribution from Western Iran, Transcaucasia and Asia Minor, where it seems to be the centre of speciation within the genus *Alburnus*. It is from here that most recent species are known. The way of immigration of the bleak into the Mediaterranean part of Europe can be explained in a similar way as Komárek (1953) did for the genus *Varicorhinus*. At present landbridges and river connection existing in the past are lost. Westwards to the Iberian peninsula through this eastern way the penetration of the bleak to Spain and Portugal was not possible due to the early postglacial history of the basin of the Mediterranean Sea. The north-westward way from the recent France was closed earlier by the forming of the Pyrenees. Similar is the situation with the trend of the Italian bleak "*alborella*" to broaden its distribution to the north, where the way was closed by the Alps. The complicated repeatedly changing hydrological conditions of the Balkan peninsula were favourable for the forming of isolated endemic populations, not only of the bleak, but also of other fish species, later often proclaimed as subspecies or nationes, possibly also for the conservation of the very old rests of certain stil earlier fauna representatives of world distribution, as shown by many examples of Komárek (1953). Thienemann (1925) cited the bleak among other examples of fish species for which the Scandinavian peninsula forms the northern boundary of their geographic distribution.

SUMMARY

The morphometrical comparison of the bleak from different European localities within its area of the distribution is given. Sexual differences are minimal. The bleak *Alburnus alburnus* (Linnaeus, 1758) from the river Varbica (drainage of the river Marica, mouthing into the Aegean Sea, southern Bulgaria), has considerably larger head (26—28, ave. 25), longer base of D (11—12, 11.6), P 21—22, ave. 21.1), V (14—16, ave. 15.4), higher D (13—21, ave. 19.0), A (14—17, ave. 15.2) smaller body depth (14—22, ave. 20.5), all proportions expressed in the percentage of the body length without caudal fin, when compared with other populations of the bleak from the Balkans and the nominal form. The latter must be attributed to the Baltic Sea drainage in Sweden due to its natural occurrence. The Varbica bleak shows also a shorter preorbital distance (22—29, ave. 25.2), larger postorbital distance (45—54, ave. 50.5), when expressed in % of the head length. In 72 specimens studied in the dorsal fin were always found 8 soft (ramified) rays, in the anal fin 14—17, ave. 16.0 rays and 43—51, ave. 47.0 scales in the lateral line. We have also taken into consideration the data on the bleak from the Karelia (USSR) up to the delta of the Danube and the Balkans, together with the data on the forms of the bleak described from

Italy as separate species or subspecies. The bleak from Italy represents apparently the separate species *Alburnus albidus*. The bleak from the Varbica seems to be the separate subspecies of the second rank (natio), which is distinct not only from the typical form, but also from the form of the bleak inhabiting the more westward affluent of the Aegean Sea, namely the river Struma, which was described as *A. alburnus strumicae* Karaman, 1955.

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The plates 1 and 2 will be found at the end of this issue.

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NEW EOSENTOMON AND ACERENTULUS SPECIES (PROTURA) FROM FEDERAL REPUBLIC GERMANY

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Abstract. Four new *Eosentomon* species and one new *Acerentulus* species from the southern part of the Federal Republic Germany are described: *Eosentomon foliaceum* sp. n., *Eosentomon fichteliense* sp. n., *Eosentomon funkei* sp. n., *Eosentomon stumppi* sp. n. and *Acerentulus ochsenhausenus* sp. n. All these species were found in the soil of spruce forests.

During extensive ecological studies in spruce forests in the southern part of the Federal Republic Germany a rich material of Protura has been collected. These ecological studies were started and conducted by Prof. Dr. W. Funke, head of the Department of Animal Ecology and Morphology at the University of Ulm. During ecological investigations of the spruce forest soil fauna a special attention was paid to the ecology of Protura. The detailed studies of the proturan ecology were carried out by J. Stumpp as a theme of his PhD dissertation. The Protura were sent to me for a taxonomical evaluation. The rich material was very interesting not only from the taxonomical point of view, but it contains also taxa highly interesting for further phyletical studies. In one species the variability of some morphological characters important in contemporary proturan taxonomy was studied in detail by Rusek and Stumpp and the results are prepared to be published in a separate contribution.

DESCRIPTIONS OF THE NEW SPECIES

Eosentomon foliaceum sp. n. (Figs. 1—3)

Diagnosis: 1230 μm long. Anterior additional chaeta missing on head. PR = 6.25 On mesonotum and metanotum chaeta pl'as long as pl. Tracheal camerae dilated basally. Foretarsi with conspicuous long and wide, leaf-shaped, flat sensilla b'2, sensilla b'and c'missing, TR = 4.7. Basal chaeta of tarsi III thin, setaceous. Chaeta a 3 missing on abdominal tergites IV—VII. Abdominal tergite VII without chaetae al, a2 and a3, chaeta pl'reaching to hind tergite margin. Chaetotaxy of abdominal sternites VIII—X $\frac{0}{7}$ 44. Penis with long basiphallar chaetae.

Description: Body of typical *Eosentomon*-shape. 1230 μm long and 210 μm wide. Colour goldish yellow. Head 125 μm long and 100 μm wide. Pseudoculus 20 μm in diameter; PR = 6.25. Dorsal chaetotaxy of head as in Fig. 1D, anterior additional chaeta missing, posterior one (pa) present on head. Chaetae on head short, subposterior chaeta (sp) 12 μm and posterior one (p) 6 μm long (Fig. 1D). Labral chaeta lb present, 7 μm long, rostral chaeta r shorter than subrostral chaeta sr (Fig. IE). Lateral and dorsal sensilla of maxillary palpus (Fig. lJ) of the same length.

Chaetae on mesonotum (Fig. 1A) and metanotum short. pl'posteriorly to line pl-p2; p2'short. Length of mesonotal chaetae pl : pl' : p2 : p2' : p3 as 13 : 13 :

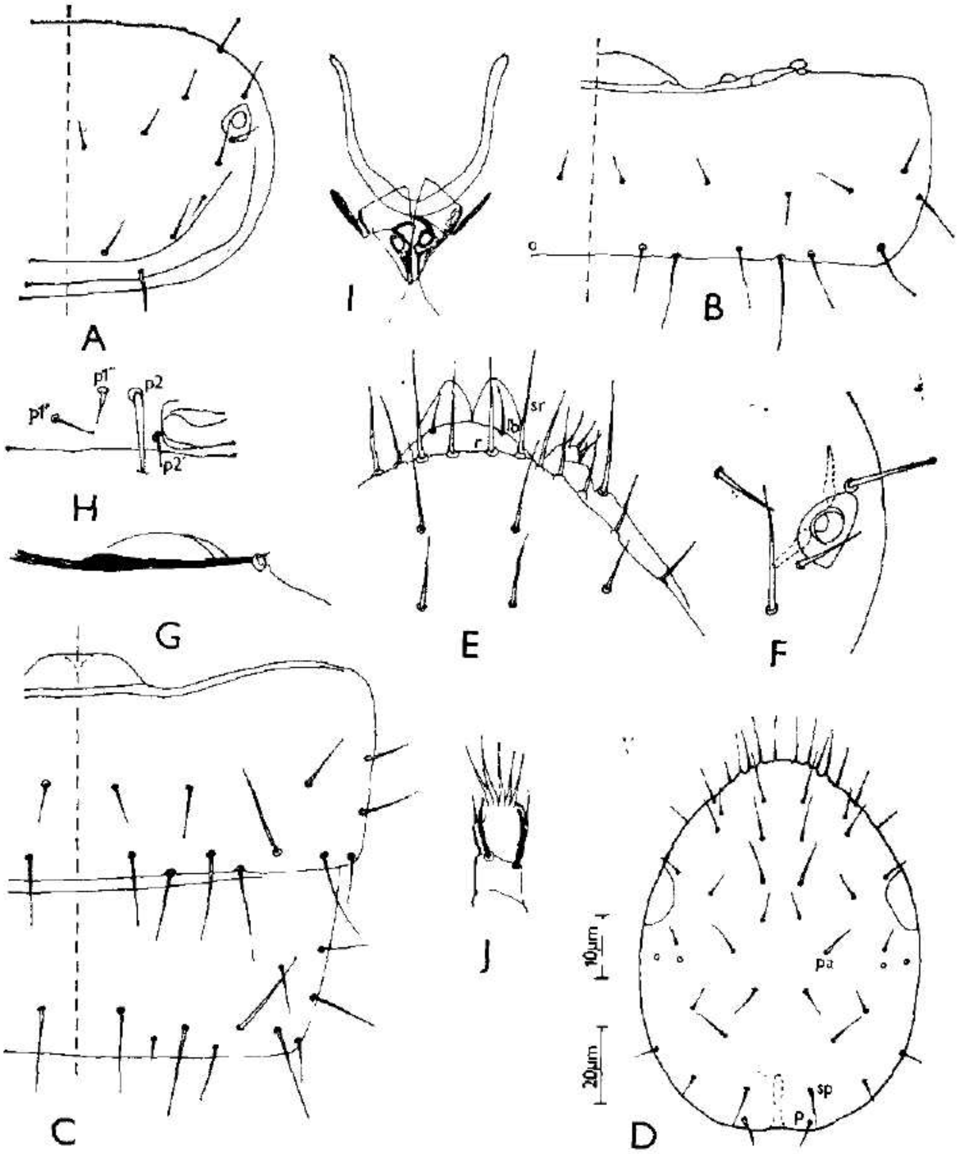

Fig. 1. *Eosentomon foliaceum* sp. n.: A — chaetoaxy of right half of mesonotum; B — chaetotaxy of right half of abdominal tergite III; C — chaetotaxy of right half of abdominal tergites VI—VII; D — chaetotaxy of dorsal side of head; E — chaetotaxy of labrum and frontal part of head (dorsally); F — tracheal camerae and stigmal opening on metanotum; G — laterostigma III; H — chaetotaxy of posterior part of abdominal tergite VIII; I — female squama genitalis; J — maxillary palpus. Scale: Figs. A—D : 20 µm; E—J: 10 µm.

: 15 : 7 : 16 µm. Stigmal openings on notal surface 6 µm in diameter, tracheal camarae (Fig. 1F) short (7—10 µm), dilated basally.

Foretarsus (Figs. 2A, B) with conspicuously large, foliaceous sensilla b'2 and missing sensillae b' and c'. Sensillae c and f2 slightly, g and e strongly dilated in

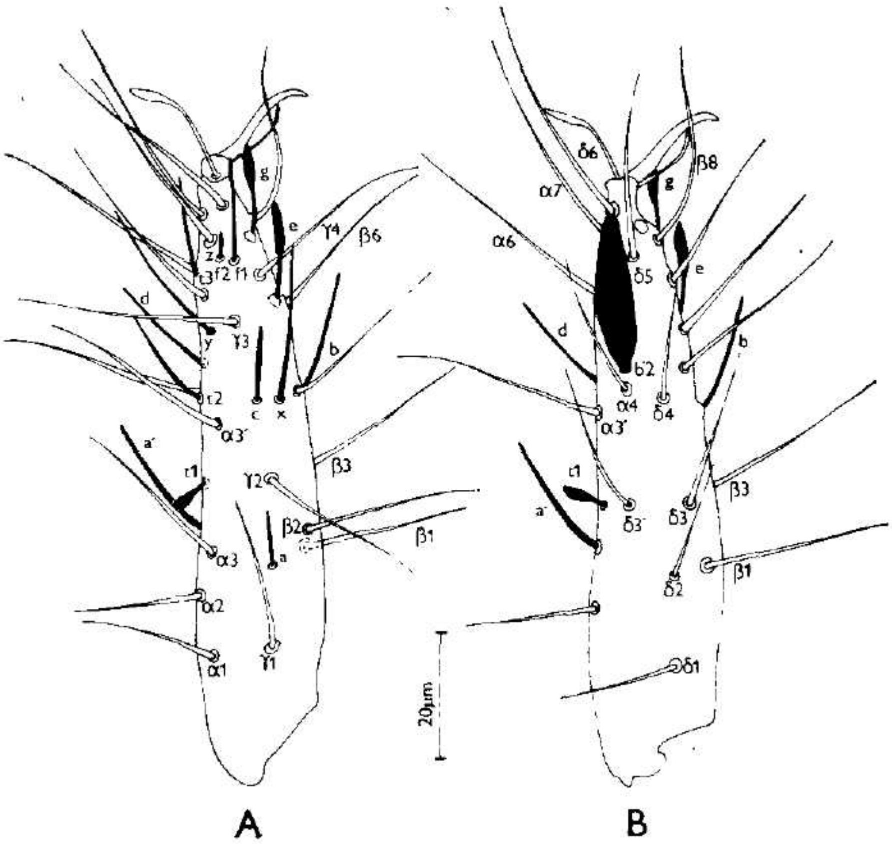

Fig. 2. *Eosentomon foliaceum* sp. n.: A — dorsal side of foretarsus; B — ventral side of foretarsus. Scale: Figs. A, B : 20 µm.

apical third. Sensilla a : b : c : d : e : f : f2 : g : a' : b' : b'2 : t1 : t2 : t3 as 9 : 20 : : 12 : 17 : 14 : 14 : 6 : 16 : 22 : 25 : 8 : 17 : 13 µm.

Length of foretarsus 95 µm, claw 20 µm, empodial appendage 15 µm; BS = 1.0, TR = 4.7, EU = 0.75. Empodial appendage II and III very short, basal chaeta of third pair of legs thin, setaceous (Fig. 3C).

Abdominal chaetotaxy as in following formula (Figs. 1B, C, 3A, B):

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
d	$\frac{4}{10}$	$\frac{10}{14}$	$\frac{10}{14}$	$\frac{8^{2)}}{16}$	$\frac{8}{16}$	$\frac{8}{16}$	$\frac{4^{3)}}{16}$	$\frac{6}{9}$	8	8	8	$\frac{6}{3}$
v	$\frac{4}{4}$	$\frac{6}{4}$	$\frac{6}{4}$	$\frac{6}{10}$	$\frac{6}{10}$	$\frac{6}{10}$	$\frac{6}{10}$	$\frac{0}{7}$	4	4	8	$\frac{8}{4}$

Posterior accessory chaetae on abdominal tergites I—VI longer than the principal ones (Figs. 1B, C); p1' on abdominal tergite VII short (6 µm) (Fig. 1C), posteriorly

[2)] a 3 missing; [3)] a1, a2 and a 3 missing (Fig. 1C) to level of p2, reaching to hind margin of tergite; pl''on abdominal tergite VIII thickened basally, on level of p2 (Fig. 1H). Dorsal chaetae on abdominal tergite X 8 μm long, on abdominal tergite XI 6 μm long. Antecosta (Figs. 1B, C) flexed in lateral part, with broad, but slightly visible anterior lobe. Laterostigma II—IV large, without reticulation (Fig. 1G). Abdominal sternite VIII whith lateral sclerotization (Fig. 3D). Female squama genitalis as in Fig. 1, male genitalia as in Fig. 3E, penis with long basiphallar chaetae.

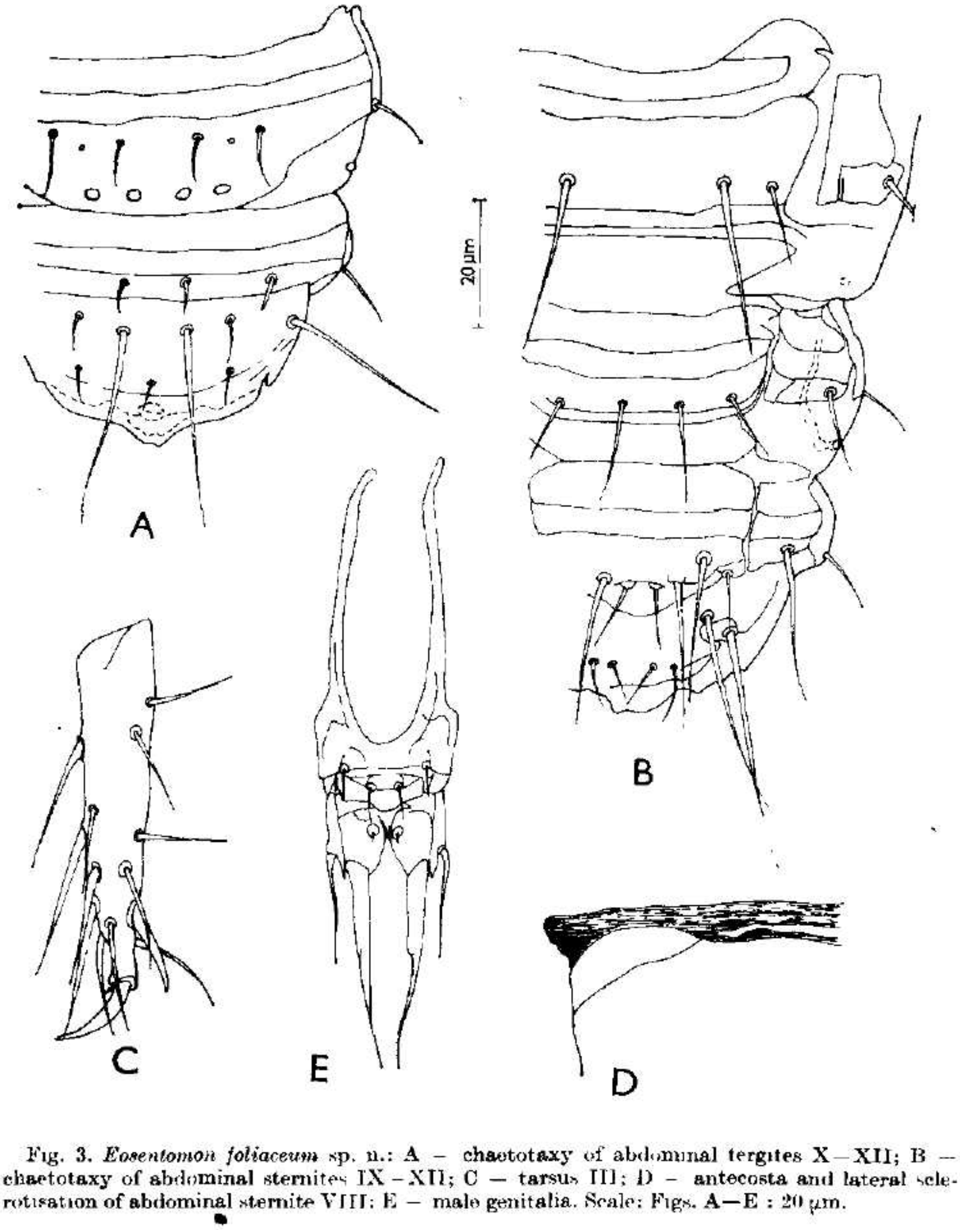

Fig. 3. *Eosentomon foliaceum* sp. n.: A — chaetotaxy of abdominal tergites X—XII; B — chaetotaxy of abdominal sternites IX—XII; C — tarsus III; D — antecosta and lateral sclerotisation of abdominal sternite VIII; E — male genitalia. Scale: Figs. A—E : 20 μm.

tomon-species. It is easily distinguishable by the very large, foliaceous sensilla b'2 on ventral side of foretarsi. Among the European *Eosentomon*-species it is the only one which has on abdominal tergites IV-VII in anterior row 8884 chaetae.

Holotype ♂ No. U1/151084 03N1 and 10 paratypes in the Institute of Soil Biology of the Czechoslovak Academy of Sciences at České Budějovice, 10 paratypes in the collection of the Department of Animal Ecology and Morphology, University of Ulm, Federal Republic Germany.

Locus typicus: Federal Republic Germany, Ulm, District XIV Eselsberg 3, University experimental forest, 610 m a.s.l., 60—70 years old spruce forest (*Picea abies*), soil type brown forest soil with moder to row humus. pH 3.1. The new species occured in the soil samples during the whole year.

Further locality: Federal Republic Germany, Ochsenhausen, experimental forest of the University Ulm, District XV "Am Spritzweiher", 520 m a.s.l., 60—70 years old spruce forest (*Picea abies*), soil type pseudogley to parabraunerde with moder to row humus, pH 2.9. February 1985 one male in soil samples.

Derivatio nominis: The name of the new species is derived from the leaf-like shape of the sensilla b'2 on foretarsi.

Eosentomon fichteliense sp. n. (Figs. 4—6)

Diagnosis: 1200 μm long. Anterior additional chaeta missing on head, PR = 9.6. On mesonotum and metanotum pl' litle longer than p1, p2' minute. Tracheal camerae dilated basally, thickset. Foretarsi with dilated sensillae c, e, g, f1, f2 and a' slightly thickened, TR = 5.9. Basal chaeta on tarsi III thick, spine-like. Chaeta a1 and a3 missing on abdominal tergite VII. Chaeta pl' on tergite VII reaching to hind tergite margin. Chaetotaxy of abdominal sternites VIII—X $\frac{9}{7}$ 66. Penis with short basiphallar chaetae.

Description (all measurements from holotype): Body 1200 μm long and 200 μm wide. Colour white. Head 115 μm long and 90 μm wide. Pseudoculus 12 μm long. PR = 9.6. *Dorsal chaetotaxy of head as in Figs. 4A, 6B; anterior additional chaeta* missing, posterior one (pa) present. Chaetae on head short, subposterior chaeta sp 12 μm and posterior one (p) 10 μm long (Fig. 4 A). Labral chaeta lb 8 μm, rostral chaeta r 10 μm and subrostral chaeta sr 13 μm long (Fig. 6B). Lateral and dorsal sensilla of maxillary palpus (Fig. 6D) of the same length.

Chaetae on mesonotum (Fig. 4B) and metanotum long, pl' posteriorly to line p1—p2; p2' minute, 3 μm long (Fig. 4B). Length of mesonotal chaetae p1 : p1' : p2 : p2' : p3 as 13 : 15 : 17 : 3 : 20 μm. Stigmal openings on notal surface 6 μm in diameter, tracheal camerae 7 and 9 μm long, dilated basally, thickset (Fig. 6C).

Foretarsus (Figs. 5A, B) with short and thin sensilla a, sensilla c dilated distally, sensillae e and g dilated in apical third, f1 dilated distally, longer than f2. Sensilla a' slightly thickened, b'2 thin and long, c' thin, shorter than b'2. Sensilla a : b : c : d : e : f1 : f2 : g : a' : b'2 : c' : t1 : t2 : t3 as 10 : 15 : 1 : 20 : 11 : 7 : 4 : 12 : 16 : 15 : 10 : 7 : 16 : 11 μm. Length of foretarsus 83 μm, claw 14 μm long, empodial appendage 13 μm; BS = 0.9, TR = 5.9. EU = 0.9. Empodial appendage II and III very short (1 μm), basal chaeta of third pair of tarsi spinelike, 12 μm long (Fig. 6E).

Abdominal chaetotaxy as in the following formula (Figs. 4C-G, 6A):

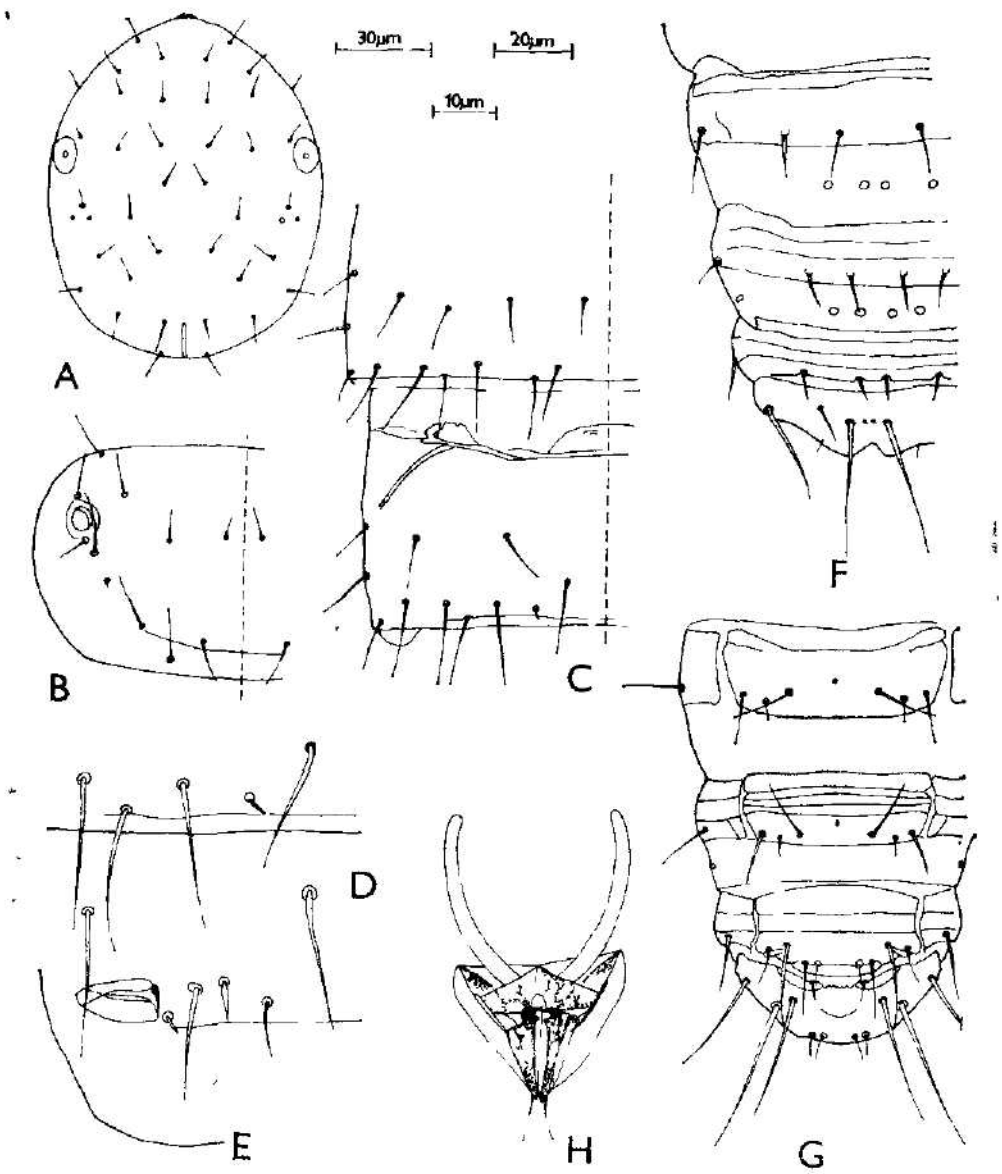

Fig 4. *Eosentomon fichteliense* sp. n.: A — dorsal chaetotaxy of head; B — chaetotaxy of left half of mesonotum; C — chaetotaxy of left half of abdominal tergites VI–VII; D — chaetotaxy of left part of abdominal tergite VII; E — chaetotaxy of left part of abdominal tergite VIII; F — dorsal chaetotaxy of left half of abdominal tergites IX–XII, G — chaetotaxy of ventral side of abdominal segments IX–XII; H — female squama genitalis. Scale: Figs. A–C: 30 µm; F, G: 20 µm; D, E, H: 10 µm.

d	$\frac{4}{10}$	$\frac{10}{14}$	$\frac{10}{14}$	$\frac{10}{16}$	$\frac{10}{16}$	$\frac{10}{16}$	$\frac{6^{2)}}{16}$	$\frac{6}{9}$	8	8	8	$\frac{6}{3}$
v	$\frac{4}{4}$	$\frac{6}{4}$	$\frac{6}{4}$	$\frac{6}{10}$	$\frac{6}{10}$	$\frac{6}{10}$	$\frac{6}{10}$	$\frac{0}{7}$	6	6	8	$\frac{8}{4}$

Posterior accessory chaeta on abdominal tergites I–VI almost of the same length (15–20 µm) as the principal chaetae (18–22 µm) (Fig. 4C); pl'on abdominal tergite VII short (4 µm) (Fig. 4D), behind line p1–p2, reaching hind tergite margin. Chaeta pl'' on abdominal tergite VIII 8 µm long, thickened basally, on level with p2, reaching to hind tergite margin (Fig. 4E). Dorsal chaetae on abdominal tergite X 11 µm long, these on tergite XI 7–8 µm long (Fig. 4F). Antecostae (Figs. 4C, 6F) thin, with slightly sclerotized central lobe. Laterostigma II–IV without reticulation (Fig. 6F). Lateral sclerotization on abdominal sternite VIII with hind margin not connected with antecosta (Fig. 6A). Female squama genitalis as in Fig. 4H. Penis (Fig. 6G) with short basiphallar chaetae.

Affinities: The new species is related to *E. pinetorum* Szeptycki, 1984. They differ clearly by the shape of some sensillae on foretarsi: a is reaching to $\frac{2}{3}$ distance

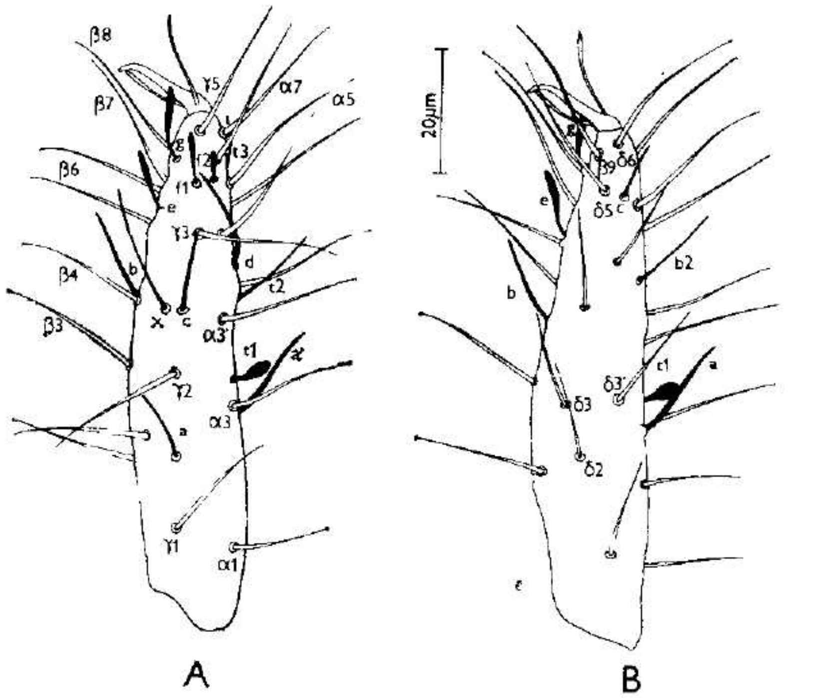

Fig. 5. *Eosentomon fichtelianse* sp. n.: A — dorsal side of foretarsus, B — ventral side of foretarsus. Scale: Figs. A, B: 20 µm.

[2)] a1 and a3 missing

a′ is slightly thickened and shorter than t2 in *E. fichteliense* (thin and longer than t2 in *E. pinetorum*), c is thickened apically in the new species (thin and longer in *E. pinetorum*). On abdominal tergite VIII p2′ is thin and almost as long as pl″ in *E. pinetorum*, whereas it is much more shorter and thick in *E. fichteliense* sp. n. (Fig. 4E).

Holotype No Fg4 12 84/69 ♂ and 6 paratypes in author's collection in the Institute of Soil Biology of the Czechoslovak Academy of Sciences, České Budějovice, Czechoslovakia, 7 paratypes in the Stumpp's collection in the Department of Animal Ecology and Morphology, University of Ulm, FRG.

Locus typicus: Federal Republic Germany, Bavaria, Fichtelgebirge mountains, Schneeberg, 700—980 m a.s.l., 50—70 years old spruce forest (*Picea abies*), soil sample from a podzol soil type with row humus, pH 3.2—3.3. 4.12. 1984 14 specimens.

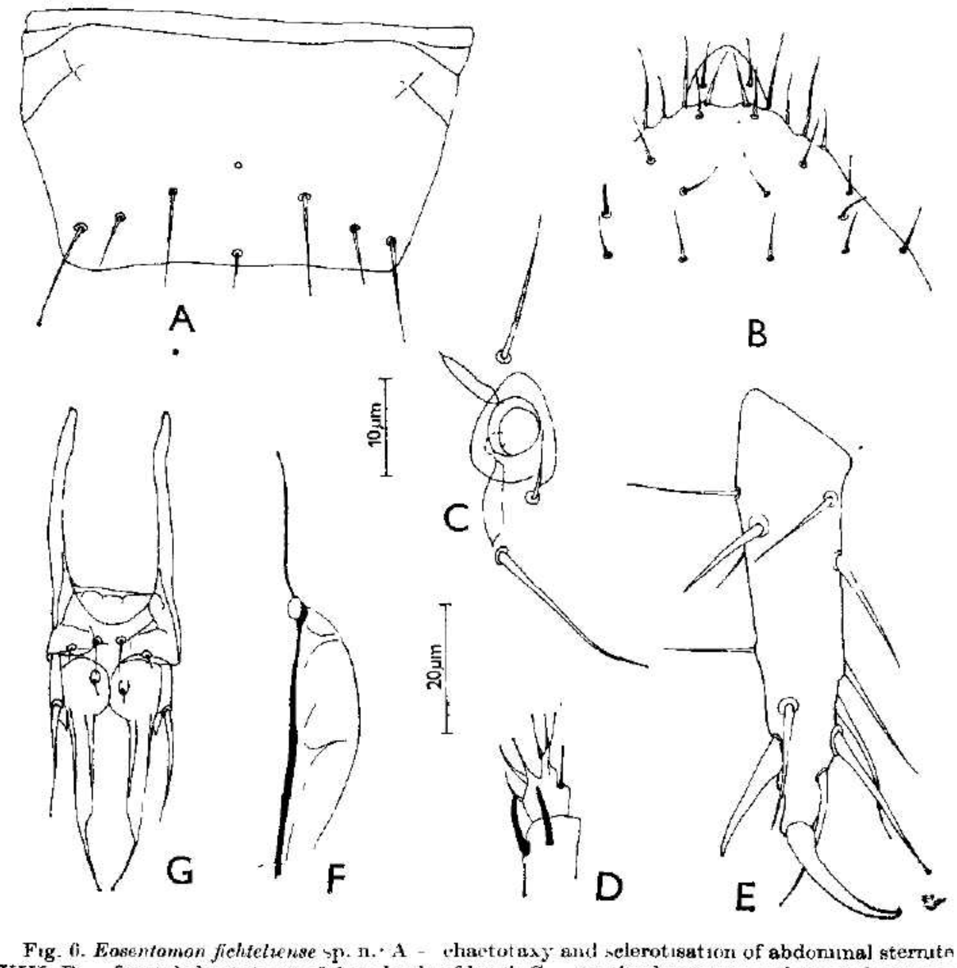

Fig. 6. *Eosentomon fichteliense* sp. n.: A — chaetotaxy and sclerotisation of abdominal sternite VIII; B — frontal chaetotaxy of dorsal side of head; C — tracheal camerae and stigmal opening on mesonotum; D — maxillary palpus, E — tarsus III; F — laterostigma III; G — male genitalia. Scale: Figs. A, B, G: 20 µm; C—F: 10 µm.

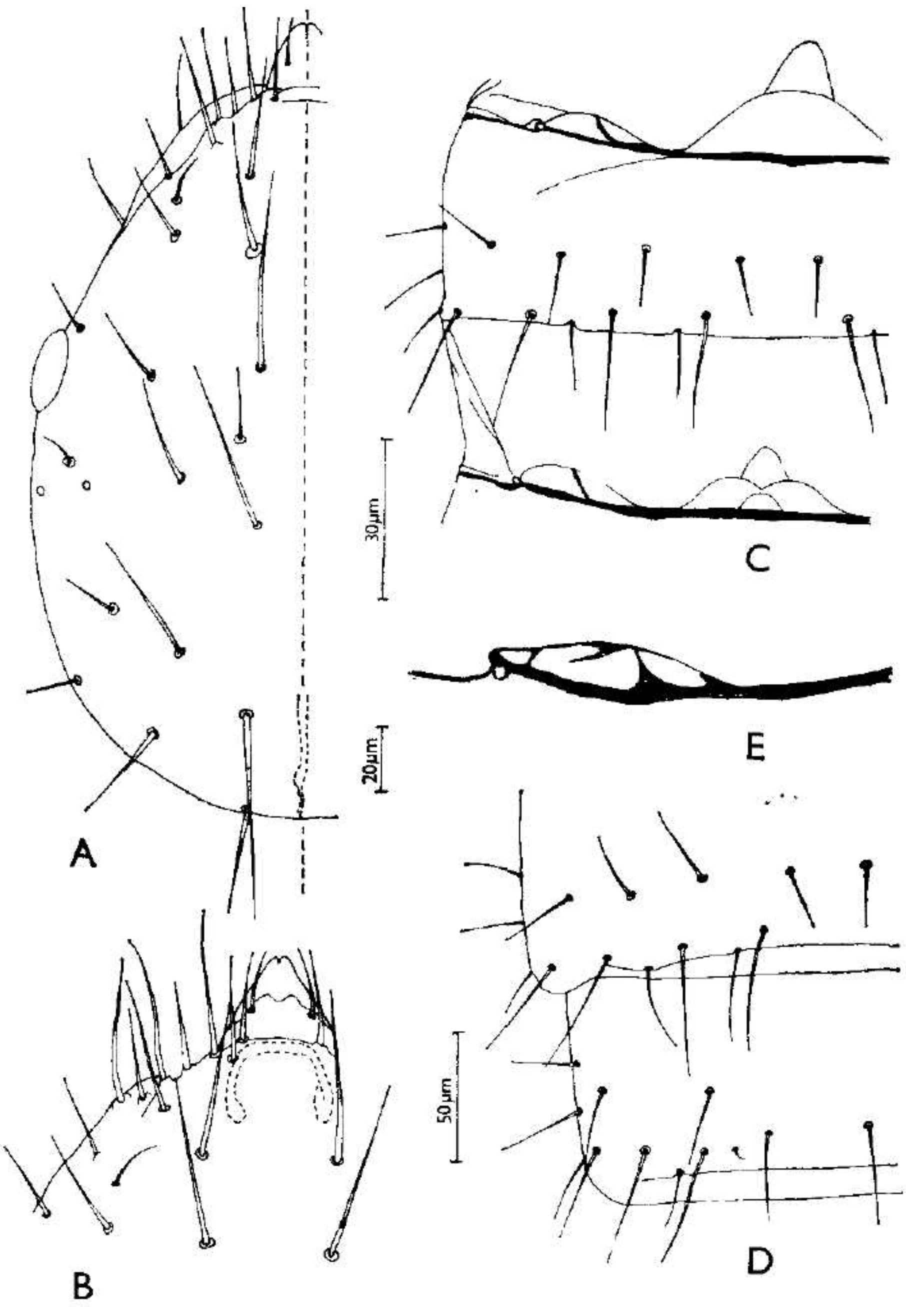

Fig. 7. *Eosentomon funkei* sp. n.: A — dorsal chaetotaxy of left half of head; B — frontal chaetotaxy of dorsal side of head; C — antecosta III and IV and chaetotaxy of left half of abdominal tergite III; D — chaetotaxy of left half of abdominal tergites VI–VII; E — laterostigma III and lateral part of antecosta III. Scale: Figs. A: 30 µm; B, E: 20 µm; C, D: 50 µm.

Derivatio nominis: The new species bears the mountain's name where it was found.

Eosentomon funkei sp. n. (Figs. 7—10)

Diagnosis: 1260—1460 μm long. Anterior additional chaeta missing on head; PR = 11. On mesonotum and metanotum chaeta pl' shorter than pl. Tracheal camerae distinctly dilated basally. Foretarsi with sensillae e and g dilated in apical third, TR = 5.2. Basal chaeta of tarsi III only slightly thickened. Chaetae a1 and a3 missing on abdominal tergite VII. pl' not reaching hind margin of abdominal tergite VII. Chaetotaxy of abdominal sternites VIII — X $\frac{0}{7}$ 66. Penis with moderate basiphallar chaetae.

Description (all measurements from holotype): Body 1460 μm long and 260 μm wide. Colour goldish yellow. Head 165 μm long and 105 μm wide. Pseudoculus 15 μm

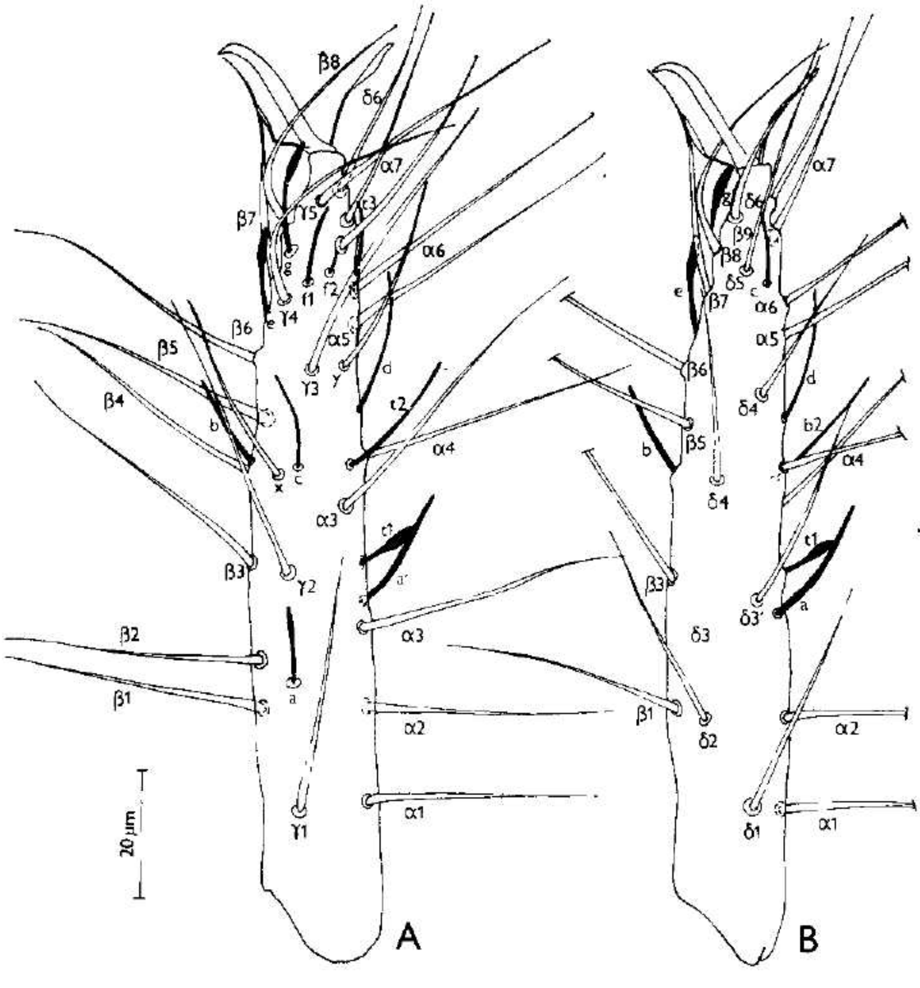

Fig. 8. *Eosentomon funkei* sp. n.: A — dorsal side of foretarsus; B — ventral side of foretarsus. Scale: Figs. A, B: 20 μm.

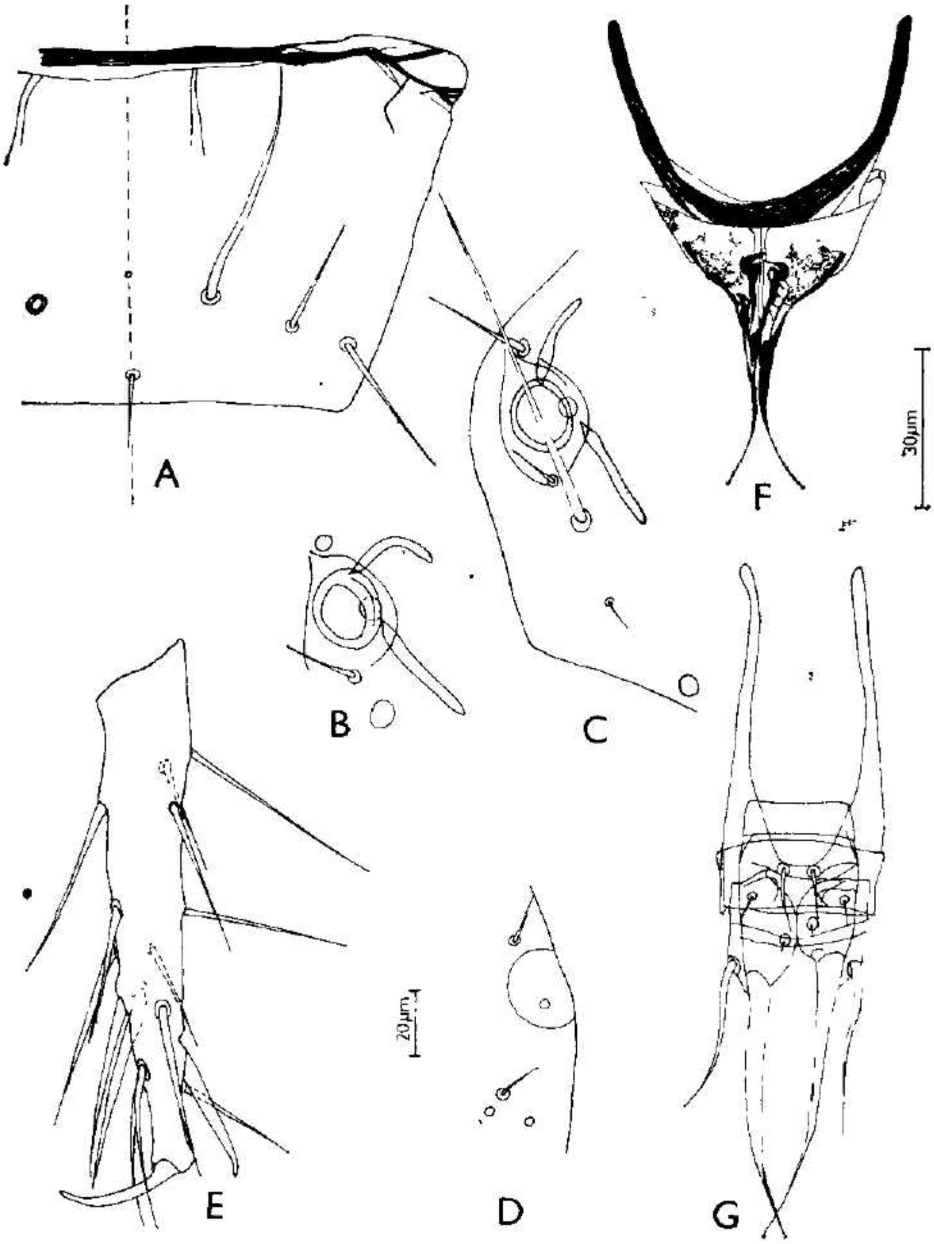

Fig. 9. *Eosentomon funkei* sp. n.: A — abdominal sternite VIII; B — tracheal camerae and stigma on metanotum; C — lateral part of mesonotum; D — pseudoculus; E — tarsus III; F — female squama genitalis; G — male genitalia. Scale; Figs. A : 30 µm; B—G: 20 µm.

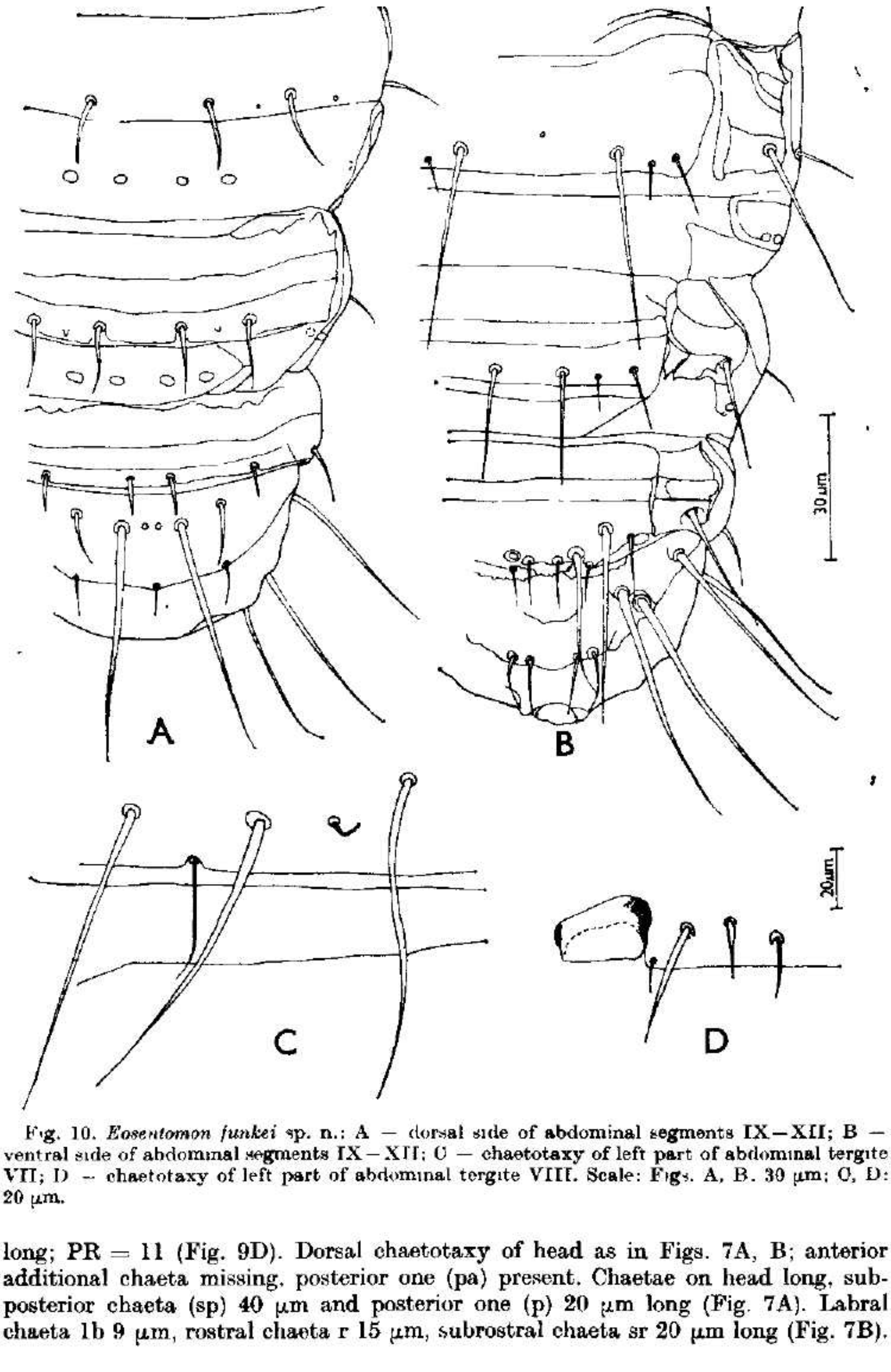

Fig. 10. *Eosentomon funkei* sp. n.: A — dorsal side of abdominal segments IX–XII; B — ventral side of abdominal segments IX–XII; C — chaetotaxy of left part of abdominal tergite VII; D — chaetotaxy of left part of abdominal tergite VIII. Scale: Figs. A, B. 30 µm; C, D: 20 µm.

long; PR = 11 (Fig. 9D). Dorsal chaetotaxy of head as in Figs. 7A, B; anterior additional chaeta missing, posterior one (pa) present. Chaetae on head long, subposterior chaeta (sp) 40 µm and posterior one (p) 20 µm long (Fig. 7A). Labral chaeta lb 9 µm, rostral chaeta r 15 µm, subrostral chaeta sr 20 µm long (Fig. 7B).

Chaetae on mesonotum and metanotum long, pl' posteriorly to line p1—p2; p2' 6 µm long (Fig. 9C). Length of mesonotal chaetae p1 : p1' : p2 : p2' : p3 as 45 : 26 : : 60 : 6 : 60 µm. Stigmal openings on notal surface 9 µm in diameter, tracheal camerae 20 and 14 µm long, dilated basally (Figs. 9B, C).

Foretarsus (Figs. 8A, B) with short and thin sensilla a, sensilla c thin, little longer than a, sensillae e and g dilated in apical third, f1 longer than f2, thin. Sensilla a'distinctly thickened, c'thin. Sensilla a : b : c : d : e : f1 : f2 . g : a' : b'2 : c' : t1 : : t2 : t3 as 14 : 13 : 13 : 22 : 16 : 13 : 8 : 15 : 20 : 22 : 14 : 10 : 21 : 21 µm.

Length of foretarsus 130 µm, claw 25 µm, empodial appendage 15 µm; BS = 0.96, TR = 5.2, EU = 0.6. Empodial appendage II and III very short (1 µm), basal chaeta of third pair of tarsi only slightly thicker than other chaetae (Fig. 9E).

Abdominal chaetotaxy as in following formula (Figs. 7C, D, 9A, 10A-D):

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
d	4/10	10/14	10/14	10/16	10/16	10/16	6[2]/16	6/9	8	8	8	6/3
v	4/4	6/4	6/4	6/10	6/10	6/10	6/10	0/7	6	6	8	8/4

Posterior accessory chaetae on abdominal tergites I—VI shorter (28—30 µm) than principal chaetae (50—55 µm) (Figs. 7C, D); pl' on abdominal tergite VII short (5 µm) (Fig. 10 C), on level of p2, not reaching hind tergite margin. Chaeta p1'' on abdominal tergite VIII 11 µm long, thickened basally on level with p2, passing hind tergite margin (Fig. 10D). Dorsal chaetae on abdominal tergite X 14—15 µm long, these on abdominal tergite XI 8—9 µm long (Fig. 10A). Antecostae (Figs. 7C, E) thin, with slightly visible central lobe. Laterostigma II—IV small, without reticulation (Fig. 7E). Abdominal sternite VIII without lateral sclerotization (Fig. 9A). Female squama genitalis as in Fig. 9F. Penis with moderate basiphallar chaeta (Fig. 9G).

Affinities: The new species belongs to the group with 10 anterior chaetae on abdominal tergite VI and 6 chaetae on abdominal sternites IX—X. It is related to *E. mixtum* Condé, 1945, *E. vulgare* Szeptycki 1984, *E. pinetorum* Szeptycki, 1984 and *E. fichteliense* sp. n., The relation of *E. funkei* sp. n. to these species is given in the following key:

1. Chaeta pl' does not reach hind margin of abdominal tergite VII 2
— Chaeta pl passing over hind margin of abdominal tergite VII 3
2. Length 1600—1650 µm, sensilla f1 on foretarsi thickened apically . . . . *E. mixtum* Condé, 1954
— Length 1280—1460 µm, sensilla f1 on foretarsi thin, filiform (Fig. 8A) . . . . . . *E. funkei* sp. n.
3. Tracheal camerae slim, long, maxillar palpi with short dorsal and long lateral sensila. . . . . . . *E. vulgare* Szeptycki, 1984
— Tracheal camerae thickened and short 4
4. Foretarsi with short sensilla a, thin sensillae a and c. On abdominal tergite VIII chaeta p'2 long . . . . *E. pinetorum* Szeptycki, 1984
— Foretarsi with long sensilla a, thickened sensilla à and slightly thickened sensilla c (Fig. 5A). Chaeta p'2 on abdominal tergite VIII short (Fig. 4E) . . . . *E. fichteliense* sp. n.

Holotype No. Fg 4.12.84/82D and one paratype in the Institute of Soil Biology of the Czechoslovak Academy of Sciences at České Budějovice, Czechoslovakia, one paratype in the collection ot the Department of Animal Ecology and Morphology, University of Ulm, Federal Republic Germany.

[2] a1 and a / missing

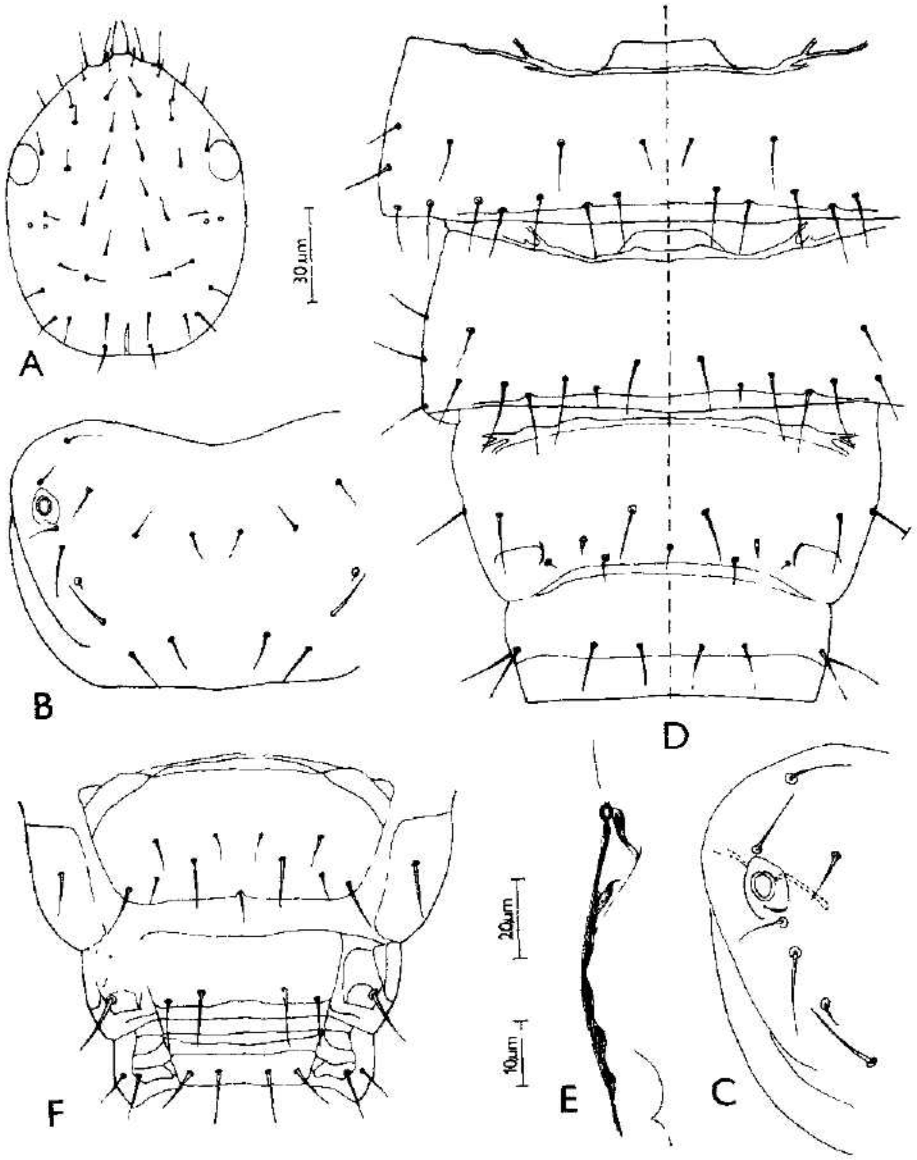

Fig. 11. *Eosentomon stumppi* sp. n.: A — dorsal chaetotaxy of head; B — chaetotaxy of mesonotum; C — left part of mesonotum; D — chaetotaxy of abdominal tergites VI–IX; E — laterostigma and antecosta III; F — ventral chaetotaxy of abdominal segments VIII–X. Scale: Figs. A: 30 µm; B, D, F: 20 µm; C, E: 10 µm.

Locus typicus: Federal Republic Germany, Bavaria, Fichtelgebirge mountains, Schneeberg, 700–980 m a.s.l., 50–70 years old spruce forest (*Picea abies*), soil samples from a podsol soil type with row humus, pH 2.6–2.9. 4.12. 1984 one specimen.

Further locality: FRG, Bavaria, Welzheimer Wald, Edelmannshof, 540 m a.s.l., 50–70 years old spruce forest *(Picea abies)*, soil samples with moder — raw humus, pH 3.2–3.3. 5.3 1985 two specimens.

Derivatio nominis: The new species is dedicated to Prof. Dr. W. Funke, head of the Department of Animal Ecology and Morphology (Biology III), University of Ulm, well known ecologist, working especially in forest ecology.

Eosentomon stumppi sp. n. (Figs. 11–13)

Diagnosis: 790 μm long. Anterior additional chaeta missing on head. PR = 7.9. On mesonotum and metanotum chaeta pl′ longer than pl. Tracheal camerae slim, without distinct dilatations. Foretarsi with sensillae e and g dilated in apical part, TR = 4.0. Basal chaeta of tarsi III thin, setaceous. Chaeta a 3 missing on abdominal tergite VI. Abdominal tergite VII with a4 and a5 chaetae only, pl′ reaching to hind tergite margin. Chaetotaxy of abdominal sternites VIII–X $\frac{0}{1}$ 44. Penis with short basiphallar chaetae.

Description (all measurements from holotype): Body 790 μm long and 150 μm wide. Colour white. Head 95 μm long and 70 μm wide. Pseudoculus 12 μm in diameter; PR = 7.9. Dorsal chaetotaxy of head as in Figs. 11A, 13F, anterior additional chaeta missing, posterior one (pa) present. Chaetae on head short, subposterior chaeta sp 8 μm and posterior one (p) 7 μm long (Fig. 11A). Labral chaeta lb 6 μm long, rostral chaeta r 11 μm long, subrostral chaeta sr 10 μm long, (Fig. 13F).

Chaetae on mesonotum (Figs. 11B, C) and metanotum short, pl′ posteriorly to line pl–p2; p2′ 6 μm long (Fig. 11C). Length of mesonotal chaetae pl : pl′ : p2 :

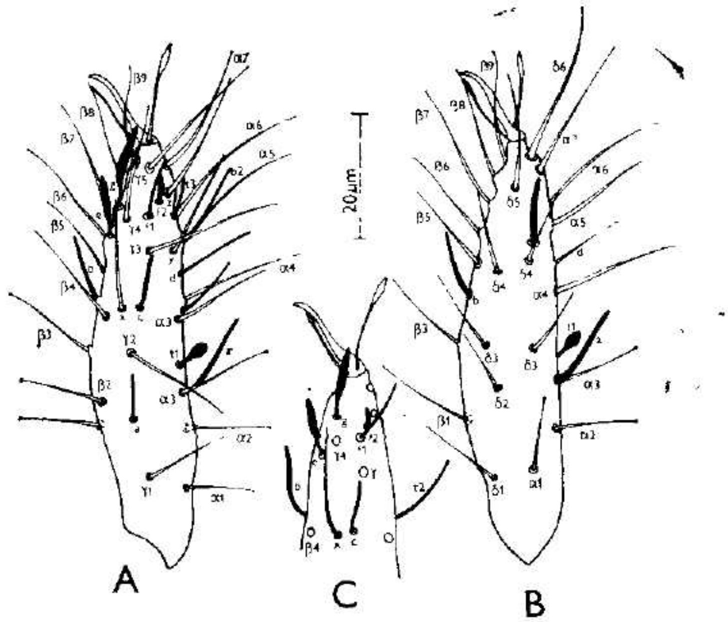

Fig. 12. *Eosentomon stumppi* sp. n.: A — dorsal side of foretarsus; B — ventral side of foretarsus; C — sensillae dorsally on distal part of foretarsus. Scale: Figs. A–C: 20 μm.

: p2' : p3 as 9 : 13 : 12 : 6 : 13 μm. Stigmal openings on notal surface 4 μm in diameter, tracheal camerae 10 μm long, slim, without dilatations (Fig. 13E).

Foretarsus (Figs. 12A, B) with short and thin sensilla a, thickened sensillae b, c, a' and c'; sensilla e dilated in apical half, g in distal $\frac{2}{3}$. Sensilla a : b : c : d : e : f1 : f2 : : g : a' : b2' : c' : t1 : t2 : t3 as 8 : 12 : 10 : 12 : 10 : 9 : 4 : 12 : 14 : 14 11 : 5 : 11 : : 8 μm.

Length of foretarsus 65 μm, claw 16 μm, empodial appendage 13 μm; BS = 0.9, TR = 4.0, EU = 0.8. Empodial appendage II and III very short (1 μm), basal chaeta of third pair of legs thin, setaceous (Fig. 13A).

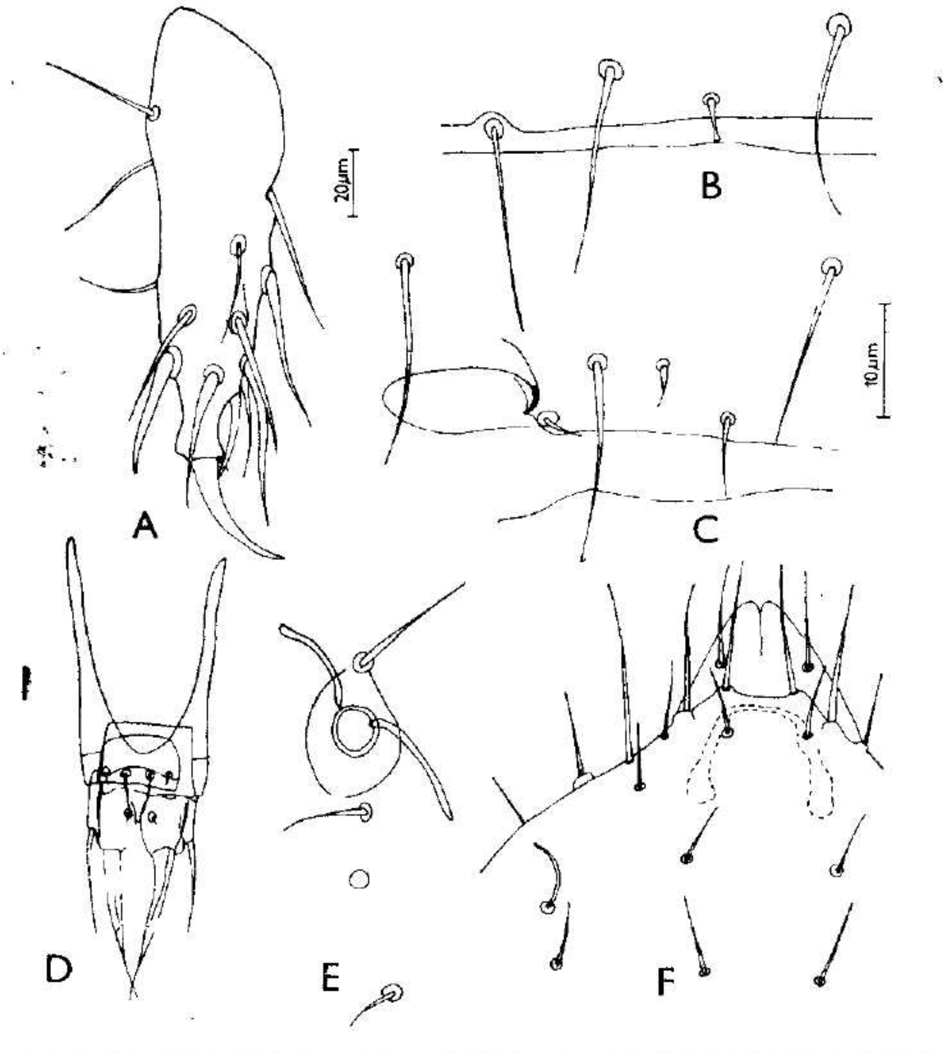

Fig. 13. *Eosentomon stumppi* sp. n.: A — tarsus III; B — chaetotaxy of left part of abdominal tergite VII; C — chaetotaxy of left part of abdominal tergite VIII; D — male genitalia; E — tracheal camerae and stigma on mesonotum; F — frontal chaetotaxy of dorsal side of head. Scale: Figs. A, D: 20 μm; B, C, E, F: 10 μm.

Abdominal chetotaxy as in following formula (Figs. 11D, F, 13B, C).

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
d	4/10	10/14	10/14	10/16	10/16	8[2]/16	4[3]/16	6/9	8	8	8	6/3
v	4/4	6/4	6/4	6/10	6/10	6/10	6/10	0/7	4	4	8	8/4

Posterior accessory chaetae on abdominal tergites I—VI longer than the principal ones (Fig. 11D); pl′ on abdominal tergite VII short (4 μm) (Fig. 13B), posteriorly to level of p2, reaching to hind margin of tergite. Chaeta pl″ on abdominal tergite VIII slim (Fig. 13C), 4 μm long, on level of p2. Dorsal chaetae on abdominal tergite X 7 μm long, these on abdominal tergite XI 5 μm. Antecostae (Figs. 11D, E) thin, with slightly visible central lobe Laterostigma II—IV large, without reticulation (Fig. 11E). Lateral sclerotisation on abdominal sternite VIII reaching with hidn margin to antecosta (Fig. 11F). Penis with short basiphallar chaetae (Fig. 13D).

Affinities: The new species is related to *E. armatum* Stach, 1927 and *E. noseki* Tuxen, 1982. *E. stumppi* sp. n. differs from them clearly by the position of the sensilla c′ on foretarsi. It lies distally from the line α6—δ6 in *E. armatum* and *E. noseki*, whereas in *E. stumppi* sp. n. the thickened c′ sensilla lies proximally from this line. In *E. armatum* are present both anterior and posterior additional chaetae on head, in *E. stumppi* sp. n. the anterior additional chaeta is missing.

Holotype ♂ No. Fg 4. 12. 84/36 26 in the Institute of Soil Biology of the Czechoslovak Academy of Sciences at České Budějovice, *one paratype in the collection of the Department* of Animal Ecology and Morphology, University of Ulm Federal Republic Germany.

Locus typicus: Federal Republic Germany, Bavaria, Fichtelgebirge mountains, Schneeberg. 700—980 m a.s.l., 50—70 years old spruce forest (*Picea abies*). Soil samples from a podsol soil type with row humus. pH 3.2—3.3. 4.12. 1984 two specimens.

Derivatio nominis: The new species is dedicated to its collector J. Stumpp, contributing by his PhD dissertation to the knowledge of proturan ecology.

Acerentulus ochsenhausenus sp. n. (Figs. 14—16)

Diagnosis: Length 1115 μm. Foretarsus 90 μm long, sensilla a thick, long, reaching to base of γ3, sensilla a′ thick, short, BS = 0.35, TR = 3.3, EU = 0.18. Chaetae al and pl′ missing on abdominal tergite VII. Comb VIII with 8—9 moderate teeth. Female squama genitalis with one apical spine on acrostyli.

Description (all measurements from holotype): Body 1115 μm long and 200 μm wide. Colour goldish yellow. Head 120 μm long and 90 μm wide. Chaetotaxy of head as in Fig. 16A. Pseudoculus 10 μm long and 11 μm wide, of typical *Acerentulus*-shape (Fig. 14C). Filamento di sostegno with 20 μm long distal part dilated terminally (Fig. 14D). Maxillary palpi with slim, setaceous sensillae, sensilla on labial palpi slim.

Foretarsus (Figs. 14A, B) 90 μm long. Sensilla a distinctly thickened, long, reaching to insertion of chaeta γ3; sensillae b—g slim and long. Sensilla t1 claviform, t2 very thin, t3 basally thickened, a′ thickened. Sensillae a : b : c : d : e : f : g : t1 : t2 : t3 : : a′ : b′ : c′ as 28 : 25 : 26 : 26 : 28 : 25 : 24 : 10 : 27 : 7 : 20 : 21 : 21 μm. Length of claw 27 μm, empodial appendage 5 μm; BS = 0.35, TR = 3.3, EU = 0.18. Chaetotaxy of tarsus III as in Fig. 15A.

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[2]) a3 missing, [3]) a1, a2 and a3 missing

Abdominal chaetotaxy (Figs. 15B, C, 16C, D) as in following formula:

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
d	6/10	8/12	8/12	8/12	8/12	8/14[2]	6[3]/16[4]	6/16	12	12	6	9

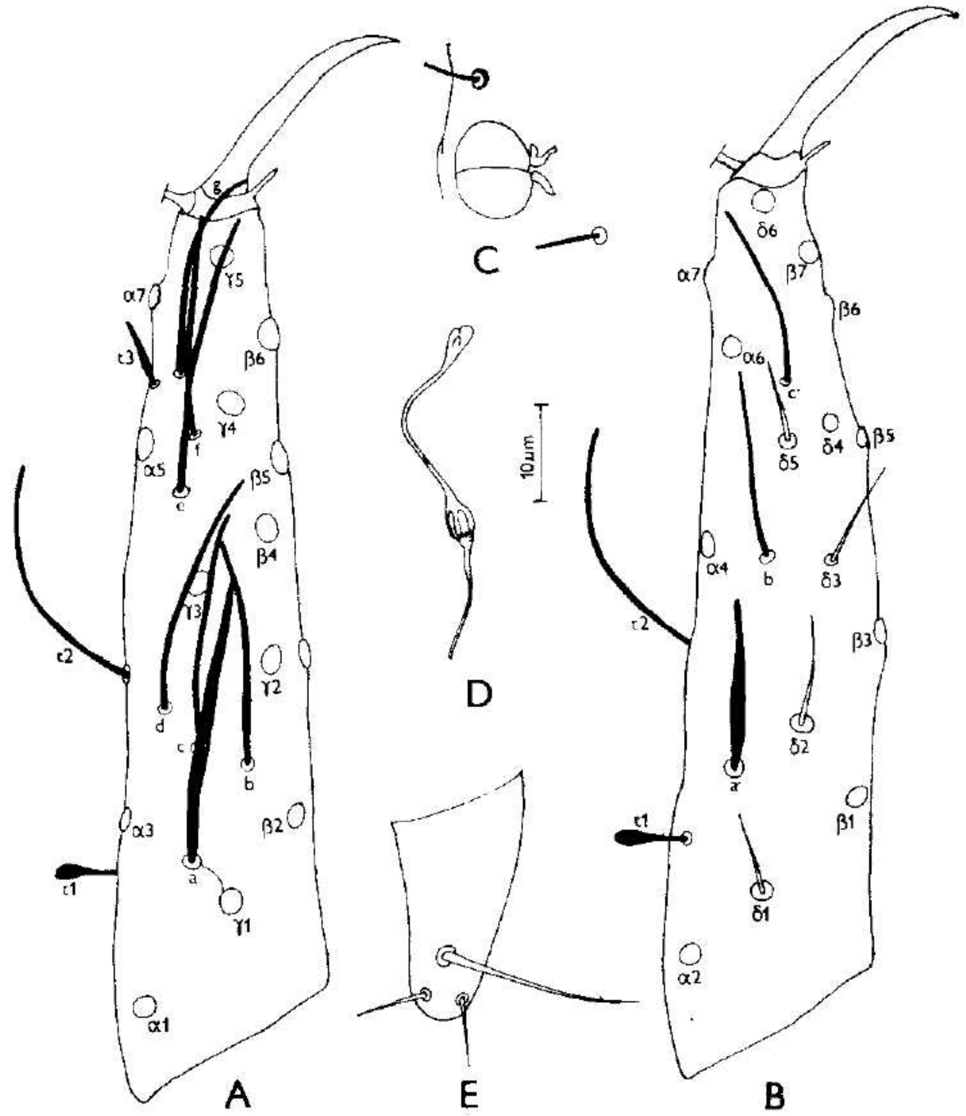

Fig. 14. *Acerentulus ochsenhausenus* sp. n.: A — dorsal side of foretarsus; B — ventral side of foretarsus; C — pseudoculus; D — filamento di sostegno; E — abdominal leg III. Scale: Figs. A–E: 10 µm.

[2] p1' and p3' missing, [3] a1 missing, [4] p1' missing (Fig. 16)

v	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{4}{2}$	4	4	6	6

Pleural pectines missing (Fig. 16B), sclerotized ribs, connected with rotary wheels, without teeth. Comb VIII with 8–9 moderate teeth (Fig. 15B). Female squama

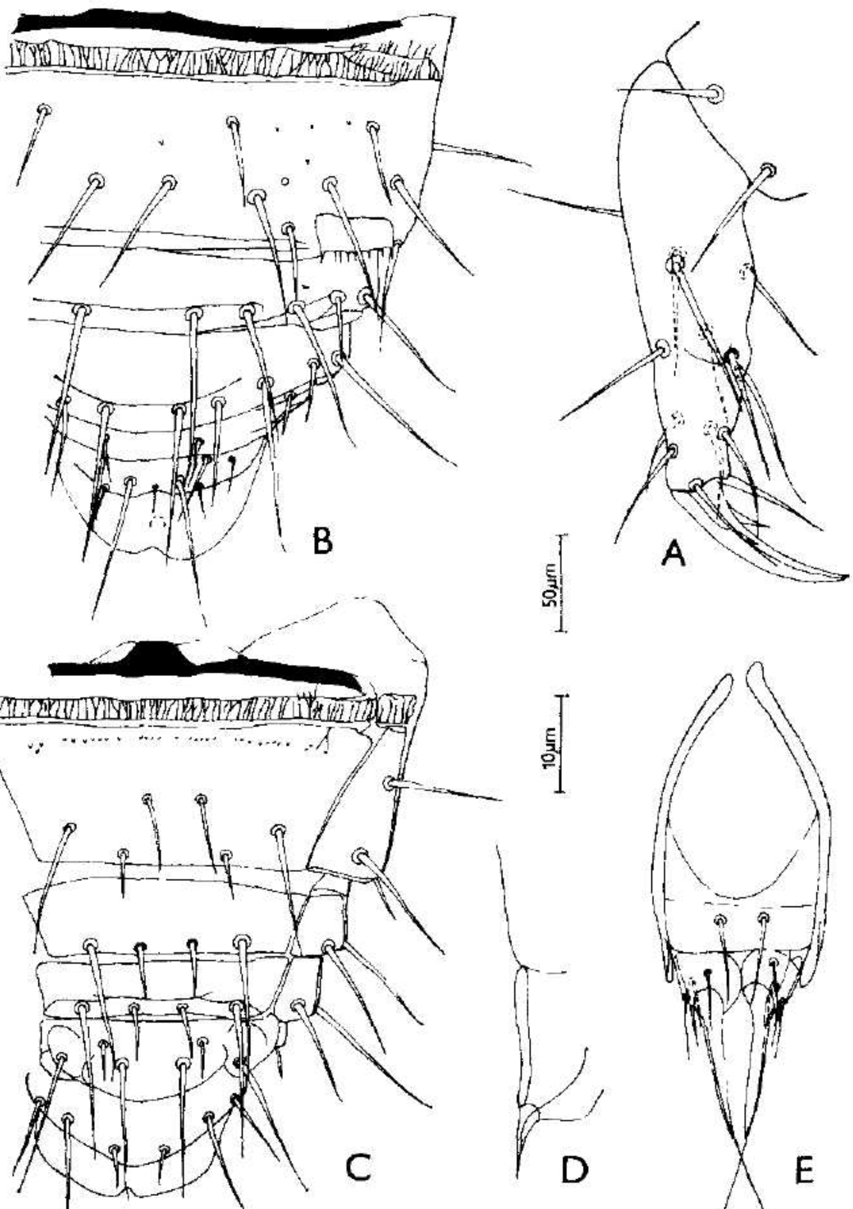

Fig. 15. *Acerentulus ochsenhausenus* sp. n.: A — tarsus III; B — dorsal side of abdominal segments VIII–XII; C — ventral chaetotaxy of abdominal segments VIII–XII; D — acrostylus of female genitalia; E — male genitalia. Scale: Figs. A: 10 µm; B–E: 50 µm.

genitalis with one terminal spine on acrostylus (Fig. 15D). Male squama genitalis as in Fig. 15E.

Affinities: The new species belongs to the *confinis*-group having a long sensilla a reaching to γ3 and sensilla b almost of the same length as c. It is related with *Acerentulus gisini* Condé, 1952. The new species has the same chaetotaxy of abdominal tergite VII with missing al and p1′ chaetae, but differs from it clearly by the sensilla a on foretarsi. In *A. ochsenhausenus* sp. n. the sensilla is very thick, whereas it is thin in *A. gisini*. The indices TR in these two species are different, too (in *A. gisini* TR = 4.3, in sp. n. TR = 3.3).

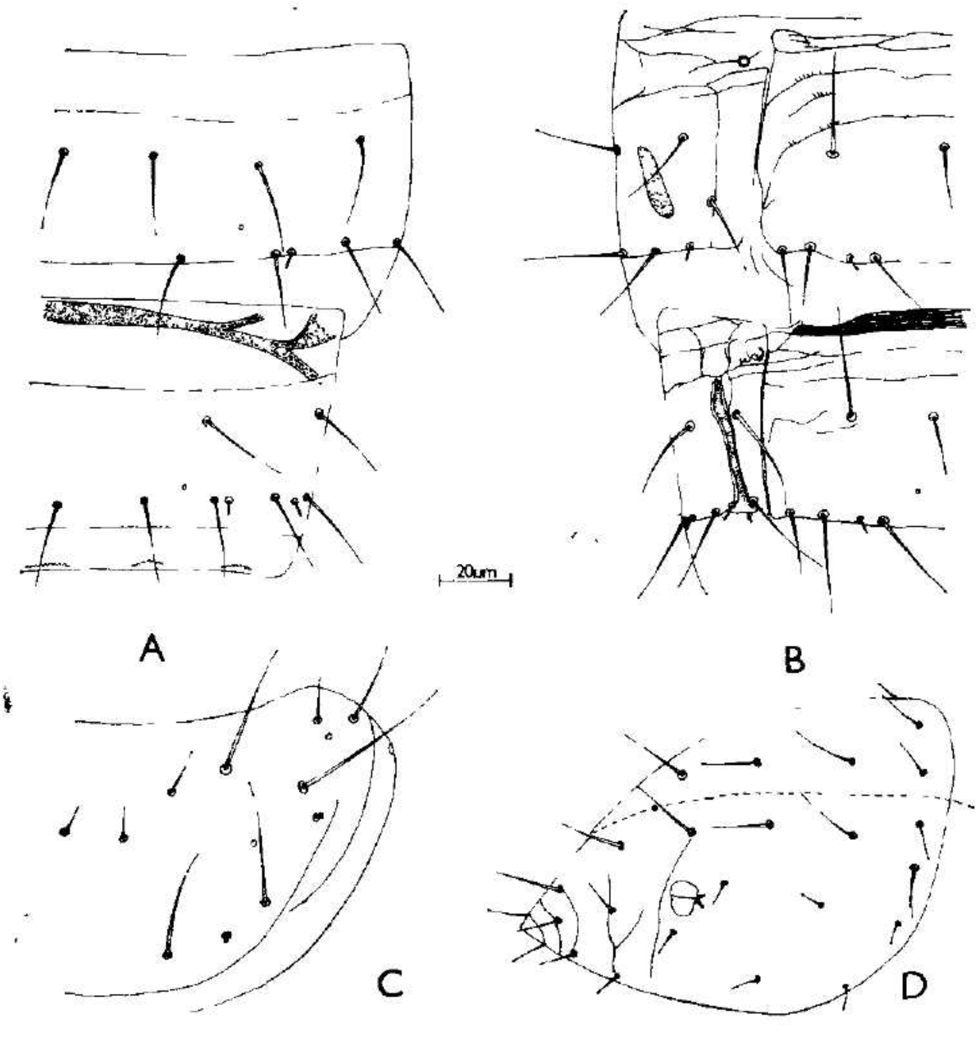

Fig. 16. *Acerentulus ochsenhausenus* sp. n.: A — dorsal chaetotaxy of right side of abdominal segments VI–VII; B — ventral chaetotaxy of left side of abdominal segments VI–VII; C — chaetotaxy of right side of mesonotum; D — dorsal chaetotaxy of head. Scale: Figs. A–D: 20 μm.

Holotype ♂ No.Ux5.2.85/69N1 and 3 paratypes in the Institute of Soil Biology of the Czechoslovak Academy of Sciences at České Budějovice, 3 paratypes in the collection of the Department of Animal Ecology and Morphology, University of Ulm, Federal Republic Germany.

Locus typicus: Federal Republic Germany. Ochsenhausen, University of Ulm experimental forest, District XV "Am Spitzweiher", 520 m a.s.l., 60—70 years old spruce forest (*Picea abies*), soil type pseudogley to parabraunerde with moder to row humus. pH 2.9. In soil samples, 5.2. 1985 7 specimens.

Derivatio nominis: The new species bears the name of the locus typicus (Ochsenhausen).

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THE LONGTIMELY EXPOSED ROCK DEBRIS PITFALLS

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Abstract. The experiments with rock debris pitfalls are described; the pitfalls were placed in the depth of rock debris one year long without regular emptying. As the conservation liquid the aqueous solution of 7% formaldehyde and 20% glycerol with an addition of soaking agent proved well.

The rock debris formations represent by their character and specific thermic regime a quite exceptional biotope in the landscape. The rock debris is a very heterogeneous milieu. The life conditions inside the rock debris are very different in dependence on the plant cover of the debris and on its exposure. Even at the same rock debris locality the conditions on the surface and in the depth are very different (Růžička, in press a). In the deeper layers, where all-year-round relatively constant microclimatic conditions persist, the occurrence of many rate species of invertebrates are to be expected. In the territory of Czechoslovakia the occurrence of glacial relicts in the mountain rock debris is possible. As the individual collecting in the deeper layers of rock debris is very difficult, we use here for the collecting of material the modified pitfall traps (Růžička, 1982). The regular emptying of the pitfalls in the rock debris, however, can hardly be taken into consideration. We made therefore an experiment with the pitfalls which were placed in the rock debris for one year long without regular emptying the material.

The used pitfalls consisted of a cylinder made of Novodur (= hardened vinyl) and of a wooden (later made of Novodur, too) board fitting to the upper opening of the cylinder. The diameter of the cylinder is 10.5 cm, its height is 13 cm; the dimensions of the board are approximately 20 × 30 cm. At the height of 6 cm above the cylinder bottom, three openings have been drilled to enable the draining of surplus liquid in the case that water would flow into the pitfalls.

The pitfalls were filled with the conservation liquid. We used several variants of the liquid — various mixtures of formaldehyde with ethylene glycol and glycerol. In the years 1984–85 we placed five modified pitfalls in the rock debris of the Šumava Mountains; three of them were placed from 4 August, 1984, till 27 July, 1985, in the rock debris of the Vydra river valley, and two were exposed from 6 October, 1984, till 28 July, 1985, in the rock debris on the slope of the mountain Luč. The pitfalls were placed from 0.5 m to 2 m deep below the debris surface. In the summer days, when the pitfalls were emptied, the temperatures of 9–16 °C were measured in the immediate vicinity of them, while the external temperatures amounted to 20–25 % °C. The final content of formaldehyde in the fixation Liquid decreased from 9–12 % to 4–7 % (Tab. 1). The environment conditions under which the individual pitfalls were placed were different and hardly registrable — temperature, humidity, air flow, flowing-down water, etc. Nevertheless, it was necessary to evaluate the conservation liquids in some way. Basing on the final values of formaldehyde content and on the field conditions, the best result was found in the mixture of 9% formaldehyde and 20% glycerol. After 10 months of field exposure, the formaldehyde content of its sank from 9% to 5.5%.

Starting from the results of the first year's experiment, we exposed from 26 October, 1985, till 4 October, 1986, in rock debris on the slope of the mountain Obří hrad in the Šumava Mountains six pitfalls with conservation liquid consisting of 7% formaldehyde and 20% glycerol. Owing to the thickness of the liquid, 10 drops of soaking agent Orwo F 905 were added

Table 1

No.	conservation liquid initial composition	final content of formaldehyde after one year's exposition
1	12 % formaldehyde	6.6 %
2	12 % formaldehyde	5.2 %
3	12 % formaldehyde, 68 % etylene glycol	4.3 %
4	9 % formaldehyde, 20 % glycerol	5.5 %
5	9 % formaldehyde, 76 % etylene glycol	4.3 %
6	7 % formaldehyde, 20 % glycerol	4.0 %
7	7 % formaldehyde, 20 % glycerol	2.0 %
8	7 % formaldehyde, 20 % glycerol	1.5 %
9	7 % formaldehyde, 20 % glycerol	1.4 %
10	7 % formaldehyde, 20 % glycerol	0.1 %
11	7 % formaldehyde, 20 % glycerol	0.0 %

to the solution. After one year's exposition, the formaldehyde content sank in these pitfalls to 0–4% (Tab. 1). However, an important fact was ascertained that only in the pitfall with zero content of formaldehyde the material was partly macerated, while in the pitfall with a content of only 0,1% of formaldehyde the material was already preserved in a perfect condition.

There was a full volume of the conservation liquid in all pitfalls in the time when they were emptied. In no case a danger of dry-up of the liquid exists because of the cold and humid milieu in the depth of rock debris. More likely the dilution of the conservation liquid by the flowing-down water must be taken into consideration. Therefore it is necessary to pay a great attention to the sheltering of pitfalls with flat stones.

The wooden board did not proved well in the construction of pitfalls. The wood warped under the influence of moisture, and in some cases the board partly came off from the cylinder.

In spite of a considerable formaldehyde content, which could have a repellent effect on the animals, rather rich and interesting catches were found in all pitfalls. Besides the mites and springtails, the spiders, beetles, and flies were found in the pitfalls. On average (of course, with great variations), the following numbers were found per pitfall in one year's course: 9 spiders, 9 beetles (7 staphylinids among them), and 13 Diptera (9 specimens of the genus *Chionea* among them).

Of the spiders, *Theridion belliosum* and *Leptyphantes notabilis*, rare species bound by their occurrence to rock debris irrespective of altitude, were found there. Furthermore, the rare mountain species *Robertus scoticus*, *Lepthyphantes monticola*, *Theonoe minutissima* etc. were caught. By means of the rock debris pitfalls a sufficient material of the nordic species *Bathyphantes eumenis* was obtained, which enabled an evaluation of this species. In the rock debris of the Bohemian mountain ranges this species forms a specific subspecies which is adapted by its body shape to the microcavernicolous way of life (Růžička, 1988).

Of the beetles, predominantly the submontane and montane forest species were found in the rock debris. Tens of specimens of the rare staphylinid *Leptusa flavicornis* were caught (this species was collected only sporadically before). Among others, e.g. the staphylinids *Stenus glacialis* and *Stenus montivagus* as well as the carabid *Pterostichus negligens* (the first record in the Šumava Mountains) were cought.

In the material obtained one male of the diplopod *Leptoiulus weberi* Verhoeff, 1927, was found; it represents the first find of this species in the territory of Czechoslovakia.

Many remarkable invertebrates occur in the rock debris. The specific thermic conditions often enable an extrazonal occurrence of these animals reflecting the development of fauna in the former time periods. However, the collecting of these animals in the depth of rock debris is very difficult and laborious. The tested type of all-Novodur rock debris pitfall proved to be very suitable for collecting invertebrate animals in the depth of rock debris. As the fixation liquid we recommend the aqueous solution of 7% formaldehyde and 20% glycerol with an addition of soaking agent. The pitfalls with this fixation liquid can be left in the depth of rock debris all-year-round without regular emptying the material. In spite of the little number of specimens caught, the catching by means of pitfalls in the depth of rock debris presents valuable data on the invertebrate fauna of the territory under study.

Acknowledgements

I wish to express my thanks to Ing. J. Kopáček for the analyses of formaldehyde content in the fixation liquids. RNDr. J. Boháč, CSc., and RNDr. K. Tajovský I am indebted for the determination of the material of beetles and diplopods.

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REVIEWS

W. Schober & E. Grimmberger: Die Fledermäuse Europas, kennen – bestimmen – schützen. Kosmos Naturführer, Franckh'sche Verlagshandlung, Stuttgart, 1987; 222 stran, četné nákresy, barevné a černob. fotografie

Společnost Kosmos vydala v kapesním formátu průvodce evropskou faunou netopýrů, jehož autory jsou dva východoněmečtí odborníci. Kniha pojednává o fylogenetickém vývoji, hlavních adaptacích, rozšíření, stanovištích, ultrazvukové orientaci, ročním životním cyklu, rozmnožování, sociálním životě, zimním spánku, migracích, kroužkování a ochraně netopýrů. V systematickém přehledu jsou uvedena základní data o všech 30 druzích evropské chiropterofauny a je podán úplný klíč k jejich určení. Ten je založen především na zevních znacích dospělých živých jedinců, znaky na lebkách včetně chrupu jsou uvedeny jen u skupin jinak obtížně rozlišitelných druhů. Nechybějí však údaje o rozpětí tělesných rozměrů, kondylobazální délky lebky, hmotnosti a o zubním vzorci. K druhové determinaci jsou využity i záznamy ultrazvukových detektorů, prezentované formou grafů.

Recenzovaná příručka má vynikající technickou úroveň, z hlediska detailní fotodokumentace určovacích znaků a celkového vzhledu včetně zbarvení jednotlivých částí těla nemá v evropské literatuře o savcích obdobu. Určitým nedostatkem je chybění samostatného klíče k určení druhů podle lebek, dentice, případně podle penisové kosti (bakula). Pro její moderní a vědecky správný obsah i vhodnou formu můžeme knížku Schobera a Grimmbergera doporučit všem zájemcům o savce i dalším biologům, ochráncům přírody a milovníkům zvířat.

J. Gaisler & V. Hanák

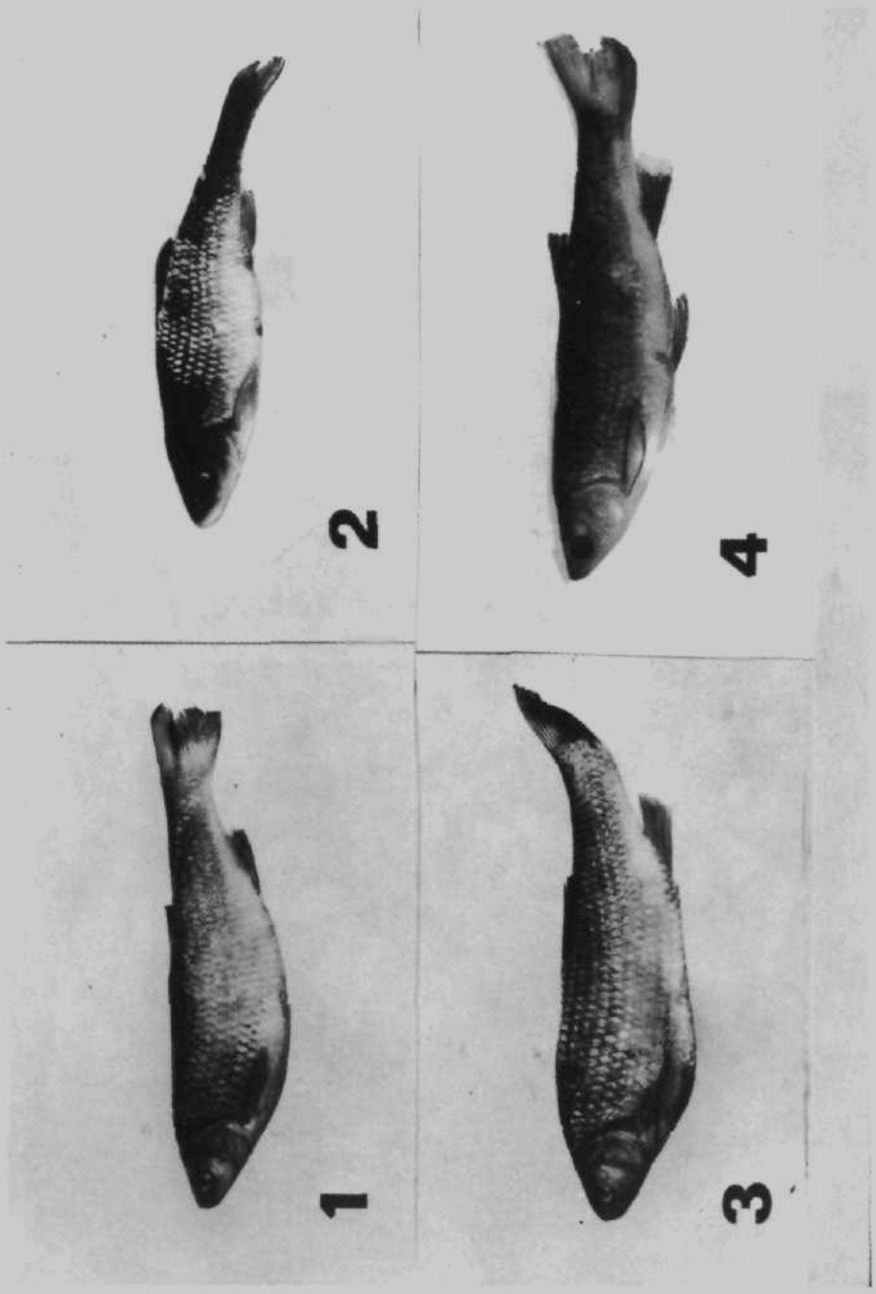

Fig. 1. The specimen of the chub (*Leuciscus cephalus*) without ventrals (TL 207 mm, SL 175 mm, W 94 g, male). Fig. 2. The specimen of the chub (*Leuciscus cephalus*) without ventrals (TL 193 mm, SL 160 mm, W 75 g, male). Fig. 3. The specimen of the chub (*Leuciscus cephalus*) without ventrals (TL 250 mm, SL 205 mm, W 160 g, male). Fig. 4. The specimen of the dace (*Leuciscus leuciscus*) without left ventral fin (TL 194 mm, SL 160 mm, W 67 g, male).

Fig. 5. The radiograph of the roach *(Rutilus rutilus)* with vertebral anomaly (TL 215 mm, SL 175 mm, W 210 g, male).

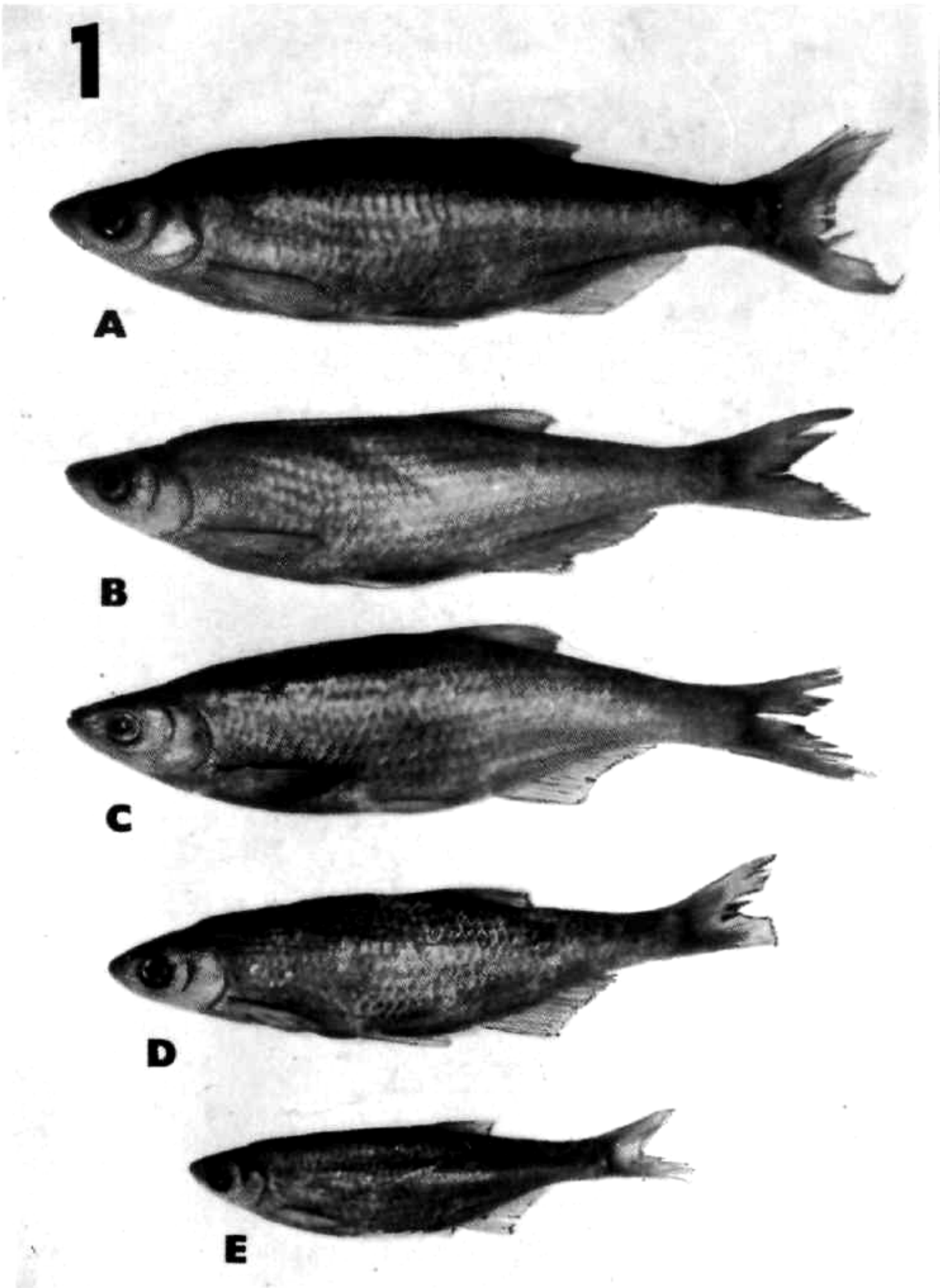

Plate 1. The bleak ***(Alburnus alburnus)*** from the Slapy riverine lake, caught 17 – 24. VII. 1957. A, 30108, TL 237, SL 195, W 105 (the first number designates the catalogue number of the fish collections of the Department of Zoology, Charles University, following numbers represent total and standard length in mm, the last one weight in grams).

B, 30096, TL 217, SL 180, W 80; C, 30117, TL 216, SL 180, W 75; D, 30103, TL 209, SL 173, W 70; F, 30257, TL 186, SL 154, W 55; G, 30104, TL 138, SL 116, W 20.

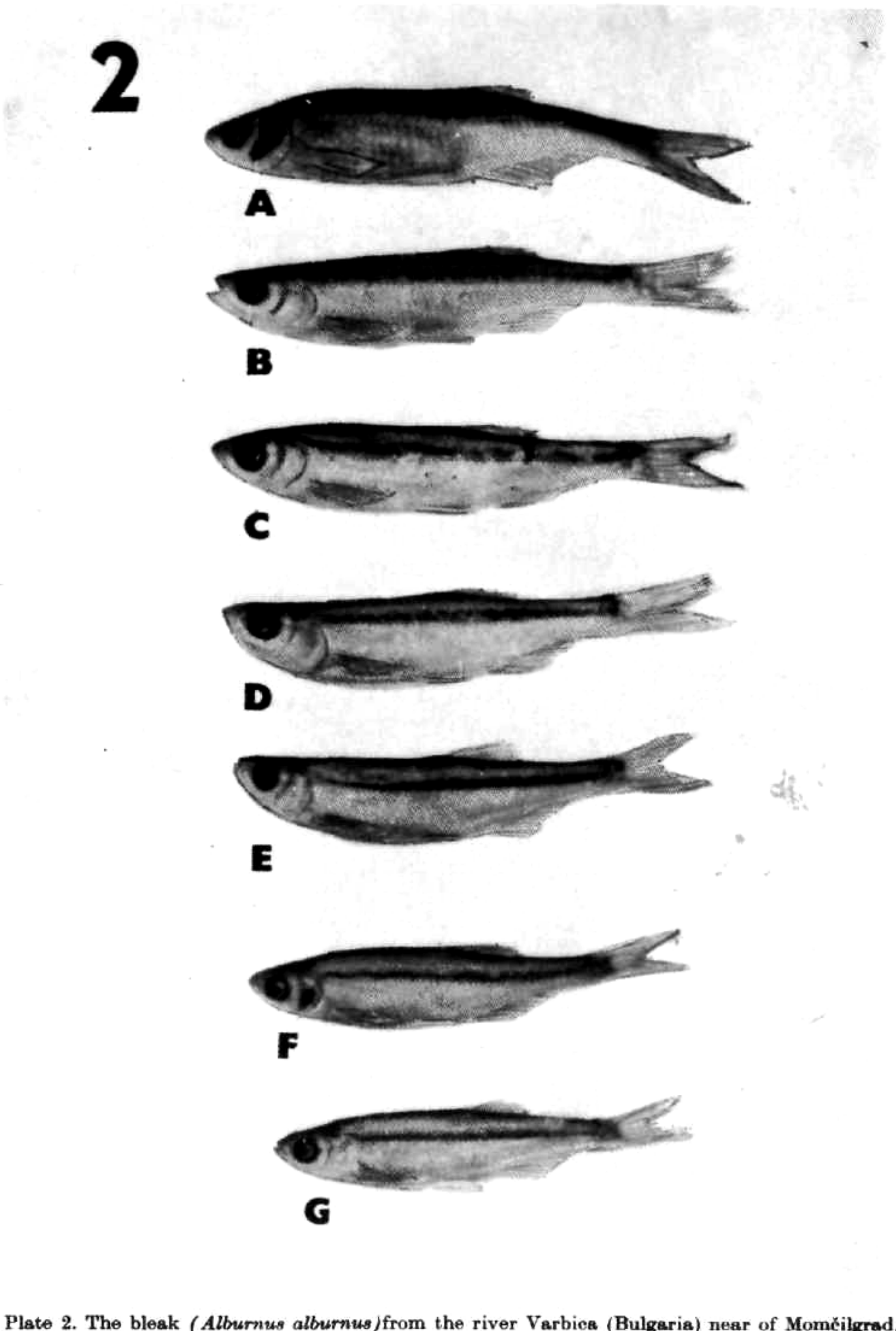

Plate 2. The bleak *(Alburnus alburnus)* from the river Varbica (Bulgaria) near of Momčilgrad, 22. VI. 1977.
A, TL 117, SL 96, W 6.0; B, TL 113, SL 91, W 5.0; C, TL 112, SL 91, W 5.0; D, TL 106, SL 83, W 4.5; E, TL 101, SL 83, W 4.0; F, TL 93, SL 77, W 3.0; G, TL 87, SL 72, W 2.5.

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