VĚSTNÍK

ČESKOSLOVENSKÉ SPOLEČNOSTI

ZOOLOGICKÉ

XLIV
1980
2

ACADEMIA PRAHA
ISSN 0042—6595

VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
ročník XLIV

Vydává Čs. společnost zoologická, Viničná 7, 128 44 Praha 2, v Academii, nakladatelství ČSAV, Vodičkova 40, 112 29 Praha 1. Tiskne Státní tiskárna, n. p., závod 4, Sámova 12, 101 46 Praha 10. — Objednávky a předplatné přijímá PNS, admin. odbor. tisku, Jindřišská 14, 125 05 Praha 1. Lze také objednat u každého poštovního úřadu nebo doručovatele. Cena jednoho výtisku Kčs 10,—, roční předplatné (4 čísla ročně) Kčs 40,—. (Tyto ceny jsou platné pouze pro Československo.)

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Toto číslo vyšlo v dubnu 1980

VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ

Roč. 44 Čís. 2 Duben 1980
Tom. No. April

★

Bibliografická zkratka názvu časopisu — *Věst. čs. Společ. zool.*
Abbreviatio huius periodici bibliografica

OBSAH — CONTENTS

Věst. čs. Společ. zool., **44**: 81–91, 1980

Institute of Parasitology, Czechoslovak Academy of Sciences, Prague

REDESCRIPTION OF THE NEMATODE PROCAMALLANUS SPICULOGUBERNACULUS WITH NOTES ON RELATED FORMS

Nimai Chand DE and František MORAVEC

Received August 15, 1978

Abstract: A redescription of the nematode *Procamallanus spiculogubernaculus* Agarwal, 1958, based on specimens collected from the fish *Heteropneustes fossilis* from West Bengal, India, is presented A detailed morphometrical comparison of this species with the other species described from freshwater fishes of the Indo-Malaysian region indicates that *Procamallanus daccai* Gupta, 1959, *P. hindenensis* Lal, 1965, *P. magurii* Lal, 1965, *P. devendri* Sinha et Sahay, 1966, *P. ottuei* Varma et Varma, 1971 and *P. sprenti* Bashirullah et Hafizuddin, 1974 are new synonyms of the species *P. spiculogubernaculus*.

At present the genus *Procamallanus* Baylis, 1923 comprises a large number of species that are parasites of the freshwater and marine fishes of the tropical and subtropical regions. Many specific descriptions are, however inadequate or erroneous and the differential diagnoses are often based on features which are generally known to be subjected to considerable intraspecific variation or can only be determined with difficulty (e. g. presence of a weakly sclerotized left spicule, number and arrangement of the last pairs of caudal papillae in male, etc.). As a result of the taxomical confusion caused by insufficient knowledge of the morphology of individual species as well as by erroneous data in literature, the identification of *Procamallanus* species is rather problematic at present and often leads to unjustified descriptions of additional new species. It has been known (see Yeh, 1960, Fernando and Furtado, 1963), that the shape and measurements of the spicules and the gubernaculum of these nematodes are highly variable depending on the degree of their sclerotization; these organs may be completely lacking in young males or they exhibit other abnormalities. There is also considerable variation in the number of caudal papillae in the male, both preanal and postanal. Moreover, a group of the most posterior pairs is represented by very small paillae which are not visible in lateral view and. sometimes it is difficult to establish their exact number even when observed from the ventral side. However, namely these features are often used for differentiation of species

In our opinion, further detailed studies will prove the conspecificity of many nominal species which are, for the time being, considered valid. It is supported by the fact that numerous species are reported from the same geographical region from the only host species. Thus, 10 species of the genus *Procamallanus* have been described only from the fish *Heteropneustes fossilis* from India and neighbouring countries (Sri Lanka, Bangladesh); on the other hand, e. g. the African species *P. laeviconchus* has been recorded from 23 host species of different families, *P. siluri* from 13 species of hosts, etc. Unfortunately ,most

of the type specimens are not available and, accordingly, the reexamination of these species depends on obtaining topotypic and other materials.

During an investigation of the helmiths of fishes from West Bengal, India, in 1973 the first author collected a large number of nematodes which were identified as *P. spiculogubernaculus*. This material made it possible to study in detail the morphology of this species and to redescribe it.

Procamallanus spiculogubernaculus Agarwal, 1958 — Fig. 1

Syn.: *Procamallanus daccai* Gupta, 1959; *Neocamallanus heteropneusti* Chakravarty, Majumdar et Sain, 1961; *Procamallanus chakravartyi* Fernando et Furtado, 1963; *P. confusus* Fernando et Furtado, 1963; *P. mathurai* Pande, Bhatia et Rai, 1963; *P. hindenensis* Lal, 1965; *P. magurii* Lal, 1965; *P. devendri* Sinha et Sahay, 1966, *P. ottuei* Varma et Varma, 1971; *P. sprenti* Bashirullah et Hafizuddin, 1974.

Description: Small nematodes with transversely striated cuticle. Body of living nematodes reddish in colour. Mouth opening spherical, with narrow membraneous rim. Four (2 dorsoventral and 2 ventrolateral) mouth papillae and two lateral amphids present. Barrel-shaped buccal capsule yelow-brown in colour, smooth, without any spiral thickenings; anterior rim of buccal capsule formed by six large, arch-shaped processes. Posterior end of buccal capsule distinctly strengthened, forming a kind of basal ring. Oesophagus divided into anterior muscular and posterior glandular parts. Nerve ring surrounding muscular oesophagus at its anterior half; excretory pore slightly below nerve ring. Small, simple deirids located just below nerve ring level.

Male (9 specimens): Body length 2.20—3.87 mm, body width 0.054—0.081 mm. Length of buccal capsule 0.049—0.063 mm, width 0.030—0.045 mm, length of basal ring 0.006 mm. Muscular oesophagus 0.186—0.261 mm long and 0.038—0.054 mm wide, glandular oesophagus 0.232—0.346 mm long and 0.027—0.049 mm wide Nerve ring 0.102—0.141 mm, excretory pore 0.156—0.232 mm, and deirids 0.121—0.156 mm from anterior extremity. Narrow caudal alae present. Tail ventrally bent, conical, 0.035—0.049 mm long; tail tip rounded, sometimes elevating ventrally as a papilla-like formation. Preanal papillae: mostly 8 pairs of subventral pedunculate papillae present, but occasionally these occurred in combinations 6 + 8 or 9 + 10; second pair (counting from cloacal opening) of these papillae located more ventrally than others. One pair of small adanal papillae present. Postanal papillae: 6 pairs of subventral papillae present, 4th pair considerably larger than others. Two unequal spicules; right spicule well sclerotized, 0.300—0.370 mm long; left spicule slightly sclerotized and ill-visible, 0.129—0.150 mm long. In one specimen with incompletely sclerotized, twisted spicules, right and left spicules 0.164 mm and 0.078 mm long, respectively. Strongly sclerotized gubernaculum Y-shaped, 0.046—0.072 mm long, with right anterior arm somewhat bigger than other. In the smallest male (body length 2.2 mm) both spicules and gubernaculum indistinct.

Female (9 specimens) (measurements of a juvenile female in parentheses): Body of gravid females (containing eggs or larvae) 3.56—7.49 (3.44) mm, maximum width 0.090—0.189 (0.096) mm. Length of buccal capsule 0.069—0.081 (0.063) mm, width 0.048—0.069 (0.057) mm, length of basal ring 0.009 mm Length of muscular oesophagus 0.264—0.333 (0.282) mm, width 0.057—0.066 (0.057) mm; glandular oesophagus 0.318—0.450 (0.336) mm long and 0.042—0.072

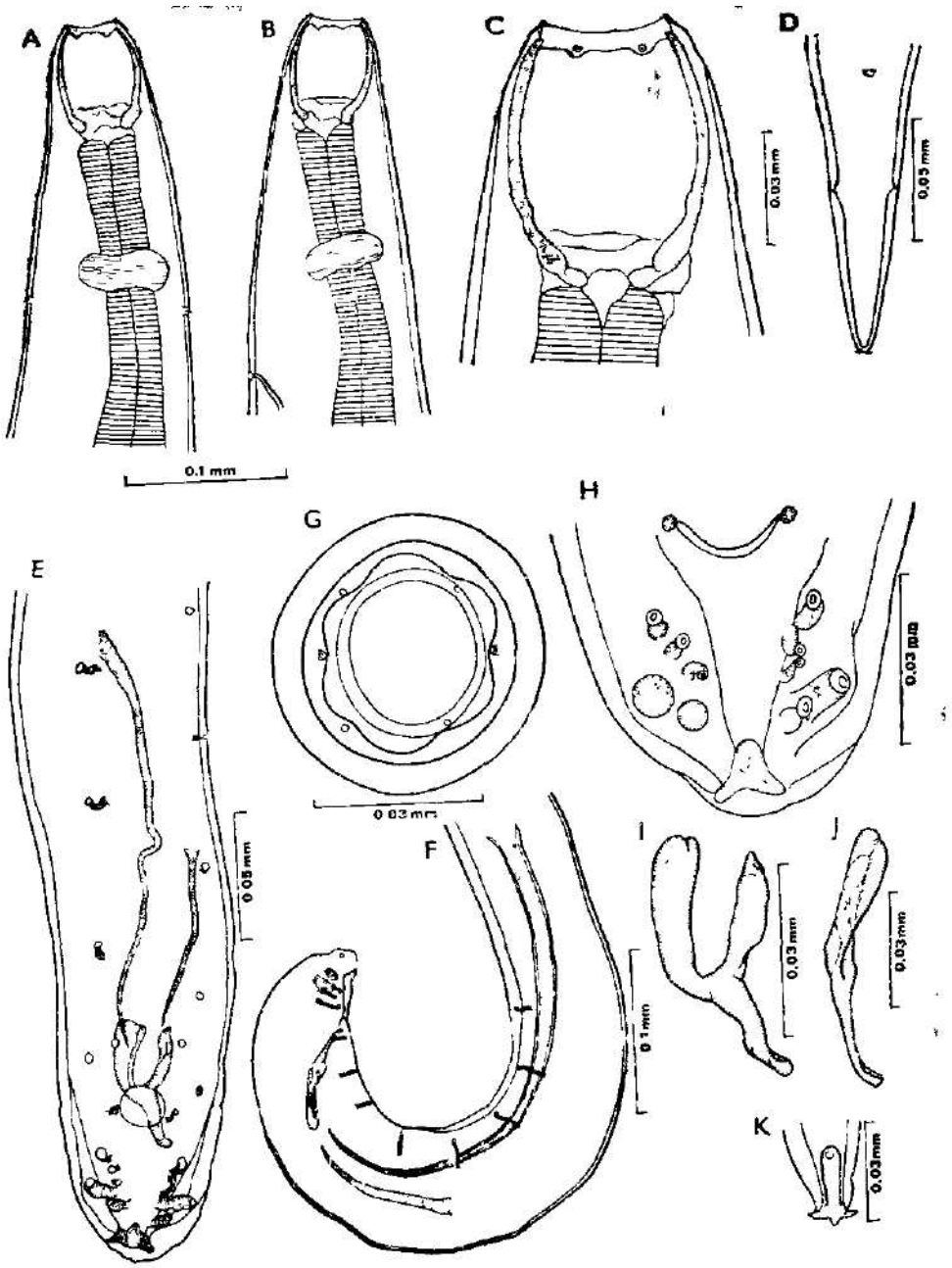

Fig. 1. *Procamallanus spiculogubernaculus* Agarwal, 1958. A, B — anterior end of female, dorsal and lateral views; C — buccal capsule; D — female tail, ventral view; E, F — posterior end of male, ventral and lateral views; G — head end, apical view; H — male tail, ventral view; I, J — gubernaculum, ventral and lateral views; K — tail tip of female.

(0.048) mm wide. Distance of nerve ring from anterior end 0.129—0.156 (0.126) mm, of excretory pore 0.198—0.273 (0.198) mm, of deirids 0.159—0.198 (0.174) mm. Vulva slightly postequatorial, 1.58—3.48 (1.46) mm from posterior extremity. Tail conical, 0.093—0.138 (0.090) mm long, ending in three small processes about 0.003 mm long (one dorsal and two ventrolateral): phasmids at about mid-length of tail.

Host: *Heteropneustes fossilis* (Bloch).

Location: stomach.

Locality: fishpond at Asansol, West Bengal, India (24 August 1973)

Deposition of specimens: Institute of Parasitology, Czechoslovak Academy of Sciences, Prague.

DISCUSSION

In the Indo-Malaysian region, members of the genus *Procamallanus** Baylis, 1923 belong to the most frequent parasites of freshwater fishes, mostly catfishes, and a number of species have been described from this area. In spite of their often inadequate or erroneous descriptions, many species seem to be morphologically very close to each other and in many cases their conspecificity can be assumed. It is also indicated by the fact that such species are mostly reported from the same host species.

One group of such related forms is represented by the species *Procamallanus spiculogubernaculus* Agarwal, 1958, *P. daccai* Gupta, 1959, *P. chakravartyi* Fernando et Furtado, 1963 (= *Neocamallanus heteropneusti* Chakravarty Majumdar et Sain, 1961), *P. confusus* Fernando et Furtado, 1963, *P. mathurai* Pande, Bhatia et Rai, 1963, *P. hindenensis* Lal, 1965, *P. magurii* Lal, 1965, *P. devendri* Sinha et Sahay, 1966, *P. ottuei* Varma et Varma, 1971, and *P. sprenti* Bashirullah et Hafizuddin, 1974. Most of them were described on specimens obtained from the fish *Heteropneustes fossilis*, only *P. magurii* from *Clarias batrachus* and *P. daccai* from an unidentified siluroid fish. The validity of some of these species has already been discussed. Fernando and Furtado (1963) considered that *P. spiculogubernaculus*, *P. chakravartyi* and *P. confusus* were probably conspecific, but only Sahay et al. (1970) synonymized *P. confusus* with *P. spiculogubernaculus*. According to Sood (1967) *P. confusus*, *P. chakravartyi* and *P. mathurai* are synonyms of *P. daccai*.

Our nematode specimens obtained from *H. fossilis* are morphologically almost identical with all the species mentioned above (Table 1). Greater differences concern only the presence of the second (left) spicule and the variation in the number of caudal papillae in the male.

The species *P. daccai*, *P. chakravartyi*, *P. mathurai*, *P. hindenensis*, *P. magurii*, *P. devendri*, *P. sprenti* and *P. ottuei* are described as to possess only one (right) spicule and gubernaculum, while the left spicule is allegedly absent. Two unequal spicules and the gubernaculum are reported for *P. spiculogubernaculus* and *P. confusus*; however, it is obvious from the drawings and the descriptions that in these cases the authors mistook the anterior arm of the

*) In 1952 Olsen divided the original genus *Procamallanus* into two genera by including the species characterized by the presence of spiral thickenings on the buccal capsule into an independent genus *Spirocamallanus*; although the latter has been recognized by many recent authors (e. g. Yeh, 1960; Ivaškin et all., 1971, Petter, 1974; Stromberg and Crites 1974; Chabaud 1975), regarding the paper by Moravec and Amin (1978) we consider it a synonym of the genus *Procamallanus* s. l.

Table 1. Comparison of measurements of the related forms of *Procamallanus*

	P. spiculogubernaculus after Agarwal 1958		*P. daccai* after Gupta 1959		*P. chakravartyi* after Chakravarty et al. 1961	
	♂	♀	♂♂	♀♀	♂♂	♀♀
Length of body	3.68	4.84	3.55–4.5	4.76–7.39	3.9–4.0	4.8–7.2
Width of body	0.088	0.088	0.10–0.125	0.12–0.13	0.120	0.156–0.168
Length of buccal capsule	0.06	0.08			0.048–0.060	0.084–0.092
Width of buccal capsule	0.036	0.048			0.036–0.048	0.060–0.068
Length of muscul. oesophagus	0.024	0.032	0.325–0.625	0.26–0.35	0.204–0.228	0.030–0.324
Length of gland. oesophagus	0.3	0.048			0.36–0.44	0.336–0.540
Right spicule	0.344		0.36–0.48		0.216–0.252	
Left spicule	–		–		–	
Gubernaculum	about 0.07*		0.06–0.07		0.072	
Pairs of preanal papillae	4		7–8		15 (?)	
Pairs of adanal papillae	–		1		–	
Pairs of post. papillae	3		9 (?)		1 (?)	
Distance of vulva from poster. end		2.2		2.1–3.43		2.4–3.3
Length of tail		0.1	0.05–0.07	0.12–0.18	0.036–0.048	0.096–0.132
Host	*Heteropneustes fossilis*		siluroid fish		*Heteropneustes fossilis*	
Distribution	India		Bangladesh		India	

*) Treated as a spicule

Table 1. Continued

	P. confusus after Fernando and Furtado 1963		*P. mathurai* after Pande et al. 1963		*P. hindenensis* after Lal 1965	
	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
Length of body	3.15—5.0	4.2—4.8	3.2—4.1	5.0—7.8	2.7—4.0	5.1—7.1
Width of body	0.045—0.085	0.085	0.092—0.11	0.13—0.15	0.05—0.11	0.11—0.17
Length of buccal capsule		0.06	0.048—0.051	0.054—0.064	0.053—0.059	0.064
Width of buccal capsule		0.045	0.032—0.038	0.04	0.032	0.043—0.059
Length of muscul. oesophagus	0.235	0.270—0.300	0.23—0.29	0.3—0.4	0.166—0.298	0.268—0.357
Length of gland. oesophagus	0.270	0.330—375	0.26—0.33	0.37—0.48	0.255—0.426	0.341—0.639
Right spicule	0.255		0.25—0.27		0.227—0.514	
Left spicule	—		—		—	
Gubernaculum	0.045*		about 0.07		+	
Pairs of preanal papillae	7 + 1		7		9	
Pairs of adanal papillae	—		1		—	
Pairs of post. papillae	7 + 1		4		4	
Distance of vulva from poster. end				2.46—3.52		2.1—2.4
Length of tail		0.150		0.09—0.112		0.085—0.149
Host	*Heteropneustes fossilis*		*Heteropneustes fossilis*		*Heteropneustes fossilis*	
Distribution	Sri Lanka		India		India	

Table 1. Continued

	P. magurii after Lal 1965		*P. devendri* after Sinha and Sahy 1966		*P. ottuei* after Varma and Varma 1971	
	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
Length of body	3.36—5.29	7.14—11.53	3.2—3.5	6.4—6.8	3.56—4.27	5.0—7.6
Width of body	0.096—0.149	0.149—0.256	0.05—0.08	0.13—0.14	0.07—0.1	0.08—0.14
Length of buccal capsule	0.053—0.075	0.085—0.107	0.032—0.036	0.048—0.05		0.07—0.08
Width of buccal capsule	0.043—0.053	0.048—0.064	0.028—0.038	0.03—0.032		0.04—0.05
Length of muscul. oesophagus	0.245—0.371	0.330—0.658	0.144—0.158	0.2—0.202	0.23—0.25	0.25—0.33
Length of gland. oesophagus	0.413—0.599	0.511—0.720	0.21—0.24	0.27—0.274	0.31—0.58	0.37—0.49
Right spicule	0.371—0.436		0.288—0.3		0.31—0.35	
Left spicule	—		—		—	
Gubernaculum	+		0.044—0.052		0.05—0.06	
Pairs of preanal papillae	9		8		7	
Pairs of adanal papillae	—		—		1	
Pairs of post. papillae	5		6		4	
Distance of vulva from poster. end		3.61—5.39		2.93—3.18		
Length of tail		0.107—0.170	0.03—0.04	0.08—0.082		0.08—0.14
Host	*Clarias batrachus*		*Heteropneustes fossilis*		*Heteropneustes fossilis*	
Distribution	India		India		India	

Table 1. Continued

	P. spronti after Bashirullah and Hafizuddin 1974		*P. spiculogubernaculus* own specimens	
	♂♂	♀♀	♂♂	♀♀
Length of body	4.40—4.93	4.99—7.36	2.20—3.87	3.56—7.49
Width of body	0.084—0.089	0.013—0.018**	0.054—0.081	0.090—0.189
Length of buccal capsule	0.063—0.067	0.073—0.098	0.049—0.063	0.069—0.084
Width of buccal capsule	0.036—0.045	0.048—0.052	0.030—0.045	0.048—0.069
Length of muscul. oesophagus	0.250—0.311	0.308—0.389	0.186—0.261	0.264—0.333
Length of gland. oesophagus	0.340—0.390	0.390—0.530	0.232—0.346	0.318—0.450
Right spicule	0.354—0.424		0.300—0.370	
Left spicule	—		0.120—0.150	
Gubernaculum	about 0.07		0.046—0.072	
Pairs of preanal papillae	9		7 ± 1—2	
Pairs of adanal papillae	1		1	
Pairs of post. papillae	6		6	
Distance of vulva from poster. end		2.32—3.57		1.58—3.48
Length of tail	0.061—0.071	0.116—0.161	0.035—0.049	0.093—0.138
Host	*Heteropneustes fossilis*		*Heteropneustes fossilis*	
Distribution	Bangladesh		India	

**) Probably an error for 0.13—0.18

gubernaculum for the left spicule. In our specimens the left spicule is only slightly sclerotized and therefore ill-visible, while the right spicule and the gubernaculum are strongly sclerotized (mostly yellow in colour) and accordingly very distinct; the left spicule is better visible in ventral view, whereas in the lateral view it is indistinct. It explains why this spicule was overlooked by all the previous authors. A similar case has been reported by Moravec and Amin (1978) in the species *P. siluri* Osmanov, 1964. The presence of two spicules and the gubernaculum is apparently a generic feature of nematodes of the genus *Procamallanus;* in various species these organs may, however, exhibit a different degree of sclerotization. In very young males both the spicules and the gubernaculum may be completely indistinct, which was observed in the smallest male of the present material.

Also the shape of the gubernaculum corresponds to the presence of two spicules in our specimens, this being due to its function; the gubernaculum is Y-shaped, with relatively long, unequal anterior arms; its longer right arm corresponds to the much longer and better developed right spicule, while the shorter arm is correlated with the smaller, weakly sclerotized left spicule. In lateral view the gubernaculum appears to be bipartite. As to the variations in the number of caudal papillae in individual species (Table 1), these may be due to either a considerable intraspecific variability or inaccurate data in the literature; these papillae, especially the postanals, cannot be properly examined in lateral view. Almost identical numbers and distribution of caudal papillae in comparison with our specimens are reported for the species *P. devendri* (Sinha and Sahay, 1966) and *P. sprenti* (Bashirullah and Hafizuddin, 1974).

A reliable specific feature of *Procamallanus* members seems to be the presence or absence of small processes on the tail tip of adult females (Moravec, 1975; Moravec and Amin, 1978). Such processes have not been described in *P. chakravartyi* and *P. confusus,* while they are present in all the other species in question; in our specimens, as also in *P. mathurai, P. ottuei* and *P. sprenti,* there are always three processes. The ventrolateral processes overlap in lateral view and, consequently, it appears that only two processes are present; it explains why *P. spiculogubernaculus, P. daccai, P. hindenensis, P. magurii* and *P. devendri* were reported to have females with only two caudal processes.

It follows from the above discussion that there are no substantial morphometrical differences (Table 1) amongst the nematode forms in question and, therefore, we consider them to be identical. In view of priority the valid name of this species is *Procamallanus spiculogubernaculus* Agarwal, 1958; its synonyms are *P. daccai* Gupta, 1959, *P. chakravartyi* Fernando et Furtado, 1963, *P. confusus* Fernando et Furtado, 1963, *P. mathurai* Pande, Bhatia et Rai, 1963, *P. hindenensis* Lal, 1965, *P. magurii* Lal, 1965, *P. devendri* Sinha et Sahay, 1966, *P. ottuei* Varma et Varma, 1971 and *P. sprenti** Bashirullah et Hafizuddin, 1974.

*) In his list of the parasites of freshwater fishes of Bangladesh, Bashirullah (1973) reported *P. bangladeshi* Bashirullah et Hafizuddin, 1973 as the parasite of *H. fossilis* (p. 73); the latter specific name, which is invalid and now cannot be considered a synonym, was later apparently changed to *P. sprenti* by the authors (Bashirullah and Hafizuddin, 1974) while describing the nematode as a new species.

In 1969 Khan and Yaseen reported female nematodes from *Heteropneustes fossilis* from Bangladesh which they identified as *Procamallanus viviparus* Ali, 1957. Although Ali (1957), while describing the latter species on specimens from *Mystus microphthalmus* from India, does not mention the presence of spiral thickenings on the buccal capsule, it is obvious from his drawings (Pl. I. Fig. 10) that these are present in *P. viviparus*; on the other hand the specimens found by Khan and Yaseen (1969) possessed a smooth buccal capsule without any thickenings and they probably belonged to the species *P. spiculogubernaculus.*

The hitherto data indicate that *P. spiculogubernaculus* mainly depends on the host *Heteropneustes fossilis;* it may, however, occur in other siluroid and some other fishes as suggested by the finding of this species in *Clarias batrachus* (Lal, 1965). On the other hand, there are two additional congeneric species, *P. heteropneusti* Ali, 1957 and *P. muelleri* Agrawal, 1966, described from *Heteropneustes fossilis* of India that are not synonymized with *P. spiculogubernaculus* in this paper. *P. heteropneusti* (syn. *P. clarius* Ali, 1957 – see Agrawal, 1966) appears to be an independent species occurring mainly in *Clarias batrachus. P. muelleri* is morphometrically very similar to *P. spiculogubernaculus,* differing from it, however, by the presence of two very long (1.40—1.41 mm), equal spicules and by the absence of a gubernaculum; it may well be that the spicules were described erroneously in this case (as suggested by the illustration of the posterior end of the male body) and that subsequent studies will prove *P. muelleri* and *P. spiculogubernaculus* to be conspecific.

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Věst. čs. Společ. zool., **44**: 92–93, 1980

Zoologisher Garten, Praha

CHINOBIUS ALENAE SP. N., EINE NEUE CHILOPODEN-ART AUS DEM FERNEN OSTEN (CHILOPODA: LITHOBIOMORPHA)

Luděk J. DOBRORUKA

Eingegangen am 17. Oktober 1978

Abstract: The description of the new chilopod *Chinobius alenae* sp. n. is given.

Frau Alena Čepická hatte aus ihrer Aufenthalt in der UdSSR einige Chilopoden mitgebracht, die sie mir liebenswürdig zur Bearbeitung übergab. Ich möchte ihr an dieser Stelle meinen herzlichsten Dank aussprechen. In dem Material wurde eine neue Art der Gattung *Chinobius* Verhoeff, 1934 entdeckt, deren Beschreibung ist im Folgenden gegeben:

Chinobius alenae sp. n.

Derivatio nominis: Ich widme die neue Art der Sammlerin, Frau Alena Čepická, Praha.

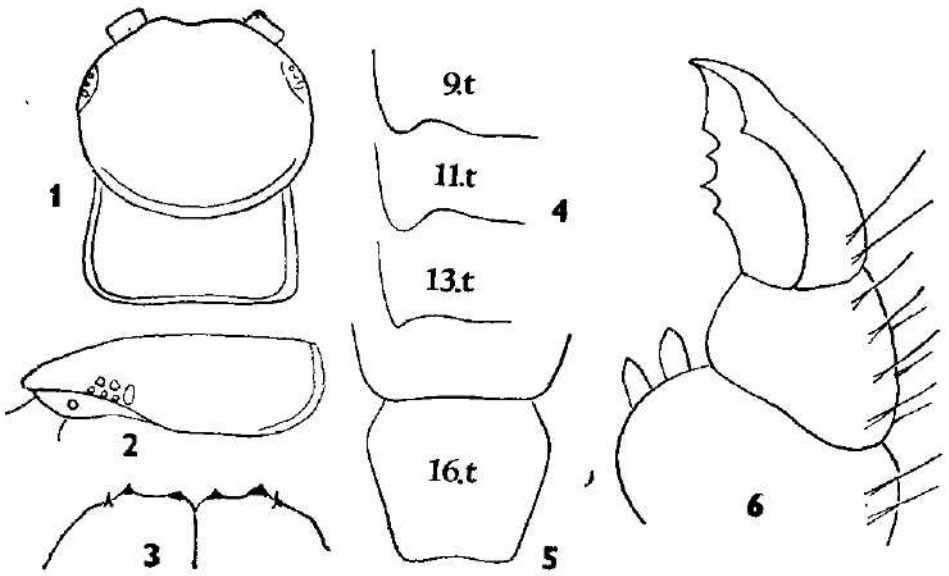
Locus typicus: *Voroněž, 30 km nordöstlich von Chabarovsk*, unter der Rinde eines gefallenen Baumes in der Laubbaum-Taiga. 5. 7. 1977 A. Čepická legit.

Holotypus: 1 ♀ Nr. XXXX/III. Evert. in der Kollektion des Nationalmuseums Prag (Abb. 1–6).

Paratypus: 1 ♀ Nr. XXXX/III. Evert. ibidem.

Diagnosis: Eine *Chinobius*-Art mit einfacher Endklaue. Klaue der ♀-Gonopoden mit 4 Zacken auf der Innen- und mit 1 Zacke auf der Aussenseite Auf der Dorsalseite des 2. Gonopoden-Gliedes mehrere lange Borsten. Bedornung des 1. Beinpaares dorsal 000111, ventral 0012-31, des 14. Beinpaares dorsal 10311, ventral 01332, des 15. Beinpaares dorsal 10310, ventral 01310.

Descriptio: *Länge 12 mm, kastanienbraun: Antennen mit 19* Gliedern. Kopf etwas breiter als lang (Abb. 1). Ozellen 6 in 2 Reihen, das Tömeswary-Organ gross wie benachbarter Ozellus (Abb. 2). Koxosternum der Prehensoren mit 2 + 2 Zähnen und starken Porodonten. Nebst den Porodonten das Koxosternum etwas erweitert (Abb. 3). Tergite 9., 11. und 13. mit kurzen Fortsatzen, deren Form aus der Abb. 4 sichtbar ist. Das 16. Tergit etwas langer als breit (Abb. 5). Koxalporen 5655. Endklaue der Beine des 15. Paares einfach. Plectrotaxis: 1. Beinpaar dorsal 00111 (p, a, a), ventral beim Holotypus 00131 (p, pma, m), beim Paratypus 00121 (p, ma, m). 14. Beinpaar dorsal 10311 (m, —, pma, p, a), ventral 01332 (—, m, pma, pma, pm). 15. Beinpaar dorsal 10310 (m, —, pma, p, —), ventral 01310 (—, m, pma, m, —). ♀-Gonopoden mit 2 + 2 konischen Spornen und einer Kralle, auf deren Aussenrand 1 Zacke, auf deren Inneseite 4 Zacken sind (Abb. 6). Auf der Dorsalseite des 2. Gliedes der Gonopoden 7 lange Borsten, auf dem Klauenglied 2 lange Borsten.



Chinobius alenae sp. n.: Abb. 1 — Kopf und das erste Tergit; Abb. 2 — Anordnung der Ozellen; Abb. 3 — Koxosternum der Prehensoren; Abb. 4 — Fortsätze des 9., 11. und 13. Tergites; Abb. 5 — 16. Tergit; Abb. 6 — ♀-Gonopoden.

Discussio: ♂ dieser neuen Art bleibt vorläufig unbekannt. Die neue Art errinnert durch die zahlreichen Zacken der Gonopondenklaue und durch die einfache Endklaue des 15. Beinpaares auf die Art *Chinobius opinatus* Zalesskaja, 1978, unterscheidet sich aber deutlich durch die Plectrotaxis der Beine, durch lange Borsten auf dem 2. Gonopodenglied und durch die Form des 16. Tergites des ♀, der bei der neuen Art die gleiche Form hat, welche man bei dem ♂ der Art *Ch. opinatus* findet.

Insgesamt sind jetzt 13 Arten der Gattung *Chinobius* Verhoeff, 1934 bekannt (cf. Matic, 1973 und Zalesskaja, 1978), von welchen einige noch ungenügend bekannt sind. Es bleibt z. B. zu entscheiden, ob *Chinobius orientalis* (Sseliwanoff, 1878) und *Chinobius orientalis* Matic, 1973 Synonyma oder Homonyma sind.

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Věst. čs. Společ. zool., **44**: 94–100, 1980

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ON THE FIND OF SALMO SALAR REMAINS IN A RITUAL WELL OF THE EARLY BRONZE AGE AT GÁNOVCE (CZECHOSLOVAKIA) WITH REGARD TO THE OCCURRENCE OF THIS SPECIES IN THE UPPER VISTULA BASIN

Juraj HOLČÍK and Johannes LEPIKSAAR

Received July 14, 1978

Abstract: The remains of the Atlantic salmon — *Salmo salar* Linnaeus, 1758 discovered during archaeological investigation of a ritual well of the Bronze Age Man at Gánovce (northern Slovakia) are described. This find together with a remarkable decrease in Atlantic salmon in the Baltic sea and Subcarpathian rivers as well suggests that in Early Holocene this species was more numerous and maybe even predominant, and only later was it replaced by the sea trout which markedly predominates at the present time.

INTRODUCTION

By courtesy of Dr. Cyril Ambros, Archaeological Institute of the Slovak Academy of Sciences, Nitra, we have obtained four fish vertebrae found during archaeological excavations of a ritual well of the Early Bronze Age Man at a locality known as "Hrádok" at Gánovce (northern Slovakia, 20°10′E, 49°5′N). The well has been discovered in holocene sediments established amidst the Late Pleistocene filling. Along with grains and rich archaeological material it also contained a number of bones of both wild (*Cervus elaphus, Alces alces, Capreolus capreolus, Ursus arctos, Castor fiber, Erinaceus europaeus, Bos primigenius*) and domestic (*Bos taurus, Equus caballus, Canis familiaris, Sus scrofa, Capra* sp., *Ovis* sp.) animals and even the bones of man (Ambros, 1959). According to Vlček and Hájek (1963) the well dates back to about 1,500 years B. C., which was later confirmed by C_{14} method (Groningen) according to which the age of this ritual well determined from the well-preserved timbering is 1465±35 years B. C. (Novotný and Kovalčík, 1978)

Because preliminary the first rough examination showed that the vertebrae come from some big salmonid fisches and three large salmonids, i. e. Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*) and the huchen (*Hucho hucho*) could be considered in the mentioned territory, the second author examined these finds and compared them with the skeletons of recent salmonids. It was found that all four vertebrae belonged to two specimens of the Atlantic salmon — *Salmo salar* Linnaeus, 1758. Since the occurrence of this species in the upper Vistula basin and thus also in the territory of southern Poland and northern Slovakia was not clear and, according to some authors (Kux and Weisz 1960, Balon, 1964), even questionable, we decided to introduce more details on these finds.

RESULTS

1. Description of vertebrae

One of the vertebrae (No. 1) comes from the praecaudal part of skeleton, while the three others (No. 2, 3, 4) from the caudal one. Their measurements are given in Table 1. The free neurapophyses and parapophyses of the prae-

Tab. 1. Measurements (in mm) of corpus vertebrae of the Atlantic salmon from Gánovce

No.	Skeletal region	Length medio-ventral	Length dex.	Length lateral sin.	Diameter (horiz × vert.) cranial	Diameter (horiz × vert.) caudal
1.	Vertebra praecaudalis	7.1	6.8	6.6	8.4 × 7.8	8.6 × 7.7
2.	Vertebra caudalis	11.1	10.0	10.0	14.7 × 11.7	14.3 × 11.7
3.	Vertebra caudalis	10.4	9.6	9.5	14.2 × 11.5	14.1 × 11.8
4.	Vertebra caudalis	(9.5)	—	(8.8)	—	12.7 × 10.2

caudal vertebra have fallen out, leaving for characteristic pits on the intact corpus vertebrae. The neural and haemal arches of the caudal vertebrae, excepting the basal parts, are broken off, and the corpus of vertebra No. 4 is damaged, too (Plate 1).

2. Species determination

The pits of parapophyses of vertebra praecaudalis (No. 1) are not as wide apart as in *Hucho hucho*. The medioventral part of corpus between these pits is narrow and constricted in the middle. These features are characteristic of the genus *Salmo*. The general form of the corpus vertebrae is relatively broader than in *Salmo trutta*. The more constricted form of the medioventral septum between the parapophysis pits is closer to that in *Salmo salar* than in *Salmo ttruta*.

The pore structure of the lateral parts of corpus vertebrae in vertebrae caudales (No. 2–4) seems to be characteristic of the genera of *Salmonidae*. In *Hucho hucho*, the pores are coarse and their size is more or less the same. There is no concentration of fine small pores in the end parts of the corpus. In the genus *Salmo* the pore structure is much more heterogenous. There are many small pores among large ones. Especially on the ends of the corpus there usually are zones of very fine small pores. In *Salvelinus alpinus* which has been examined, too, the pore structure seems to be more homogenous but the small fine pores are predominant.

The pore structure of three subfossil vertebrae caudales from Gánovce resembles the structure of *Salmo*, and not of *Hucho* or *Salvelinus*. The relatively broader form of the corpus vertebrae and the relatively strong development of zygapophyses support the identification of finds as *Salmo salar* rather than *Salmo trutta*. The corresponding vertebrae of sea trout seem to be more slender and they have less developed zygapophyses.

3. The position of the found vertebrae in the vertebral column

Considering the range of individual variation an exact estimation of position

is very difficult. Therefore the following considerations are of only approximate value:

Vertebra No. 1, resembles the 9th vertebra praecaudalis in recent skeletons of *Salmo salar*, while vertebrae 2–4 are similar to the 10th, 15th and 18th vertebrae caudalis, respectively, of the same species.

4. Estimation of total length of fishes, their fork length and weight

The total length of the two salmons from Gánovce was estimated by using the ratio between the respective vertebrae and total length in two recent Atlantic salmons (Tab. 2). As follows from Table 3, the praecaudal vertebra

Tab. 2. Measurements (in mm) of vertebra praecaudalis and vertebrae caudales of two recent Atlantic salmons and the relation (in parantheses) between the total length of fishes (fresh) and the lateral length of vertebral corpus (dried preparates)

Total length of fish	Lateral length of corpus vertebrae and ratio			
	Vertebra praecaudalis IX	Vertebra caudales X	XV	XVIII
580	5.3 (109.43)	6.3 (85.29)	6.5 (89.23)	6 (96.66)
1202	11.2 (107.32)	13.3 (90.37)	13.0 (92.46)	12.6 (95.39)

belonged to a fish of total length of 71—74 cm, while 3 caudal vertebrae may come from fishes measuring about 84—90 cm. If the conversion formula fork length = 0.9173 × total length is used (Beckman and Clark 1936), the corresponding fork length could be 65—68 cm and 77—83 cm, respectively.

Tab. 3. Estimation of the total length of Atlantic salmon from Gánovce according to their vertebrae (using the relationship from Tab. 2 as factors)

No. of vertebra	Lateral length of vertebra (mm)	Factor	Total length (cm)	Mean
1	6.8	109.43	74.4	
		107.32	73.0	
	6.6	109.43	72.2	72.6
		107.32	70.8	
2	10.0	85.29	85.3	
		90.37	90.4	87.9
3	9.6	89.23	85.7	
		92.46	88.8	87.3
4	8.8	96.66	85.1	
		95.39	83.9	84.5

According to the length — weight formula introduced by Pope and coauthors (1961; log weight = $-5.038 + 3.0 \times$ log fork length) the weight of these fishes was about 2.5—2.9 and 4.2—5.2 kilograms, respectively.

Tab. 4. Age and growth (total length, fork length in brackets) of Atlantic salmon from Gánovce according to particular vertebrae. Growth after + is growth in the sea.

No. of vertebra	Estimated total length at capture	Age group Freshwater, Sea	Back calculated length at each annulus in cm				
			1	2	3	4	5
1	72.6	II, 2	16.0 (17.7)	23.2 (21.3)	*42.1 (38.6)	72.5 (66.5)	
2	87.9	III, 2	14.6 (13.4)	29.2 (26.8)	37.9 (34.8)	*71.0 (65.1)	87.9 (80.6)
3	87.3	III, 2	12.1 (11.1)	27.2 (25.0)	36.8 (33.8)	*65.4 (60.0)	87.3 (80.1)
4	84.5	III, 2	14.1 (12.9)	27.1 (24.8)	43.3 (39.7)	*63.9 (58.6)	84.5 (77.5)
Mean for No. 2—4	86.6		13.6 (12.5)	27.8 (25.5)	39.3 (36.1)	*66.8 (61.2)	86.6 (79.4)
Mean for 1 and 2—4			14.8 (13.6)	25.5 (23.4)	40.7 (37.4)	69.7 (63.9)	86.6 (79.4)

5. Estimation of the number of fishes

Considering individual variation and difficulties in exact estamination of the numerical order of isolated finds of vertebrae, all three caudal vertebrae from Gánovce may come from the same fish whose total length was approximately 84–90 cm. The praecaudal vertebra seems to come from a somewhat smaller fish, about 71–74 cm long. The number of annuli found in individual vertebrae as well as the back-calculated growth also point to two specimens as follows below.

6. Age and growth

The reading of annuli by means of microscope and using both the top and in-base illumination resulted in distinguishing 3 completed annuli in vertebra No. 1, and 4 annuli in vertebrae Nos. 2—4, following by the wide new increment. Position of the annuli and the distance between them allow to recognize 2 years spent in the river and 2 in the sea by the smaller fish, while 3 and 2 years respectively by the larger one. The calculated growth by using the method of Lea is shown in Table 4.

DISCUSSION

The remains of Atlantic salmon found in the ritual well of the Bronze Age, together with recent findings of this species in the Dunajec river (Holčík 1959, Tichý 1975) are proofs that the salmon continuously migrated to the upper part of the Vistula basin both at praehistoric and present times. There is no doubt that the found vertebrae come from fishes caught in the Poprad river running only 3 kilometers from this site. The Gánovský brook which flows nearby the well cannot be considered at all, not only because it is a small creek with a muddy bottom, but mainly because it is a tributary of the Hornad river which belongs to the Danube basin where salmon never lived. The find of the salmon vertebrae (and not of the sea trout, which in the recent period has significantly predominated over the salmon in the whole territory of Poland (Rembiszewski and Rolik 1975) suggests that in the praehistoric period the upper Vistula basin had probably been exclusively inhabited by salmon and not by the sea trout which replaced the former species later. This hypothesis is supported by recent fishery statistics and data introduced by Dixon (1937), Chrzan (1959) and Chełkowski (1965), showing a continuous decrease of salmon accompanied by the increase of sea trout in the Baltic sea. As follows from the figures of Dixon (l. c.) and Chrzan (l. c.) concerning Polish catches of salmonids in the Baltic sea, the average share of salmon in the years 1931—1933, 1946—1950, and 1951—1955 was 97, 83.5 and 46.2 %, respectively, while the share of sea trout in the same periods was 3, 16.5 and 53.8 %, respectively. The continuous disappearance of salmon and increasing occurrence of sea trout in Polish Subcarpathian rivers can also be seen in a review by Jokiel (1959).

The occurrence of salmon in the Dunajec and Poprad rivers has certainly been very rare in this century, but it cannot be excluded. Besides the original stock also the offspring of salmon imported from Estonia and introduced into the Dunajec in 1925 could occur there (Kolder 1959), and the fish caught in Nowy Targ in 1930 and described by Holčík (1959) probably came from that stock. As the size and weight of the sea trout is usually smaller than

that of the salmon (Berg 1948, 1949, Chełkowski 1965, Chrzan 1959), the unique records of salmonids weighing over 10 kilograms checked both in the Dunajec and Poprad river around the year 1940 apparently concerned the Atlantic salmon and not the sea trout. The photograph of a fish weighing 11 kilograms, caught in the Slovak stretch of the Dunajec river in September of 1947, showing a well developed kype, published by Tichý (1975), obviously represents the Atlantic salmon and not the sea trout. The final disappearance of salmon from the upper Vistula basin can be ascribed not only to the damming of rivers during and after World War II and to rapidly increasing pollution (Staff 1950, Kolder 1959), but probably also to climatic changes.

If the age and growth of the salmons from Gánovce are compared with those of recent salmon stock from the Vistula (Jokiel 1959), some apparent differences can be recorded. In the recent salmon population of the Vistula the age of smolts is 1 or 2 years, never more. In the Gánovce specimens the smolting stage appeared at 2 and 3 years. The growth of the recent Vistula salmon is more rapid than that of the salmons from Gánovce, as follows from Fig. 1. Another conspicuous phenomenon is that growth rate during the stay in the river was more rapid than now, while the sea increments were much lower than in the recent salmon. As it is known that towards north smolts are older at the time of migration (Jones 1959), it can be concluded that in that period of the Early Holocene (i. e. in XVth century B. C.) the climate of the upper Vistula basin was probably colder than now. More rapid growth in rivers can be explained by warmer summers or better food conditions while the low intensity of growth in the sea can also be ascribed to higher population density.

CONCLUSIONS

The four vertebrae found in the ritual well of the Early Bronze Age in Gánovce (1,500 B. C.) belonged to two specimens of Atlantic salmon, of about 71–74 and 84–90 cm in total length. The fishes were obviously caught in the Poprad river, the right tributary of the Dunajec river (upper Vistula basin). These finds along with unique records of the Atlantic salmon in the upper Vistula basin in the middle of this century show that this territory has continously been inhabited by this species both at praehistoric and recent times. The disappearance of the Atlantic salmon from the upper Vistula basin can be ascribed not only to the damming and pollution of rivers but probably also to changed climatic conditions. Higher age in the smolting stage, better growth during life in the river and slower in the sea, as well as smaller size are probably due to different climatic conditions in this territory in Early Holocene.

Acknowledgements

The authors are indebted to Dr. Cyril Ambros (Archaeological Institute of the Slovak Academy of Sciences at Nitra) for kind loan of the vertebrae and for valuable information. Professor Dr. Bohuslav Novotný (Philosophical Faculty of the Comenius University at Bratislava) is acknowledged for loan of some literature and valuable comments, and Dr. Ing. J. Guziur (Institute of Ichthyobiology and Fisheries, Olsztyn, Poland) for kind loan of Dixon's paper.

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Fig. 1 and Plate I will be found at the end of this issue.

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Věst. čs. Společ. zool., **44**: 101—104, 1980

Czechoslovak Zoological Society

LAMPRODRILUS JAMBURAENSIS SP. N. FROM THE TUNDRA ON THE BANK OF THE OB-RIVER (OLIGOCHAETA, LUMBRICULIDAE)

Sergej HRABĚ

Received January 12, 1979

Abstract: The present paper contains the description of new *Lamprodrilus jamburaensis* from the tundra on the bank of the Ob-River near the north polar circle.

By the kindness of Prof. Dr. B. Ryšavý I have received for determination Lumbriculidae collected by him in small lakes and pools filled with thawing snow in the tundra on the left bank of the Ob-River. The collection contains 40 individuals of the new species of the genus *Lamprodrilus* besides immature specimens of another genus of the family Lumbriculidae.

My thanks are due to Prof. Dr. B. Ryšavý for giving me the opportunity to study this collection.

Lamprodrilus jamburaensis sp. n.

The body is 15—22 mm long, about 1 mm wide, composed of 70—75 segemnts.

The prostomium is large, rounded at the end and longer than its basal width.

Setae simple, not furked, dorsal ones 120 μm long in segment 2, 128 μm in segment 5, ventral ones 193 μm in segment 5. (Fig. 1.)

Cylindrical clitellum covers segment l/n 9—13.

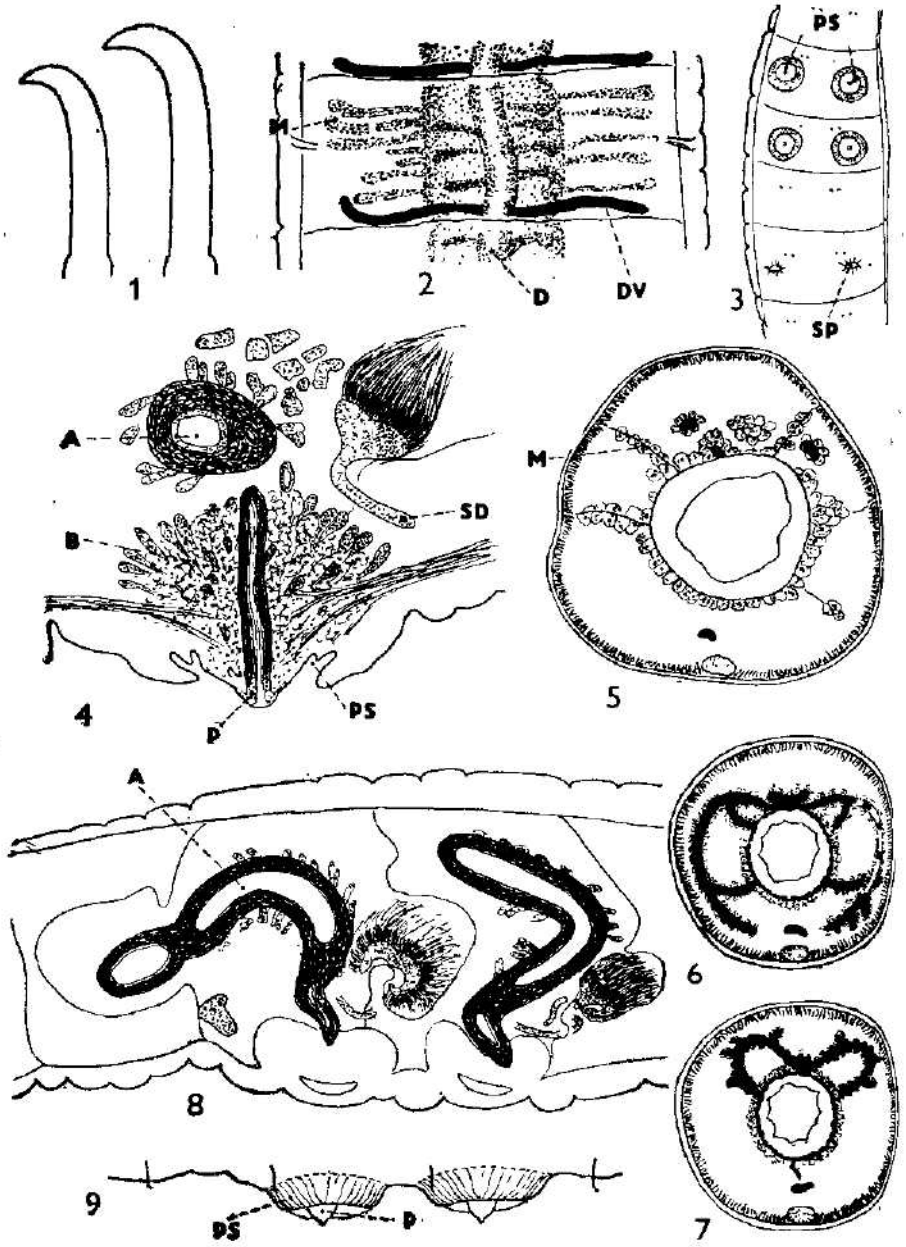
Two pairs of male ducts open in segments 10 and 11 at the end of large conical penes situated in the centre of large but shallow penial sacs (Figs. 3, 4, 8, 9 PS). One pair of spermathecae posterior to the setae on segment 13 (Fig. 3 SP).

Epidermis approx. 8 μm thick, the longitudinal muscular layer (18—21 μm) is less than 3 times as thick as the epidermis.

Chloragogen cells cover the pharyngeal glands and also the alimentary canal from segment 6. The cells are small, max 70 μm long, mostly arranged in one layer. In 20 anterior segments they cover the muscles with which the alimentary canal is attached to the body-wall (Figs. 2, 5 M). These narrow structures, absent from middle and posterior segments, resemble contracted vessels.

Chloragogen cells also cover the lateral vessels from segment 13, but not the dorsoventral ones occuring in 16—17 anterior segments. These connect the dorsal vessel with the ventral one and occur in the vicinity of posterior dissepiments (Fig. 2 DV).

Behind the clitellum there are two pairs of lateral vessels per segment. The anterior pair is longer than posterior one. Both pairs are branched into nume-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rous contractile diverticula and join the dorsal vessel with a perivisceral sinus: the anterior pair opens by 2 pairs of vessels into the sinus: the upper vessels in the upper half of the alimentary canal, the lower ones in the lower half of the tract (Fig. 6). The second pair is shorter and opens by one pair of branches into the sinus in the upper half of the alimentary canal (Fig. 7).

Two pairs of testes are attached in segments 10 and 11 to the dissepiments 9/10 and 10/11, 1 pair of ovaries in segment 12 to the dissepiment 11/12.

Two pairs of large (posterior) male funnels are near the orifice of seminal vesicles on dissepiment 10/11 and 11/12. Narrow (15 μm) spermducts go into segments 11 and 12, turn back into segments 10 and 11, enter the muscle layer of atria and open into their cavity near the middle of the length of atrial ampulla (Figs. 4, 8 SD). Atria are composed of a long cylindrical ampulla, a narrow duct and a large conical penis lying in a broad penial sac (Figs. 8, 9 PS). Atrial ampullae sometimes enter the neighbouring segment. The atrial wall consists of the inner epithelial layer (7—10 μm), muscular tissue (17—28 μm) and a layer of sparse prostatic cells, 40—50 μm long. The diameter of the atrial ampulla (without prostatic cells) measures 100 μm, the duct is 260 μm long, its external diameter is 25 μm. A glandulomuscular bulb surrounds the atrial duct, it is composed of muscular fibres and pyriform glandular cells with long ducts (Fig. 4 B). These cells originate from sunken epidermal cells, the penes are therefore not covered with epithelium. Penial sacs, 220—240 μm wide, are shallow, covered with normal epithelium, sharply defined from the high cylindrical clitellar cells (Figs 3, 4, 9 PS).

Spermathecae with a globular ampulla and a large duct opening into a shallow invagination of epidermis.

One pair of female funnels in segment 12 on dissepiment 12/13.

Notes. The diameter of the body of *Lamprodrilus jamburaensis, michaelseni* Hr. and *mrazeki* Hr. does not exceed 1.5 mm. The longitudinal musculature is less than 3 times as thick as the epidermis. Special copulatory glands in the form of rosettes, glandular stripes are absent, glandular cells participate in the formation of penial bulbs. The above species differ by these features from the remaining *Lamprodrilus* spp.

The new species resembles *L. michaelseni* described from the vicinity of Bitolje in Macedonia, and also occurs in Lake Janina (J. Komárek 1927 leg). In the new species, the diameter of atrial ampullae (without prostatic cells measures 100 μm. the muscular layer of atria is 17—28 μm thick, prostatic cells max. 50 μm long, not covering the whole surface of atria. The ventral setae of segment 10 are 125 μm long, the dorsal ones 97 μm. The large penial

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Fig. 1—9. *Lamprodrilus jamburaensis* sp. n. 1. — Distal end of setae in segment 3, × 900; 2. — Segment 7, the dorsoventral vessels and muscles covered with chloragogen cells, × 80; 3. — Ventral surface of segment 9—14. × 25; 4. — Longitudinal section of ectal end of the male duct, × 150; 5. — Transverse section of segment 8, × 100; 6. — Transverse section showing the first pair of lateral vessels, communicating with perivisceral sinus, × 80; 7. — Transversal section showing the second pair of lateral vessels, × 80; 8. — Longitudinal section through segment 9—11, × 60; 9. — Penial sacs and penes in segment 10—11 from the side, × 60. A — atrial ampulla, B — glandulomuscular bulb, D — dorsal vessel, DV — dorsoventral vessel, M — muscle attaching the alimentary canal to the body-wall, P — penis, PS — —penial sac, SD — spermduct, SP — spermathecal pore.

sacs are another feature characteristic of the new species. On the contrary, the diameter of atrial ampullae of *L. michaelseni* (without prostatic cells) measures 60—70 μm, the muscular layer is very thin (6.5—10 μm), prostatic cells 50—70 μm long, cover the whole surface of atria, ventral setae of segment 10 are 150 μm long, dorsal ones 120 μm, large penial sacs absent.

The chief mode of reproduction of *L. mrazeki* is architomy in cysts (Hrabě 1929 b). Regenerated genital organs vary in number and position, they are shifted some segments forward to the anterior end of the body. The first pair of the ventral vessels opens into the perivisceral sinus by only one pair of narrow vessels (Hrabě, 1929 b, tab. 1, fig. 2). The chloragogen cells are large in comparison with those of *L. jamburaensis*.

Locality. Small lakes and pools near a former fishermen's settlement Jambura on the left bank of the Ob-River, east of Salechard (formerly Obdorsk), 10—24 June, 1975 B. Ryšavý leg. (Collectio Hrabě: Hr. 1928—1—12).

Notice. In my collection of Oligochaeta are preserved the preparations of all species of which I have written from 1926. Nomenclatura oligochaetologica published in 1976 by the University of New Brunswick should be corrected in this respect.

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Věst. čs. Společ. zool., 44: 105—115, 1980

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FURTHER NOTES ON THE GROWTH OF PIKE, ESOX LUCIUS FROM CZECHOSLOVAKIA (PISCES, ESOCIDAE)

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Received March 22, 1978

A b s t r a c t: Growth rate of pike, *Esox lucius* Linnaeus, 1758, collected during the years 1956—1976 from six Labe river back-waters and the lower part of the river Berounka has been studied from the scales of 270 specimens. Pikes of seven age classes were recorded. With regard to previous research, the growth of pike throughout Bohemia is balanced without considerable ranges.

INTRODUCTION

The studies on the growth of pike in Czechoslovakia using the scale structure were initiated by O l i v a (1955) and followed by Č i h a ř (1961), F r a n k and V o s t r a d o v s k ý (1961), B a l o n (1965), P o u p ě (1974) and T a n d o n and O l i v a (1978). Van E n g e l(1940), Van O s t e n (1960), F r o s t and K i p l i n g (1961) and F r o s t (1963) studied the growth of pikes from the United States of America. M i l l e r and K e n n e d y (1948) described the growth rate of pike from Northern Canada and D a h l (1961) from Denmark. B e r g (1948) quoted the growth of pike from the territory of the U.S.S.R., T o n e r and L a w l e r (1969) published a synopsis of biological data on the pike.

V o s t r a d o v s k ý (1968, 1969 a, b, c; 1970, 1971) worked on the population dynamics of pike from great Lipno valley river water reservoir. For more complete list of literature readers are referred to T a n d o n and O l i v a (1978).

MATERIAL AND METHOD

270 specimens of pike were collected from the following backwaters: Procházkova 38 specimens; Malá Arazimova 39 specimens; Černá tůň 38 specimens; Mansfeldova 21 specimens; Velká Arazimova 12 specimens; Poltruba 80 specimens and from the lower part of the river Berounka 42 specimens The description of most of the localities was published by O l i v a (1955).

The whole material was collected in backwaters by Dr. O. Oliva and his co-workers mostly during seining operation, a part of the material and scale of all specimens from the lower part of the river Berounka were collected by Mr. J. Pásek during the years 1954—1977.

The scales collected during the years 1954—1977 were sorted out yearwise and locality-wise Three to four scales were used for the present studies. For the

This work is a part of studies in Prague supported by UNESCO course on Modern Problems in Biology.

measurement of the scales "Documator" (microprojector, Carl Zeiss, Jena, magnification 17.5) was used using centrolateral scale radius and on this radius the distances of different annuli were measured. All the scale were studied in dry mounts. Lea's desk was used for the back-calculations of body lengths at the respective annuli with a correction factor of 4.5 cm. (Fig. 1). In some of the specimens from the river Berounka, only total length was recorded at the time of collection. In such cases, the body length was calculated by the following conversion factor.

Total length = 1.146 standard length

(calculated from the data of O l i v a, 1955)

For the calculation of specific rate of linear growth, the following formula was used:

$$Cl = \frac{L_2 - L_1}{L_1} \cdot 100$$

where Cl = *specific rate of linear growth*

L_2 and L_1 = computed standard lengths at successive years of life

The specimens from the backwater Poltruba are analysed yearwise in order to study the growth in different years from yearwise in order to study the growth in different years from 1949–1976 and to prove eventual differences in growth.

The measurements are expressed to the nearest mm. in case of scale and cm. in case of body length.

RESULTS AND DISCUSSION

The body length/centrolateral scale radius relationship (Fig. 1) shows linear relationship and the scale formation appeared at 4.5 cm. of standard length. The back calculated lengths, using 4.5 cm. as a correction factor indicate that the first annulus was formed when the pike had attained the average size of 18.9 cm. from Malá Arazimova; 18.5 cm. from Černá; 17.9 cm. from Mansfeldova; 17.1 cm. from Velká Arazimova; 16.8 cm. from Poltruba; 18.1 cm. from Procházkova and 19.5 cm. from the lower part of the river Berounka. Among backwaters from Poltruba, maximum number of age groups have been recorded from I to V, from Černá and Mansfeldova only two age groups 0 and I have been recorded, from lower part of the river Berounka six age groups from II to VII have been recorded (Table 1).

In the backwater Procházkova during the years 1955, 1956, 1957, 1958, 38 specimens were caught belonging to VI age classes. In the age class 0, 6 specimens ranging from 90—200 (130) mm. of body length were collected In the age class I, 6 specimens, ranging from 230—300 (269) mm. of body length, l_1 = 180—220 (196) mm. In the age class II 17 specimens ranging from 330—430 (369) mm., l_1 = 130—200 (164) mm., l_2 = 240—340 (278) mm In the age class III, 3 specimens ranging from 510—555 (528) mm., l_1 = = 160—220 (193) mm., l_2 = 300—380 (343 mm., l_3 = 440—480 (543) mm. In the age class IV, 2 specimens ranging from 600—635 (617) mm., l_1 = 160–190 (175) mm., l_2 = 340—360 (350) mm., l_3 = 450—480 (465) mm., l_4 = 520–540 (530) mm. In the age class V, 2 specimens ranging from 720–740 (730) mm., l_1 = 185 mm., l_2 = 300–320 (310) mm., l_3 = 400–410 (405) mm., l_4 = 530–580 (555) mm., l_5 = 600—620 (610) mm. In the age class VI, 6 specimens ranging from 815—860 (837) mm., l_1 = 175 mm., l_2 = 295–370 (335) mm., l_3 = 380—420 (400) mm., l_4 = 510—540 (525) mm., l_5 = 650–680 (665) mm., l_6 = 720—735 (727) mm.

Average of 38 specimens gives the following ranges and mean; l_1 = 130–—200 (180) mm., l_2 = 240—380 (323) mm., l_3 = 380—480 (431) mm., l_4 =

= 510–580 (537) mm., l_5 = 600–680 (638) mm., l_6 = 720–735 (727) mm. Their annual increments between l_1 and l_2 142 mm., l_2 and l_3 108 mm., l_3 an l_4 106 mm., l_4 and l_5 101 mm. and l_5 and l_6 84 mm. are calculated.

In the backwater Velká Arazimova during the years 1953, 1959, 1971, 12 specimens were caught belonging to three age classes. In the age class I, 7 specimens ranging from 210—280 (241 mm., l_1 = 150—247 (179) mm. In

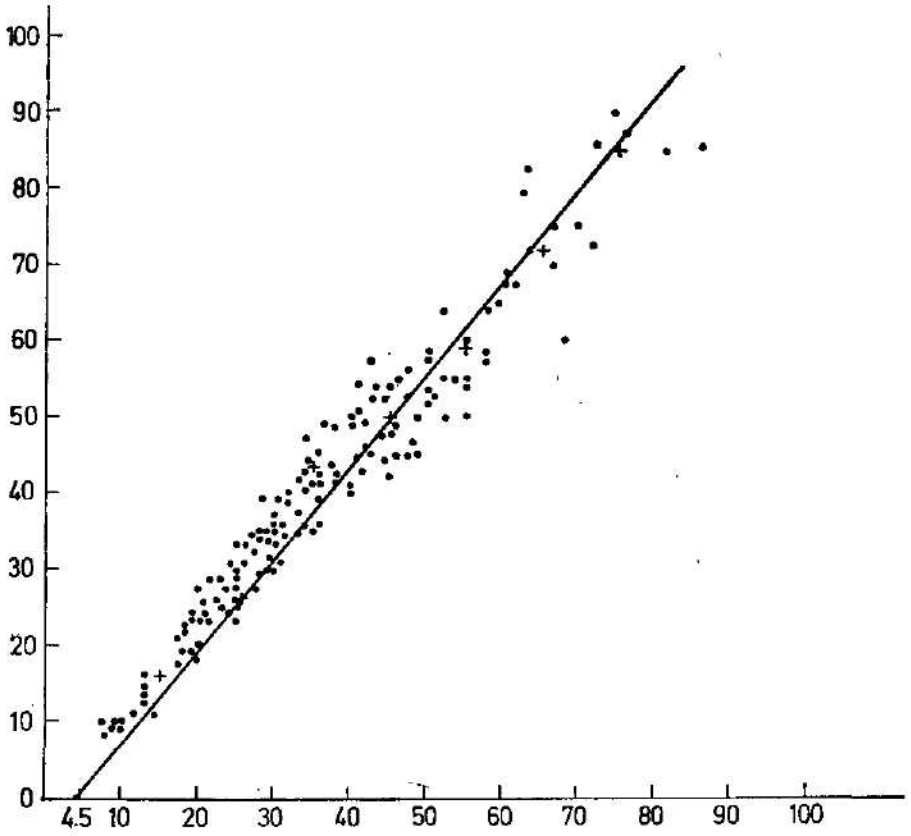

Fig. 1. Relationship between body length and scale radius in *Esox lucius*. Body length (cm.) is along abscissa and scale radius (mm.) is along ordinate. Dots = = original dots., Crosses = average readings at 10 cm. interval.

the age class II, 4 specimens ranging from 312—385 (357) mm., l_1 = 170——200 (182) mm., l_2 = 200—270 (233) mm. In the age class III, one specimen with 583 mm. of body length, l_1 = 152 mm., l_2 = 300 mm., l_3 = 480 mm.

In the back water Malá Arazimova during the years 1954, 1955, 1956, 1958, 1959, 39 specimens were caught belonging to three age classes from 0 to II. In the age class 0, 18 specimens ranging from 86—230 (166) mm. In the age class I, 19 specimens ranging from 245—345 (281) mm.. l_1 = 140—246 (189) mm. In the age class II, 2 specimens ranging from 350—380 (365) mm., l_1 = 175—180 (177) mm., l_2 = 286—326 (306) mm.

In the backwater Černá tůň during the years 1955, 1956, 1957, 1976, 38 specimens were caught belonging to two age classes 0 and I. In the age group 0, 16 specimens ranging from 80—190 (129)mm. In the age class I 22 specimens ranging from 200—365 (253) mm., l_1 = 142—230 (185) mm

In the backwater Mansfeldova 21 specimens were collected during the years 1956 and 1957 belonging to two age classes 0 and I. In the age class 0, 2 specimens were collected ranging between 122–135 (128) mm. In the age class I, 19 specimens were collected ranging between 180—330 (252) mm, l_1 = = 120—218 (179) mm.

Table 1. Growth of pike, *Esox lucius* from the river Berounka collected during the years 1975, 1976, 1977.

Age group	Number of specimens	Body length at the time of capture (mm.)		Average back-calculated lengths in mm						
				l_1	l_2	l_3	l_4	l_5	l_6	l_7
II	18	Mean	437	178	302					
		Min.	390	140	260					
		Max.	460	200	332					
III	12	Mean	452	189	286	380				
		Min.	450	184	250	340				
		Max.	500	340	340	450				
IV	7	Mean	561	187	277	390	464			
		Min.	500	170	240	350	440			
		Max.	610	220	310	440	480			
V	3	Mean	666	216	300	336	420	506		
		Min.	660	170	280	330	410	500		
		Max.	680	250	320	340	430	520		
VI	1		680	220	270	320	370	450	580	
VII	1		720	180	260	340	420	500	580	650
Total	42	Mean	195	195	282	354	413	485	580	650
		Min.		140	260	320	370	450	—	-
		Max.		250	340	450	480	520	—	-
Annual increment (mm.)					87	72	59	72	95	70
Specific rate of linear growth (Cl)					44.6	25.5	16.6	17.4	19.6	8.6

From the backwater Poltruba, 80 specimens were caught during the years 1954, 1955, 1957 1971 and 1976 belonging to I—V age classes. The present data are arranged according to the year of hatching and are as follows

In 1950, 2 specimens hatched and attained the age of five years ranging between 695—760 (728) mm., l_1 = 160— 180 (170) mm., l_2 = 300—350 (325) mm., l_3 = 400—440 (420) mm., l_4 = 500—560 (530) mm., l_5 = 590—640 (615) mm.

In 1950, 2 specimens hatched and attained the age of five years ranging between 620—630 (628) mm., l_1 = 145—180 (162) mm., l_3 = 380—390 (385) mm., l_4 = 455—475 (465) mm., l_5 = 550—570 (560) mm.

In 1951, 2 specimens hatched, one attained the age of three years with body length 410 mm., l_1 = 160 mm., l_2 = 260 mm., l_3 = 270 mm. Second spec-

men attained the age of four years with body length 530 mm., l_1 = 180 mm., l_2 = 270 mm., l_3 = 385 mm., l_4 = 470 mm.

In 1952, 5 specimens hatched and attained the age of three years ranging from 390—465 (412) mm., l_1 = 140—200 (166) mm., l_2 = 270—340 (287) mm., l_3 = 330—440 (367) mm.

In 1953, 12 specimens hatched and attained the age of two years ranging between 235—385 (329) mm., l_1 = 140—212 (174) mm., l_2 = 225—340 (291) mm.

In 1954, only one specimen hatched and attained the age of three years with body length 510 mm., l_1 = 180 mm., l_2 = 360 mm., l_3 = 425 mm.

In 1955, 2 specimens hatched and attained the age of two years ranging between 305—360 (333) mm., l_1 = 170—180 (175) mm., l_2 = 220—240 (230) mm.

In 1969. 5 specimens hatched and attained the age of two years ranging between 300—330 (312) mm., l_1 = 140—160 (149) mm., l_2 = 215—290 (250) mm.

In 1970, 5 specimens hatched and attained the age of only one year ranging between 210—255 (236) mm., l_1 = 130—195 mm.

In 1972. 11 specimens hatched and attained the age of four years ranging between 430—535 (471) mm., l_1 = 140—180 (160) mm., l_2 = 230—310 (265) mm., l_3 = 300—440 (367) mm., l_4 = 390—500 (430) mm.

Table 2. Growth of pike, *Esox lucius* from different back-waters of Czechoslovakia

Locality	Number of specimens		Average back-calculated lengths (in mm.) l_1	l_2	l_3	l_4	l_5	l_6
Procházkova	38	Body length	181	323	431	537	638	727
		Total length	209	370	500	590	730	830
Malá Arazimova	39	Body length	183	306				
		Total length	210	350				
Černá	38	Body length	185					
		Total length	210					
Mansfeldova	21	Body length	179					
		Total length	208					
Velká Arazimova	12	Body length	171	267	480			
		Total length	200	320	550			
Poltruba	80	Body length	168	272	376	460	587	
		Total length	198	330	420	540	680	
Total	228							
	Mean body length		177	292	429	498	612	727
	Mean total length		205	342	490	560	705	830

In 1973, 6 specimens hatched out of which two attained the age of three years ranging between 415—420 (418) mm., l_1 = 150 mm., l_2 = 240—270 (255) mm., l_3 = 320—325 (323) mm. Four specimens attained the age of four years ranging between 445—450 (447) mm., l_1 = 170—190 (178) mm., l_2 = = 230—330 (270) mm., l_3 = 350—420 (387) mm., l_4 = 395—490 (432) mm.

In 1974, 10 specimens hatched, five attained the age of two years ranging

Table 3. Comparison of first year increment (l_1) of pike, *Esox lucius* from Poltruba back-water and mixed material of Poupě, 1974 during the years 1947–1958, 1968–1970 and 1972–1976.

Author	No. of specimes	1947	1948	1949	1950	1951	1952	1953
Poupě, 1974	112	170	140	143	133	197	195	156
Author	80	—	—	170	162	170	166	174
		1954	1955	1956	1957	1958	1968	1969
		163	173	166	177	166	177	151
		180	175	—	—	—	168	149
		1970	1972	1973	1974	1975	1976	
		176	—	—	—	—	—	
		162	160	164	168	181	174	

between 280—300 (291) mm., l_1 = 140—180 (164) mm., l_2 = 220–280 (270) mm. Four specimens attained the age of three years ranging between 365—440 (404) mm., l_1 = 160—190 (170) mm., l_2 = 225—260 (238) mm. l_3 = 300—380 (325) mm. Only one specimen attained the age of four years with body length 505 mm., l_1 = 170 mm., l_2 = 250 mm., l_3 = 380 mm. l_4 = 420 mm.

In 1975, 11 specimens hatched, out of which 4 specimens attained the age of one year ranging between 260—275 (268) mm., l_1 = 160—180 (172) mm. 7 specimens attained the age of two years ranging between 290—340 (309) mm. l_1 = 140—200 (170) mm., l_2 = 240—300 (270) mm.

In 1976, only one specimen hatched and attained the age of one year with body length 265 mm. and l_1 = 174 mm.

In the present collection none of the specimen hatched during the years 1956—1967 and 1971.

The rate of growth in the backwaters is almost the same in the first year (Table 2). The maximum rate of growth in the first year is found in the Černá backwater (185 mm.) and minimum from Poltruba backwater (168 mm.). In the second year the specimens from the Procházkova and Malá Arazimova backwaters grow at higher rate than the specimens from the Velká Arazmova and Poltruba backwaters. In the subsequent years from IIIrd to VIth age classes, the specimens from the back water Poltruba grow at lower rate than the specimens from the Procházkova backwateer.

From the lower part of the river Berounka, the maximum annual rate of increment was found to be (Table 1) in between l_5 and l_6 (95 mm.) and minimum in between l_3 and l_4 (59 mm.).

The relationship between the scale radius/body length in the present sample is found to be linear (Fig. 1). Poupě (1974) obtained linear relationship between scale radius/body length up to the size of 58 cm. and afterward it became curvilinear. Tandon and Oliva (1978) described curvilinear relationship and the enclosed nomogram for back calculations of respective

lengths. Linear relationship obtained by me could be due to a different graphical interpretation.

The fish population observations (O l i v a, 1955, 1960) with relation to pikes are presented in Table 4. Considering the availability of non-carnivorous fished which constitute the major food of pike in almost all their size groups, it can be observed that the minimum number of non-carnivorous fishes were available during the years 1955—1956 in the Poltruba backwater and by weight was from the Malá Arazimova backwater during the year 1952. Similary the availability of food fished per pike per kilo hectar, again it was lowest in the Poltruba backwater during the year 1956 after poisoning. Considering the fish population observations of O l i v a (1955, 1960) the maximum rate of growth is expected from the Velká Arazimova back water, but in the present sample the maximum rate of growth has been recorded from the Černá back-water, apparently due to planting of young pikes into the reservoir with rich number of bitterlings and crucian carps.

Since the number of specimens from the Velká Arazimova in the present sample was very low (only 12 pikes) as compared to other backwaters this difference can be ignored. Hydrobiological conditions (H r b á č e k, 1962; H r b á č e k and N o v o t n á - D v o ř á k o v á, 1965) during the years 1953—1956 in the Poltruba backwater, e.g., alkalinity, temperature and transparency, were less favourable than in the Velká Arazimova, Černá and Mansfeldova backwaters. At present there is no data available concerning total fish biomass of the Procházkova backwater. There is no report of pikes and perches from the Černá backwater (O l i v a, 1955). On June, 6, 1955 and June, 20, 1955 85 small pikes with average weight 6.3 g. were planted into the Černá backwater (Through personal communication of Dr. O. Oliva). The number of non-carnivorous fishes was unknown, but certainly some number of fishes penetrated during periodical overflow from the neighbouring backwaters, e. g., Poltruba and Procházkova. Rapid growth of pikes from the Černá backwater was apparently due to the large number of non-carnivorous fishes as compared to the size and number of pikes.

There is no hydrobiological data regarding the Procházkova backwater at my disposal.

In the present sample, in the 1+ age class maximum rate of growth was recorded from the Černá backwater (18.5 cm.), 2+ age class from the Procházkova backwater (32.3 cm.), 3+ age class from the Velká Arazimova backwater (48 cm.) and onwards upto 6+ age classes the specimens from the Procházkova backwater grow at higher rate than the specimens from the Poltruba backwater, but these differences are not significant due to statistically small number of catched pikes.

The yearwise analysis of growth rate of pikes from the Poltruba backwater indicated that before the poisoning (O l i v a, 1960), during the years 1949—1955, the growth rate was higher in all the age classes apparently due to the large number of non-carnivorous fishes (ratio of pike to non-carnivorous fishes 1:182). During the years 1968—1976, the growth rate in all the age classes was slow with minor differences due to the eradication of scrap fish population (ratio of pike to other species in 1956, 1:88). In the present collection there is no data during the years 1956—1967. From the Poltruba backwater concerning the development of fish population here, only occasionally samples of pike scales were made.

Table 4. Fish biomass data as compared to pikes from different backwaters (calculated from Oliva, 1955, 1960)

Locality and year	Ratio Pike: non-carnivorous fishes	Ratio Pike: perches	Ratio Pike: non-carnivorous fishes kg/ha.	Ratio Pike: perches kg/ha.	Ratio Pike non-carnivorous fishes by weight in g
Malá Arazimova 1952	1 : 219	1 : 0	1 : 12	1 : 0	1 : 1
Velká Arazimova 1953	1 : 339	1 : 214	1 : 47	1 : 2	1 : 47
Poltruba 1955	1 : 182	1 : 0.3	1 : 8	1 : 0.2	1 : 9
1956	1 : 88	1 : 0	1 : 7	1 : 0	1 : 8

While comparing the first year yearwise growth of pikes from the Poltruba backwater with the findings of Poupě (1974) of the (Table 2.) mixed material from different localities, it has been observed that during the years 1949—1955, the specimens from Poltruba were growing at higher rate except in the year 1952. During the years 1968—1970 Poupě's sample showed higher rate of growth, which is apparently due to the eradication of scrap fish population by poisoning during the year 1956 (Oliva, 1960) in the Poltruba backwater.

The occurrence of maximum age classes from the Poltruba and Procharkova backwaters is apparently due to the large surface area and volume of these backwaters, also Carbine (1945) described it "space factor", evidently combined with sufficient food possibilities as responsible for better growth in pike.

Vostradovský (1969) remarked the females pikes grow at higher rate than males and survive upto the highes classes. In the present sample sex data are lacking, because most specimens after removing some scales from their bodies were again liberated and sex determination in pike without section is doubful except the spawning period.

Eddy and Carlander (1940, 1942) described that higher carbonate content, McCarrasher (1962) described low alkalinity are responsible for higher rate of growth. At present, there are no data regarding the carbonate contents from different backwaters, but maximum alkalinity (Hrbáček 1962 Hrbáček and Novotná-Dvořáková, 1965) had been recorded from the Poltruba backwater and in the present collection relative minimum rate of growth has been observed from the population of the Poltruba backwater

Wesloh and Olson (1962) took attention to the number of perches which may be responsible for the rapid growth of pike. Domanevskii (1963) supposed abundance of other fishes in general caused rapid growth The findings of Tandon and Oliva (1973) and the present investigations when compared with the fish population studies (Table 4) of Oliva (1955, 1960) are in conformity with Domanevskii (1963). Tandon and

Oliva (1978) reported various species of scrap fishes from the intestines of pikes from all age groups while analysing "trophy pikes".

Somewhat different rates of growth of pikes in the backwaters studied are apparently due to the fact, that the sample of 228 pikes at my disposal from six backwaters was collected during the years 1954—1976; during a very long period of 22 years different favourable and less favourable conditions as a whole or in part appeared in some detail unknown to me. The pikes showed adaptations to these conditions. Hydrobiological and fish population studies, especially the exact determination of fish biomasses were only studied for a limited time period from 1951—1956. But it was confirmed that those pikes grew better which were under favourable conditions, i.e "surrounded" by large biomass of scrap fishes, and at lower rate under less favourable conditions, i. e. during life where scrap fishes were reduced. But in no case pikes were able to reduce fundamentally the scrap fishes in the reservoir with which they cohabitated; the so-called "voracity" of pikes is exagerated by anglers and fishermen.

The growth rate of pike from the lower part of the river Berounka is similar to the findings of Tandon and Oliva (1978). The slight differences are due to the fact that the present sample is only from the lower part of the river Berounka, whereas Tandon and Oliva (1978) studied the rate of growth from the mixed material of pikes from the rivers Berounka and Vltava.

In general the growth tempo of pike in inundation area of the river Elbe in central Bohemia shows to be rather constant within long observations. The scrap fish biomass was considered to be responsible for the growth of pike, however the over-population of pikes never reduced the number of scrap fishes in the reservoirs.

Toner and Lawler (1969) point out that the growth of pike varies according to the latitude, being slow in the north and faster near the southern limits of distribution, which may be connected with better food conditions. The maximum rate of growth was reported from Ireland (Healy, 1956) and minimum from northern Canada (Miller and Kennedy, 1948). Pikes from the territory of Czechoslovakia occupy the intermediate position as far as growth rate is concerned.

In addition to geographical position other factors such as sex, habitat and food conditions (Oliva, 1955; Frank, Vostradovský, 1961; Balon, 1965; Sedlár, 1971) are apparently also responsible.

Frost (1963) observed that both the sexes of pikes from Windermere lake grow at the same rate up to the age of three years, thereafter females grow quicker; my material was not sexed and therefore I can not confirm this statement.

The growth of pike in backwaters is slower than in rivers and valley water and large bodies water reservoirs.

Acknowledgements

I am thankful to Dr. O. Oliva, Sen. Lecturer of Vertebrate Zoology, Charles University, Prague, for suggesting the problem, furnishing the necessary sources and guidance, for the material and critically going through the manuscript. I am also thankful to him for the keen interest shown to me during this work, and to Mr. Jiří Pásek for the supply of pike scales from the river Berounka. Thanks are also

due to Dr. K. B. S. Dhillon, Principal, Management S. G. N. Khalsa College, Sriganganagar (India), and to UNESCO for sponsoring my studies in ichthyology in Prague, Czechoslovakia.

SUMMARY

Growth of pike, Esox lucius Linnaeus, 1758 was studied from scales procured in the years 1954—1976. Body length centrolateral scale *radius relationship* indicate that the scales appeared when the pike attained the body length of 45 mm.

The total length-standard length conversion factor: Total length = 1.139 standard length.

Out of the six backwaters under study, maximum rate of growth has been recorded from the Černá backwater and minimum from the Poltruba backwater.

Specimens from the backwaters *Poltruba* were analysed yearwise, their growth was balanced and showed no great ranges.

The rate of growth of pike from backwaters is somewhat slower than from the rivers Berounka and Vltava.

Pikes from the territory of Czechoslovakia grow at slower rate than from the territories of U.S.A. and Ireland, but at higher rate than the pikes from Canada and Denmark.

Scrap fish population has been found to be responsible for the growth of pike.

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Věst. čs. Společ. zool., 44: 116—121, 1980

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ON THE CUTANEOUS GUSTATORY ACUITY AND ECOLOGY OF CERTAIN CATFISHES

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Received August 15, 1978

Abstract: A study of the population of cutaneous taste buds from various skin areas in seven catfishes belonging to six families indicates a possible correlation of gustatory acuity with their different habitats.

INTRODUCTION

Various senses play significant roles in the procurement of food in fishes occupying different habitats. The teleosts are generally endowed with integumentary gustatory sense which enables them to select their food (Atema, 1971; Bardach and Atema, 1971; Hara, 1971; Kapoor et al., 1975a).

Despite numerous reports on the site and form of gustatory receptors in different fish taxa, less attention has been given to finding gustatory acuity in Indian catfishes with respect to their different habitats. and this evoked our interest in this problem.

In a fish, the epiderms — with the underlying supporting basal membrane — is a stratified squamous, epithelial investment equipped with aquatic adaptations. The dermis comprises connective tissue, pigment cells, blood vessels and nerve fibres. The barbels and finds (except the adipose) have a skeletal inlay. The present study refers to the distribution of taste buds and their possible correlation with the habitat of fishes.

MATERIAL AND METHOD

Live and healthy siluroids *Mystus seenghala* (Sykes) and *Rita rita* (Hamilton) [Family: Bagridae], *Wallago attu* (Bloch and Schneider) [Family: Siluridae], *Chaca soma garua* (Hamilton) [Family: Schilbeidae], *Bagarius bagarius* (Hamilton) [Family: Sisoridae], *Clarias batrachus* (Linnaeus) [Family: Claridae] and *Heteropneustes fossilis* (Bloch) [Family: Heteropneustidae] were collected from freshwater sources. Skin pieces from marked areas (Figs. 1 and 2), unless otherwise mentioned, from the fishes were fixed in Bouin's solution and Zenker's fluid. Paraffin embedded sections (6μ—8μ) were stained by routine techniques. The population of taste buds per area was worked out by counting them per fifty sections and then finding average per ten sections. This gave an overall picture of the gustatory acuity.

RESULTS

The taste buds occurring in the epidermis of the fish are generally flask-like (Fig. 3) or elongate (Fig. 4) and their orientation is usually perpendicular

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to the epidermal plane. Two regions can be distinguisher in the epidermis of *B. bagarius,* unlike that of the other fishes: non-tuberculated furnished with taste buds, and tuberculated with tiers of cells containing indistinct nuclei, the most cells being surmounted by caps with spiny protuberances.

The area-wise distribution of cutaneous taste buds in fishes (Table I) shows that they are not uniformly distributed in various parts of the same or different fishes. The taste buds generally congregate in the distal parts of barbels; however, in the maxillary barbels of *R. rita, B. bagarius, C. batrachus* and *H. fossilis,* they are more numerous in the proximal part.

They are even present on the pectoral spines of all fishes and the upper caudal lobe extension of *B. bagarius.* They are usually of larger size in paired fins than in unpaired ones.

There are more taste buds on the upper lip than on the lower lip, concentrated mainly on their latero-distal edges. They have also been found in the opercular region of the fishes under study.

The density of taste buds is much greater in the head region than in the rest of the body except for *W. attu* which shows a reverse order.

DISCUSSION

Various correlations been drawn by earlier workers on the intensity and site with habitat or food finding exercise. It has been generally believed that there is a concentration of taste buds in the distal parts of barbels which come in immediate contact with food (Moore, 1950; Satô, 1957; Nagar and Mathur, 1958), but our observations do not support this entirely since the maxillary barbels of *R. rita, B. bagarius, C. batrachus* and *H. fossilis* show a larger number of taste buds in the proximal region.

Our observations that the taste buds are larger in paired fins may have substance in view of the relationship expressed for the silty water fish *Extrarius aestivalis* with its bottom habitat (Moore, 1950). The gustatory range is augbented with the spreading out of the taste buds on the pectoral spines of these fishes, and even on the upper caudal lobe of *B. bagarius* as reported in *Sisor rhabdophorus* (Mahajan, 1967). Reports on their distribution on lips are at variance. The results of the present investigation agree with those of Bardach and Loewenthal (1961) in *Gymnothorax moringa* but do not support the view of Rajbanshi (1966 a, b) who observed them on the ventral surface of the dorsal lip and dorsal surface of ventral lip in *Wallago attu* and only on the dorsal lip in *Clarias batrachus* respectively. That the taste buds occur in the opercular region has been reported by Miyadi (1929), Moore (1950), Davis and Miller (1967), and Whitear (1971). Their occurrence on the inner surface of the operculum of the fishes under study should be useful in determining the edibility of food during respiration, as has also been indicated in *Extrarius aestivalis* by Mooore (1950).

The density of taste buds varies in different parts of the body; generally there are more of them in barbels, lips and head. We thus corroborate the remark by Kapoor et al. (1975 a) that: "In teleosts taste buds are commonly on the finds and body as well as within the oral cavity and pharynx. The number of taste buds may vary greatly from one part of the body to another but the greatest number are found in regions most closely associated with food contact".

Table 1. Population of taste buds in different regions of the examined fishes.

Character / Name of Fish	Regions A&B	C&D	E&F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	Mean
Barbels																					
M. seenghala	15	8	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11.00
R. rita	30	28	52	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	37.00
W. attu	20	7	*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13.50
C. garua	18	10	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11.30
B. bagarius	25	26	18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23.00
C. batrachus	200	200	125	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	175.00
H. fossilis	50	38	33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		40.30
Fins																					
M. seenghala	—	—	—	0	2	1	0	2	0	—	—	—	—	—	—	—	—	—	—	—	00.83
R. rita	—	—	—	10	18	10	19	15	20	—	—	—	—	—	—	—	—	—	—	—	15.33
W. attu	—	—	—	0	0	3	0	3	*	—	—	—	—	—	—	—	—	—	—	—	01.20
C. garua	—	—	—	0	2	5	0	4	*	—	—	—	—	—	—	—	—	—	—	—	02.20
B. bagarius	—	—	—	2	13	6	4	14	4	—	—	—	—	—	—	—	—	—	—	—	07.50
C. batrachus	—	—	—	3	2	7	7	10	*	—	—	—	—	—	—	—	—	—	—	—	05.80
H. fossilis	—	—	—	5	4	6	3	4	*	—	—	—	—	—	—	—	—	—	—	—	04.40
Lips																					
M. seenghala	—	—	—	—	—	—	—	—	—	20	10	—	—	—	—	—	—	—	—	—	15.00
R. rita	—	—	—	—	—	—	—	—	—	35	20	—	—	—	—	—	—	—	—	—	27.50
W. attu	—	—	—	—	—	—	—	—	—	20	10	—	—	—	—	—	—	—	—	—	15.00
C. garua	—	—	—	—	—	—	—	—	—	30	15	—	—	—	—	—	—	—	—	—	22.50
B. bagarius	—	—	—	—	—	—	—	—	—	60	17	—	—	—	—	—	—	—	—	—	38.50
C. batrachus	—	—	—	—	—	—	—	—	—	70	62	—	—	—	—	—	—	—	—	—	66.00
H. fossilis	—	—	—	—	—	—	—	—	—	55	25	—	—	—	—	—	—	—	—	—	40.00
Operculum																					
M. seenghala	—	—	—	—	—	—	—	—	—	—	—	0	1	1	—	—	—	—	—	—	00.66
R. rita	—	—	—	—	—	—	—	—	—	—	—	3	4	4	—	—	—	—	—	—	03.66
W. attu	—	—	—	—	—	—	—	—	—	—	—	0	2	1	—	—	—	—	—	—	01.00
C. garua	—	—	—	—	—	—	—	—	—	—	—	1	2	1	—	—	—	—	—	—	01.33
B. bagarius	—	—	—	—	—	—	—	—	—	—	—	2	2	1	—	—	—	—	—	—	01.66
C. batrachus	—	—	—	—	—	—	—	—	—	—	—	2	3	2	—	—	—	—	—	—	02.33
H. fossilis	—	—	—	—	—	—	—	—	—	—	—	2	2	2	—	—	—	—	—	—	02.00

Skin in general																					
M. seenghala	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	5	0	3	4	4	03.33
R. rita	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	6	2	5	3	3	04.83
W. attu	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	1	0	2	2	01 33
C. garua	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	4	1	0	1	1	01.50
B. bagarius	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	3	0	1	2	1	02.00
C. batrachus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12	1	0	0	0	2	02.50
H. fossilis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	1	0	1	1	0	01.33

* The region for which the lettering/s stand is absent in the fish; lettering see Figs. 1—4.

Each catfish has a different gustatory acuity and its position in this respect in the downgrade order is: *C. batrachus, R. rita, H. fossilis, B. bagarius, C. garua, W. attu* and *M. seenghala*. We are inclined to believe that *C. batrachus* is best adapted to bottom habitat. In contrast, *M. seenghala, W. attu* and *C. garua* are midwater feeders. This partly in concordance with the remark made by Alexander (1965) that fishes belonging to Siluridae and Schilbeidae are not bottom dwellers in the strict sense. Also the difference between the two bagrids in cutaneous gustatory acuity is worth mentioning — *R. ritta* is better adapted to bottom life than *M. seenghala*. This strengthens the notion that the taste buds may be indicative of the habitat and feeding habits of a fish or vice-versa.

On the basis of different foods taken by teleosts and their feeding habits, several types have been recognized, i.e., plankton feeders, herbivores, omnivores, carnivores, and specialists (Kapoor et al. 1975 b). The above-mentioned fished are mainly carnivores and they utilize the integumentary sense as one of the means to find and select food materials.

Acknowledgements

We are grateful to Dr. O. Oliva and Dr. A. Romanovský, Dept. of Zoology, Charles University, Prague and Dr. K. K. Tandon, Dept. of Zoology, Panjab University, Chandigarh, for their valuable suggestions; and to Dr. S. D. Misra, Head of the Zoology Department, University of Jodhpur, for extending facilities four our work in the department.

SUMMARY

Seven catfishes belonging to six families have an integumentary gustatory sense. A study of the population of taste buds leads to the following inferences:

(I) The concentration of taste buds varies in different parts of the body of a fish, but usually they are more numerous on barbels, lips and head.

(II) Each fish has a different gustatory acuity. Accordingly, the placement in the downgrade order is: *C. batrachus, R. rita, H. fossilis, B. bagarius, C. garua, W. attu, M. seenghala.*

(III) The density of cutaneous taste buds may be indicative of the habitat and feeding habit of a fish or vice-versa.

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The plate (Figs. 1—4) will be found at the end of this issue.

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Věst. čs. Společ. zool., **41**: 122—127, 1977

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THE EFFECTS OF COOLING AND GLYCEROL ON THE PROFILE OF PROTEINS AND ESTERASES IN THE HAEMOLYMPH OF GALLERIA MELLONELLA (LEPIDOPTERA)

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Received August 5, 1978

Abstract: Cold treatment of the pupae of *Galeria mellonella* L. induced an increase in the osmotic pressure and glycerol content of the haemolymph. In pupae kept at 9 °C for 16 days the osmotic pressure raised from 300 mOsm to 397 mOsm and in those kept for 61 days at 4 °C to 542 mOsm. The glycerol content increased from 64 mg% to 175 mg% in the first grup and to 135 mg% in the second group. The 175 mg% concentration of glycerol seems to inhibit the cold-induced increase of blood globulins but the appearance of the "cooling protein" is not suppressed

INTRODUCTION

It has been well established that low temperature reduces metabolic processes of insects to the minimum (Prosser and Brown, 1962) but that certain species can accomodate themselves to these unfavourable conditions (Lozina — Lozinsky, 1972).

In the pupae of *Galleria mellonella* (Marek, 1970, 1978), a temperature of 4 °C induces reduction of total metabolism, synthesis of glycerol and further metabolic changes which are vital for the adaptation of the insect to cold. The present work describes the occurrence of proteins (kryoglobulins) in the haemolymph of pupae following injection of glycerol and simultaneous cooling. The paper calls attention to insect kryoglobulins and their importance in early stage of cooling and in the adaptation of pupae to cold. The author also examines the importance of glycerol for the appearance of kryoglobulins, especially what concentration and synthetic rate of glycerol inhibit the occurrence of kryoglobulins at the beginning of cooling.

MATERIAL AND METHOD

A culture of *Galleria mellonella* was maintained at 30 °C and in darkness on Haydak food modified after Balazs (1958) and Sehnal (1966). Pupae 1 to 7 days old were used for the experiments. They were placed in Petri dishes and kept in a refrigerator at 4 °C or 9 °C for different length of time.

The glycerol was injected at 1 μl per 100 mg of pupal weight by means of calibrated microinjection pipette inserted ventrally into the intersegmental region of the abdomen. The pupae were narcotized in water prior to injection.

To collect haemolymph, the pupae were individually centrifuged in narrow tubes filled with water at 1,000 rev./min for 10 min. The haemolymph accumulated in

a relatively thick coherent layer from which it was collected into an inserted glass needle. Phenylthiourea was added to the haemolymph as an antimelanizant.

Changes in haemolymph proteins were studied by electrophoresis on cellulose acetate strips (Cellogel, Chemetron) using Veronal buffer pH 8.6. The electrophoresis at 300 V was carried out at rom temperature for 12 minutes. The separated proteins detected with Ponceau S.

Table 1. The effects of cooling on changes in glycerol content and osmotic pressure in the haemolymph of pupae of *Galleria mellonella*.

Days of cooling of pupae	Cooling at 4 °C		Cooling at 9 °C	
	osmotic pressure mOsm	glycerol mg%	osmotic pressure mOsm	glycerol mg%
0 (control)	300	64	30	4
2	315	—	—	—
3	—	70	—	—
4	—	—	320	99
6	342	85	—	—
7	—	83	325	113
8	355	—	328	127
10	362	82	—	—
13	372	94	—	—
16	—	—	397	175
17	370	104	—	—
20	391	110	—	—
47	533	117	—	169
61	542	135	—	—

The activity of esterase isoenzymes was determined by starch gel electrophoresis performed at 4 °C, 500 V and 15 mA using TRIS-citric acid buffer at pH 8.6, in tanks filled with pH 8.2 buffer consisting of boric acid and sodium hydroxide. After 3 hrs the starch gel was incubated for 30 mins in 100 ml phosphate buffer, pH 6,9, to which were added 2 ml of 1% acetone solution of 1-naphtyl butyrate with 250 mg of the diazonic salt of Fast Blue BB (according to Laufer, 1960). Coupling of the above reagents gave an azocompound whose hydolysis by esterases was visible as a change of colour.

Osmotic pressure of the haemolymph was determined with a Knauer semimicro osmometer type M on the basis of determined values of kryoscopic depression. Resulting values were expressed in mOsm = $\triangle$ t °C/1,86

The content of glycerol in the haemolymph of cooled and uncooled pupae was determined colorimetrically in 10 μl of haemolymph at the wave length of 410 nm using ammonium acetate, isopropanol, acetylaceton and potassium periodate (according to Továrek, 1974).

RESULTS

The osmotic pressure of the haemolymph of pupae exposed to 4 °C increased during 20 days of cooling in a uniform way from 300 mOsm to 390 mOsm, i.e. by 28 %. Within 61 days of cooling the osmotic pressure increased to 542 mOsm, i.e by 80 %. In a few preliminary comparative experiments with pupae cooled at +2 °C for 7 days we found an increase to 347 mOsm. This value is close to that determined in the haemolymph of pupae cooled at +4 °C.

When determing the content of glycerol in haemolymph we used the same samples as those for the determination of osmotic pressure. It is evident from Table 1 that during cooling at 4 °C for 20 days the content of glycerol was gradualy raising from 64 mg % to 110 mg %, i. e. by 72 %; on the 61st day of cooling it was 134 mg %, which was — in comparison with control — an increase by 109 %. In pupae cooled at 9 °C the amount of glycerol in haemolymph increased within 8 days by about 100 % and in 16 days it reached 173 % of the control value. On the 47th day of cooling (9 °C) the amount of glycerol was slightly lower — 169 mg %. The content of glycerol determined in the haemolymph of a few pupae exposed to 2 °C for 7 days was almost identical with that found in experiments at 4 °C.

When analysing the haemolymph proteins of control pupae (Fig. 1) by electrophoresis on cellulose acetate strips we found 4 faintly stained protein

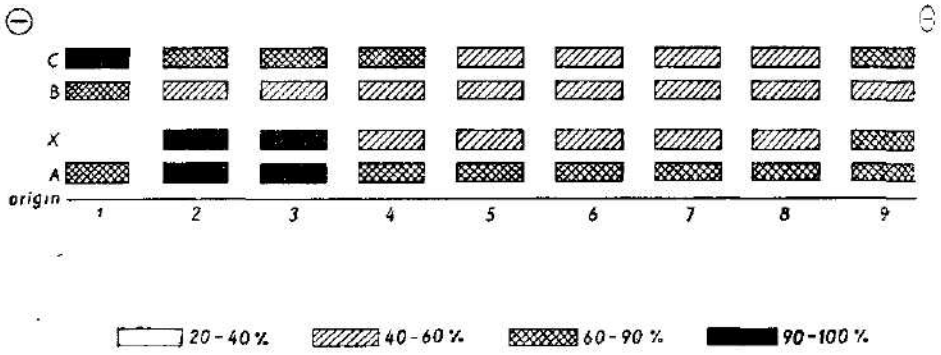

Fig. 1. The effects of cooling and glycerol on the spectrum of globulins in the haemolymph of pupae of *Galleria mellonella*.
A — control at 30 °C. B — cooled at 9 °C for 7 days and injected with glycerol. C — cooled at 9° C for 7 days. D — cooled at 9° C for 7 days and injected with 50% glycerol. E — cooled at 9 °C for 16 days. F — cooled at 4 °C for 8 and 16 days. G — cooled at 4 °C for 2 days, and then injected with glycerol and kept at 4 °C for 4 days. H — cooled at 4 °C for 2 days.

bands in the region of gamma-globulins (i.e. those migrating from origin to the cathode). After 7 days of cooling at 9 °C (experiment C, Fig. 1) the protein bands nos. 3 and 4 increased whereas when the pupae were kept in cold for 16 days (exp. E) the bands 3 and 4 decreased.

When the pupae were exposed to 4 °C, as early as on the 2nd day of cooling we observed an increase of the proteins of band 4 (exp. H, Fig. 1). On the 7th and also 8th day of cool treatment an intensive enlargement became evident in band 3, while bands 1 and 2 remained quantitatively unaltered as compared to controls. At the 16th day of cooling at 4 °C there was no reduction of protein bands 3 and 4; this is in contrast to the reduction of these bands in pupae exposed to 9 °C.

Interesting results were obtained when 50% or 100% glycerol solution was injected into pupae and the pupae were immediately cooled. In those kept at 9 °C we did not find any changes in bands 2, 3 or 4 up to the 16th day.

The same suppression of the cold-induced changes of blood proteins was observed in pupae exposed to 4 °C.

The esterase isoenzymes (Fig. 2) separated by starch gel electrophoresis showed marked changes in response to cooling. In contrast to the controls, the pupae kept at 4 °C contained after 7 to 17 days a "cooling protein" (band X), but simultaneously there was a reduction of esterases in bands

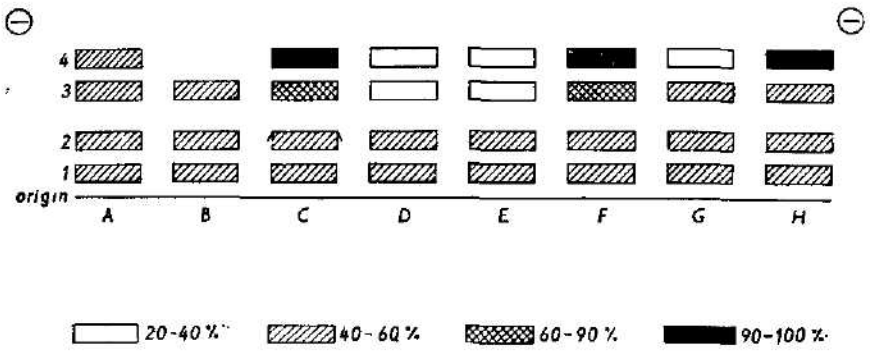

Fig. 2. The effects of cooling and glycerol on the spectrum of esterase isoenzymes in the haemolymph of pupae of *Galleria mellonella*.
1. — control at 30 °C. 2. — cooled at 4 °C for 7 days. 3. — cooled at 4 °C for 17 days. 4.— cooled at 9 °C for 7 days . 5. — cooled at 9 °C for 17 days. 6. — cooled at 4 °C for 7 days and injected with glycerol 7. — cooled at 9 °C for 7 days and injected with glycerol. 8. — cooled at 4 °C for 2 days, and then injected with glycerol and kept at 4 °C for 4 days. 9. — cooled at 4 °C for 5 days, then injected with glycerol and kept at 4 °C for 2 days.
The total volume injected was 1 μl into 100 mg of pupae. 20—40 % = traces, *40—60 % = weak, 60—90 % = medium, 90—100 % = strong.*

C and B. The cooling at 9 °C also brought about the apperance of the "cooling protein" band but it was less intense than in pupae chilled at 4 °C (see electrophoregrammes 4 and 5 in Fig. 2). We suggest that the content of the "cooling protein" was lower because the level of glycerol rose up to 175 mg% (Tab. 1), this level being limiting for the appearance of the esterase.

When the glycerol content was increased by injection of 100% glycerol and the pupae immediately placed at 4 °C or 9 °C, the amount of both the "cooling protein" and the esterase band C decreased. The electrophoregrammes 8 and 9 (Fig. 2) indicate that 2 days at 4 °C induced only a weak increase of the "cooling protein", whereas 5 days of cooling induced a profound increase; the "cooling protein" level, however, did not reach its maximum owing to the presence of the injected glycerol.

DISCUSSION

Resistance to cold in poikilotermic animals is an important problem which has received much attention (Lozina-Lozinsky, 1972). Adaptation of animals to cooling is a complex process. The ability to adapt to cold stress often represents one of the vital conditions for the existence of the given species.

Reduction of ambient temperature leads in *Galleria mellonella* to changes in total metabolism and, among others, also to the increase of glycerol in haemolymph (Marek, 1974). This is usually a preventive way in which insect adapts to cold stress. Only in some species the content of glycerol is not directly related to resistance to cold, as shown by Somme (1966), who studied the effect of injected glycerol on the freezing point in *Anagasta kuehniella*.

Since the content of glycerol in the haemolymph of *G. mellonella* does not increase (Marek, 1974) after cooling as much as expected from data on other species (Asahina, 1966), it seemed probable that metabolites other than glycerol increase the resistance of *G. mellonella* to cold. This assumption was confirmed by the finding that the cooling of *G. mellonella* pupae increases the content of cations, free amino acids, uric acid and even of esterase isoenzymes and globulins (Marek, 1974). These accumulated metabolic substances seem to play together with glycerol — an equally important role in the adaptation of *G. mellonella* to cold.

The present results show again that cold stress affects the content of blood globulins and induces the occurrence of a new esterase. Cooling at 4 °C or 9 °C affects all 4 bands of globulin-like proteins separated by electrophoresis. Injection of glycerol into pupae just prior to cooling inhibits the increase of globulins, including the cooling protein. The role of these proteins in chilled animals remains unclear. There is some evidence (Harper, 1971) that globulins play a certain role in binding the excess of water. This is supported by the finding (Marek, 1974) that the water content of haemolymph declines by only 2 per cent during 3 days of cooling.

It is possible to observe an interesting connection between the content of glycerol and the presence of globulins in the haemolymph of pupae cooled at 4 °C and 9 °C. It is well known that cooling at about 10 °C is optimal for the synthesis of glycerol in insects (Lozina-Lozinsky, 1972). We also found that the glycerol content of pupae cooled at 9 °C would be higher by 30% (175 mg%) within 16 days of cooling than in pupae cooled at 4 °C (135 mg%). Hence, the low temperature of 9 °C induces an increase in globulins and a simultaneous rise of the glycerol content above 135 mg% causes that these globulins later disappear. It means that the content of glycerol in haemolymph — in the present case 135 mg% — represents a limiting value for the increase in globulins including the synthesis of some esterase isoenzyme. These conclusions were also confirmed by our experiments in which glycerol was injected into the pupae cooled at 4° C and 9 °C. If the pupae were cooled with a higher content of glycerol (i.e. above 135 mg%) electrophoresis did not detect globulins in haemolymph and altogether reduced activity of esterase could be observed. The lowered activity of isoenzymes after injection of glycerol possibly indicates the existence of a feed-back mechanism. The hydrolysis of lipids by esterases does not seem to be indispensable for maintaining the high level of glycerol (135 mg%), which probably plays an immediately role in the resistance to cold.

Acknowledgements

I gratefully acknowledge the technical assistance of Jana Benešová.

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Věst. čs. Společ. zool., **44**: 128–138, 1980

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SOME LESS FREQUENT FORMS OF TESTACEA (PROTOZOA: RHIZOPODA) IN SMALL STREAMS OF THE ČSSR

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Received May 31, 1978

Abstract: The present paper deals with some rare forms of Testacea that were found during the investigation of the microfauna of minor streams on the territory of Moravia (ČSSR). They are representatives of the following genera: *Arcella*, *Centropyxis*, *Cyclopyxis*, *Cyphoderia*, *Difflugia*, and *Pseudodifflugia*. In every form there is a description, data from literature about its distribution and its representation in the stations under investigation and/or in the microhabitats.

INTRODUCTION

During the investigation of the microfauna of our small streams it was again proved that Testacea form a permanent component of the population of the stream, so that their importance for the whole biocenosis cannot be neglected. The species variety and the considerable number of Testacea in the most varied microhabitats can also be evidenced in earlier papers by Štěpánek (1953, 1954).

From the saprobiological point of view the importance of Testacea is not negligible either. A contribution to the solution of those problems from recent time is included in the paper by Opravilová and Zelinka (1978).

Evaluating the results of the 1969—1974 investigation we found some forms that occur rarely and have not been listed from the ČSSR so far; we are giving here their descriptions and drawings, which is the main purpose of the present paper.

Biocenoses in which the forms described were found, have been evaluated in detail in papers published so far or those in press (Opravilová, 1974, Zelinka et al., 1977, Opravilová — in press).

MATERIAL AND METHOD

The material was obtained during the investigation of the stream Bobrava (1969—1970), the stream Bítýška (1972—1974) and single samples of several brooks in the Moravian Karst. The material from the stream Říčka was for the most part taken for solving a diploma project concerning the influence of the netbuilding caddis-fly larvae on the drifted organisms (Dočekalová, 1974), the remaining part of the material was collected by the authors. Testacea were collected on the one hand in the nets of caddis-fly larvae, on the other hand freely in the sapropel and in the periphyton.

The methods of sampling and the quantitative evaluation of the samples is given in the paper by Opravilová (1974).

Brief characteristics of the streams under investigations

The stream Bobrava springs above the village of Rudka at the outskirts of the Bohemian-Moravian Highlands at 470 m above sea level. It passes through a mildly hilly landscape; about one quarter of its catchment area is covered by woods. This small river flows through the following communities: Rosice, Tetčice, and Želešice. Near Popovice, to the south of Brno, it empties into the river Svratka (188 m above sea level).

The total length of the main stream is about 36 km. The depth of the stream varies from 0.05 to 1.5 m, the width from 0.2 to 10.0 m. The bottom is muddy and stony.

Samples were taken at the following stations: St. 1: a spring brooklet of the Bobrava above the village Rudka; 2: is at the distance of about 10 m from station No. 1; 3: approximately in the middle of the valley called Chroustovské údolí; 4: is situated near the bridge near the town Rosice; 5: lies on the Bobrava below Tetčice near the road to Střelice; 6: is situated on the stream in the sector between the railway station Omice and the road to Omice; 7: lies several metres before the crossroads in the direction of Ořechov-Moravany; 8: is situated near the quarry of Želešice; 9: is situated at the edge of village Želešice; 10: is situated about 200 m away from the mounth of the Bobrava into the Svratka; 11: is situated in the mounth of the Bobrava into the Svratka. Further samples were taken in some tributaries of the Bobrava. They are: the Bílá Voda, the Troubský potok, a small brooklet below Kozí hora.

The stream Bítýška has its spring above Osová Bítýška (520 to 550 m above sea level) in a pond region of the Bohemian-Moravian Highlands. It flows through Osová Bítýška and Velká Bíteš. The upper third of the stream is surrounded by agricultural landscape. From Velká Bíteš onwards the valley of the stream is lined by a belt of mixed wood of various width and meadows The stream empties into the river Svratka as its right bank tributary (235 m above sea level) above the level of the Kníničky Reservoir.

The total length of the main stream is about 37 km. The average depth is 10 to 30 cm, the width varies from 1 to 5 m. The bottom is sandy and muddy.

Samples were taken at the following three stations: St. 1: below Velká Bíteš; 2: near the village of Křoví; 3: at Šmelcovna.

The stream Říčka springs in the southernmost part of the Drahany Highlands in a woody territory among the communities of Hoštěnice, Bukovina, and Olšany (435 m above sea level). In its middle sector it flows through the Gottwald Valley in Líšeň near Brno, where a system of reservoirs has been built. Water from the last reservoir flows to a compensation channel and from there into the stream.

The total length of the main stream is about 30 km. In the sector under investigation the width is 2.20 m, the average depth is 15 to 20 cm. The bottom is sandy and stony.

Samples were taken at the following stations: St. 1: at the distance of about 80 m from the dam of the last reservoir; 2: at the distance of about 860 m from the dam of the last reservoir; 3: from the periphyton on stones of the last reservoir.

On the territory of the Moravian Karst samples were taken from the following localities: the brook of Jedovnice, the brook of Křtiny, the Luha, the Punkva, and a wood spring area north-west of community of Šošůvka.

In the following table they are some physical and chemical characteristics which were received during the investigation:

	Bobrava	Bitýška	Říčka
Water temperature °C — average	10.75	7.13	11.38
Discharge l/sec — average	—	176.33	109.11
O_2 saturation range in %	77.0—109.0	31.7—117.5	95.3—113.0

Note: The data concerning the average water temperature in the Bobrava and in the Říčka are somewhat inaccurate, as the measurements were carried out at noon hours.

LIST OF SPECIES

Besides species the paper also includes varieties and forms expressing major (variety) or minor (form) deviations within the species. These deviations concern mostly the shape, size, and the test surface.

In the following text the following abbreviations were used for the dimensions of the tests: L = length, B = breadth, D = diameter, H = height, A = diameter of aperture (pseudostom), AL = length of aperture, AB = breadth of aperture, EL = = length of excrescence, N = number of individuals; dimensions are given in μm.

Arcella discoides Ehrenberg (Figs. 1a, 1b)

Among the individuals having all the signs of the given species a specimen was found which differed from them significantly by an irregularly shaped edge (cf. drawing).
D: 110; H: 33; A: 48; N: 1.

Bitýška: sapropel

Arcella discoides Ehrenberg var. *foveosa* Playfair

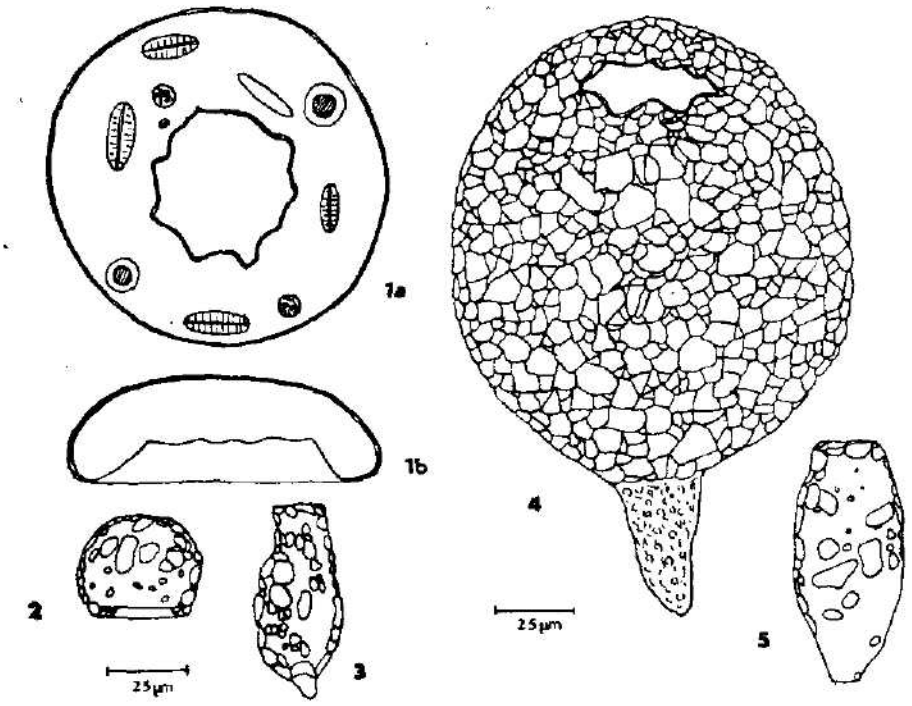
D: 72; H: 28; A: 24; N: 1.

Říčka: sapropel

In literature the occurence of this variety is stated in the Danube delta, both in the zooplankton and in the litoral (Godeanu and Godeanu and Ionescu, 1973). Schönborn (1962) mentions it from the periphyton on *Phragmites communis* L., *Typha* sp., *Potamogeton* sp. in the litoral of Great Lake of Stechlin and further from the moist mosses in the Swedish Lapland (Schönborn, 1966).

Centropyxis aerophila Deflandre var. *grandis* Štěpánek

The test, when observed from the top, is more or less circular. The aperture is egg-shaped, which differs from the original description, where it is kidney-shaped. The cover is constituted by fine xenosomata which are merged deep into the yellowish cementation substance.
D: 96; H: 55; AL: 28; AB: 41; N: 1.



Figs. 1—5. 1 — Arcella discoides, a — view from the ventral side, b — lateral view; 2 — Cyclopyxis eurystoma var. *parvula; 3 — Difflugia elegans* var. *minor; 4 — Difflugia corona* var. *unicornis; 5 — Difflugia elegans* var. *angustata.*

Bítýška: sapropel

This variety was described by Štěpánek (1963) from Katanga and it has not been found anywhere else so far.

Cyclopyxis eurystoma Deflandre var. *parvula* Bonnet-Thomas (Fig. 2)

The test is small, spherical. From the side it is comparatively high. The aperture is circular, somewhat bent inside. The cover is constituted by fine xenosomata lying freely in the basic substance of the test.
D: 34—48, 39; H: 21—41, 28; A: 14—21, 20; N: 30.

Bítýška: sapropel
Bobrava: sapropel, fallen leaves, periphyton, mosses (*Caliergonella cuspidata* [Hedw.] Loeske. *Amblystegium serpens* [Hedw.] Br. eur., *Platyhypnidium riparioides* [Hedw.] Podp.)
Říčka: sapropel

Decloitre (1977) summarized relatively numerous finds of this variety both in Europe and in other continents. As habitat he states terricolous mosses and gravelly carbonate soils. In the ČSSR Rosa (1974) found this form in the microedaphon of forest soils, whereas Haager and Haage-

rová (1969) state it from various habitats. In our material it occurred comparatively regularly. In the paper by Opravilová (1974) it is marked as *Cyclopyxis* sp.1

Cyphoderia ampulla Ehrenberg var. *thomasi* Chardez (Fig. A)

This variety differs from the typical form by a broad flattened bottom.
L: 100; B: 64; A: 20; N: 1.

Říčka: sapropel

Difflugia brychtai Štěpánek (Fig. 14. Fig. B)

L: 120; B: 69; A: 28; N: 1.

Bobrava: sapropel

The species was described by Štěpánek (1967 a) from the Vranov reservoir. The dimensions mentioned are, however, smaller than those found in the specimen from the Bobrava: L: 81; B: 46; A: 24.

Difflugia corona Wallich var. *unicornis*, nov. var. (Fig. 4)

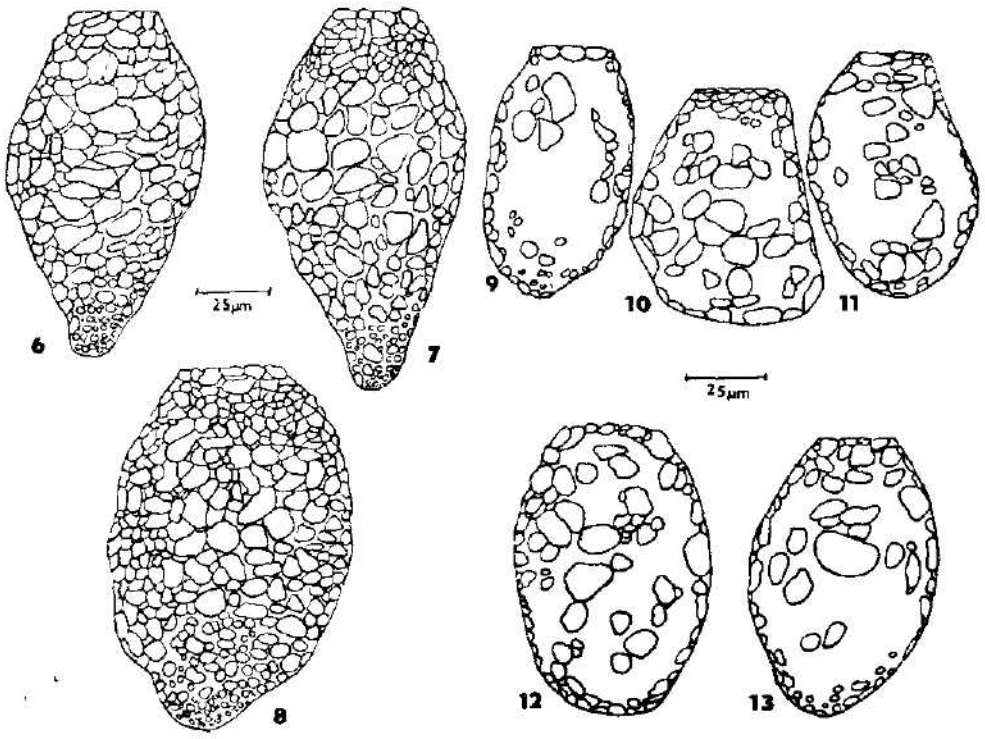
The test is elongatedly spherical. From the bottom of the test only one comparatively long thorn protrudes. The aperture has a lobe-shaped edge like the nominate form. The cover is constituted by thickly arranged xenosomata; on the thorn the xenosomata are very fine, freely placed in the cementation substance.
L: 200; B: 138; A: 69; EL: 41; N: 1.
The individuals belonging to the species *D. corona*, provided with one thorn or a low excrescence are described by Štěpánek (1952) from a pool in the proximity of Hrádek near Kunratice. Those specimens reached the following dimensions: D: 105—175; A: 35—70; EL: 5—35. Further Lena and Cacchi (1972) in the material from Argentine draws specimens with one thorn.

Difflugia difficilis Thomas (Figs. 6, 7, 8, C—G)

The test is egg-shaped, its cross-section being circular. The bottom of the test is pointed, sometimes provided with a blunt short exprescence. The aperture is circular, provided with a short neck, sometimes little distinct. The cover is formed by fine xenosomatic plates of various shapes, thickly arranged. As this species was widely spread in the localities under investigation, it was possible to follow its considerable variability concerning the test as whole and the length of the excrescence.
L: 76—145, 87; B: 44—103, 60; A: 21—48, 30; N: 239.

Bítýška: sapropel, fallen leaves, moss (*Brachythecium rivulare* Br. eur.)
Bobrava: sapropel, fallen leaves, periphyton
Moravian Karst: brook of Křtiny, the Luha, the Punkva, wood spring area: sapropel, periphyton
Říčka: sapropel, reservoir-periphyton

The species was described by Thomas (1954) from periphyton. Chardez (1956, 1972) mentioned it from sapropel, and also Moraczewski (1967),



Figs. 6—13. 6 — 8 *Difflugia difficilis;* 9— 13 *Difflugia difficilis* var. *ecornis.*

Gauthier-Lièvre and Thomas (1958) describe it mostly from swamps (Algeria, the Sudan, and Ivory Coast). Lena and Cacchi (1972) mentioned it from a swâmp in Argentine.

Difflugia difficilis Thomas var *ecornis* Chardez (Figs. 9—13)

The test is irregularly egg-shaped, mostly with a bluntly pointed bottom. The aperture is circular with a more or less distinct neck. The cover is formed by flat xenosomata of different shape which do not cover the test coherently but leave some spots quite free. The distribution of the plates is variable and diffrent in every individual.
L: 76—124, 89; B: 48—69, 56; A: 25—34, 28; N: 76.

Bítýška: sapropel, fallen leaves, periphyton, moss (*Brachithecium rivulare* Br. eur.)
Říčka: sapropel

Bítýška: sapropel, periphyton

This variety is mentioned by Chardez (1956, 1957 b, 1972) from sapropel, Green (1963) as a component of the zooplankton of a river in Nigeria, Gauthier-Lièvre and Thomas (1958) from swamps (Tunesia, Algeria, Marocco) and Laminger (1973 b) from lagoons in Quatemala.

Difflugia elegans Pénard var. *angustata* Deflandre (Fig. 5)

The test is narrow with a pointed bottom. The aperture is circular. The cover consists of flat xenosomata irregularly distributed on the surface of the test.
L: 76—90; B: 34—41; A: 21: N: 3.

Bítýška: sapropel

The variety was described by Deflandre (1926) from swamps and lagoons in Venezuela. Gauthier-Lièvre and Thomas (1958) found it in Algeria, in swamp in Mali and Tchad. From Europe (Belgium) it is stated by Chardez (1957 a).

Difflugia elegans Pénard var. *minor* Štěpánek (Fig. 3)

L: 62; B: 29; A: 14; N: 1.
Bítýška: sapropel

The variety was described by Štěpánek (1967 a) from muddy and sandy sediments of the bottom of the Vranov reservoir. In the original description he gives the following dimensions: L: 42; B: 20; A: 12.

Difflugia labiosa Wailes (Figs. 16. 16 a, Fig. H)

The test is oval with a rounded bottom. The aperture is surrounded by a short collar with a lobe-shaped edge. The collar is made of light-coloured pseudochitinous substance in which there are scattered isolated, apparently xenosomatic grains. The rest of the test is thickly covered by xenosomatic plates of different sizes.
L: 180—303; B: 117—172; A: 55—83; N: 6.

Říčka: sapropel, reservoir-periphyton

This species is mentioned by Thomas (1954) from sapropel, Chardez (1964, 1972) from sapropel and periphyton and also from the plankton of a small water reservoir in Iceland (Chardez. 1969).

Difflugia labiosa Wailes var. *acuta* Deflandre (Fig. 15, Fig. CH)

The front part of the test is regularly rounded, the rear part is elongated into a blunt point. Round the aperture there is a lobe-shaped collar. The cover is formed by xenosomata situated closely to each other.
L: 221—304; B: 129—172; A: 55—83; N: 7.

Říčka: sapropel, reservoir-periphyton

This variety was described by Deflandre (1926) from a lagoon in Venezuela. In the original description the following dimensions are given: L: 201 B: 108.
Difflugia lithophila (Pénard) Gauthier-Lièvre et Thomas *f. elongata* Štěpánek
L: 103; B: 62; A: 21; N: 1.

Bítýška: sapropel

The form was described by Štěpánek (1967 a) from the sapropel of the Vranov reservoir.

Difflugia mammilaris Pénard (Fig. I)

The test is shortly egg-shaped, the bottom narrowed, terminated by a nipple-like excrescence. The bulging walls converge towards a circular aperture. The test is covered by fine xenosomatic plates of irregular shape.
L: 103, 131—138; B: 55, 83—90; A: 34, 41—48; N: 5.

Bítýška: sapropel
Bobrava:-tributary: sapropel, fallen leaves

This species is mostly mentioned as a component of profundal. It was described by Pénard (1893) from Lake Geneva from the depth of 30 to 40 m. Grospietch (1957) noted it in Lago Maggiore (30 and 60 m), Štěpánek (1967 a) from the Vranov reservoir (30 m), Štěpánek (1967 b) from Lake Windgfällsee (2 to 3.5 m), Štěpánek (1968 a) from Lake Bodensee (100 m) and from the other lakes (Štěpánek 1968 b). Also Laminger (1973 a) found this species in Lake Bodense, Moraczewski (1967) in Lake Zegrze and Bereczky (1973 a, b) in Lake Balaton. It was also found in a karst brook (Bereczky, 1970) and in the river Tisza and Maros (Gál, 1961 a, b).

Pseudodifflugia senartensis Couteaux (Figs. J, K)

The test is egg-shaped with a cut off front edge. The aperture is circular, of small dimensions. The cover consists of xenosomatic plates which are sometimes placed next to one another, sometimes somewhat distant from each other. But always the plates are immersed deep into the basic pseudochitinous substance which is of light yellow to brown colour. The wall of the test is comparatively thick.
This species was described from the upper layer of soil of an oak forest and also later it is stated as a current edaphic element (Couteaux, 1972, 1975, 1976). We are of the opinion that the form *Pseudodifflugia globulosa* Štěpánek var. *oblonga* Opravilová, described from the Bobrava (Opravilová, 1974) and quite frequent there, agree by its characteristics with the species mentioned above and, therefore, we classify the finds from Bobrava and further localities into this species. The dimensions are given in the following table:

	Couteaux 1972	Doubrava + tributaries	Bítýška	Říčka + reservoir	Brook of Jedovnice
Length:	40	55—62,59	55—62,58	48—62,51	55
Breadth.	—	34—55,41	48—55,51	34—48,35	41
Aperture:	20	14—21,20	21	21	21
Σ of indiv:	—	79	18	32	1

Bítýška: sapropel, periphyton, moss (***Brachythecium rivulare*** Br. eur.)
Bobrava: *sapropel, fallen leaves, moss (**Platyhypnidium riparioides** [Hedw.] Podp.)*
Říčka: sapropel, reservoir-periphyton
Brook of Jedovnice: periphyton

SUMMARY

The paper brings data concerning 16 forms of Testacea; one of them is newly described: *Difflugia corona* var. *unicornis.*

For the ČSSR eight forms are new: *Arcella discoides* var. *foveosa, Centropyxis aerophila* var. *grandis, Cyphoderia ampulla* var. *thomasi, Difflugia difficilis* var. *ecornis, Difflugia elegans* var. *angustata, Difflugia labiosa, Difflugia labiosa* var. *acuta, Pseudodifflugia senartensis.*

In the species *Difflugia difficilis* var. *typica* and *D. difficilis* var. *ecornis* the variability of the test is briefly described in drawings and documented in microphotographs.

The species *Difflugia mammilaris,* which was above all stated from standing waters-lakes (from the depth of 2—100 m), was noted in the sapropel of streams in our material. Finds from running waters are isolated.

The species *Pseudodifflugia senartensis,* which has so far been known only as an edaphic element, occured relatively frequently in our material. This species seems to be a permanent component of the Testacea community of the running waters, which is also supported by findings from other stations not included in this paper.

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The figures 14—16 a and A—K will be found at the end of this issue.

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Věst. čs. Společ. zool., **44**: 139—145, 1980

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NOTES ON THREE FOLSOMIA-SPECIES (COLLEMBOLA)

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Received October 23, 1978

A b s t r a c t : Redescriptions of *Folsomia dovrensis* Fjellberg, 1976 (new to Czechoslovakia) and *Folsomia brevifurca* (Bagnall, 1949) are given. *Folsomia monosetosa* Rusek, 1966 is synonymised with *Folsomia quadrioculata* (Tullberg, 1871).

In the material from a field experiment in South Bohemia two very small specimens of a *Folsomia*-species were found. Their morphological characters corresponded well to the very short and incomplete description of *Folsomia brevifurca* (Bagnall, 1949) and with the short description of *Folsomia dovrensis* Fjellberg, 1976. *Folsomia brevifurca* is in all older keys (G i s i n 1960, P a l i s s a 1964), as well as in the revision of all *Folsomia*-species described by B a g n a l l (L a w r e n c e 1973), designated as species dubia. Only one specimen, the holotype, was found in Scotland and used for the description of *F. brevifurca*. Nobody has found this species again. The study of the holotype of *F. brevifurca* showed that our material from South Bohemia is different from it. A comparison with the description of *Folsomia dovrensis* Fjellberg, 1976 was not possible in some characters not given in its original description, e.g. the shape and repartition of sensillae on the last abdominal segments, but the slides with specimens of this species sent to me by Fjellberg enabled to determine our material as *F. dovrensis*.

In this paper redescriptions of *Folsomia brevifurca* (Bagnall, 1949) and *Folsomia dovrensis* Fjellberg, 1976 are given, and *Folsomia monosetosa* Rusek, 1966 is synonymised with *Folsomia quadrioculata* (Tullberg, 1871).

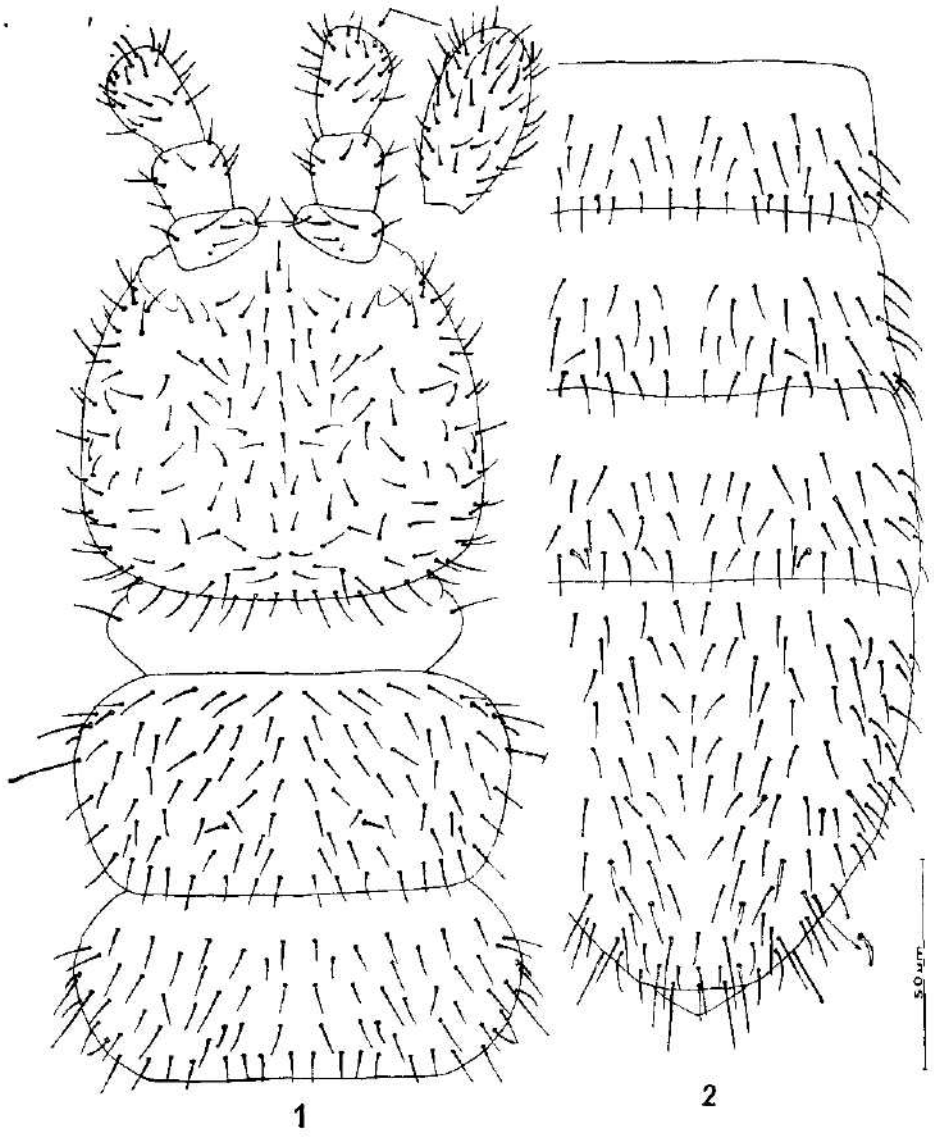
Folsomia dovrensis Fjellberg, 1976

(Figs. 1—9)

D i a g n o s i s : Length 400—500 μm, white. Without eyes. Fused abdominal segments with 2 + 2 basally thickened sensory hairs and 1 + 1 thickened sensory rods. Retinaculum with 4 + 4 teeth and one chaeta. Ventral side of manubrium with 1 + 1 chaeta. Dens with 8 chaetae on ventral and two on dorsal side.

D e s c r i p t i o n (after specimens from South Bohemia): Body 400 μm long. White, without trace of pigmentation. Chaetotaxy as in Fig. 1 and 2. Chaetae only 5—10 μm long. some chaetae. especially on last abdominal segments, 15—20 μm long.

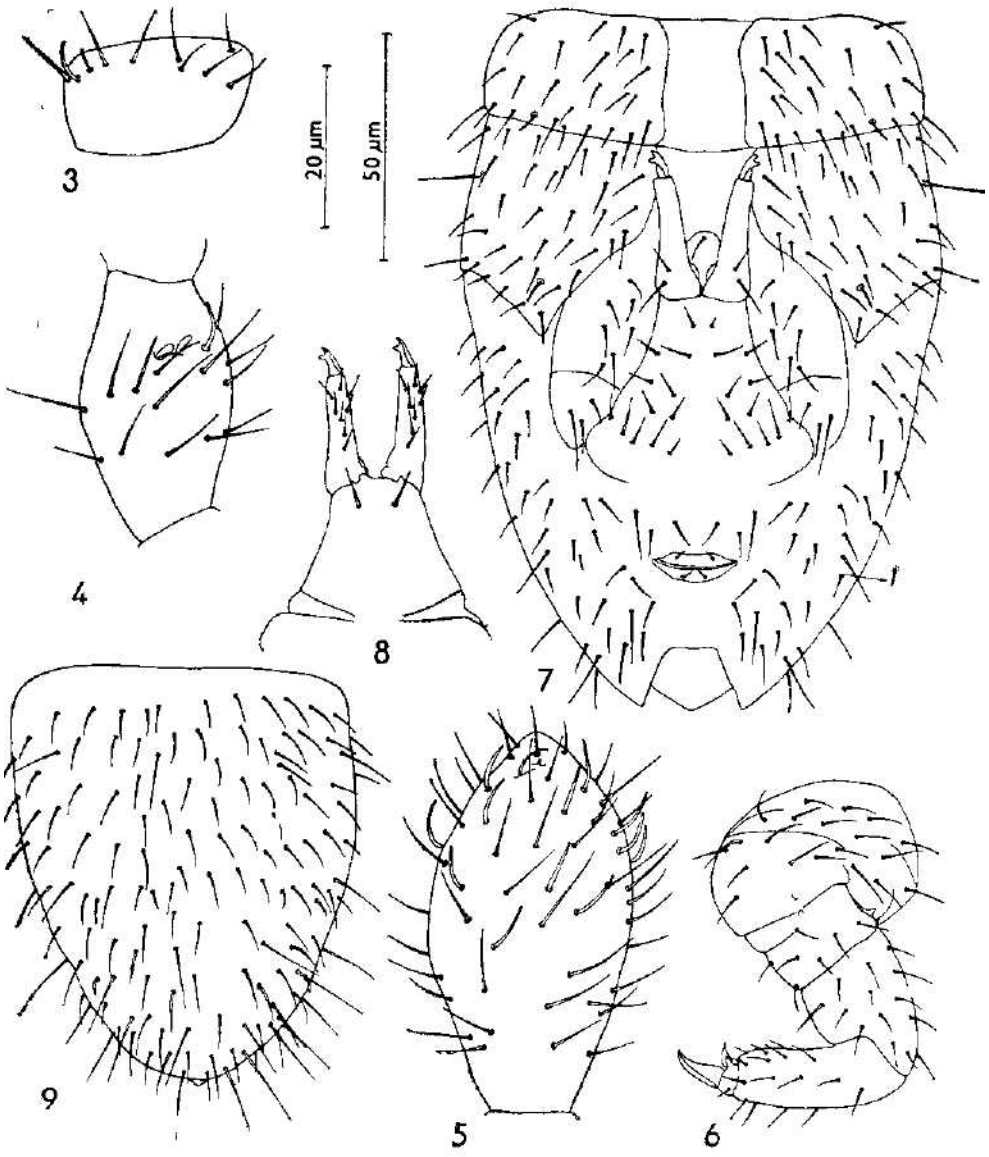
Antennae as long as head (100 : 100 μm) (Fig. 1). Antennal segments I : II : : III : IV as 10 : 15 : 30 : 45 μm. On ventral side of antennal segment I two



Figs. 1–2. *Folsomia dovrensis* Fjellberg, 1976 (after specimen from South Bohemia): 1 — dorsal chaetotaxy of head and thorax; 2 — chaetotaxy of abdominal tergites I–VI. Scale: Figs. 1—2: 50 µm.

slightly thickened sensory hairs present (Fig. 3). Antennal organ III consists of two slightly thickened sensory rods, two sensory hairs and one very small outer sensory rod (fig. 4). Antennal segment IV with many slightly thickened sensory hairs (Fig. 5).

Labrum with chaetal arrangement 2/554. Ventral side of head with 3+3



Figs. 3—9. *Folsomia dovrensis* Fjellberg, 1976 (Figs 3—8 after specimen from South Bohemia, Fig. 9 after specimen from Norway). 3 — ventral chaetotaxy of antennal segment I; 4 — dorsal chaetotaxy of antennal segment III; 5 — dorsal chaetotaxy of antennal segment IV; 6 — leg of the third pair; 7 — ventral side of abdominal segments II—IV; 8 — ventral side of furca; 9 — dorsal chaetotaxy of abdominal segments IV—VI. Scales: Figs. 3—5: 20 µm, Figs. 6—9: 50 µm.

chaetae along linea ventralis. Postantennal organ (Fig. 1) elliptical, 15 µm long and 6 µm wide.

Mesonotum with three short sensillae laterally and further 2 + 2 in front of the posterior row of chaetae (Fig. 1). Metanotum with one sensilla laterally and further 2 + 2 in front of the posterior row of chaetae (Fig. 1) Tergite I—III with 2 + 2 sensillae in posterior row of chaetae (Fig. 2). Fused abdominal segments IV—VI with 2 + 2 thin, 6 μm long sensillae on the imaginary fourth segment and 2 + 2 basally thickened, 10 μm long sensory hairs on the fifth one (Fig. 2). Laterally from the thickened sensory hairs one slightly thickened, short sensilla present (Fig. 2).

Legs short (Fig. 6), tibiotarsus without tenent hairs. Claws 11 μm long, without teeth (Fig. 6). Empodial appendage 5 μm long. Thorax ventrally without chaetae.

Ventral tube with 6 + 6 chaetae. Ventral chaetotaxy of abdomen as in Fig. 7. Retinaculum with 4 + 4 teeth on rami and one chaeta on corpus Furca reaching to the posterior margin of abdominal sternum II (Fig. 7) Manubrium : dens : mucro as 35 : 26 : 6 μm. Mucro with apical and anteapical teeth (Fig. 8). Dens ventrally with 8 and dorsally with 2 chaetae (Fig. 7, 8). Manubrium on ventral side with 1 + 1 (Fig. 8) and on dorsal side with 12 + 12 chaetae (Fig. 7). Female genital plate with 1 + 1 microchaetae on anterior and 1 + 1 microchaetae on posterior lid (Fig. 7).

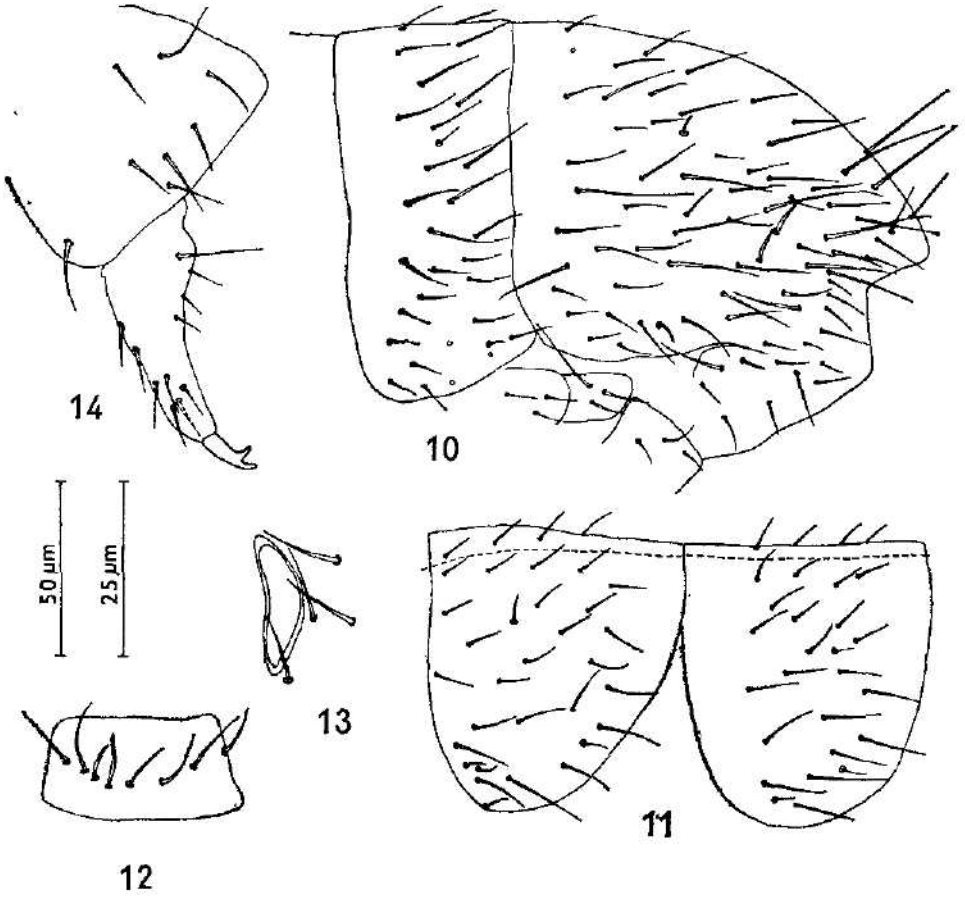
Discussion: The identity of the specimens from South Bohemia with the material from Norway was confirmed in all morphological characters. Only the sensory hairs on the imaginary fifth abdominal segment are not as distinctly thickened basally in the Norwegian specimens (Fig. 9) as in animals from south Bohemia (Fig. 2). On the other hand, the short sensilla laterally from the thickened sensory hairs is slightly thicker in the Norwegian (Fig. 9) and thinner in the Bohemian (Fig. 2) specimens. These small differences do not allow to consider the specimens from South Bohemia as different species or subspecies.

Affinties: *Folsomia dovrensis* Fjellberg, 1976 is related to *Folsomia bidentata* Lee, 1973. They differ in the chaetotaxy of ventral tube and dens and in the length of body. There are 3 + 3 chaetae on posterior surface of the ventral tube (2 + 2 in *F. dovrensis*) and 3 chaetae on dorsal side of dentes (in *F. dovrensis* only 2) in the 800 μm long *F. bidentata*. Also the chaetotaxy of dorsal side of manubrium is different in these related species. The differences from *Folsomia brevifurca* (Bagnall, 1949) are given behind its redescription.

Czechoslovak locality: South Bohemia, Byňov, about 18 km south of Třeboň and 5 km NW of Nové Hrady (1 km north of the Natural Reserve "Červené blato" bog, 490 m a.s.l. In soil samples from a spruce forest with mosses in understory, moist, soil type: brown forest soil with 5—10 cm deep moder horizon. 7. VII 1977 2 ♀♀ leg. J. Rusek.

Geographical distribution: South Bohemia (new) and Norway.

Ecological notes: During the investigation period in 1977 and 1978 only two females were found in the soil samples taken on 7. VII. 1977. The community of Collembola in which it lives is composed of *Onychiurus armatus Isotomiella minor, Isotoma notabilis, Folsomia ksenemani, Mesaphorura yosii, Isotoma violacea, Friesea truncata, Mesaphorura tenuisensillata, Anurophorus atlanticus, Pseudosinella bohemica* and some further recedent species. In



Figs. 10—14. *Folsomia brevifurca* (Bagnall, 1949) (holotype). 10 — chaetotaxy of abdominal segments III—VI (lateral view); 11 — chaetotaxy of left half of meso- and metanotum; 12 — ventral side of antennal segment I; 13 — postantennal organ; 14 — furca (lateral view). Scales: Figs. 10—11: 50 µm; 12—14: 25 µm.

Norway it occurs in high densities in soil under alpine grassland communities. The Bohemian specimens probably represents a glacial relic.

Folsomia brevifurca (Bagnall, 1949)

(Figs. 10—14)

Material examined: Holotype from R. S Bagnall Coll., British Museum 1959—591, labelled (by handwriting) Folsomia brevifurca Bagn. Type, Roslin, 146 Ash. 1. V. 37.

Description: Body 590 µm long. White, without trace of pigmentation. Chaetotaxy of some parts of body as on Figs. 10 and 11. Chaetae 10—20 µm long, some chaetae, especially on last abdominal segments, 30—40 µm long.

Antennae shorter than head (110 : 120 μm). Antennal segments I : II : : III : IV as 15 : 25 : 25 : 45 μm. On ventral side of antennal segment I two slightly thickened sensillae present (Fig. 12). Antennal organ III consists of two slightly thickened sensory rods, two sensory hairs and one very small outer sensory rod. Antennal segment IV with many slightly thickened sensory hairs.

Chaetal arrangement of labrum not clearly visible. Head with 2 + 2 chaetae along linea ventralis. Without eyes. Postantennal organ (Fig. 13) 21 μm long and 5 μm wide.

Chaetotaxy of meso- and metanotum as in Fig. 11. The number and arrangement of sensillae the same as in *Folsomia dovrensis*, but they are in the medial rows of chaetae and not in the posterior one as in *F. dovrensis* (Fig 11). The two sensory hairs on the imaginary fifth abdominal segment 12 μm long, finger-like thickened. There are no sensillae laterally from them 1 + 1 short sensilla present on abdominal sternite V (Fig. 10).

Tibiotarsus without tenent hairs. Claws 18 μm long, without teeth. Empodial appendage 7 μm long. Ventral side of thorax without chaetae.

Ventral tube with 4+4 chaetae (1+1 on posterior surface). Retinaculum with 4 + 4 teeth on rami and one chaeta on corpus. Manubrium: dens : : mucro as 50 : 30 : 9 μm. Mucro with apical and anteapical teeth (Fig. 14). Dens dorsally with 4 and ventrally with 7 chaetae (Fig. 14). Ventral side of manubrium with 1+1 chaetae, dorsal side with 7+7 chaetae (Fig. 14). Juvenile specimen without genital plate (Fig. 10).

Discussion: This species was described by Bagnall in 1949. He established for *Folsomia quadrioculata* (Tullberg, 1871), this new species and some further species a new genus *Litsteria* Bagnall, 1949. This genus was accepted by nobody and Gisin (1960) transferred his *Litsteria brevifurca* into *Folsomia*. Because of the short and insufficient original description Gisin put *Folsomia brevifurca* on the list of species dubiae. Lawrence published in 1973 a revision of the type material of all *Folsomia*-species described by Bagnall. He established that *F. brevifurca* (Bagnall. 1949) was described after one juvenile, not well preserved specimen and considered it also as species dubia. The juvenile stages were studied and described only in a few *Folsomia*-species. We cannot say at present if *F. brevifurca* belongs to a species already described or if it is a good species of which the adults remain unknown. The adults must be longer than 590 μm, without eyes, and the manubrium must bear at least 1+1 chaetae ventrally and 7+7 chaetae dorsally. Dorsal side of dens must bear 4 chaetae. In any case, *Folsomia dovrensis* is not identical with *Folsomia brevifurca*.

Geographical distribution: Known only from the Locus typicus in Scotland.

Folsomia monosetosa Rusek, 1966

Discussion: This species was described in 1966 from Moravian Karst, where the holotype was found in soil samples from the forest community *Acereto-Fraxinetum*. It was without trace of pigmentation, without eyes and with 1+1 chaetae on ventral side of manubrium. A new examination of the holotype by an interference microscope showed that there are 2+2 corneolae without pigment present on the head. The other characters are the

same as in *Folsomia quadrioculata* (Tullberg, 1871). The discovery of 2+2 corneolae on the head led us to the conclusion that *Folsomia monosetosa* Rusek, 1966 is only an aberrant specimen of *Folsomia quadrioculata* (Tullberg, 1871) which has no pigment in eyes and on body. Therefore *Folsomia monosetosa* Rusek, 1966 is a syn. nov. of *Folsomia quadrioculata* (Tullberg, 1871).

Acknowledgements

I am very grateful to Mr. P. N. Lawrence (British Museum) and Dr. A. Fjellberg (Norway) for lending me the slides with the holotype of *Folsomia brevifurca* (Bagnall, 1949) and with material of *Folsomia dovrensis* Fjellberg, 1976.

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Věst. čs. Společ. zool., 41. 146—151. 1980

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INFLUENCE OF COLD AND INTERMITTENT FASTING ON THE ACTIVITY OF ESTERASE ISOENZYMES IN SERUM AND TISSUES OF MICE

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Received June 13, 1978

Abstract: The authors studied by electrophoresis on starch gel specific tissue esterase isoenzymes in four organs and serum of mice strain H of both sexes. With the control groups ingesting food daily ad libitum and kept at 22 °C intermittently fasting group (with free access to food on alternate day) and a group exposed to a reduced environmental temperature (4 °C) was compared. Esterase isoenzymes of serum and studied organs of the intermittent fasting and cold stressed mice migrated to the anode (14 fractions) and to the cathode (1 fraction). Marked sexual differences were found as regards the presence of different isoenzyme fractions in the investigated organs and differences influenced by a change of the dietary regime and the reduced external temperature

INTRODUCTION

In an effort to the extend knowledge on the influence of various factors on the activity of esterase isoenzymes we investigated changes of the activity in serum, liver, kidneys, perirenal adipose tissue and in the intestinal wall in three groups of white mice of both sexes: one was fed ad libitum, the second was fed intermittently and the third was exposed to a reduced environmental temperature.

By using electrophoresis various authors achieved a standard, quantitative separation of isoenzymes. The activity of esterase isoenzymes in mouse kidney was investigated by Paul and Fottrell (1961), Shaw and Koen (1963) and Ruddle (1966), in liver by Hunter and Burustone (1960), in epididymal adipose tissue by Allen and Hunter (1960) and in plasma by Hunter and Strachan (1961).

Functional and biological evidence of *electrophoretically differentiated* esterase isoenzymes is so far scarce. The method of their electrophoretic assessment is very suitable and sufficiently sensitive, as proved in experiments with a different orientation but in the same animal species by Marker and Hunter (1959), and Ruddle and Harrington (1967). We assume that a reduced environmental temperature and intermittent fasting, being factors which markedly influence the intermediary metabolism will be manifested also by an altered esterase isoenzyme activity in the investigated tissues.

MATERIAL AND METHOD

For the experiments white laboratory mice strain H were used kept a temperature of 22 ± 1 °C with a 12-hour regimen of light (6 a.m. — 6 p.m., 6 p.m. — 6 a.m. darkness). All animals were fed a standard laboratory diet (for composition see Fábry, 1959). With the control group which had free access to food we compared the group where days of free access to food alternated with days of complete fasting. The third group of mice fed ad libitum was placed throughout the experimental period in boxes without bedding at a temperature of 4 °C. The last 16-hour period of the experimental control as well as adapted animals received a fixed amount of food (1 g per 10 g body weight) after a preliminary 20 hour period of fasting. The experimental period was 4 weeks.

Horizontal electrophoresis was applied. For separation of isoenzymes a discontinuous system of buffer was used, as described by Smithies (1955 and 1959), i.e. boric acid — TRIS, pH = 8.6.

As electrophoretic carrier we used hydrolyzed starch (SERVA Co., Heidelberg). Electrophoresis took place at a temperature of 4 °C, 600 V and 15 mA for a period of 6 hours Esterase isoenzymes were identified after incubation of starch plates in 100 ml phosphate buffer pH = 6.9 and after addition of 2 ml 1% acetone solution of 1-naphtyl butyrate with 250 mg Fast Blue BB diazonium salt. The incubation period was 30 minutes at room temperature.

For electrophoresis on starch gel serum and supernatants from homogenized tissues were used. Homogenates always from equal part of competent organ were

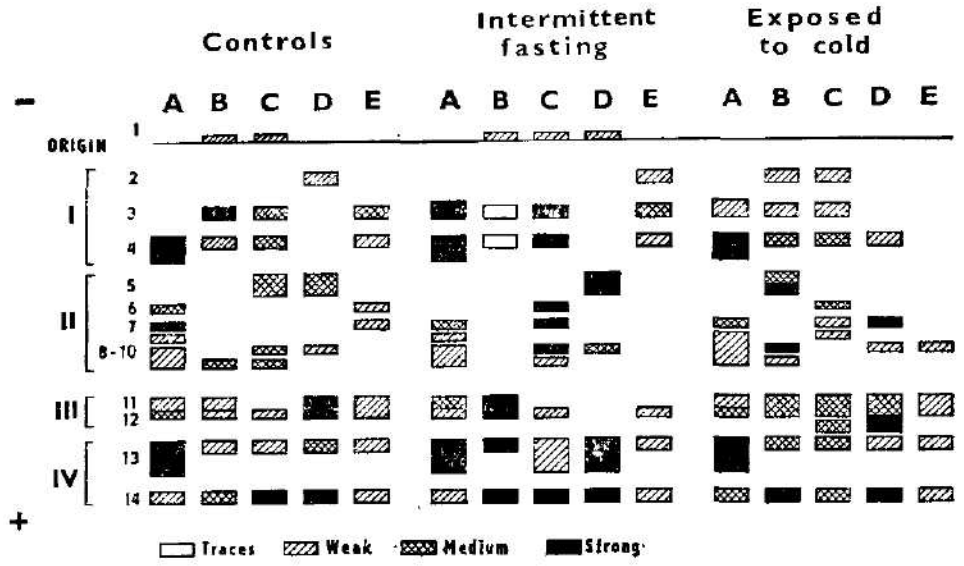

Fig 1. Electrophoreogram of esterase isoenzymes in extracts from serum (A), liver (B), kidneys (C), small intestine (D) and adipose tissue (E) controls, intermittent fasting and cold exposed males of mice.

prepared. Specimens (supernatants) were centrifuged at 15,000 rot./min. for 30 mins. before they were applied for electrophoresis.

For better orientation on the results electrophoreograms we decided to divide the resulting esterase isoenzymes into zones, similarly as Ruddle (1966) in his work. Moreover every isoenzyme separated on starch gel is described by a number.

The numbers increase from the start (application of sample) in the direction towards the anode. The zones are described by Roman numerals. This system of classification is constant for all analyzed esterase isoenzymes as the conditions of electrophoresis were accurately reproduced.

RESULTS

A) Esterase isoenzymes migrating to the cathode

In our experiments only one esterase isoenzyme migrating in the electric field to the cathode was assessed. As apparent from the electrophoreograms (fig. 1 and 2), this enzyme was found in extracts from liver, kidneys and small intestine of intermittently fasting males and females. In males ingesting food ad libitum and kept at a temperature of 22 °C the isoenzyme is present in kidneys and liver. In the same group of females it is lacking in the liver and is present in the extract from tissue of the small intestine.

B) Esterase isoenzymes migrating to the anode

Zone I — three esterase isoenzymes (No. 2, 3 and 4) were which are readily separated. Fraction 4 is typical for serum and the majority of tissues of the animals in all investigated groups with the exception of extracts from the small intestine. Only in males exposed to cold this fraction was found in the small intestine. Fraction 3 of zone I was not found in serum of control groups of either sex. In the remaining experimental groups it is present in all tissues of females. it is lacking in the intestine in all groups of males and in adipose tissue of males exposed to cold.

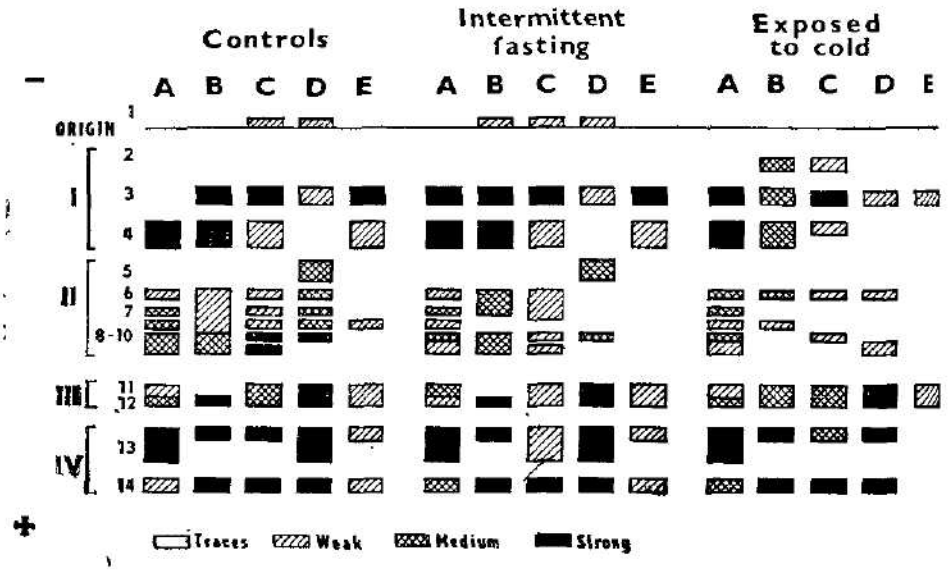

Fig. 2. Electrophoreogram of esterase isoenzymes in extracts from serum (A), liver (B), kidneys (C), small intestine (D) and adipose tissue (E) controls, intermittent fasting and cold exposed females of mice.

Zone II – at first sight it is obvious that the activity of esterase isoenzymes of fraction 5, 6, 7, 8, 9 and 10 of this zone declines in all tissues of females exposed to cold or intermittent fasting. In males the overall changes are not so marked. Due to the action of cold in females fraction 7 disappeared completely. In males this fraction was found only in adipose tissue of the control group, in the renal extract of intermittently fasting males and in the extract of the small intestine of males exposed to cold.

Also the subsequent fraction -8- is present in all investigated tissues and in serum of the female control group. It is not found in individuals exposed to intermittent fasting and cold and was found only in liver extract of animals exposed to cold. In tissues of males of all experimental groups this fraction is not present. Fraction 9 is found in females of the control group, in serum and in all tissues except adipose tissue. In females exposed to cold this fraction disappears also in the intestine. In the control groups of males fraction 9 is not present in the liver extract. Intermittent fasting does not influence the distribution of this fractions but in animals kept in the cold fraction 9 is found in the liver, adipose tissue and it disappears in the kidneys. Fraction 10 was found in serum of all investigated groups. It is lacking in the intestine and adipose tissue of females from the control group and the intermittently fasting group. In females exposed to a reduced environmental temperature it is present only in the intestine. The extracts of the remaining three investigated tissues lack this fraction. With slight exceptions the distribution of fraction 10 in males is similar as described for females.

Fractions 11 and 12 of zone III are represented in almost all groups of investigated animals. Fraction 11 is lacking in extracts from kidneys, intestine, and adipose tissue of intermittently fasting males. In the intestine of this group fraction 12 is also lacking.

The remaining fractions (13 and 14) of zone IV are present in different intensities in all investigated tissues and serum of both sexes with the exception of adipose tissue of females exposed to a reduced environmental temperature.

DISCUSSION

Ruddle and Harrington (1967) and Marker and Hunter (1959) investigated the activities of isoenzymes in mice of various inbred strains. Fundamentally they reached the same results although in some instances the resulting zymograms in some organs differ. Our results are consistent with both pairs of authors as regards the classification of isoenzymes into four basic zones. The frequency of fractions and their intensity is influenced by other factors such as the strain of mice used, by sex and in particular by induced external factors. Shaw and Koen (1963) found a significant sexual difference of esterase activity in mouse kidneys. Ruddle and Harrington (1967) emphasize that this sexual difference is found only in the kidney and not in other organs of mouse strains they investigated. Our results indicate, however, that marked sexual differences are typical for all tissues we investigated. The smalles differences were recorded in male and female blood sera. In conjunction with the sexual dimorphism of esterase the question arises of its biological impact. As regards the sexual difference of renal esterases Shaw and Koen (1963) expressed the hypothesis that isoenzymes may influence the breakdown of male steroids. Ruddle and Harring-

ton (1967) expressed the view that there may be a certain correlation between hormones excreted in the urine of males (which influence among others the length of the oestrous cycle of females) and the presence of the revealed isoenzymes and their activity in the kidneys of males and females. This assumption is supported by some observations and experimental studies. In any case it is not posible to make any final conclusions at present.

Barnett and Rostgaard (1965), based on the assessed high isoenzyme activity in the gut and adipose tissue of mice, assume that they play a major part in the lipid and carbohydrate metabolism and in the transport of their components.

The environmental temperature and change in the meal pattern are factors which influence in a significant way various functions of the animal organism. When the animal is exposed to a low temperature, it develops gradually various adaptational manifestations which enable it to cope better with the action of this adverse factor. During the initial stages of adaptation reserves are reduced which serve to obtain a major amount of heat, as in relation to the immediate need of an increased amount of energy the ability to ingest larger amounts of food develops gradually.

The increased nutrient suppley to tissues leads to an increased metabolic turnover (Trapani 1960, Mefferd 1960). This is associated with an increase activity of various enzyme systems involved in metabolic processes (You and Sellers 1951, Desmarais 1954, Janský 1963).

When alternating the period of free access to food with periods of complete fasting, the position is similar. A marked increase of food intake occurs, better nutrient utilization and with this an increase of enzyme activities is associated (review by Fábry 1969). The ability to increase the food intake and general metabolic turnover differs in different animal species even if closely related (Šimek et al. 1973. Šimek 1975).

For investigations of the esterase activity we selected tissues with a high metabolic activity, which participate in a significant way in the general metabolic turnover. Although the obtained zymograms of esteras isoenzymes were not evaluated quantitatively, from the enclosed documentation it is apparent at first sight that there is a marked decrease of activity or disappearance of some fraction in groups of mice exposed to a reduced environmental temperature or to intermittent fasting. We may thus speak globally of a general decline of enzyme activity in the experimental groups as compared with controls. It seems that we have recorded in our experiments in both experimental groups the stage of declining function incl. enzyme activity i.e. period when the organism only begins to cope with the different dietary and temperature regime. In order to confirm this assumption it will be necessary to record changes throughout the period of adaption of the experimental animals to new conditions and to evaluate quantitatively the assembled results. The submitted results which can be considered preliminary, however confirm again that an altered environmental temperature and altered dietary regime are factors which interfere in a marked way with functions of the enzyme system of animals, as has been proved by various authors previously in relation to various vital functions and in different animal species and man (for review see Fábry 1969, Janský 1973).

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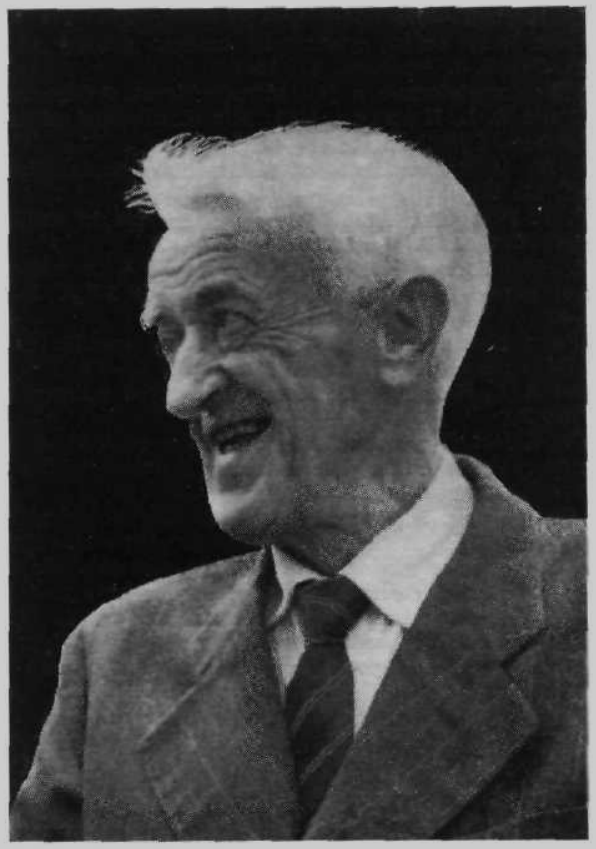
Věst. čs. Spol. zool., 44: 152–156, 1980

František VOLF

7. IX. 1898 — 3. I. 1979

One of the best-known Czechoslovak ichthyopathologists, František Volf, died after a long illness in Prague on January 3rd, 1979 at the age of 80. He was born in southern Bohemia, in the village Branná near the famous fish-pond town Třeboň



(Wittingau). He attended the elementary and grammar schools in Třeboň and continued his studies at the Czech Technical University in Prague, from which he graduated with the degree of Agriculture Engineer. After a short employment a brewery in Třeboň he took a position in the State Fisheries and Hydrobiology Research Institute in Prague from Jan. 1st, 1924. He worked there until his retirement in 1958. In 1931 he obtained the degree of Doctor of Technical Sciences,

in 1948 he was appointed Senior Lecturer (Docent) of the University of Agriculture in Prague.

Apparently the typical landscape of southern Bohemia with its numerous ponds similar to lakes and dikes planted with giant oaks, mostly built in the 15th and 16th centuries, inhabited by many water birds and typical personalities of pond fishermen influenced Volf's lifelong involvement in fishery research. Volf's papers appeared every year from 1925, sometimes in series, in scientific journals mostly published by the Czechoslovak Academy of Agricultural Sciences, but also in the fishery magazines "Rybářský věstník" and "Československé rybářství". He help up the good tradition of Czechoslovak ichthyology, from A. Frič († 1913) to K. Schäferna († 1950), in popularizing scientific results also for the general public. His first papers dealt with crayfish pest, furunculosis of trout, *Bacterium coli* commune in fish intestines, fungus disease in carp, and gill fungus in carp (*Branchiomyces sanguinis*) He returned to these problems almost 30 years later when he published the first case known in Czechoslovakia of gill fungus in pike (1956). He was also interested in the technical side of fish hatcheries, fisher techniques, especially those concerning ponds and recently also new built valley reservoirs, in the bionomy of important river and pond fishes. In particular he studied the pike (*Esox lucius*), pike-perch (*Stizostedion lucioperca*), eel (*Anguilla anguilla*), whitefish (*Coregonus lavaretus maraena*) and salmon (*Salmo salar*).

The main interest of the late František Volf during his 50 years of research were infectious diseases of fish, fungus diseases and invasion diseases caused by various zooparasites He spent many years of his life by therapy of the infectious dropsy of the carp (*Cyprinus carpio*) From 1930 this disease seriously damaged Czech pond fishery mainly based on the carp culture.

It is chiefly his merit, and also the merit of several of his younger coworkers, that it was possible to keep carp production in artificial ponds in balance thanks to his diagnoses and complexity of the research conducted by him. His papers concerning these problems from 1935 to 1975 give evidence of his endeavour to solve the problem entirely.

Among zooparasites causing invasion diseases of fishes, especially the genus *Dactylogyrus* (1927), *Coccidians* (1944), *Myxobolus* (1946), *Diplostomum* (1952), *Myxosoma carebralis* (1956, 1957, 1958) and *Ichthyophthirius* (1957) were studied.

F. Volf also published important contributions concerning the pathology of reproduction in fishes, effects of artificial nourishment on health condition, avitaminosis, and problems of pollution. The summary of his research, specified for fishery practice, was published in 1958 in the book „Rybářská zdravověda" (together with Josef Havelka).

He showed that correct diagnosis, cure and prevention of zooparasitic diseases are of great importance for reduction of the loss of fish and efficancy of fisheries. His fundamental contribution in this respect is now enlarged upon through younger students working under better conditions than in Dr. Volf's time

He took great interest in practical application of the results of his laboratory research in fisheries He was respected for his work and well-liked for his friendly and kind disposition.

After retirement he continued his studies, especially of the use of antibiotics in the treatment of various fish diseases, and compiled, often together with Josef Havelka, various booklets on applied ichthyology for fishery practice, wishing to share as much as possible of his knowledge of ichthyopathology with the general public.

Dr. Volf travelled in his younger years in various countries (e.g. Poland, Yugoslavia, Bulgaria, both German states, England), but he loved best his native southern Bohemia and its ponds, and he spent most of his free time resting there.

Dr F. Volf was an active member of several scientific societies; several years he served as president of the Fisheries Comission of the Czechoslovak Academy of Agriculture, Chief Editor of the fisheries monthly „Československé rybářství", exami-

ner of many theses in fisheries for various academic grades both at universities and at aggricultural colleges.

He inspired and trained many students and research workers in fisheries and ichthyopathology. His life was fully devoted to ichthyopathology, based on fundamental knowledge of fish ecology and the whole extent of hatchery methods, better pond fishery economics, water hygiene, protection against negative effects on fish life. He realized the necessity of preserving all values incorporated in fishery in the broad sense for a wholesome and productive landscape. Those close to him also knew his wide cultural interests; e g he was a good active musician.

A quiet and kind man will live in the memory of all who had the opportunity to meet him and work with him.

Václav Dyk and *Ota Oliva*

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Physiology of movement — Biomechanics. Symposium Mainz, October 1976, W. Nachtigall Ed., 1977, Fortschr. Zoologie, Bd. 24 2—3, DM 198,— Gustav Fischer Verlag Stuttgart—New York.

The Symposium covers in 28 contributions a very broad field of the biomechanics of animal movement. Two papers exceed this field — one on the strength problems in plants (Müller) and one on the mechanical properties of sea urchin teeth (Märkel at al.). Papers on "classical" biomechanics — those concerning the mechanical properties of the skeleton — are in minority: problems of static stress in the mammalian skeleton, stresses in the horse skeleton at rest and during jumping (Preuschoft and Fritz), kinematics of the vertebrate jaw frame (Buhler), functional morphology of legs of the insects of the genus *Gerris* in relation to their body mass (Darnhofer-Demar). There are two papers on the mechanism of ciliary motion essentially on the molecular level (Machemer) and one on the biomechanics of the sensory organ of mosquito (Risler). All remaining papers concern problems of hydro- and aerodynamics of animal movement. In the case of swimming creatures the structures studied work at very different Reynolds' numbers: the paper of Wu deals with ciliary beat, that of Videler is devoted to mechanics of the fish tail and Ungerechts gives some data on the drag of a model of the shark body measured in a wind tunel. An interesting paper of Weihs shows that periodic jet propulsion of aquatic animals gives a higher thrust force than continuous flow.

Most papers relate to bird and insect flight. Of these only two concern gliding flight: that of Csicáky on the body lift of the finch and that of Martin and Carpenter on the character of flow on butterflies wings. In both cases wind-tunnel measurements were done on models. In gliding flight a steady state may be assumed and this makes aerodynamic calculations easy. In spite of that more papers are devoted to flapping flight which is of course more interesting for a zoologist but difficult to analyse because practically all parameters change periodically and no steady state is ever established. The paper of Bilo and Nachtigall summarises some older data and especially results on stereographic motion pictures on the sparrow flight. On the basis of these data Hummel and Mollenstädt calculate aerodynamic forces acting on this wing during the downstroke; yet the assumption of a stationary state was to be made. The same applies to the contribution of Rüppell concerning the upper-side flow measurements on a model of a fulmar wing with special attention to high angles of attack. The assumption of the stationary state was criticized in a short comment by Liebe. Stork, Kühnel and Rheinbold invesstigated the character of flow along the beating wing by taking motion pictures of a flying blackbird with fine threads attatched to the wing surface. A paper by Nachtigall gives the polar of the wing of *Tipula* together with the description of the measuring device for this delicate structure ($l_2 = 17$ mm, $b_{max} = 5$ mm). Further papers on technics of measurement are given by Zarnack and by Koch. A data acquisition processor for electrophysiological experiments is described by Zarnack and Möhl; using this apparature they analysed flight steering in the locust. Pfah gives a detailed description of the fore wing and the fore wing joint of the same insect. Schneider und Bohne analyse the coupling of front and hind wing in Heteroptera. A different aspect appears in the paper of Oehme, Dathe and Kitzleg on the energetic aspects of bird flight by relating power requirement to flight speed and body mass.

The volume is introduced by an article of Alexander on the progress of animal mechanics and by an extensive (42 pages) review of Nachtigall on the significance of the Reynolds' number especially in biology; this is an excellent introduction into biological aerodynamics.

The title of the book may be a little misleading — most contributions are rather of biophysical than of physiological (in the strict sense) character. Some minor errors (in Fig. 23 p. 46 the drawing of the airfoil N 60 R is designated Gö 625; in Fig. 2 p. 144 the symbols in the drawing do not correspond to those in the text) are negligible. As a whole the book gives an excellent insight into the recent development of the field and is valuable for biologists working in morphology, physiology, ecology and other fields.

V. Kubišta

Die Tierwelt Deutschlands. 66. Teil. *Thysanoptera,* Fransenflügler. Von G. Schliephake und K. Klimt. — VEB Gustav Fischer Verlag Jena 1979. 477 S., 528 Abb., 34 Tab., L 6 Br., DDR 113,— M.

66. díl populární sbírky Die Tierwelt Deutschlands je věnován řádu třásnokřídlých (Thysanoptera), skupině, k jejímuž taxonomickému poznání položil už v roce 1895 *solidní základ svou monografií naš prof. B. Uzel.*

Prvých 69 stran je věnováno obecné části, v níž je stručnou formou pojednáno o morfologii, bionomii, ekologii, hospodářském významu, rozšíření, historii a stavu výzkumu a konečně sběru a preparaci třásnének. Každá kapitola úvodní části je doplněna odkazy na nejdůležitější literární údaje.

V úvodu speciální části podává autor přehled vyšší klasifikace řádu ve svém pojetí z r. 1975. Následuje klíč k určení 4 čeledí, vyskytujících se na pojednávaném území a podstatnou část díla tvoří potom taxonomická charakteristika 246 druhů a 57 rodů, doplněná klíči podčeledí a rodů v rámci čeledí a druhů v rámci rodu. Druhové charakteristiky jsou doplněny meristickými údaji základních znaků a prozeně i vyobrazením kritických znaků na 93 tabulích pérovek. Ke každému druhu jsou připojena data o typovém materiálu (uložení, locus typicus) a poznámky k chorologii a rozšíření.

Schliephakeho zpracování řádu Thysanoptera představuje solidní taxonomickou studii této skupiny, v níž najdou poučení nejen specialisti zoologové, ale i entomologové pracující v užitých oborech zemědělských, ovocnářských, zahradnických, zelinářských i lesnických, stejně jako pracovníci ochrany rostlin.

K. Hůrka

Clark, R. J., D. G. Smith, L. H. Kelso, 1978: *Working bibliography of owls of the world, with summaries of current taxonomy and distributional status.* NWF Scientific/Technical Series No. 1, Washington: National Wildlife Federation, XIV + 319 pp., Price $ 9.00.

Die in den letzten Jahrzehnten stark ansteigende Anzahl von ornithologischen Publikationen sowie die Unmenge von Zeitschriften, in den diese Arbeiten erschienen (von den Büchern und verschiedensten Sammelbanden gar nicht gesprochen) macht es dem gegenwärtigen Ornithologen recht schwierig sich in diesem Literatururwald zu orientieren. Dementsprechend pflegt die Kenntnis der entsprechenden Literatur bei vielen auf dem ornithologischen Gebiet tatigen Wissenschaftlern sowie Laien relativ schwach zu sein. Dieser Mangel der biologischen Forschung unserer Zeit schaffen nicht mal die großen Berichtzeitschriften (wie Zoological records, Referativnyj žurnal, Berichte Biologie und Biochemie usw.) trotz ihrer mächtigen Hilfe zu beseitigen. Infolgedessen erscheint es als hoch empfehlenswert Bibliographien für die einzelnen ornitologischen Gebiete zu komplieren. Für die Eulen haben dies Richard J. Clark, Dwight G. Smith und Leon H. Kelso getan.

Alle drei bekannten Eulenforscher haben wahrend einer elfjährigen Feinarbeit eine im November 1978 erschienene Bibliographie geschaffen, die einen wirklichen Meilenstein in der Geschichte der ornithologischen Bibliographien vorstellt. Die eigentliche Bibliographie enthalt 6590 Titel und ist in einer klassischen Art und Weise alphabetisch nach den Autorennamen angeordnet. Zu einer wirklichen "working bibliography" machen jedoch die rezensierte Arbeit die Kapitel 5—7, in denen mittels einer Computer-Bearbeitung drei Schlussel zum Auffinden erwünschter Informationen zusammengestellt sind. Im Kap. 5 ist das gesammte Material nach den geographischen Gebieten und innerhalb von denen nach den Eulengattungen aufgeschlusselt, im Kap. 6 nach den Gattungen und innerhalb von denen nach ausgewählten Informationskategorien (Anatomie, Verhalten, Ökologie, Physiologie, Systematik, Schutz, Allgemeines und Verbreitung) und im Kap. 7 einfach nach den Gattungen. Diese Einteilung erhöht beträchtlich die Suchgeschwindigkeit des Benutzers

der Bibliographie und verrät außerdem von dem Inhalt der zitierten Arbeiten auch manches, was eventuell von ihren Titeln nicht zu ersehen ist.

Recht hilfsreich ist auch das Verzeichnis der Volksnamen aller Eulenarten, der einerseits systematisch nach den Eulenarten, andererseits alphabetisch nach den Namen selbst angeordnet ist und der 72 Sprachen aus allen Weltteilen berücksichtigt. Eine knappe, jedoch informationsreiche Übersicht bringt die tabellarische Zusammenstellung (systematisch angeordnet) mit Angaben über die Anzahl der Unterarten der betreffenden Art, ihrer Verbreitung und Lebensstätte. Eine kurze Diskussion einiger systematischen Probleme der Strigiformes ergänzt zusammen mit einer Übersicht der vom Aussterben bedrohten Eulenarten und -unterarten geeigneterweise die Arbeit.

Um jedoch nicht nur über die Vorteile des rezensierten Bandes zu sprechen: Es gibt auch einige wenige Fehler in der Arbeit, die alle wohl auf den Sprachunkenntnissen der Autoren beruhen. Unter den Nationalsprachen wird tschechoslowakisch und yugoslawisch aufgeführt, wobei unter tschechoslowakisch tschechisch gemeint ist (slowakisch ist richtig gesondert aufgeführt) und unter yugoslawisch offensichtlich sorbo-kroatisch. Außerdem gibt es in den nicht-englischen Titeln mehr Druckfehler als eventuell wünschenswert wäre.

Zusammenfassend muß allerdings die Working bibliography of owls of the world sehr hoch geschätzt werden und sie sollte in keiner größeren ornithologischen Bibliothek fehlen.

Es muß an dieser Stelle betont werden, daß es sehr empfehlenswert wäre ähnliche Bibliographien auch für andere Vogelgruppen zu schaffen. Es ist die höchste Zeit das mit einer drohenden Geschwindigkeit anwachsende ornithologische Schrifttum in solchen Bibliographien zu unterfangen und dann diese nur noch zu ergänzen. Jahr für Jahr wird diese Aufgabe schwieriger, man muß jedoch hoffen, daß dem wegzeigerischen Beispiel der Eulenbibliographie von Clark, Smith und Kelso weitere Autoren folgen werden.

Die Working bibliography of owls of the world ist bei der National Wildlife Federation (1412 16th St., N. W., Washington. D. C. 20036, USA) zu beziehen.

J. Mlíkovský

Sedlag, U., 1978: *Wunderbare Welt der Insekten*, pp. 1—216, 120 farbige Reproduktionen, 22 farbige Fotoaufnahmen, 1. Auflage, 35.000 Exemplare, Preis 24.— DM.

Es liegt vor uns ein interessantes populärwissenschaftliches Buch über Insekten, und es wäre in der Menge dieser Literatur unter Umständen nicht angebracht, es zu besprechen, wenn uns schon auf den ersten Blick nicht ein Werk vorlage, das unsere Aufmerksamkeit verdient. Der prinzipielle Unterschied zwischen diesem Werk und einem — sozusagen — Serialprodukt dieses Genres scheint vor allem in dem Umstand zu sein, dass die Autoren den verantwortungsvollen Weg eines Dienstes der Öffentlichkeit eher als leider so üblichen Weg des Geldverdienens wählten. Somit gehört das Buch zu denjenigen seiten gewordenen Publikationen der letzten Jahre, die trotz einer relativ hohen Auflage binnen einer kurzen Zeit praktisch vom Markte verschwunden sind und ist somit z. Z. kaum mehr erhältlich.

Das Buch ist rein inhaltsmässig gesehen keiner einseitigen oder einstromigen Auffassung (etwa einer rein ökologischen, oder rein endokrinologisch-physiologischen, morphologischen, sammlerischen usw.) unterzogen, sondern es versucht, das ganze Gebiet der Entomologie zugänglich zu machen. Dies ist nie eine leichte Aufgabe. Der erfahrene Autor, der sowohl als Forscher als auch als Padagoge tätig warr, konnte die Gefahren dieses Fortganges meistern, weil es ihm gelang, selbst die statistisch-deskriptiven Seiten einer solchen Auffassung dynamisch, modern und vor allem sehr anschaulich darzubieten. Dazu standen ihm reichliche Möglichkeiten zur Verfügung, von vielen guten Illustrationen gebrauchzumachen. Dazu kommt, dass er viele der sonst üblichen (z. B. morphologisch-anatomischen, bionomischen usw.) Schemen durch deren originelle Auffassung sehr anschaulich

machte. Dies ist ihm vor allem auch gelungen, weil er in fast allen Fällen die letzten Errungenschaften der so vielseitigen Insektenforschung kritisch auslas und sie, trotz dem Spezialgebiete der Entomologie, nicht aus dem Rahmen der Zoologie und der Biologie rutschen liess.

Somit entstand ein selbst für einen Nichtentomologen nicht nur atraktives, sondern auch lehrreiches Buch, das estetisch seine Aufgabe in einer jeden Bücherei sehr gut erfüllt.

Sollte doch auf Einiges kritisch hingewiesen werden, so dürfte man vielleicht aufmerksammachen, dass die Insekten oft in sehr konkreten ökologischen Situationen in diesem Buch in ganz nichtphysiologischer „Preparationslage" abgebildet werden, dass manche Farbtöne wenig sauber auskamen, und dass vielleicht doch die chorologische Seite der Insektenbionomie, die für einen Naturnfreund oder Liebhaber nicht so ausschlaggebend sein dürfte, die aber bei dem sich immer steigernden Interesse um die Probleme der biologischen Umwelt auch allgemein wichtig wurde, doch zu kurz kamen.

Die Ansichten auf den Inhalt, oder auf das Ausmass einer solchen Veröffentlichung können allerdings von Fall zu Fall unterschiedlich sein. Und so sei doch vor allem mit Freude festgestellt werden, dass in unserem Falle ein Buch vorliegt das zu lesen einen Reiz sowohl einem Fachmann als auch einem Liebhaber bietet. Diese Feststellung sei dem Autor und seinen Mitarbeitern zu einer Anregung, dieses so erfolgreich angefangene Werk weiter zu entfalten. *D. Povolný*

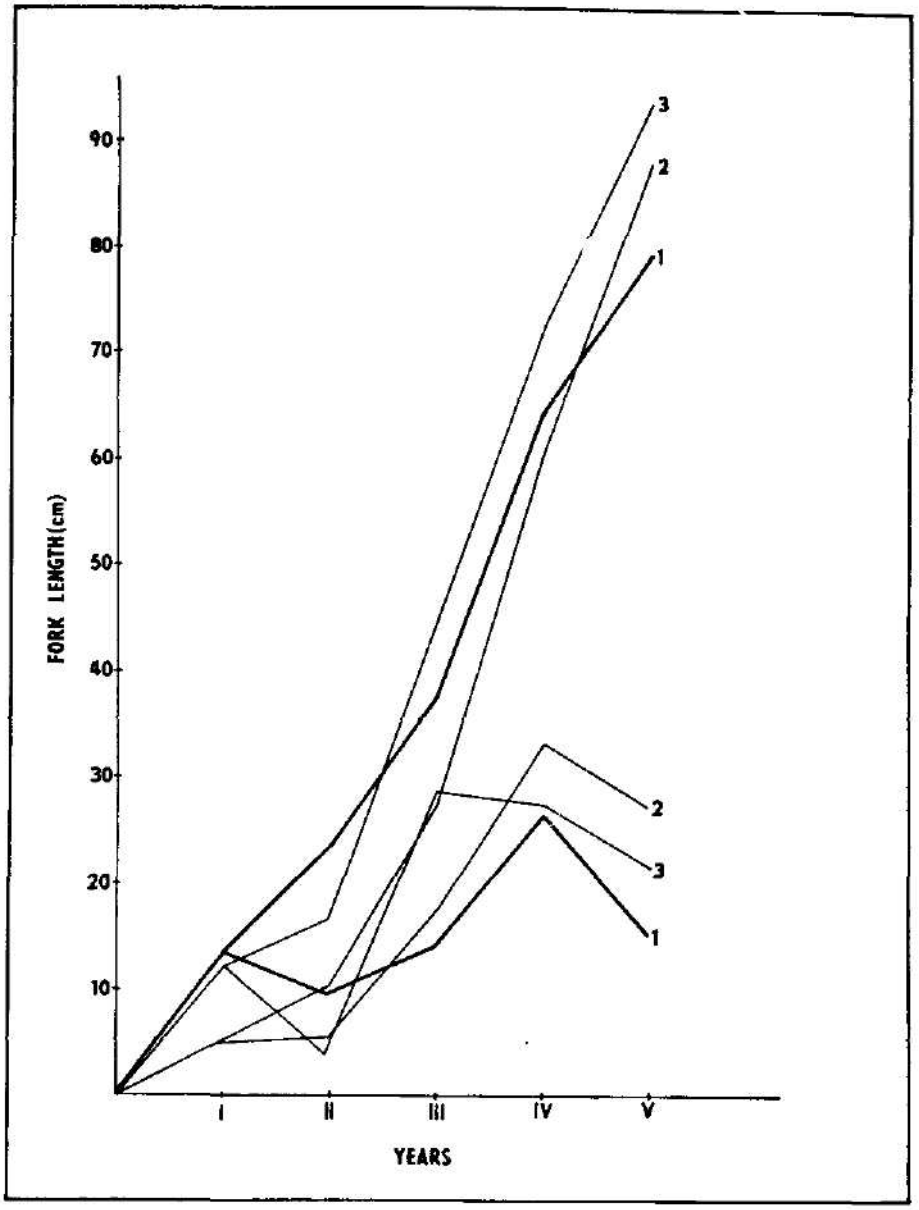


Fig. 1. Comparison of linear growth of atlantic salmon. 1 — Gánovce, 2 — Baltic Sea (D i x o n, 1937), 3 — Vistula river (J o k i e l, 1959).

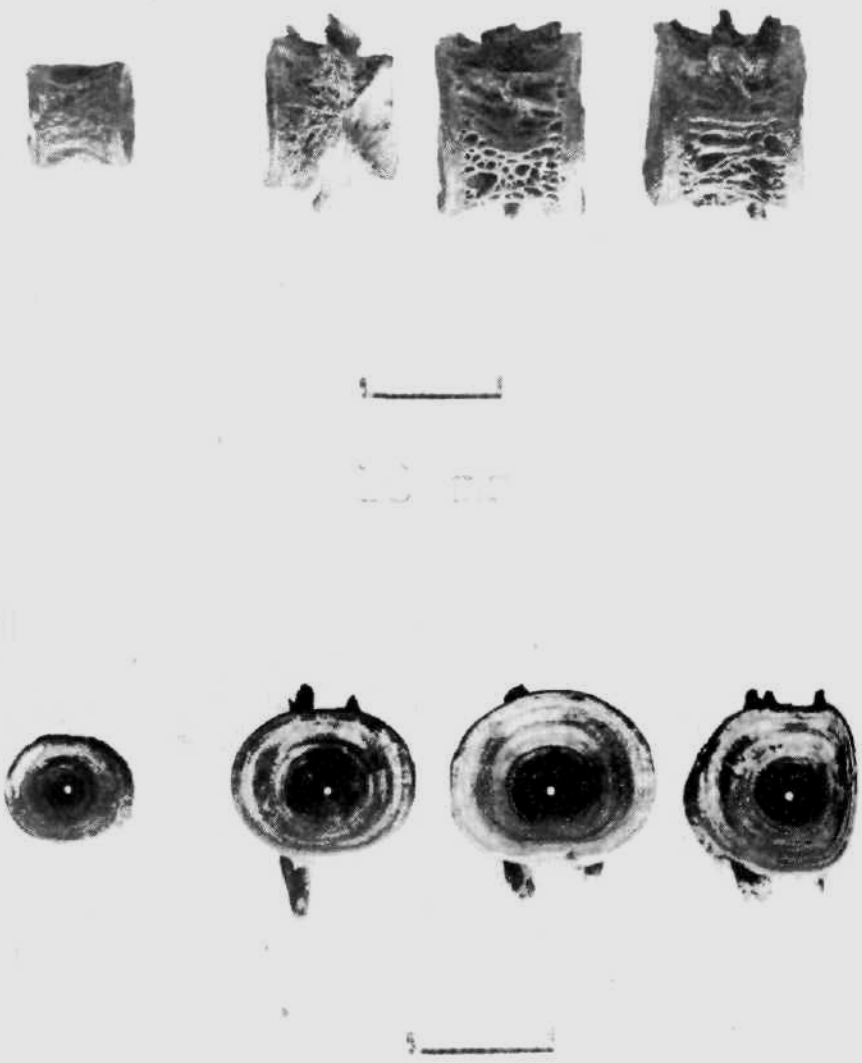
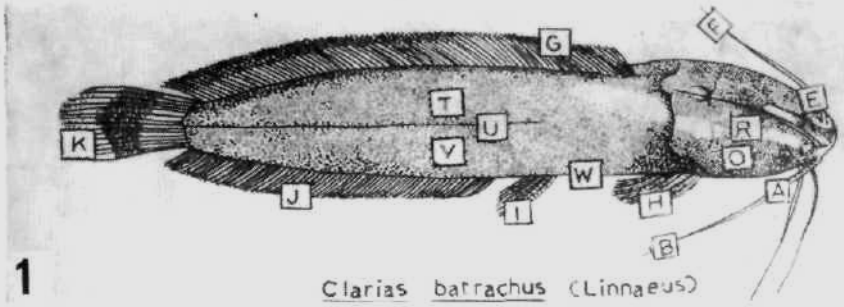


Plate 1. Lateral (right side — top) and cranial (bottom) view on vertebrae of Atlantic salmon from Gánovce. On left side 9th precaudal vertebra of specimen of about 71—74cm of the total length; on right side 18th, 15th and 10th caudal vertebrae of specimen measuring about 84—90 cm of the total length. Photo by ing. I. Krupka.



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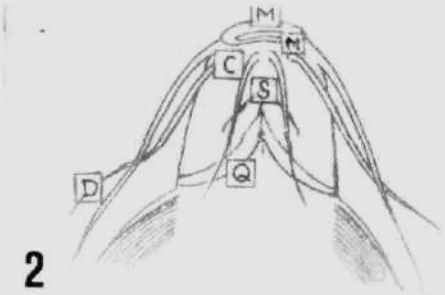

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3

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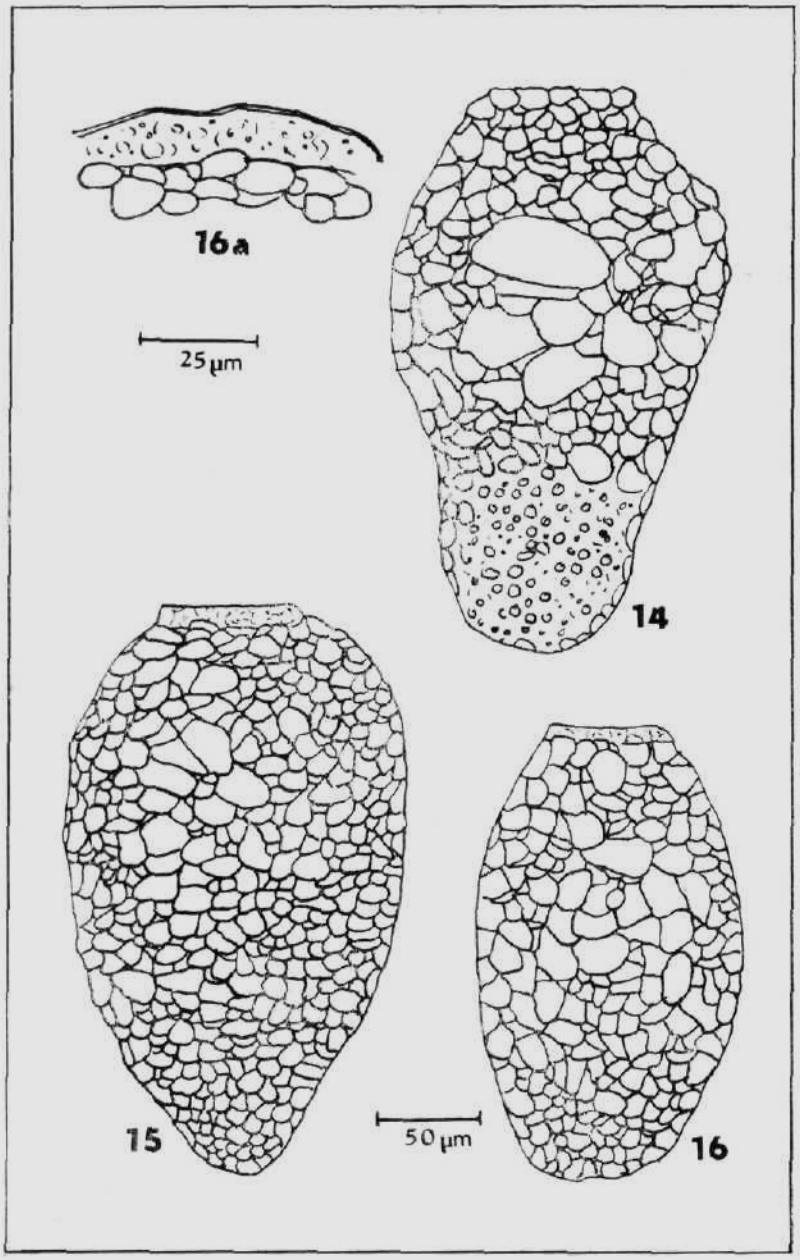
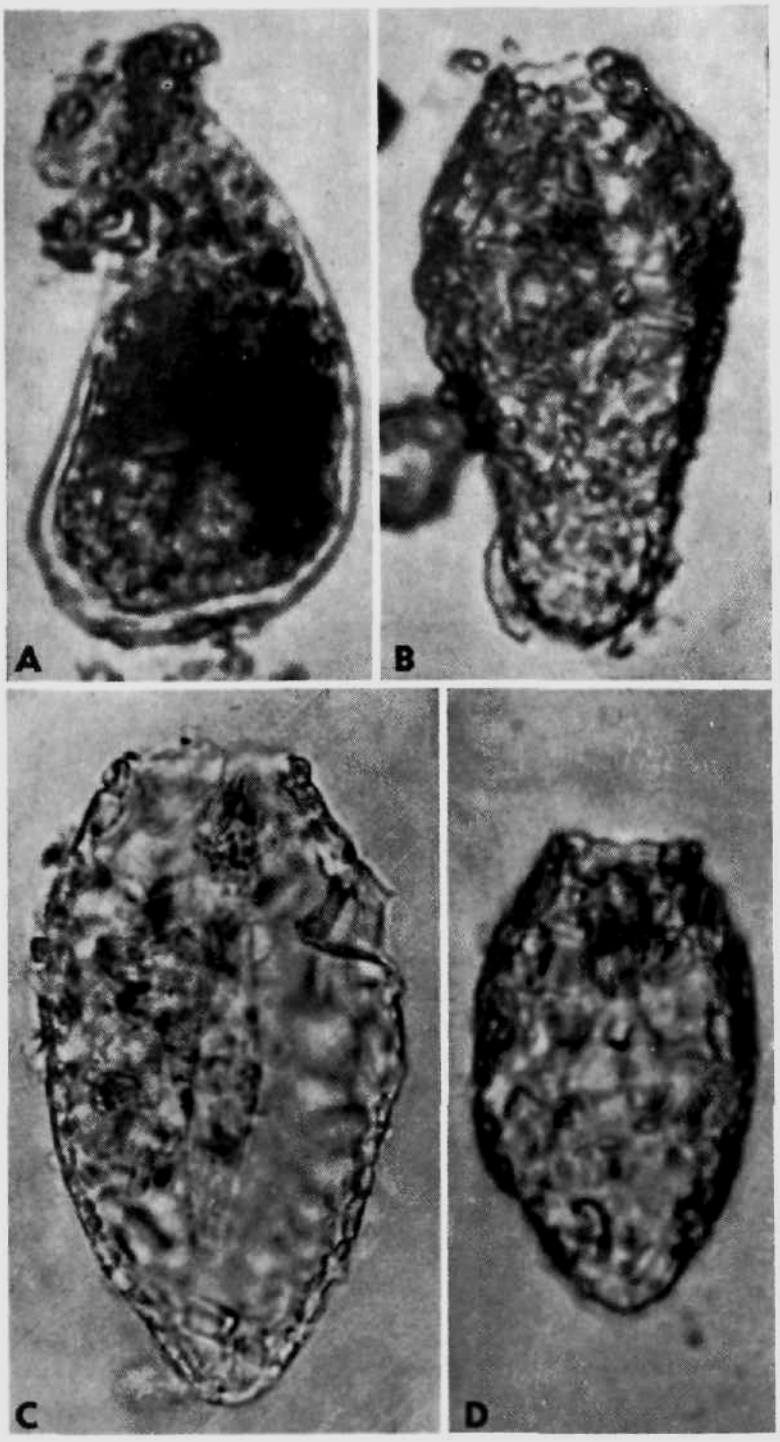
Figs. 1, 2. Areas examined (areas L & P could not be shown in the given diagrams L. is absent in the fish, and P, is an unexposed surface.) in the present study.
Fig. 3. Transverse section of maxillary barbel of *R. rita* showing flask-shaped taste bud. × 300.
Fig. 4. Transverse section of maxillary barbel of *C. batrachus* showing elongated taste bud. × 300.

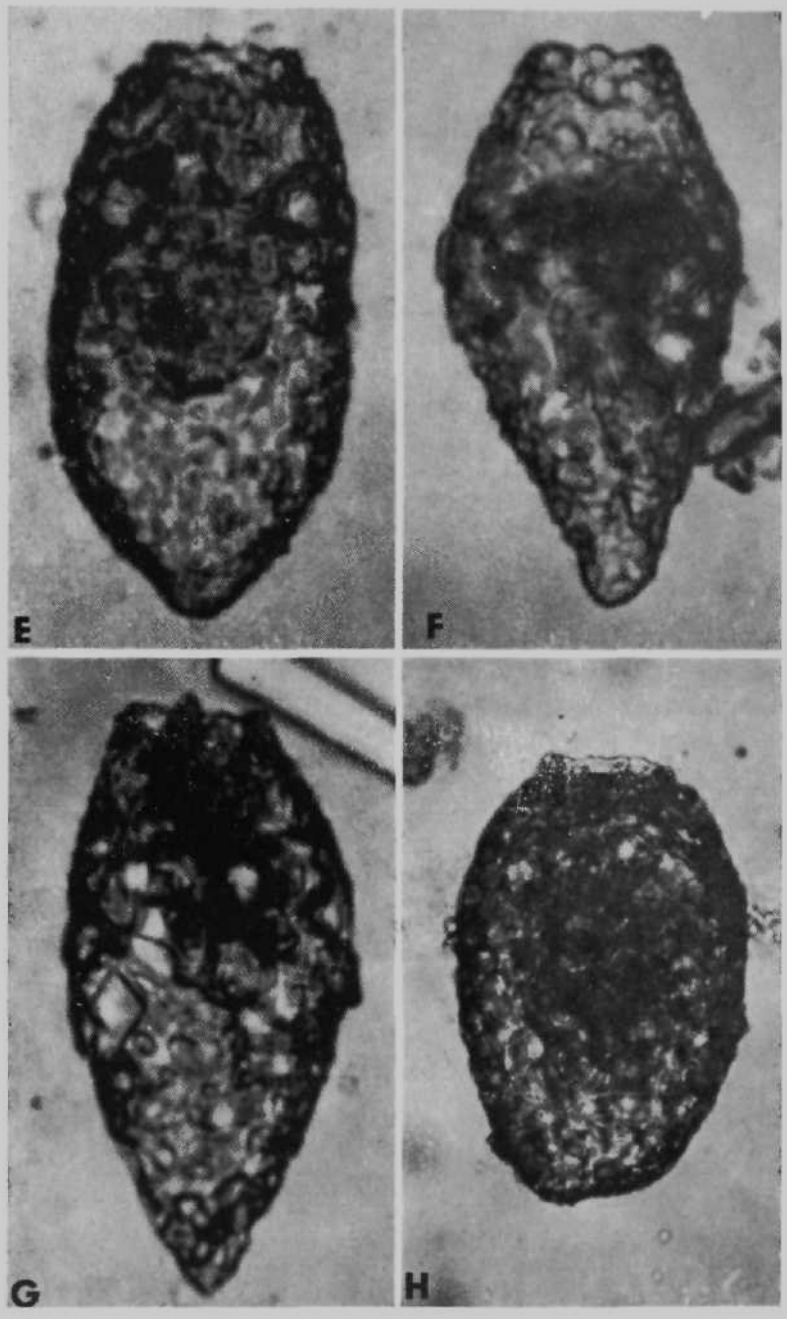
Key to letterings: A. maxillary barbel, proximal region; B. maxillary barbel, distal region; C. mandibular barbel, proximal region; D. mandibular barbel, distal region; E. nasal barbel, proximal region; F. nasal barbel, distal region; G. dorsal fin; H. pectoral fin; I. pelvic fin; J. anal fin; K. caudal fin; L. adipose fin; M. upper lip; N. lower lip; O. operculum-skin outer surface; P. operculum-skin inner surface; Q. operculum flap; R. skin from dorsal surface of head; S. skin from ventral surface of head; T. skin from above lateral line; U. skin from lateral line; V. skin from below lateral line; W. skin from belly.



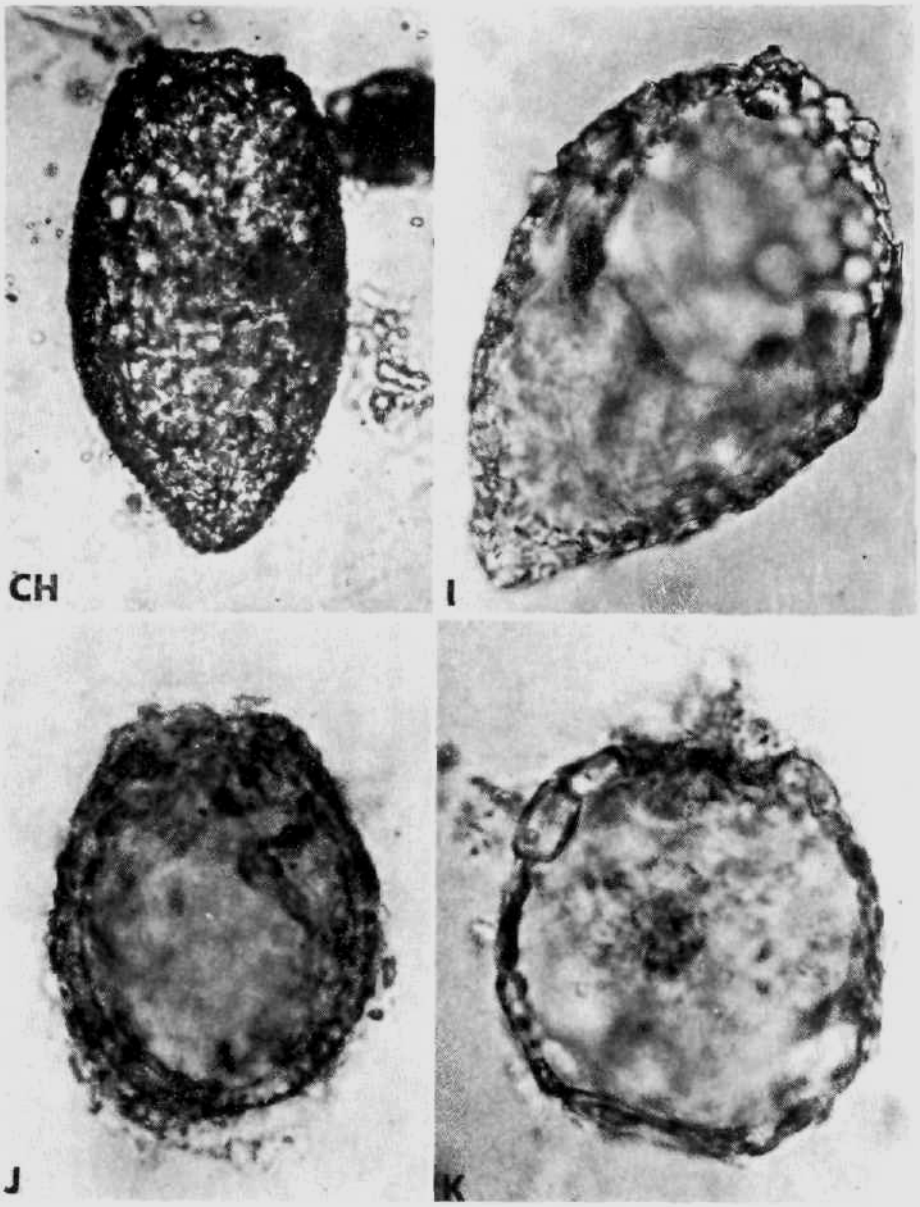
Figs. 14—16. 14 — *Difflugia brychtai;* 15 — *Difflugia labiosa* var. *acuta;* 16 — *Difflugia labiosa,* 16 a — *D. labiosa,* collar.



Figs. A—D. A — *Cyphoderia ampulla* var. *thomasi*; B — *Difflugia bruchtai*; C, D —



Figs. E—H. E, F, G — *Difflugia difficilis*; H — *Difflugia labiosa*.



Figs. CH–K. CH — *Difflugia labiosa* var. *acuta*; I — *Difflugia mammilaris*; J, K – *Pseudodifflugia senartensis*.

POKYNY PRO AUTORY

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

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

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

Vlastní práce: 1. Velmi stručný abstrakt, v rozsahu nejvýše 15 řádek, v angličtině. 2. Úvod do problematiky (stručně). 3. Materiál a metodika (u známých metod pouze odkaz). 4. Vlastní část experimentální nebo popisná. 5. Diskuse. 6. Závěr. 7. Seznam citované literatury (nikoliv bibliografie!). 8. Adresa autora. 9. Tabulky, texty k obrázkům a grafům. Celý rukopis je průběžně stránkován.

Citace prací proveďte podle jednotného vzoru: autor, rok, název, časopis (mezinárodními bibliografickými zkratkami), ročník, sešit pouze v případě, že ročník není průběžně stránkován, stránky. U knižních titulů nakladatel a místo vydání. Např.: Hrabě S., 1975: Second contribution to the knowledge of marine Tubificidae (Oligochaeta) from the Adriatic Sea. *Věst. čs. Společ. zool.*, 39: 11–119.

Přepis cyrilice proveďte podle mezinárodních pravidel vědecké transliterace (nikoliv fonetické transkripce) — viz ISO Recommendation R 9. International System for the transliteration of cyrillic characters 1. Ed. October 1955 nebo Zekalle R., 1964: *Pedobiologia*, 4 : 88–91, Jena.

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

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

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

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

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