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OBSAH — CONTENTS

Banareseu P.: Some additional remarks on the genus <i>Squalidus</i> Dybowski (Pisces: Cyprinidae)	97
Čihař J.: Taxonomical and ecological notes on <i>Cottus gobio</i> Linnaeus, 1758, and <i>Cottus poecilopus</i> Heckel, 1863 (Osteichthyes: Cottidae)	102
Groschafft J.: The occurrence of trematodes of the genus <i>Lutztrema</i> Travassos, 1941 (Trematoda: Dicrocoeliidae) in the blackbird (<i>Turdus merula</i> L.) in Czechoslovakia	111
Halašková V.: Some new species of the family Zerconidae from North America (Acari: Mesostigmata)	115
Hrbáček J.: Redescription of <i>Daphnia zschokkei</i> Stingelin	128
Neradová J.: Cysticercoids of the cestode <i>Sobolevicanthus krabbeella</i> (Hughes, 1940) from crustaceans	132
Řepa P.: Nahrung und Wachstum des Flussbarsches (<i>Perca fluviatilis</i> Linnaeus, 1758) in seinem ersten Lebensjahr	135
Šimek V.: Influence of short-term and long-term intermittent fasting on morphological changes of the digestive system of the golden hamster (<i>Mesocricetus auratus</i>)	151
Štěrba O.: Über die geographische Verbreitung der Harpacticiden in der Tschechoslowakei (Copepoda: Harpacticoida)	162
Tenora F.: Parasitic nematodes of certain rodents from Afghanistan	174

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**SOME ADDITIONAL REMARKS ON THE GENUS SQUALIDUS DYBOWSKI
(PISCES: CYPRINIDAE)**

PETRU BANARESCU

Received November 13, 1967

Abstract: The author makes some additional remarks and corrections on his 1961—1962 papers on the genus *Squalidus*. *Gnathopogon intermedius* Nichols and *G. ymae* Oshima are valid species of *Squalidus*.

In two successive papers published in this journal (Banareescu, 1961, 1962), I showed that *Squalidus* is the right name for the fishes commonly ascribed to *Gnathopogon* (this name applies for the species usually recorded as *Leucogobio*) and I considered *Squalidus* a subgenus of *Gobio*. Nakamura (1963) adopted this nomenclatural change, recognizing *Squalidus* as generically distinct. In my 1961 paper I recognized three species of *Squalidus*: *chankaensis* with 9 subspecies, *gracilis* with two, *mayedae* with two and one problematic; I also suggested that Nichols' "*Gnathopogon*" *similis* and *intermedius* seem to belong to the true *Gnathopogon* (e.g. *Leucogobio*). Two additional subspecies of *Squalidus* were described by Banareescu & Nalbant (1964).

The extensive series examined after 1962 and the additional information obtained, enabled me to give supplementary data on the gudgeons belonging to *Squalidus*, including some nomenclatural changes.

Squalidus chankaensis Dybowski, 1872

In my 1961 paper I recognized 9 subspecies of this wide ranging species; a tenth one, *vietnamensis*, was described in 1964 and now I recognize *G. similis* Nichols as an 11-th subspecies. Whilst some of the subspecies are very similar (for ex. *wolterstorffi* and *punctatus*, whose ranges are so distant), there are rather strong differences between other subspecies with adjacent ranges, such as *argentatus* and *sihuensis* or *argentatus* and *nitens*. It seems therefore possible that the 11 representative forms, here lumped as subspecies of *chankaensis*, actually belong to two or three more or less sibling species: *biwae* (monotypic), then *argentatus* (including *argentatus*, *mantschuricus*, *vietnamensis* as subspecies), with usually 38—41 scales, and *chankaensis* (including the remaining 7 subspecies), with 34—38 scales, rarely 33, 39 or 40. Field and genetical studies are necessary to clarify this problem;

because of the slight morphological overlap between the group *chankaensis* and the group *argentatus*, I continue to consider all 11 forms as subspecies of *chankaensis*.

Squalidus chankaensis biwae Jordan & Snyder, 1900)

In my 1961 paper I followed Fang (1942) in considering *japonicus* (Sauvage) the right name of the slender Japanese gudgeon usually recorded as *G. biwae*; but the examination of the syntypes of *Squalidus japonicus* Sauvage (H.N.H.N., A 6494) clearly indicated that they are the same as *Gobio mayedae* Jordan & Snyder. The Japanese fish I named *Gobio (Squalidus) chankaensis japonicus* must thus retain the name *Squalidus chankaensis biwae* (Jordan & Snyder).

Squalidus chankaensis tsuchigae Jordan & Hubbs)

Most authors synonymize this Korean fish with *Gobio coreanus* Berg; but the photograph of the type specimen (F.M.N.H. 58712, Fig. 3.), kindly presented me by Dr. L. P. Woods demonstrates that this fish is close to *S. chankaensis*, having a large eye and rather small, horizontal mouth, while the available paratype of *G. coreanus* Berg (Z.I.A.N. 13801; Banarescu, 1961, Pl. II, Fig. 2.) is a fish related to *Squalidus japonicus* (= *mayedae*). The specimens figured by Uchida (1939) and Chyung (1961) as *Gnathopogon coreanus* belong actually to *S. chankaensis tsuchigae*.

Squalidus chankaensis similis (Nichols, 1929)

Nichols figure of his *Gnathopogon similis* is inadequate and I suggested (Banarescu, 1961) that this fish may be a true *Gnathopogon* (= *Leucogobio*). But the examination of the photograph of the type specimen (Fig. 1.), kindly presented me by the Department of Fishes, American Museum of Natural History, clearly demonstrates that this fish is a *Squalidus*, having a subterminal mouth and emarginate dorsal fin; from the two *Squalidus* living in the Lower Hwang-ho, *similis* is closer to *chankaensis* (it has a large eye, whose diameter is about equal to the snout and 113% of interorbital width) and must be considered a subspecies of this species. It has 37–38 scales, depth about 22.2% of standard length, head 27.0%.

Squalidus chankaensis sihuensis (Chu, 1932)

The 12 specimens from Chekiang (without precise locality), M.N.H.N. 34.57–59, recorded by Banarescu (1961 and 1962, Table I) as *S. chankaensis argentatus* actually belong to *sihuensis*; they differ from *argentatus* mainly in having fewer scales (34–36) and larger eye. The range of *sihuensis* seems restricted to Central Chekiang, while the specimens from Tsien-Tang River, South Chekiang, are identical with *argentatus*, which occur also in the whole Yangtze drainage, including North Chekiang. *S. chankaensis sihuensis* may prove identical with *S. chankaensis nitens* (Günther).

Squalidus chankaensis argentatus (Sauvage & Dabry, 1874)

This subspecies has the widest range and is the best represented in scientific collections. In my 1961 paper I mentioned only 7 specimens (besides

Tab. 1. Body proportions in *Squalius clarkensis argentatus*

	Type Yangtze M.N.H.N. 5038	Nanking U.S.N.M. 8650	Hankow Z.M.B. 16665	Liang-tze-Hu, Hupeh	Tungting Lake, Hunan			Szechwan M.N.H.N. 34.62	Chekiang M.N.H.N. 34.56, 60, 61	Kwangsi A.N.S. 84094
					Z.M.B. 16664	N.M.W. 51337	A.M.N.H. 11009			
L. lat.	39-40	39-41	39-40	39-40	37-38	39-40	38	(37) 39-40	39-40	
St. length, mm	100.0	42.0-52.5	41.0-81.0	86.0-87.0	98.2	112.2	89.0	90.-92.0	117.0	
Body depth	22.0	15.3-21.8	18.3-23.4	20.9-21.8	22.9	20.6	20.2	19.8-20.3	19.6	
Caud. pedum.	17.5	17.2-23.6	17.4-21.6	17.8-18.6	19.2	19.4	19.1	18.7-20.2	19.6	
Least depth	10.0	8.1-9.8	8.1-9.3	7.9-8.1	8.25	8.6	8.4	8.4-9.1	7.85	
Predors. dist.	45.0	41.5-46.5	42.0-44.9	45.0-46.0	45.5	44.0	42.6	43.2-44.0	43.5	
P-V dist.	25.0	24.3-27.4	21.8-25.0	26.5-25.6	23.8	24.2	24.5	23.9-27.8	25.6	
V-A dist.	25.0	22.2-24.5	23.4-26.4	24.2-25.0	26.5	27.2	25.6	24.4-26.2	25.6	
Head	24.2	24.8-27.6	24.8-27.8	24.2-25.8	24.8	25.0	24.2	23.6-25.4	25.4	
Snout	7.8	6.5-7.7	6.8-7.7	7.8-8.0	8.15	9.05	6.6	6.7-8.1	8.55	
Eye	7.5	7.1-8.4	6.8-8.7	7.2-7.5	7.05	6.95	6.95	6.9-7.4	7.55	
Barbel	6.2	3.9-5.6	5.5-7.6	5.5-6.2	7.15	8.25	5.95	4.4-6.5	6.85	
Eye in % of inter-orbital	100.0	103.0-128.0	100.0-117.0	100.0-105.0	96.0	88.5	103.0	90.0-112.0	110.0	

the 12 ones wrongly scribed to *argentatus* and which belong to *sikuensis*). Since then, I examined further series:

U.S.N.M. 86500, Nanking, lower Yangtze, 6 spec., 42.0–52.5 mm (originally labelled *Pseudogobio esocinus*).

A.M.N.H. 11009, Tungting Lake, middle Yangtze, 10 spec., 36–64 mm.

Z.M.B. 16654, Tungting Lake, 1 spec., 98.2 mm.

N.M.W. 51337, Tungting Lake, 1 spec., 112.2 mm (labelled *Pseudogobio esocinus*) (Fig. 4.).

Z.M.B. 16665, Hankow, middle Yangtze, 7 spec., 41–81 mm.

A.N.S.P. 85094, Poseh, Kwangsi, Hakiang drainage, 1 spec., 117 mm.

The number of scales and body proportions of all specimens examined are indicated in table I. The subspecies is characterized by 39–41, rarely 38, exceptionally 37 scales and eye, in large-sized specimens, usually shorter than snout. All Yangtze specimens belong to this subspecies, including those from the Upper Yangtze (Szechwan); the single available Upper Yangtze specimen (M.N.H.N. 34.62) agree with the other *argentatus*. *Gobio hsüi* Wu & Wang, 1931, described from Szechwan, is, according to the figure, a synonym of *argentatus*; Wu & Wang described it with 37 scales, but the specimen figured by them has 39 scales, as normally in *argentatus*. The specimens from Tsien Tang River, South Chekiang, recorded by Herre and Lin (1936) as *Gobio wolterstorffi* are referable to *argentatus*; they have 39–40 scales. Curiously enough, the single available specimen from Hsikiang drainage, South China, too is an *argentatus*, agreeing with the Yangtze specimens in all characters.

Squalidus chankaensis punctatus (Nichols, 1925)

Further specimens available: H.Z.S. 11294, Foochow, Fukien, 6 spec., 77–107 mm; U.S.N.M. 86022, Yen-ping-fu, Fukien, 9 spec., 44.5–60.0 mm. Both series differ rather strongly in body proportions: in the Yen-ping-fu specimens the dept is 17.8–21.5% of standard length, the head 24.2–27.0%, the snout 6.1–7.8%, the eye 8.1–8.9% of st. length and 104–125% of interorbital width; in the much larger Foochow specimens I found: depth 23.8–26.7%; head 23.5–26.5%; snout 7.1–8.5%; eye 7.2–7.8% and 92 to 103%. Thus, although this subspecies is characterized, in general, by a very large eye, there are, among the largest specimens, some in which the eye is slightly smaller than the snout and the interorbital width.

Squalidus intermedius (Nichols, 1929)

The original figure of this fish is inaccurate, but according to the photograph of the type specimen (Fig. 2.), kindly presented me by the Department of Fishes, American Museum of Natural History, this fish is a *Squalidus*, very close to *S. chankaensis*, but differing from *S. chankaensis similis* in its much deeper body (depth 25.0–28.6% of standard length) and smaller eye (6.95 to 8.0% of st. length and about 87% of interorbital width. The range of this species is apparently restricted to the lower Hwang-ho, where it lives sympatrically with *S. chankaensis similis*.

Squalidus ijimae (Oshima, 1919)

Banareseu (1961) suggested that this gudgeon may be a subspecies of *S. japonicus* (= *mayedae*); having examined three specimens from Taichung, Taiwan, I.B.T.S. 1335, received in exchange from Prof. J. Chen,

I found that in this fish the mouth is as small as in *chankaensis*, but oblique as in *japonicus*; the fish can be ascribed thus to neither of these species and must be considered specifically distinct. In the three specimens examined the body is deep: depth 25.9–27.5% of st. length, as against 20.6% in the type specimen. The range of the species includes Taiwan Island.

I have nothing to add on the two other species within the genus: *Squalidus gracilis* (Temminck & Schlegel) and *Squalidus japonicus* (Sauvage) (= *mayedae*).

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Abbreviations used: A.N.S.P. = Academy of Natural Sciences, Philadelphia; A.M.N.H. = American Museum of Natural History, New York; B.M.N.H. = British Museum, Natural History; H. Z. S. = Zoologisches Staatsinstitut und Museum, Hamburg; I.B.T.S. = Institutul de Biologie Tr. Savulescu, București; M.N.H.N. = Muséum National d'Histoire Naturelle, Paris; N.M.W. = Naturhistorisches Museum, Wien; U.S.N.M. = United States National Museum, Washington; Z.I.A.N. = Zoologičeskij Institut Akademii Nauk, Leningrad; Z.M.B. = Zoologisches Museum der Humboldt Universität, Berlin.

SUMMARY

Some supplementar data to formers papers on the genus *Squalidus* are given: The righth name for the Japanese representative of *S. chankaensis* is *S. ch. biwae*; *S. ch. tschicigae* is considered distinct from *S. japonicus coreanus*; *Gnathopogon similis* is a subspecies of *S. chankaensis*; the range of *S. chankaensis sihuensis* is apparently restricted to Central Chekiang; the Hsikiang specimens of *S. chankaensis* are identical to the Yangtze subspecies *argentatus*; large specimens of *S. chankaensis punctatus* are described; *Gnathopogon intermedius* and *G. nijimae* are valid species of the genus *Squalidus*.

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

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**TAXONOMICAL AND ECOLOGICAL NOTES ON COTTUS GOBIO
LINNAEUS, 1758, AND COTTUS POECILOPUS HECKEL, 1836
(OSTEICHTHYES: COTTIDAE)**

Dedicated to the 70th birthday of Professor V. D. Vladykov

Jiří ČIHÁŘ

Received April 8, 1968

Abstract Two species of sculpins, *Cottus poecilopus* Heckel, 1836 and *Cottus gobio* Linnaeus, 1758, were studied from the taxonomical and ecological point of view. *Cottus poecilopus* prefers higher altitudes in the stream than *Cottus gobio*. Probably the hybridization takes place on localities where both species occur. Some body proportions change with age. The most important character of the sexual dimorphism in both species is the width of the mouth, which is greater in males. With regard to material studied (312 specimens of *Cottus poecilopus*, 14 specimens of *Cottus gobio*) it was possible to complete the existing descriptions of the first named sculpin species.

INTRODUCTION

In 1952 a group of students — hydrobiologists and ichthyologists of the Faculty of Natural Science at Charles University in Prague — carried out a relatively extensive hydrobiological and ichthyological investigation of the rivers Morávka and Mohelnice in the Beskydy Mountains (Silesia). The detailed results were summed up in an unpublished Czech paper (1954) with English and Russian summaries, which is deposited in the Silesian Institute of the Czechoslovak Academy of Sciences.

Apart from the other species of fish in the haul there were 312 specimens of *Cottus poecilopus* Heckel, 1836 and 14 specimens of *Cottus gobio* Linnaeus, 1758. Studies on the food of the sculpins and on food relations between the sculpins, minnow and brown-trout have appeared in print (Štráškraha, Čihář, Frank, Hruška, 1966).

The present paper aims at a brief survey of some findings on the ecology, systematics and sexual dimorphism of the two species of Czechoslovak sculpins.

The author would like to present here his best thanks to Doc. Dr. O. Oliva for his valuable advice and the loan of some literature which is not easily accessible; the author is also obliged to him for having read the paper.

MATERIALS AND METHODS

The fish were caught by means of a shocker for electrofishing at seven localities in the Morávka and at one locality of the Mohelnice (Tab. I, Fig. 1). They were fixed immediately after having been caught, and placed into an approximately 6% formal solution.

The measuring was carried out with a 0.5 mm precision by compasses, weighing to a 1 g precision per the weight Pesola.

The following proportions were measured in each sculpins: longitudo totalis, long. capitis, long. pedunc. caudae, altitudo pedunc. caudae, min. alt. corporis, long. maxillae, latitudo oris, longitudo pinae ventralis and long. 4. radii pinae ventralis.

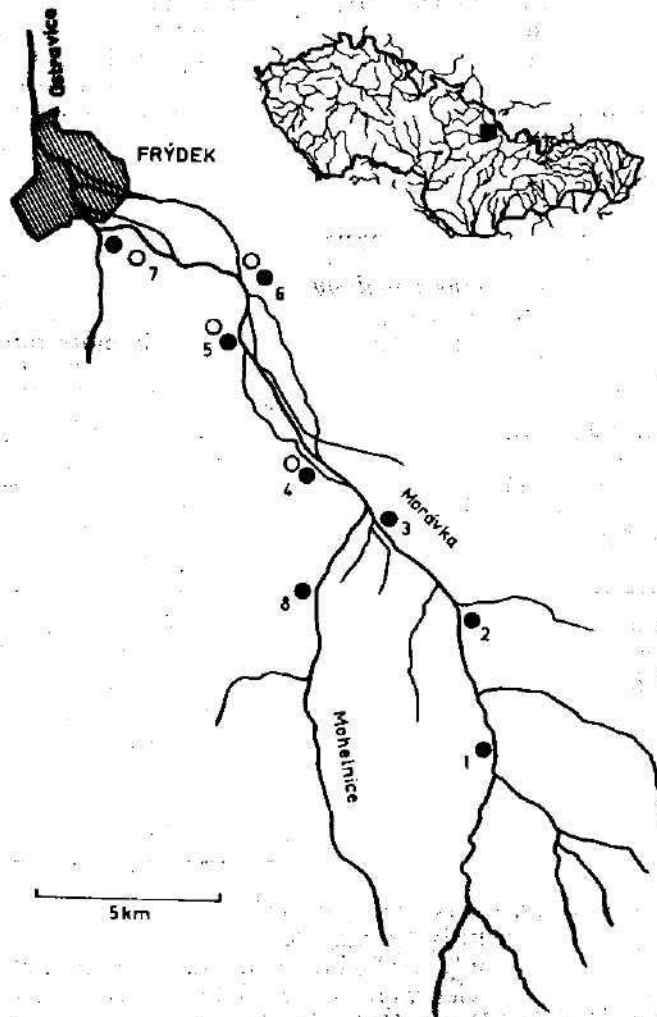


Fig. 1. The rivers Morávka and Mohelnice with the localities, where *Cottus gobio* (○) and *Cottus poecilepus* (●) were caught.

Since in the majority of previous papers on the systematics of the Czechoslovak sculpins the total body length (long. totalis) was taken as the basis in the comparison of the individual proportions the author kept to the same scheme even though a further comparison with the results of proportional measurements by some foreign authors may be made more difficult as they generally used as the basis standard length without the caudal fin (long. corporis) for this purpose.

RESULTS AND DISCUSSION

1. History of occurrence and ecology of the sculpins

For a relatively long time, up till 1949, *Cottus poecilopus* was considered to occur only in the waters of the Carpathian region. V l a d y k o v (1926, 1931) described this species from the Tisa system in the Carpathian area. Although H y k e š (1921) reported, that it was probably a typical fish for the highest mountain ranges in Europe. It was only O l i v a (1949) who returned again to this question and was the first to report the find of *Cottus poecilopus* in several Moravian rivers; he pointed out that this species was much more frequent in Moravia, than it had been presumed till then. D y k (1950, 1952) described *Cottus poecilopus* from the rivers Opavice and Moravice; B a l o n (1952) published tables on the measurements of both *Cottus* species of the Olza river.

The great number of *Cottus poecilopus*, caught in the rivers Morávka and Mohelnice, evidence the frequent occurrence of this species in the Czechoslovak tributaries of the Odra, where, at places, it is more numerous than *Cottus gobio*.

Tab. 1. Places of hauling the sculpins and the oxygen content in the water at the individual localities

Locality	Number of specimens		O ₂ in mg/l
	<i>C. poecilopus</i>	<i>C. gobio</i>	
Morávka at Heštula	65	—	14.4
Morávka at Psárky	92	—	11.9—14.1
Morávka at Pražma	64	—	8.1— 8.5
Morávka at Raškovice	5	1	8.1
Morávka at Vyš. Lhota	3	3	9.9—10.1
Morávka at Nošovice	42	8	10.7
Morávka at Frýdek	5	2	9.0— 9.1
Mohelnice at Papežov	36	—	—

From Tab. 1 and Fig. 1 it is seen that in the upper reaches of the Morávka *Cottus poecilopus* was exclusively caught, whereas *Cottus gobio* was caught together with the former only in the lower altitudes (Tab. 1). The same conditions as to the two species were observed by V l a d y k o v (1926) in Carpathian Ukraine, by D y k (1952) in Moravia, by B a l o n (1952) and O l i v a (1956). Zelinka's opinion (Z e l i n k a, 1951), that *Cottus poecilopus* requires a higher oxygen content in the water than *Cottus gobio* was also confirmed.

2. Taxonomical remarks

The systematics of the Czechoslovak sculpins was studied in the past by a number of authors. Apart from the above mentioned papers by V l a d y k o v (1926, 1931), D y k (1950, 1952), B a l o n (1952), O l i v a (1949, 1950, 1956, 1960) and Z e l i n k a (1951), these fishes were also investigated by M a h e n (1927), K u x and W e i s z (1960), F r a n k, O l i v a and

Šafránek (1962), Weisz and Kux (1962), Holčík (1966), Skořepa (1967) and others.

The characters according to which the two sculpins species in Czechoslovakia differ from each other also include the length and colouration of the ventral fins, length of their inner ray and the course of the external line (Heckel, 1936; Heckel and Kner, 1858; Dybowski, 1869 (cit. Berg, 1949); Berg, 1949; Oliva, 1956; Banarescu, 1963.

Tab. 2. Length of the inner ray of the ventral fin in proportion to its length

In % long. pinnæ ventralis long. IV. radii	Number of specimens	
	<i>C. poecilopus</i>	<i>C. gobio</i>
11–25	4	—
26–35	100	—
36–45	154	—
46–55	38	—
56–65	2	—
66–75	1	2
76–85	—	11
86–90	—	1
average	39,3	80,3

According to all the above authors the diagonally striped ventral fin in the *Cottus poecilopus* always reaches as far as the anal opening, and frequently also exceeding it, whilst the unicoloured fins in *Cottus gobio* never extends as far as the anal opening. Differences are also reported in the length of the inner rays of the ventral fins, which in *Cottus poecilopus* never exceeds 40 p.c. of the ventral fin length, in *Cottus gobio* they are much longer and their length amounts approximately to 80 p.c. of that of the ventral fins. Another differentiating character between the two species of the sculpins is — according to the quoted authors — the course of the lateral line, which invariably ends before the caudal fin base and it is interrupted in *Cottus poecilopus*; on the contrary in *Cottus gobio* it extends over all the body length and is never interrupted.

Contrarily to the above data, the length of the ventral fins is nearly the same in both the sculpins species from Silesia (see Tab. 1 and 2); in some cases the fins in *Cottus gobio* from the Morávka extend up to the anal opening. Z e l i n k a (1951) observed the same phenomenon, too, in two individuals of *Cottus gobio*, in which the ventral fins were strikingly long and, on the other hand, the 4th ray of these fins was extremely short.

Contrary to Z e l i n k a (1951), the present author did not observe that the inner ray of their ventral fin was very short in the material of *Cottus gobio* from the Morávka river. Another case is in *Cottus poecilopus*, however, where the length of the inner ray very often exceeded the limit given for this species, i.e. 40 p.c. of the ventral fin length (in more than 30 p.c. of all the caught *Cottus poecilopus*, see Tabs. 2 and 4).

Tab. 3. *Cottus gobio*, proportional measurements

Size group mm		60—69	70—79	80—89
Number of fish		2	4	8
In % long. totalis	long. capitis	25.0	25.5	26.0
	long. pedunc. caudae	14.5	14.4	13.6
	long. pinnae ventralis	16.5	16.5	17.2
In % long. capitis	latitudo oris	58.0	59.8	64.1
	long. maxillae	39.5	40.8	41.4
In % long. ped. caudae	altitudo ped. caudae	42.0	44.3	48.0
	min. alt. corporis	32.0	36.8	38.4
In % long. V.	long. IV. radii pinnae V.	79.5	83.3	79.1

Neither is the rule as the lateral line in the sculpins generally valid for the Silesian material. In some specimens of *Cottus poecilopus* from the Morávka the lateral line was interrupted (in 4.2 p.c. of all *C. poecilopus*), in 1 *Cottus gobio* the lateral line was twice interrupted in the area of the distal edge of the back fin. A similar phenomenon was observed in *Cottus gobio* by Nybelin

Tab. 4. *Cottus poecilopus*, proportional measurements of juvenile specimens

Size group in mm		40—49	50—59	60—69
Number of fish		5	24	33
In % long. totalis	long. capitis	23.4	23.1	23.5
	long. pedunc. caudae	14.6	15.4	14.5
	long. pinnae ventralis	16.0	17.3	17.5
In % long. capitis	latitudo oris	56.6	56.2	57.4
	longitudo maxillae	38.6	40.3	40.3
In % long. ped. caudae	alt. pedunculi caudae	52.0	54.0	59.3
	min. altit. corporis	40.2	46.3	45.9
In % long. V.	long. IV. radii V	41.4	44.3	40.6

(1958 — cit. Müller, 1960) in the Swedish individuals, Müller (1960) in specimens from the tributaries of the Fulda, and finally Koli (1958) in this species in Sweden and Finland.

The mentioned findings are presumably evidences of the hybridization of the two sculpins species in the area where they occur together. Similar cases are quite frequent in fishes (cf.e.g. B a l o n, 1966 in the perch and the pike-perch).

Tab. 5. *Cottus poecilopus*, ♂♂, proportional measurements

Size group in mm		70-79	80-89	90-99	over 100
Number of fish		30	59	29	5
In % long. totalis	long. capitis	24.3	24.2	24.2	24.4
	long. ped. caudae	13.5	13.5	13.6	13.4
	long. pinnae ventr.	18.2	20.6	19.4	20.8
In % long. capitis	latitudo oris	63.1	68.6	68.5	72.2
	long. maxillae	41.8	46.6	46.7	49.0
In % long. ped. caudae	alt. ped. caudae	63.2	62.7	64.1	66.0
	min. alt. corporis	51.7	53.4	55.5	52.6
In % long. V.	long. 4. radii V	36.7	35.9	36.8	31.8

3. Measurements of proportions

Results of the proportion measurements of both sculpins are summed up in Tables 3-6. Some proportions, for instance the values of long. pinnae ventralis, latitudo oris, long. maxillae, lat. pedunc. caudae and min. alt. corporis grow evidently higher in relation to the greater body length. The weight: length ratio curve in the two species is parabolic.

Tab. 6. *Cottus poecilopus*, ♀♀, proportional measurements

Size group in mm		70-79	80-89	90-99	over 100
Number of fish		55	34	20	5
In % long. totalis	long. capitis	23.4	23.2	23.2	22.2
	long. ped. caudae	13.9	14.0	13.8	13.0
	long. pinnae ventr.	17.1	17.5	16.9	16.9
In % long. capit.	latitudo oris	58.9	61.4	61.9	65.4
	longit. maxillae	43.7	41.8	47.4	43.4
In % long. ped. caudae	alt. ped. caudae	60.8	60.9	62.0	60.8
	min. alt. corporis	49.9	50.9	52.5	51.8
In % long. V.	long. 4. radii V.	39.0	38.2	35.5	35.2

Tab. 7. Proportional measurements of *Cottus gobio* according to the different authors

Author		Oliva 1950	Balon 1952	Dyk 1952	Čihař own results
Number of fish		20	3	5	14
In % long. totalis	long. capitis	26.1	25.0	20.8	25.7
	long. ped. caudae	15.7	14.3	—	13.9
	long. pinæ ventr.	17.2	17.0	—	16.8
In % long. capitis	latitudo oris	58.3	—	—	61.9
	long. maxillae	—	—	—	40.9
In % l. ped. caud.	alt. ped. caud.	52.7	46.3	—	46.0
	min. alt. corp.	43.7	37.6	—	37.0

From Tabs 7 and 8 it may be seen that there are no marked differences in the measurement results in the sculpins from Silesia and the results obtained by the previous authors. Relatively greater differences appear only in some of the proportions (long. pinæ ventralis, alt. pedunc. caudae, min. alt. corporis), which are reported by Balon (1952) in his paper. The comparison of the results in measuring *Cottus gobio* from Silesia which those obtained by Skořepa (1967) could not, however, be made since he did not count the proportions (for their comparison with the results of the foreign authors) in relation to the total length of the fish, but to its standard length.

Tab.8. Proportional measurements of *Cottus poecilopus* according to the different authors

Author		Oliva 1950	Zelinka 1951	Balon 1953	Dyk 1952	Čihař own results
Number of specimens		9	20	14	7	312
In % long. totalis	long. capitis	24.0	—	24.8	23.0	23.6
	l. ped. caudae	15.3	—	12.3	—	13.9
	l. pinæ ventr.	17.5	—	20.3	—	17.8
In % long. capit.	latitudo oris	55.1	—	—	—	62.8
	long. maxillae	43.3	40.9	—	—	43.8
In % long. ped. c.	alt. ped. caudae	59.9	60.6	74.5	—	60.9
	min. alt. corpor.	49.1	48.6	62.1	—	50.9

4. Sexual dimorphism

Vladykov (1931) pointed out that the size of the head and the length of the ventral fins is in the average greater in the males of the two sculpins

species than in the females. Oliva (1956) measured twenty *Cottus gobio* individuals and found no marked difference in the length of the head in the two sexes (see Tab. 9). He reported, however, that the width of the head, and particularly that of the mouth, is greater in males than in females.

Tab. 9. Sexual dimorphism in *Cottus gobio*

Sex	Author	Number of fish	Lat. oris in % long. capitis	Long. V in % long. totalis	Long. capit. in % l. totalis
♂♂	Oliva, 1956	10	65.0	16.7	26.4
	Čihař o. r.	7	64.7	17.0	26.1
♀♀	Oliva, 1956	10	51.7	17.8	25.9
	Čihař o. r.	7	59.3	16.9	25.3

The results of measuring both the sculpins species from the Morávka and the Mohelnice brought forth evidence for Vladýkov's (1931) and Oliva's (1950) observations. The relatively large differences between Oliva's (1950) and the present author's results may have been caused by the rather limited quantity of the studied material of *Cottus gobio*.

The mouth width is, therefore, the most significant character which differentiates the two sexes of the two sculpins species in Czechoslovakia (Tabs 9 and 10). Smaller differences were found in the length of the head and the ventral fins.

Tab. 10. Sexual dimorphism in *Cottus poecilopus* (122 ♂♂, 114 ♀♀) of the rivers Morávka and Mohelnice

Sex	Latitudo oris in % longit. capitis	Long. pinæ ventralis in % long. totalis	Long. capitis in % long. totalis
♂♂	56.2	20.1	24.2
♀♀	50.9	17.1	23.2

SUMMARY

1. *Cottus poecilopus* Heckel, 1836 lives in the river reaches at higher altitudes than those inhabited by *Cottus gobio* Linnaeus, 1758; the former has higher oxygen requirements than the latter (Tab. 1, Fig. 1).

2. The characters reported by the classical authors as those differentiating the two species of the sculpins exceed the stated limits described by them. That is an evident consequence of hybridization between these two species of the Czechoslovak sculpins in the areas, where they occur in association (Tab. 2).

3. Some proportions, as e.g. long. pinæ ventralis, latitudo oris, long. maxillae, a.s.o., become relatively greater with the growing length of the body (Tabs 3-8).

4. The most important character according to which the sexes of the Czechoslovak sculpins differ from each other is the width of the mouth (latitudo oris), lesser differences were observed in the length of the head and ventral fins. (Tabs 9 and 10), which is in agreement with the data reported by Vladykov (1931) and Oliva (1956).

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THE OCCURRENCE OF TREMATODES OF THE GENUS
LUTZTREMA TRAVASSOS 1941, (TREMATODA: DICROCOELIIDAE)
IN THE BLACKBIRD (*TURDUS MERULA* L.) IN CZECHOSLOVAKIA

JINDŘICH GROSCHAFT

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Abstract: The first finding of the species *Lutztrema monenteron* (Price et McIntosh, 1935) in Europe is recorded with a redescription of the species *Lutztrema skrjabini* Ryšavý, 1955. A comparison was made between these two species and other morphologically similar species of the genus *Lutztrema*, parasitic in birds of the family *Turdidae*.

Ryšavý (1955) described the species *Lutztrema skrjabini* Ryšavý, 1955 from blackbirds (*Turdus merula* L.) obtained from localities in Central Bohemia. In reevaluating this collection and in studies of new material from the same area we found in blackbirds in addition to the species described by Ryšavý also the species *Lutztrema monenteron* (Price et McIntosh, 1935) Travassos, 1941. For a comparison of both species we are giving their description with a redescription of the species *Lutztrema skrjabini* Ryšavý, 1955.

Family: *Dicrocoeliidae* Odhner, 1911

Genus: *Lutztrema* Travassos, 1941

1. *Lutztrema monenteron* (Price et McIntosh, 1935) Travassos, 1941
(Fig. 1)

Host: *Turdus merula* L.

Location: bile ducts

Locality: Central Bohemia (Prague)

Description: Elongated trematodes, both ends attenuated, overall size 3.22—4.41 by 0.403—0.455 mm. Oral sucker subterminal, size 0.139 to 0.159 by 0.134 to 0.159 mm. Pharynx, partly covered by the sucker, size 0.057—0.075 by 0.067—0.075 mm. Intestinal tube followed by the esophagus that passes into a simple, not bifurcating intestine, extending in curves along the upward running uterine branches and ending close to the posterior margin of the vitellaria, often with an extended termination. Ventral sucker at a distance of 0.487—0.700 mm from the anterior margin of the oral sucker, measuring 0.252—0.328 by 0.252—0.302 mm. Ratio of suckers 1 : 1.75 to 1 : 2.22 to the advantage of the ventral sucker. Cirrus pouch situated above the ventral sucker, size 0.159—0.210 by 0.066—0.117 mm. Genital pore opening at half the distance between both suckers. The relatively spherical

testes measure 0.243–0.302 by 0.226–0.352 mm and are situated below the ventral sucker tandem on the longitudinal axis of the body. Spherical ovary distinctly smaller than testes, size 0.109–0.168 by 0.142–0.180 mm. Vitellaria placed at both sides of the body close below the ovary, length 0.352 to 0.546 mm, joined at their anterior portion. Posterior portion of the body occupied by the uterus, its upwards running branch passing the ovary, testes, ventral sucker. The genital pore opens at the anterior portion of the cirrus pouch at about half the distance between both suckers. The eggs measure 0.034–0.038 by 0.019–0.022 mm.

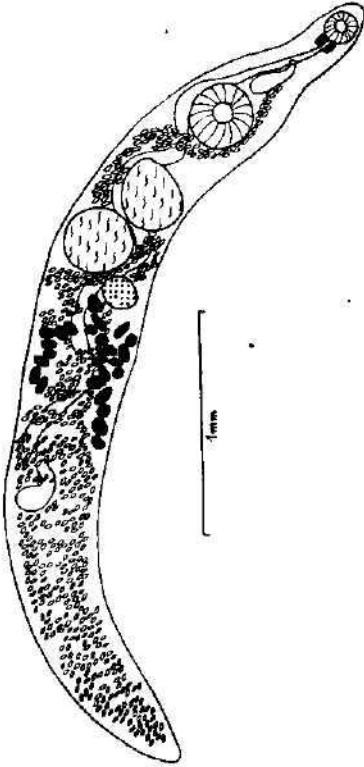


Fig. 1. *Lutztrema monenteron* (Price et McIntosh, 1935)

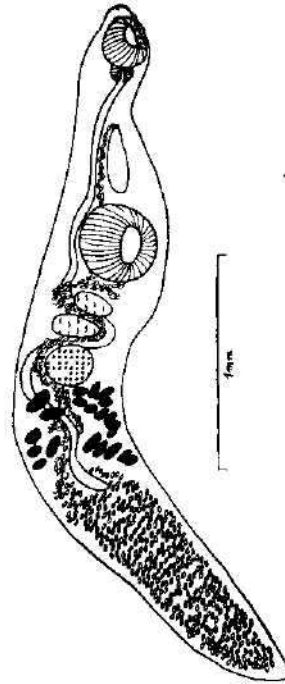


Fig. 2. *Lutztrema skrjabini* Ryšavý, 1955

2. *Lutztrema skrjabini* Ryšavý, 1955 (Fig. 2)

Host: *Turdus merula* L.

Location: bile ducts

Locality: Central Bohemia

Redescription: Elongate trematodes of conical shape attenuated at both ends. Overall length 3.220–4.800 mm width 0.487–0.596 mm. Subterminal oral sucker 0.210–0.220 by 0.184–0.218 mm. Thick pharynx situated close below the sucker, size 0.058–0.075 by 0.084–0.100 mm, is followed by a narrow esophagus passing into the intestine. This is not bifurcated and

Tab. 1. Comparison of the measurements of morphologically related species of the genus *Lutztrema* Travassos, 1941

Species	<i>Lutztrema monenteron</i>		<i>Lutztrema bhattacharyai</i>		<i>Lutztrema skrjabini</i>	
	Price et McIntosh	our material	Pande, 1939	Ryśavý, 1955 redescription		
Body length	1.900-5.200	3.220-4.410	3.8	3.220-4.800		
Body width	0.630-0.670	0.400-0.450	0.300-0.340	0.480-0.590		
Oral sucker	0.120-0.170 x	0.139-0.159 x	0.120 x 0.140	0.210-0.220 x		
Ventral sucker	0.123-0.150 0.170-0.320 x	0.134-0.159 0.252-0.328 x	0.270 x 0.250	0.184-0.218 0.332-0.336 x		
Pharynx	0.200-0.320 0.042-0.065 x	0.252-0.302 0.057-0.075 x	0.050 x 0.070	0.319-0.378 0.058-0.075 x		
Cirrus pouch	0.050-0.070 0.160-0.320 x	0.067-0.075 0.159-0.210 x	0.100 x 0.060	0.084-0.100 0.243-0.285 x		
Testis I. (anterior)	0.065-0.100 0.140-0.260 x	0.066-0.117 0.243-0.302 x	0.230 x 0.250	0.092-0.109 0.084-0.126 x		
Testis II. (posterior)	0.250-0.460 0.140-0.260 x	0.226-0.352 0.243-0.294 x	0.250 x 0.270	0.176-0.235 0.092-0.143 x		
Ovary	0.250-0.460 0.090-0.125 x	0.260-0.303 0.109-0.168 x	0.160-0.200	0.168-0.260 0.185-0.201 x		
Ova	0.100-0.220 0.032 x 0.016	0.142-0.180 0.034-0.088 x	0.021 x 0.015	0.193-0.201 0.034-0.036 x		
Vitellaria	—	0.019-0.022		0.021-0.023		
Ratio of suckers	1:1.4-1:1.88	0.352-0.546 1:1.75-1:2.22	0.5	0.445-0.722 1:1.63-1:1.71		
Distance between suckers		0.487-0.700	0.55	0.798-1.010		
Ratio of distance between suckers	1:2.3-1:4.0	1:3.33-1:4.40	1:4.3	1:2.7-1:2.8		

terminates in one half of the body length close below the vitellaria. The pear-shaped genital pouch placed in the first fifth of the body length above the ventral sucker, the genital pore opens in half the distance between the suckers. Large spherical ventral sucker situated on the border between the first and second third of body length, size 0.332—0.336 by 0.319—0.378 mm. Testes juxtaposed in the direction of the longitudinal axis of the body, shape triangular. Anterior testis 0.087—0.126 by 0.176—0.235 mm, posterior testis 0.092—0.143 by 0.168—0.260 mm. Spherical ovary always larger than testes, size 0.185—0.201 by 0.193—0.201 mm, situated laterally of the longitudinal axis on the side opposed to the posterior testis. Posterior half of body completely occupied by the uterus. Eggs measure 0.034—0.036 by 0.021 to 0.023 mm.

DISCUSSION

Trematodes of the genus *Lutztrema* found in blackbirds in Czechoslovakia, with the exception of the specimens designated *L. skrjabini* — resemble greatly in the structure of their body the species *L. monenteron* (Price et McIntosh, 1935) and *L. bhattacharyai* (Pande, 1939). The only differences were found in the eggs in comparison with the species *L. bhattacharyai*. From the species *L. obliquum* (Travassos, 1917) and also from the species *L. struni* Skrjabin et Evranova, 1953 they differ in the length of the intestine, which extends in the mentioned species to the end of the body. *L. skrjabini* Ryšavý, 1955 differs from both mentioned species in the ratio of their suckers (1 : 1.70 and less), a relatively large oral sucker and also in the ovary being larger than the testes. Contrary to the species *L. obliquum* and *L. struni* its shorter intestine finishes at the border between the second and third third of the body.

We also considered the geographical distribution of the species *L. monenteron* and assume that for the relatively expansive geographical distribution of birds of the family Turdidae (holarctic and neotropical region) and the far reaching migration of some representatives of this family, they may have several helminth species in common.

In view of these differences we have listed the trematodes (Fig. 1) found in *T. merula* L. in Czechoslovakia to the species *Lutztrema monenteron* (Price et McIntosh, 1935) and consider the species *Lutztrema skrjabini* Ryšavý, 1955 (Fig. 2), found in the same host to be a fully valid species.

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**SOME NEW SPECIES OF THE FAMILY ZERCONIDAE
FROM NORTH AMERICA
(ACARI: MESOSTIGMATA)**

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Abstract: New species of the mites of the family Zerconidae, namely *Z. farrieri*, *Z. insolitus*, *Z. comatus*, *Z. carolinensis* and a new genus *Amerozeron* with its typical species are described from soil samples of three forest types from North and South Carolina.

Thanks to the kindness of my colleague Maurice H. Farrier, Department of Entomology, North Carolina State University, Raleigh, I received the slides containing the mites of the family Zerconidae collected from the forest soils of North and South Carolina. This material contained the representatives of four species of the genus *Zercon* and one species which I designate the type of a new genus.

Our knowledge about the mites of the family Zerconidae from the North American Continent is very incomplete. Only the species *Prozercon californicus* Sellnick, 1957, *P. precipuus* Sellnick, 1957, *Zercon columbianus* Berlese, 1910, *Z. alaskaensis* Sellnick, 1958, *Z. minimus* Sellnick, 1958, *Z. fenestralis* Evans, 1955, *Z. americanus* Sellnick, 1958 and *Z. radiatus* Berlese, 1910, probably *Parazercon sarekensis* Willmann, 1939, have been found previously.

I express my thanks to Maurice H. Farrier for permitting me to study the specimens. I am obliged to Dr. Miroslav Kunst for some hints and advice.

Zercon farrieri sp. n. (Figs 1 A—C)

Diagnosis: The ventrianal shield with two pairs of setae on the anterior edge. Depressions are conspicuous, well sclerotized, being the same size, with axes parallel to the axis of the body. The pores Po_2 are situated anteromedially from the insertions of the setae Z_3 , the pores Po_3 anteromedially from the insertions of the setae Z_4 . The setae J_5 and Z_2 are absent. The margin seta R_1 is longer and feathered unlike the other members of the R-row. The insertions of the setae J_6 and Z_5 are strikingly close to each other.

Dimensions ♀: 398 μ m \times 276 μ m
♂: 275 μ m \times 212 μ m

Description of the female: The sculpture of the podonotum is tile-like on the sides, reticulated in the central part. The setae i_5 , z_2 , s_1 , s_2 ,

s_5 , r_1 and r_2 are smooth, thorn-like, the other setae are more or less feathered. The setae r_3 ($38\ \mu\text{m}$) and r_4-r_6 ($30\ \mu\text{m}$) are long and feathered. The podonotal pores are situated on the usual places (po_1 posterior to the insertion of the seta s_1 , po_2 posterior to a line connecting the insertions of the setae i_4-s_4 , po_3 above the insertion z_1-s_5).

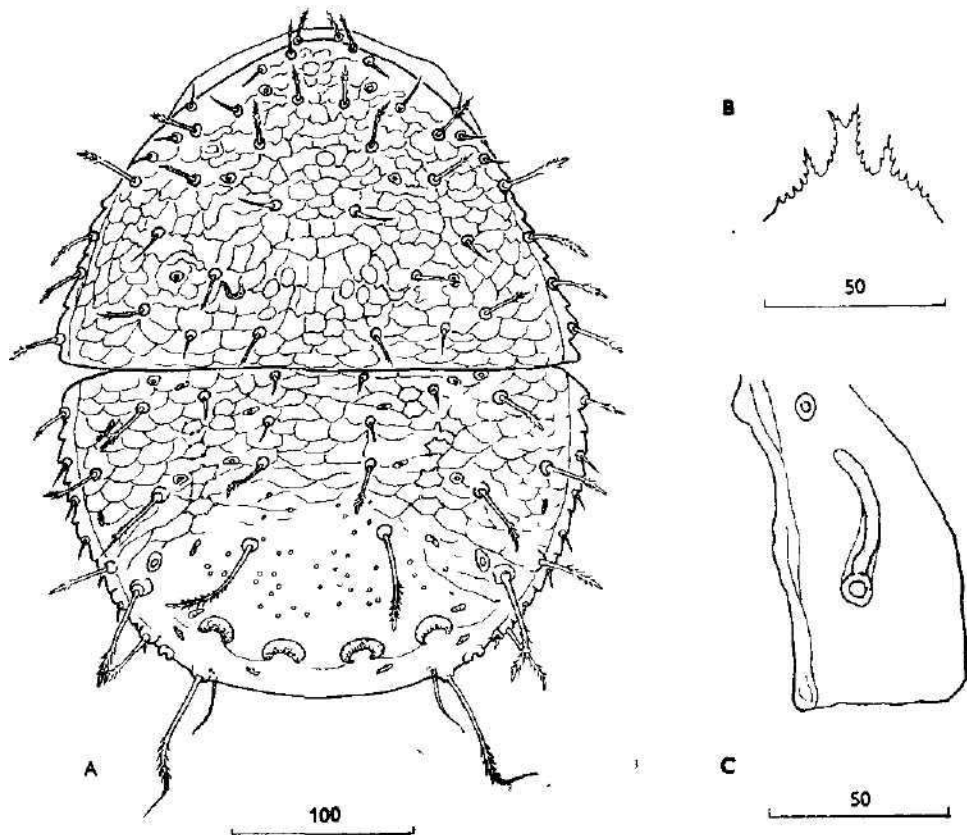


Fig. 1. *Zercon farreri* sp. n. ♀ A — dorsal side, B — tectum, C — peritreme

The tilelike sculpture of the front part of the opisthonotum gives way posteriorly sparse pits. The setae J_1-J_2 and Z_1 are short ($13\ \mu\text{m}$); J_1 and J_2 smooth, Z_1 weakly barbed. The seta Z_5 is smooth, all other setae, except the border ones, are feathered. The setae J_5 and Z_2 are absent. The margin setae R_1 are the longest of the row ($27\ \mu\text{m}$) and feathered, the setae R_2-R_7 are short, thorn-like and smooth. The distance between $J_6-J'_6$ is $132\ \mu\text{m}$. The insertions of the setae J_6 and Z_5 are strikingly close to each other.

Lengths of the setae on the opisthonotum of the female (in μm)

J_1	13	Z_1	13	S_1	32
J_2	13	Z_3	40	S_2	40
J_3	32	Z_4	54	S_3	40
J_4	54	Z_5	32	S_4	40
J_5	100				

The pores Po_1 are situated anteromedially to the insertions of the setae $S_1 - S'_1$, the pores Po_2 anteromedially to the insertions of the setae $Z_3 - Z'_3$, the pores Po_3 anteromedially to the insertions of the setae $Z_4 - Z'_4$, and in close proximity to them, Po_4 are situated on the line connecting the insertions of the setae $S_4 - J_6$.

In addition to the pores there are several pairs of smaller lentil-shaped structures, the fissures. I designate them Fd (dorsal), Fm (medial), Fl (lateral) according to their location.

The fissure Fd_1 is lateral to the line connecting the insertions of the setae $J_1 - J_2$, the fissure Fd_2 lies lateral to the insertions of the seta J_3 ; the fissure Fm_1 is situated anterolaterad of the insertion of the seta Z_1 , Fm_2 on a line connecting the insertions of the setae $J_4 - Z_4$, Fm_3 anterolaterad of the outside depressions; Fl_1 anterior to a line connecting the insertions of the setae $S_1 - S_2$, Fl_2 on a line connecting $S_2 - S_3$, Fl_3 on a line connecting $Z_4 - J_6$, Fl_4 posterior to inside depressions.

The depressions are conspicuous, well sclerotized, all of the same size, with axes parallel to the body axis.

The marginal teeth of the podonotum as well as of the opisthonotum are short and not sharp.

The peritremata (Fig. 1C) are only slightly bent.

The middle prominence of the tectum is double pointed (Fig. 1B).

Systematic position: The new species belongs to the group of species with two pairs of setae on the anterior edge of the ventrianale and with a smaller number of the setae on the opisthonotum. The row J has only five members, the row Z only four members like Sellnick's species *Zercon alaskaensis*. The difference lies in the number of the pairs of the setae on the anterior edge of the ventrianale (*Z. farrieri* has two pairs, *Z. alaskaensis* only one pair), as well as in the lengths and the feathering of the setae on the podonotum and the opisthonotum.

Distribution: U.S.A. — South Carolina.

Type locality: Burned-over pine litter and soil, Santee Experimental Forest, Berkeley Co., S. C., 25 May 1966 — 1 ♀, 1 ♂.

The species is named after Maurice H. Farrier who kindly provided me with the material.

Holotype has been deposited in U.S. National Museum, Washington

Paratype has been deposited in the collection of the author.

Zercon insolitus sp. n. (Figs 2A—C)

Diagnosis: The ventrianal shield with two pairs of the setae on the anterior edge. The depressions are conspicuous, well sclerotized, large, with axes converging posteriorly. The pores Po_2 are situated mediad of a line connecting the insertions of the setae $Z_1 - Z_3$, Po_3 within the line connecting $Z_3 - Z_4$. On the opisthonotum the setae J_2 and Z_2 are absent. The insertions of the setae J_6 and Z_5 are strikingly close to each other.

Dimensions ♀: length 350—360 μ m, width 265—275 μ m.
♂: length 281—296 μ m, width 212 μ m.

Holotype ♀: 350 μ m \times 265 μ m.

Description of the female: The texture of the podonotum is reticulated in the middle, tile-shaped on the sides. The setae of the podonotum are mostly long, smooth, but the setae i_1 , i_2 and the setae of the r-row

are long, strongly roughened. The setae i_1 and s_1 reach the length of $19\ \mu\text{m}$; the length of other setae is from $24-40\ \mu\text{m}$. The pores are located in the usual places.

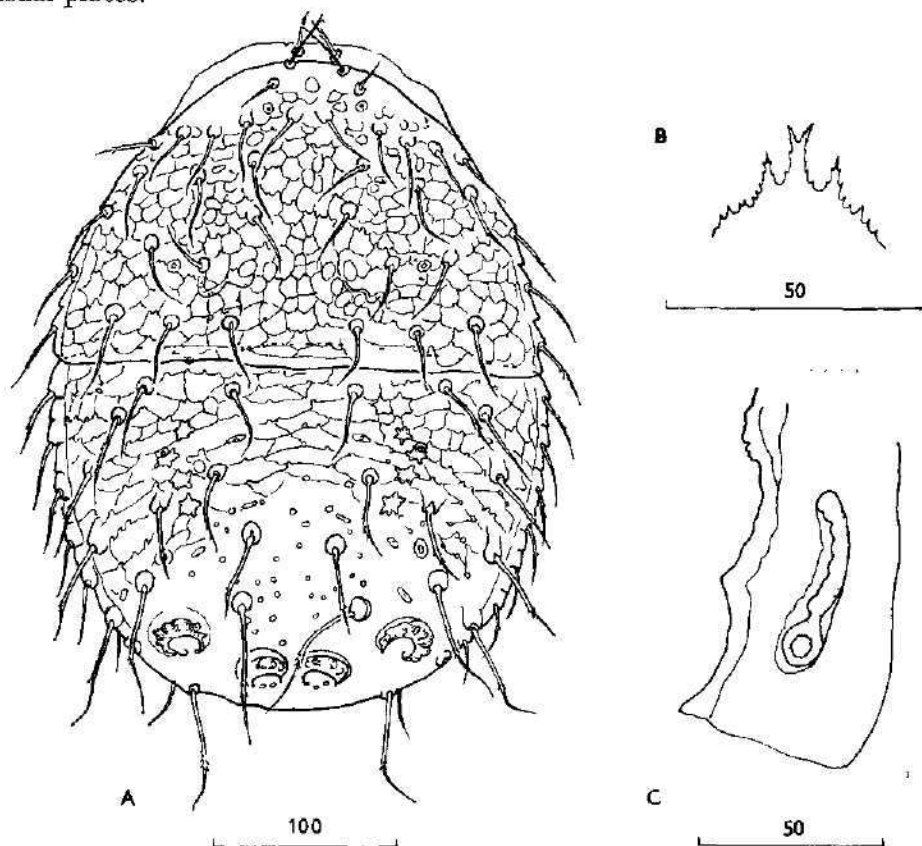


Fig. 2. *Zercon insolitus* sp. n. ♀ A -- dorsal side, B -- tectum, C -- peritreme

The opisthonorium has a reticulated sculpture anteriorly, posteriorly it is sparsely pitted. The setae of the opisthonorium are long, distinctly barbed, especially in the middle part. The marginal setae are $30-32\ \mu\text{m}$ long excepting R_1 ($35\ \mu\text{m}$) and R_7 ($27\ \mu\text{m}$). The distance between $J_6-J'_6$ is $108\ \mu\text{m}$. The insertions of the setae J_6 and Z_5 are strikingly close to each other. Lengths of the setae on the opisthonorium of the female are (in μm):

J_1	40	Z_1	43	S_1	46
J_3	40	Z_3	46	S_2	46
J_4	45	Z_4	62	S_3	46
J_5	65	Z_5	32	S_4	62
J_6	65				

The pores Po_1 are located anteromedially to the insertions of the setae Z_1 ; the hardly conspicuous pores Po_2 are on the median side of a line connecting the insertions of the setae Z_1-Z_3 , the pores Po_3 are on the median side of a line connecting Z_3-Z_4 , the pores Po_4 on a line connecting S_4-J_6 .

The fissure Fd_1 lies on a line connecting the insertions of the setae J_1-J_3 , Fd_2 on a line connecting J_3-J_4 ; Fm_2 on a line connecting J_4-Z_4 , Fm_3 anterior to the outside depressions; the fissure Fm_1 and the fissures of the margin row are not conspicuous.

The depressions are easily seen, all of the same size, with oblique axes convergent posteriorly. The marginal teeth of the podonotum as well as the opistonotum are short, not sharp.

The peritremata (Fig. 2C) are slightly bent.

The tectum has a middle prominence with two points (Fig. 2B).

Systematic position: Its overall appearance and especially the strikingly large depressions with the oblique axes places *Zercon insolitus* in the group of forms comprised of *Zercon athiasi*, *Z. encarpatus*, *Z. klinge* and *Z. balearicus*. The two last species have only one pair of the setae on the anterior margin of the ventrianal shield. All species in this group have the complete number of the setae on the opistonotum.

Distribution: U.S.A. — North Carolina.

Type locality: Hardwood litter, Umstead Park, Wake Co., N.C., 12 May 1965 — 3 ♀♀, 3 ♂♂.

Hardwood litter, Natural area, Orange Co., N.C., 8 Dec. 1965 — 1 ♀.

Hardwood litter, Duke Forest, Durham Co., N.C., 22 Dec. 1965 — 1 ♀.

Holotype in U.S. National Museum, Washington

Paratypes: 4 ♀♀ and 3 ♂♂ in the collection of the author.

Zercon comatus sp. n. (Figs 3A—C)

Diagnosis: The ventrianal shield with two pairs of setae on the anterior margin. The depressions are conspicuous, well sclerotized, the lateral ones a little larger than the interior ones, with the axes parallel to the body axis. The pores PO_2 are situated posterior to a line connecting the insertions of the setae Z_2-S_2 , the pores PO_3 are shifted forward and are situated mediad of a line connecting the insertion of the setae Z_2-Z_3 and on a line connecting pores PO_2 .

The setae of the podonotum, as well as of the opistonotum are long and smooth.

Dimensions ♀: 530 μ m \times 435 μ m.

Description of the female: The podonotum is smooth, with a fine reticular sculpture only in the back corners. The setae of the podonotum are smooth or finely pilose, relatively long. The seta s_1 is absent. The seta i_5 has a hyaline sheath at the end.

Lengths of the setae on the podonotum of the female (in μ m):

i_1	46	z_1	54	s_2	40
i_2-i_5	48	z_2	59	s_3	49
i_6	51			s_4	70
				s_5	64
				s_6	89

All setae of the r-row are weakly barbed and increasing in length posteriorly ($r_1 = 43 \mu$ m, $r_4 = 57 \mu$ m, $r_6 = 73 \mu$ m).

The pores po_1 are situated on a line connecting the insertion of setae i_1-s_2 , the pores po_2 on a line connecting i_4-s_4 , the pores po_3 on a line connecting z_1-s_5 .

The opistonotum has, in the middle of the front part, a reticular sculpture, a tilelike sculpture on the sides which gives way to triangular pits in the

posterior direction. All setae of the opisthonotum are smooth, but some marginal setae are weakly barbed. The distance between $J_6-J'_6$ is 116 μm .

Lengths of the setae on the opisthonotum of the female (in μm):

J_1	49	Z_1	67	S_1	92
J_2	54	Z_2	73	S_2	116
J_3	73	Z_3	102	S_3	129
J_4	81	Z_4	127	S_4	135
J_5	87				
J_6	135				

The marginal setae R_1-R_3 are 62 μm , R_4-R_5 67 μm , R_6 73 μm and R_7 76 μm . The pores Po_1 are situated anteromedially above the insertion of the seta Z_1 , Po_2 posterior to a line connecting Z_2-S_2 , Po_3 posterior to a line connecting J_2-Z_2 and the pore Po_4 on the line connecting Z_5-R_7 .

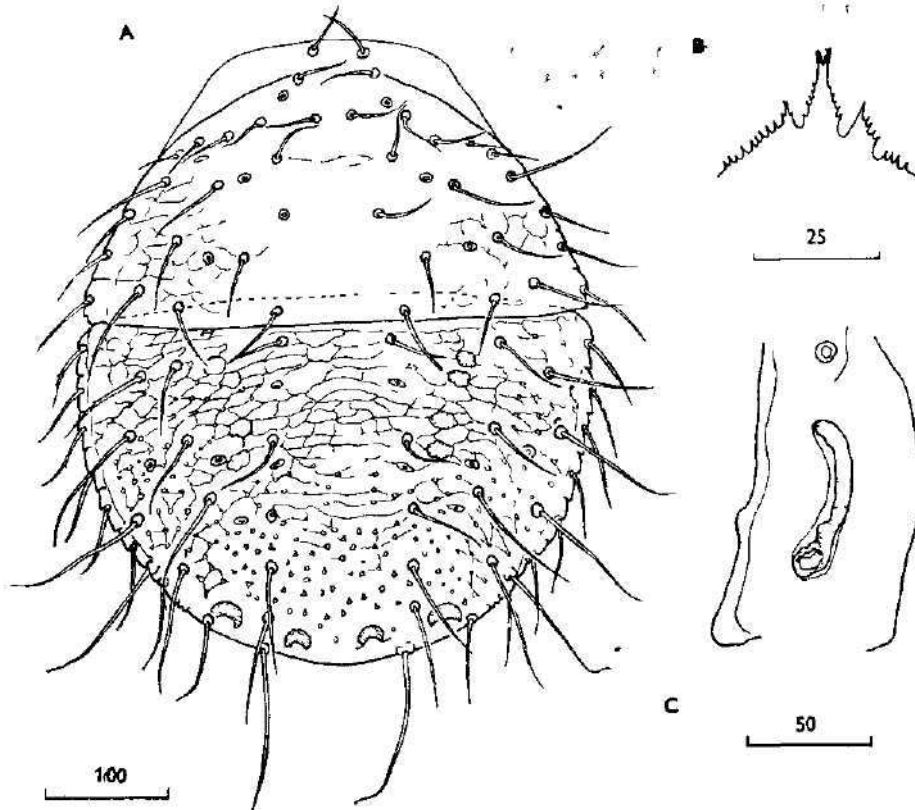


Fig. 3. *Zercon comatus* sp. n. ♀ A - dorsal side, B - tectum, C - peritreme

The fissure Fd_1 lies on a line connecting J_1-J_2 , Fd_2 on a line connecting J_2-J_3 ; Fm_2 posterior to a line connecting J_3-Z_3 ; other fissures are not conspicuous.

The depressions are conspicuous, well sclerotized, the lateral depressions are a little larger than the interior ones; their axes are parallel to the body

axis. The marginal teeth of the podonotum as well as of the opisthonotum are short and not sharp.

The peritremata (Fig. 3C) are slightly bent. The middle prominence of the tectum (Fig. 3B) is double pointed.

Systematic position: The new species belongs to the group of the species with two pairs of setae on the anterior edge of the ventrianal shield. It differs from others in that group with regard to the different dimensions of the lateral and interior depressions, to the striking length of the setae and the unusual position of the pores po_3 .

As to its appearance *Zercon comatus* is very similar to the species *Z. capitatus* Berlese which was described from North Italy. It differs from it by a greater size (530 μ m : 460 μ m) and by different size, situation and shape of the depressions and finally by the sculpture of the podonotum as well as of the opisthonotum. Considering the distance between the two localities and the differences mentioned, I am describing the form from North America as a new species. Comparison with the type specimen deposited in Firenze will reveal the degree of the affinity of both forms.

Distribution: U.S.A. — South Carolina.

Type locality: Loblolly pine litter, Santee Experimental Forest, Berkeley Co., S. C. 25 May 1966 — 1 ♀.

Holotype has been deposited in U.S. National Museum, Washington

Zercon carolinensis sp. n. (Figs 4A—D)

Diagnosis: The ventrianal shields with two pairs of setae on the anterior margin. The depressions are conspicuous, well sclerotized, all of the same size; their axes are parallel to the body axis. The pores po_2 are situated anteromedially of the insertions of setae S_2 , the pores po_3 are anterior to a line connecting the insertions J_5 — Z_4 . The marginal podonotal setae are (with the exception of the first two members) long, feathered, the marginal setae of the opisthonotum are short, thorn-like, smooth. The seta Z_5 is feathered. The insertions of the setae J_6 and Z_5 are strikingly close to each other.

Dimensions ♀: length 318—339 μ m, width 265—291 μ m.

♂: 260 μ m \times 207 μ m.

Holotype ♀: 334 μ m \times 281 μ m.

Description of the female: The reticular sculpture of the middle part of the podonotum gives way laterally to a tile-like one and posteriorly to reticulated one with refracting points at the points of the connections. The setae of the podonotum are smooth except the setae i_1 , i_2 , s_3 and s_6 . The marginal setae r_1 and r_2 are smooth, the setae r_3 — r_6 are long, feathered, with hyaline sheaths on the end (Fig. 4B).

Lengths of the setae on the podonotum of the female (in μ m):

i_1	22	z_1	16	s_1 — s_2	13
i_2 — i_6	16	z_2	13	s_3	27
				s_4 — s_5	16
				s_6	19

The setae r_1 — r_2 are 13 μ m, r_3 32 μ m, r_4 — r_5 27 μ m and r_6 30 μ m. The pores po_1 lie posterior to the insertion of seta s_1 , po_2 on a line connecting i_4 — s_4 , po_3 posterior to a line connecting z_1 — s_5 .

The upper corners of the opisthonotum are characterized by a tile-like sculpture, whereas in the anterior medial area there is a reticulated sculpture with refracting dots at the connecting points. The rest of the opisthonotum is covered with pits of large size.

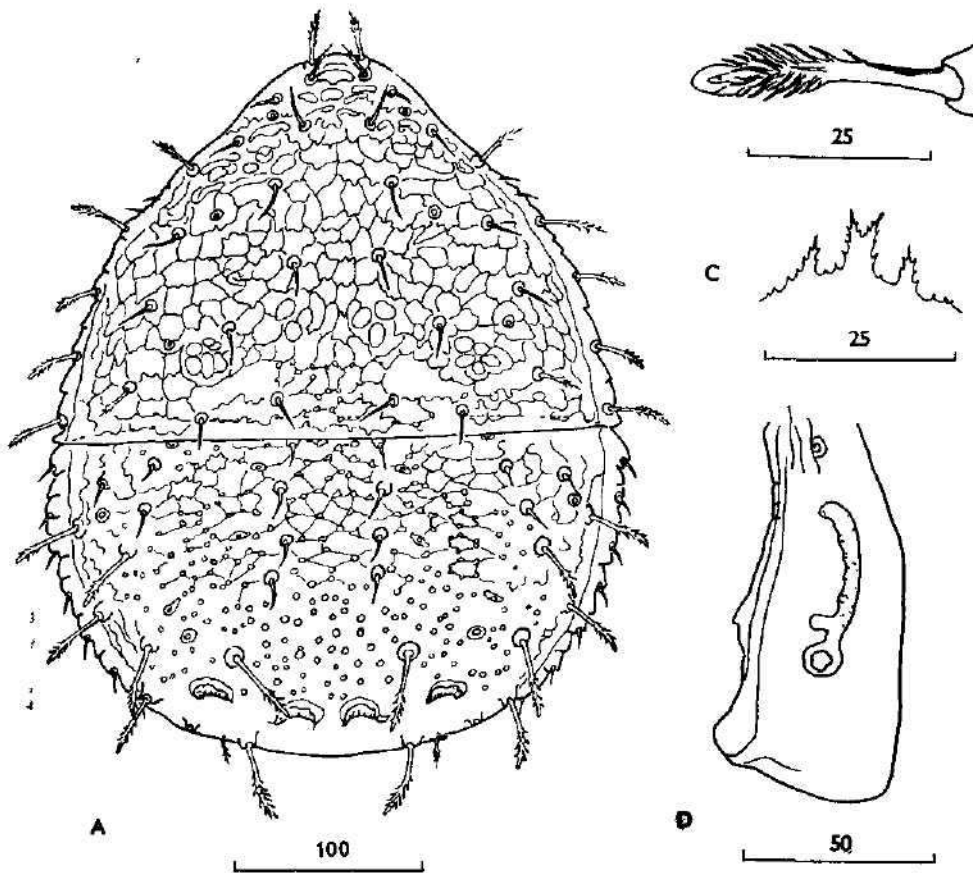


Fig. 4. *Zercon carolinensis* sp. n. ♀ A—dorsal side, B—marginal seta r_a , C—tectum, D—peritreme

The setae J_1 — J_4 , Z_1 — Z_2 , S_1 and all setae of the R-row are smooth, short, the other ones are longer and feathered, with hyaline sheaths on the extremity. The distance between the setae J_6 — J'_6 is $86\ \mu\text{m}$. The insertions of the setae J_6 and Z_5 are close to each other.

Lengths of the setae on the opisthonotum of the female (in μm):

J_1	13	S_1	13	Z_1	13
J_2	13	S_2	16	Z_2	32
J_3	13	S_3	32	Z_3	35
J_4	13	S_4	40	Z_4	35
J_5	46			Z_5	16
J_6	40				

All setae of the R-row are short, thorn-like ($8\ \mu\text{m}$), smooth. The pores Po_1 lie anteromedially to the insertions of setae Z_1 , Po_2 anteromedially to the

insertions of setae S_2 , the pores Po_3 anterior to a line connecting the insertions of the setae J_5-Z_4 , the pores Po_4 on a line connecting Z_5-S_4 .

The fissure Fd_1 is situated lateral to a line connecting J_1-J_2 , the fissure Fd_2 lateral of the insertions of setae J_3 , the fissure Fm_3 on a line connecting J_4-S_3 .

The depressions are conspicuous, all of the same size; the axes of the median ones are parallel to the body axis, the axes of the lateral depressions are slightly oblique.

The marginal teeth of the podonotum as well as of the opisthonotum are short, not sharp.

The peritremata are slightly bent, with a conspicuous prominence on the inner side anterior to the entrance to the respiratory aperture (Fig. 4D). The middle prominence of the tectum is short, broad, double-pointed (Fig. 4C).

Systematic position: The new form belongs to the group of the species of the genus *Zercon* which possesses two pairs of setae on the anterior margin of the ventrianale. It has, however, a special position owing to the strikingly different length and the feathering of the setae of the margin rows of the podonotum and opisthonotum. This kind of chaetotaxy is more frequent with some species of the genus *Prozercon*. The specimens from North Carolina strikingly resemble the species *Zercon columbianus* Berlese 1910 in general shape as well as in part of the setation (according to *Jacot*, 1937, *Z. columbianus* was found in the vicinity of Columbia, Missouri, USA). Berlese's short description states that *Z. columbianus* has seven pairs of feathered marginal setae. According to the figures these setae should be the podonotal setae s_3, r_3, r_4 and the opisthonotal setae S_2, S_3, S_4 and J_6 . In contrast to the specimens North Carolina it seems that the species *Z. columbianus* has short and unfeathered podonotal setae r_5 and r_6 and an opisthonotal seta Z_3 . These difference lead me to conclude that the individuals from North Carolina represent a new species in spite of a certain resemblance of both forms.

Distribution: U.S.A. — North Carolina

Type locality: Hardwood litter, Natural Area, Orange Co., N.C., 8 Dec. 1965 — 4 ♀♀, 1 ♂.

Hardwood litter, Natural Area, Orange Co., N.C., 29 Dec. 1965 — 1 ♀.

Holotype has been deposited in U.S. National Museum, Washington.

Paratypes: 4 ♀♀ and 1 ♂ in the collection of the author.

Amerozercon n. g.

Diagnosis: On the sides of the genital shield there are, instead of the adgenital sclerites slightly conspicuous pores of a considerable size. The peritrematal shield is cut up in a transverse direction behind the fourth pair of the coxae and is connected with the ventrianal shield on the sides. On the peritrematal shield there are two setae, the first one short, smooth — p_1 , the second one long, feathered — p_2 . The slit separating the peritrematal shield from the podonotum is absent. The large ventrianal pores are situated anterolaterally from the insertions of the adanal setae. The depressions are well sclerotized, clearly conspicuous. All the marginal setae are strongly feathered. The pores Po_3 are absent. The marginal teeth are short, not sharp.

Originally, in accordance to the number and the shape of the setae on the peritrematal shield (Fig. 5), I included this taxon in the genus *Zercon*. After

more detailed observation and comparison with the representatives of other genera the distinguishing characteristics were so exceptional that the animal cannot be included with certainty in any of the hitherto known genera without modifying their generic limits. For this reason I think the establishment of a new genus is the only appropriate solution to the problem.

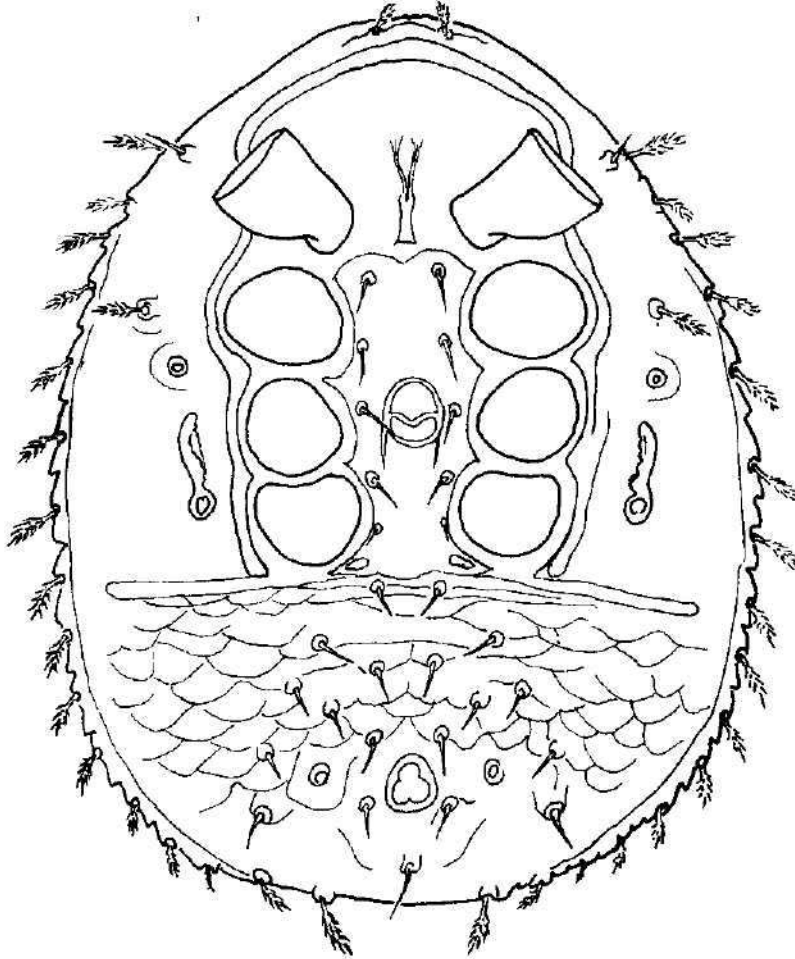


Fig. 5. *Amerozercon suspiciosus* sp. n. ♂ - ventral side.

The adgenital sclerites which are conspicuous on the species belonging to the genus *Zercon* and less conspicuous with the individuals belonging to the genus *Parazercon*, are substituted by pores situated (in the male) in the corners of the sternogenital shield, similar to the genus *Mixozzercon* where on both sides of the genital shield there are conspicuous pores of considerable size.

The slit between the peritrematal shield and the podonotum (which in the genus *Zercon* is rather broad and reaches up to the seta p_2) cannot be observed in any of the other genera, and is invisible also in the genus *Amerozercon*.

The peritrematal shield is terminated truncately posteriorly as in the genera *Zercon* and *Mixozercon*, but in contrast to these genera it is connected with the ventrianal shield laterally.

The number and the shape of the peritrematal setae are the same as in the genus *Mixozercon*. It differs from the genus *Prozercon* in the shape of the setae and from the genus *Zercon* in the location of both peritrematal setae. In *Amerozercon* seta p_1 is located at the same level as seta s_3 , seta p_2 approximately in the middle of the peritrematal shield at the level of seta r_3 , while in the genus *Zercon* the both setae are more anteriorly.

The large ventrianal pores are situated anterolaterally from the insertions of the adanal setae like the genera *Prozercon*, *Parazercon* and *Mixozercon*, but in the genus *Zercon* they lie posterolaterally.

The distance of the opisthonotal setae J_6-J_6' is short (only 46 μm) with the new genus as it is also in the genera *Parazercon*, *Prozercon* and *Mixozercon*. It is approximately twice as long in the genus *Zercon*.

All marginal setae are strongly feathered which is usual in the species *Parazercon sarekensis* Willmann, *Prozercon ornatus* Berlese and *Prozercon plumatus* Aoki.

The location of the pore po_3 on the podonotum is interesting; this pore lies lateral to a line connecting the insertions of the setae s_5-s_6 . Pore po_4 is located above the insertion of seta s_4 . This is the same location as in the species *Prozercon kochi* Sellnick and in other, as yet unpublished new species of the genus *Prozercon*.

Characters distinguishing the new genus

— from the genus *Parazercon*:

truncate termination of the peritrematal shield, number of the peritrematal setae, presence of the sclerotized depressions, full number of the opisthonotal setae

— from the genus *Mixozercon*:

connection of the peritrematal shield with the ventral one, one pair of the setae on the anterior margin of ventrianal shield, strongly feathered setae of the podonotum and of the opisthonotum

— from the genus *Prozercon*:

termination of the peritrematal shield in a transverse direction, feathered peritrematal seta p_2 .

Although there has been available only a male of this new taxon I assume that the morphological differences are of such an extent that the establishment of a new genus is justified.

Type species: *Amerozercon suspiciosus* sp. n.

Amerozercon suspiciosus sp. n. (Figs 5,6A—B)

Dimensions ♂: 519 μm \times 403 μm .

Description of the male: The podonotum has a striking tile-like sculpture. All setae of the podonotum are feathered with the exception of the setae s_1 and s_2 , which are smooth, and of the setae i_6 and z_1 , which are weakly barbed. The seta s_3 reaches a maximum length of 21 μm . The seta r_3 measures 19 μm ; the length of other setae varies between 11 and 16 μm .

The pores po_1 are situated on the line connecting the insertions of the setae i_1-i_3 , pores po_2 medially from the insertions of setae s_4 , pores po_3 lateral to a line connecting the insertions of the setae s_5-s_6 . Under the insertions of setae z_1 , there are small c-shaped sclerotized structures. All the setae of the row r are strongly feathered (Fig. 6B).

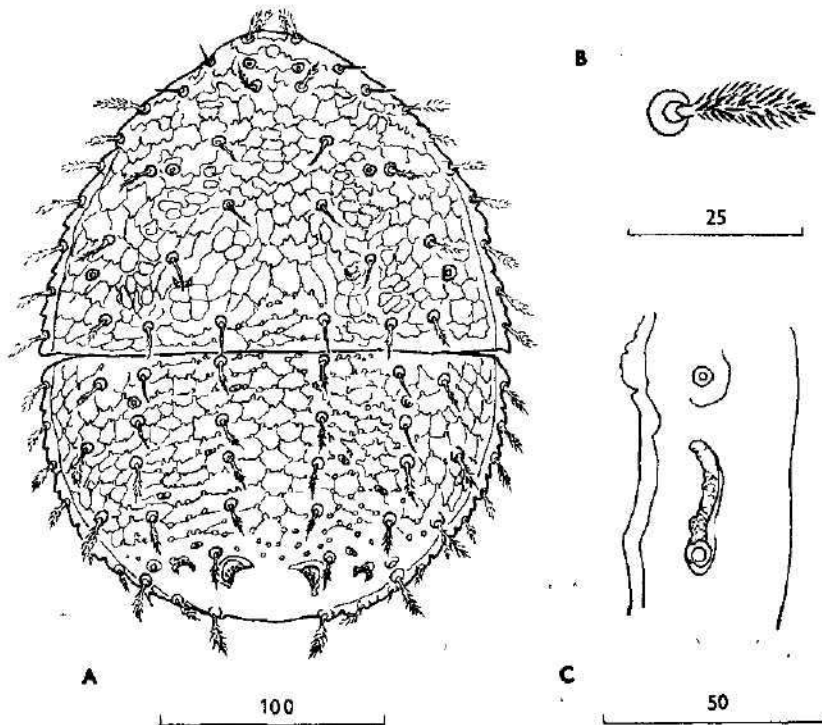


Fig. 6. *Amerozercon suspiciosus* sp. n. ♂ A — dorsal side, B — marginal seta of the podonotum

The tile-like sculpture of the podonotum is seen also on the anterior corners of the opisthonotum. The central area of the opisthonotum has characteristic netlike ornamentation with refracting dots at the connecting points. All setae of the opisthonotum are feathered, the setae Z_1 and Z_2 are weakly barbed.

The marginal setae are short (8–13 μm) and feathered (only the feathering of the last member of the row is indistinct). The distance between the setae $J_6-J'_6$ is 46 μm .

Lengths of the setae on the opisthonotum of the male (in μm):

J_1	13	Z_1	8	S_1	13
J_2	13	Z_2	11	S_2	16
J_3	13	Z_3	16	S_3	29
J_4	13	Z_4	18	S_4	19
J_5	16	Z_5	13		
J_6	19				

The pores po_2 are located laterad of a line connecting the insertions of the setae Z_1-Z_2 , the pores po_3 are probably absent, the pores po_4 lie above the

insertion of seta S_4 . As to the fissures, fissure Fd_1 is visible mediad of a line connecting the insertions of the setae J_1-J_2 , the fissure Fd_2 laterad of the insertions of J_3 , and the fissure Fm_3 anteromedially to the exterior depression.

The depressions are well sclerotized and of different size. The median ones are considerably larger than the lateral ones and the axes of all are oblique, converging posteriorly.

The marginal teeth of the podonotum as well as of the opisthonotum are short and not sharp. The peritremata (Fig. 6C) are slightly bent.

The peritrematal shield is terminated in a transverse direction and is joined laterally to the ventrianal shield.

Distribution: U.S.A. — South Carolina.

Type locality: Loblolly pine litter, Santee Experimental Forest, Berkeley Co., S.C. 25 May 1966 — 1 ♂.

Holotype in the collection U.S. National Museum, Washington.

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REDESCRIPTION OF DAPHNIA ZSCHOKKEI STINGELIN

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Abstract Based on specimens found in the Museum d'Histoire Naturelle de Geneve which cannot be opposed by a convincing evidence that they do not belong to the population from which T. Stingelin selected specimens for his description of *Daphnia zschokkei*, characters differentiating this population from most frequent populations of *D. longispina* O. F. Müller (smaller head, short spine, restricted spinulation) are described. The present material does not allow the decision whether the difference is due to genetical differences or due to differences in the habitat or in the life history induced by the habitat.

Stingelin described this species in 1894 and again (with figures) in 1895, based on specimens collected by Zschokke in two lakelets in Jardin du Valaie (oberhalb der Passhöhe von St. Bernhard) in the height of 2.610 m a.m.s.l. In the third lakelet undescribed population of *D. longispina* O. F. Müller is mentioned. In both descriptions the author points out that this species has an intermediate position between *Daphnia pulex* De Geer + *D. pennata* O. F. Müller (= *D. pulex* group) and *Daphnia paludicola* Hellich + *D. caudata* Sars (= *D. longispina* group) due to a peculiar arrangement of the tiny spinules close to the basis on the claw. Stingelin's figure No. 2 does not seem to show this peculiarity clearly. The spinulation on this figure differs from the arrangements encountered in species of *D. longispina* group by their larger size and smaller number. There are two other peculiar characters of this population mentioned in the descriptions by Stingelin or apparent from his figures brownish coloration of the shell and relatively small head. In the years following the description a concept of broadly outlined species prevailed and no proper attention of the peculiarity of the population described by Stingelin was paid. As later Brooks, 1957, has shown that if species are outlined in a narrower sense, a better understanding of factors influencing the distribution of *Daphnia* species can be gained the question of distinctness of earlier described populations became urgent also in Europe.

Due to the kindness of the late Dr Hermann Gisin I had the opportunity to study the collection of microscopic mounts of Cladocera at the Muséum d'Histoire Naturelle de Genève. On one slide there were 9 specimens of adult females of *Daphnia* labelled. *Daphnia zschokkei* Stingelin and touer 1893 Col de Fenetre (Wallis). The coverslide has been surrounded by a dark mass, the specimens were nevertheless entirely dry. There was not possible to study morphological details of these specimens without remounting. I put the slide for 24 hours in air saturated with water.

vapor at 30° C and for further 24 hours I put the slide in a beaker with distilled water. Then I separated them from the glass, tried to ensure the proper visibility of postabdomen or at least of the terminal claw and mounted them in glycerin jelly. The specimen which showed the smallest extent of disturbances with most of the postabdomen free has been mounted separately and is considered as lectotype. The others have been mounted paired on four other slides. The slides are sequentially numbered, No. 1 being the lectotype. In referring to single specimens in addition to the number of slide the latter A is used for specimen on left and B for specimen on right side as seen by direct inspection.

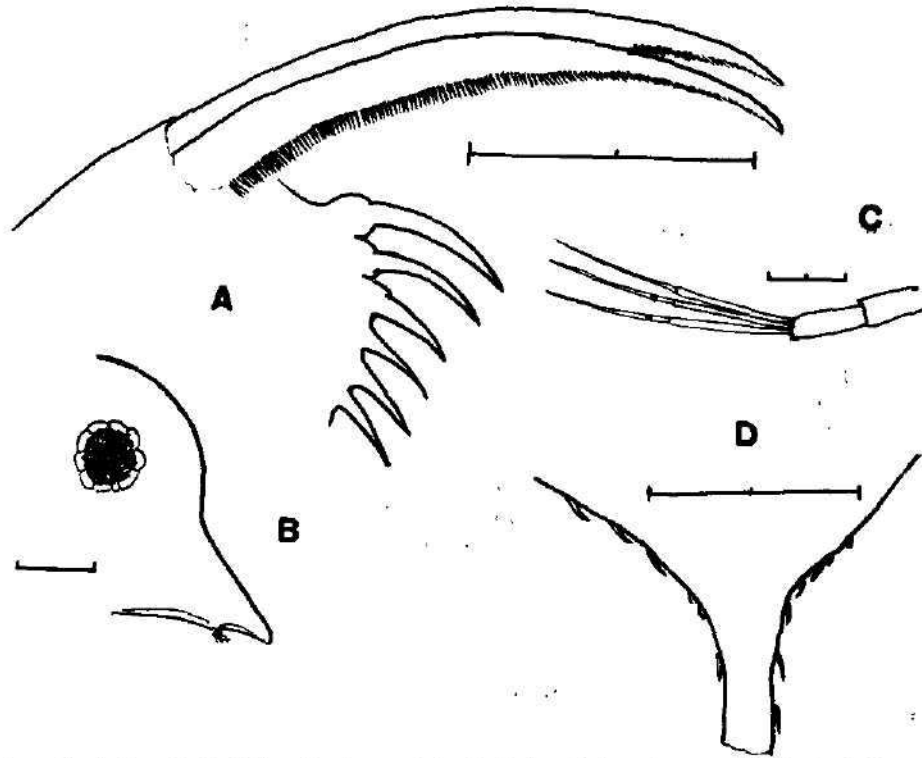


Fig. 1. *Daphnia zachakkei* Stingelin. A postabdominal claw, B frontal part of the head, C plumose setae on the antennae, D caudal part of the shell. Scale = 0.1 mm.

Although the description of Stingelin is a detailed one I found it necessary to add some comments to ensure proper reconnaissance of the distinctiveness of this population. The population is related to *D. longispina* O. F. Müller and Stingelin himself classified it in 1908 as a variety of this species.

The spinulation of the claw. As already mentioned Stingelin has considered the spinulation on the claw to be of a transient type between *D. pulex* and *D. longispina* group. The claw of the lectotype gives little possibility (Fig. 1) to support this view. The spinules are distinctly more tiny and more numerous than on Stingelin's Fig. 2. On the claws of specimens 2B and 3B the arrangement of spinules close to the base is irregular mitigating an indistinct pecten and this might be considered as a feature of transient type. The statement that this has to be considered as individual irregularity is substantiated by the fact that in the first specimen

the spinulation on the other paired claw does not show any peculiarity and in the second specimen the spinulation on the paired claw is not visible but as this specimen was close to ecdysis when preserved, the spinulation on the basis of the newly formed claw is distinctly discernible and it is entirely regular with any distinctive feature.

The brownish color of the shell is present in all specimens. This coloration is of the diffuse type found sometimes in older specimens in most *Daphnia* species. It is no sign of more intensive coloration on the dorsal part of the head and shell as found in *D. middendorffiana* Fisher (emend. Brooks) or *D. longispina alpina* Sars.

The size of specimens. Stingelin, 1894 and 1895 mentions the large size 2.8 mm as one of the outstanding features of this population. The lectotype specimen measured 2.2 mm; the range of the others is 2.0–2.35 mm. Most of the specimens have numerous eggs or embryos. It is very likely that Stingelin's data are based on largest specimen available.

The length of the head. Stingelin, 1894 and 1895 mentions the length of the head 0.7 mm which related to the body length gives relative head length of 25%. There might be some uncertainty how the length of the head was measured. However, even if we connect the tip of the rostrum with point of insertion of the antennae closest to the shell and then we are measuring the length of the head as the distance between the highest point of the head and this line (most authors prefer the line originating from the tip of the rostrum perpendicular to the body axis — which gives somewhat lower figure for the length of the head) we find that the relative length of the head of Stingelin specimen drawn on Fig. 1 is 20%. The lectotype specimen has relative length of head 20.2%. The range of four other specimens in which no substantial deformation of the body shape occurred is 16.8–18.4.

The number of the teeth on the postabdomen: Stingelin mentions 13–14. Lectotype: 11; the range of four others: 13–14.

The length of the spine and the spinulation of the shell. None of the specimens under study has intact spine but from the remnants it is obvious that it was short in agreement with Stingelin's statement and picture. The base of the spine is in all specimens much more slender than shown in Fig. 1 of Stingelin, 1895 (see also Fig. 2). The spinulation on the ventral margin of the shell is practically absent as it corresponds to less than 3% of the length of carapace. This corresponds to the statement of Stingelin, 1895 but not to his Fig. 1 which shows a much greater extent of spinulation. On the dorsal margin the spinulation does not surpass the lower third of the shell. Stingelin, 1894 mentions "bis gegen die Mitte bedornt" and his figure accentuates this statement. The most distant spinule is present in the lectotype specimen on the point corresponding to 33% of the length of the shell. The range in other 5 specimens is 15 to 32%. The spinules are small, between one-third to one-half of the distance between spinules which averages 0.03 mm.

* Note: R. Monti, 1905, described a new form from *D. zschokkei* under the name *viggezina* in which most of the characters distinguishing the population Stingelin described from *D. longispina* are absent. I was unable to find any material labelled by this name or by the type locality in the collection of Instituto Italiano Idrobiologico at Pallanza (this has been possible

by the generous support by its late director Prof. V. Tonolli) where most of the material collected by R. Monti is preserved.

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**CYSTICERCIDS OF THE CESTODE
SOBOLEVICANTHUS KRABBEELLA (HUGHES, 1940)
FROM CRUSTACEANS**

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Received March 28, 1968

Abstract: Cysticercoids of the cestode *Sobolevicanthus krabbeella* are described from the body cavity of the crustacean species *Eucyclops* (s. str.) *serrulatus* (Fischer) collected in the fishpond Mlýnský near Lednice in Moravia (Czechoslovakia).

MATERIAL AND METHODS

Cysticercoids of the cestode *Sobolevicanthus krabbeella* were found in the crustacean species *Eucyclops serrulatus* collected in the fishpond Mlýnský near Lednice in South Moravia. Of a total of 3,200 examined crustaceans only 12 were infected with cysticercoids (0.4%). The incidence of infection was one to three cysticercoids in one host. All cysticercoids were measured and pictured in vivo and most of them were used in a feeding experiment with a 4-weeks-old duckling (*Anas platyrhynchos* dom. L.). After four weeks the duckling was sacrificed and in post mortem, one adult cestode with developed male genital organs and the anlage of the female reproductive organs was found. The morphological arrangement of these organs was in accordance with those of the cestode species *S. krabbeella*. It is interesting to note that this cestode developed in a completely unspecific host. So far we have never found this cestode species in our domestic ducks and have no knowledge of it being recorded from this host in the literature.

DESCRIPTION OF CYSTICERCIDS (Fig. 1)

Cysticercoids almost spherical in shape, overall size 0.143–0.170 by 0.134–0.167 mm. Thickness of hyaline membrane on the surface of the cysticercoids 0.003 to 0.004 mm, the homogeneous membrane 0.001 to 0.002 mm thick. The basal, radially striated layer measures 0.004–0.006 mm. The outer fibrous layer measuring 0.003–0.006 mm is visible on viable cysticercoids and sometimes also on total mounts. Thickness of intermediate parenchymatous layer 0.006–0.010 mm; inner fibrous layer visible neither on viable cysticercoids nor on total mounts histologically it was not examined. The neck expanding along the inner wall of cyst attains a size of 0.004–0.012 mm and at the site of invagination even 0.016 mm; it contains numerous calcareous corpuscles measuring 0.003–0.006 mm. Scolex spherical, measures 0.080–0.110 mm in diameter, suckers 0.046–0.066 by 0.032 to 0.040 mm, rostellum 0.080–0.100 by 0.032–0.040 mm bearing 8 hooks of the skrjabinoid type, length 0.060–0.064 mm. Tail length 0.360–0.400 mm.

DESCRIPTION OF THE CESTODE OBTAINED IN THE FEEDING EXPERIMENT

Cestode located in the posterior portion of the ileum; overall length 32 mm, width 0.470 mm, maximum length of proglottids 0.309 mm. Scolex oval, markedly extended in posterior portion, size 0.120 by 0.150 mm, suckers oval, size 0.099 by 0.075 mm, rostellum 0.105 by 0.068 mm, 8 hooks of the skrjabinoïd type length 0.060 mm. Cirrus sac opening unilaterally, size 0.230–0.850 by 0.019–0.030 mm surpasses in length the width of the proglottids, thus forming several loops in its course. Cirrus armed with spines and terminating in a stiletto. Sacculus accessorius spherical, size 0.028 to

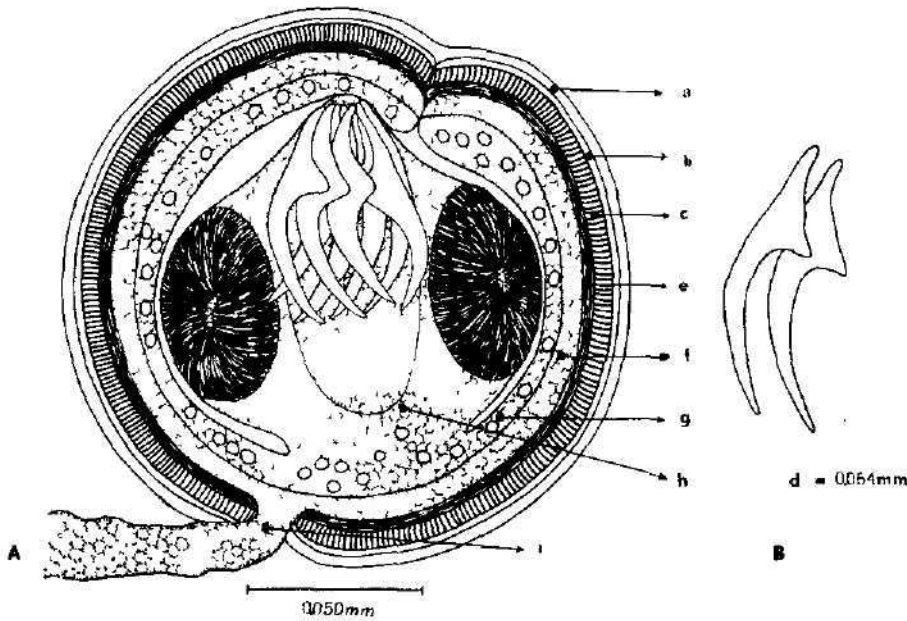


Fig. 1. Cysticercoid of the cestode *Sobolevicanthus krabbeella*

A) cysticercoid, B) hooks

a) hyaline membrane, b) homogeneous membrane, c) basal layer, d) length of the hooks, e) outer fibrous layer, f) intermediate parenchymatous layer, g) neck, h) scolex, i) tail.

0.042 mm, placed beneath the opening of the cirrus sac, its opening and inner area covered with coarse spines. Vesicula seminalis externa and interna present. Three spherical to oval testes, one situated porally, two aporally forming an obtuse or rectangular triangle, measuring 0.018–0.056 mm in diameter. In some proglottids the arrangement of the testes is different, one being poral, the other median and the third aporal, while the poral and aporal testis lie near the anterior margin of the proglottid, the median at the posterior margin. The developing ovary is lobated, size only 0.040–0.090 by 0.056–0.100 mm, vitellaria transversely oval, with unlobated margins, compact and still very small, size 0.020–0.023 by 0.020–0.029 mm.

DISCUSSION

Although the cysticercoïd of the cestode *Sobolevicanthus krabbeella* has not yet been described in the literature, Mrázek (1890) observed in crustaceans of the species *Eucyclops serrulatus* (= *Cyclops agilis* Koch) cysticercoïds "of a spherical or elongated, sometimes elliptic shape" which measured in width from 0.120 to 0.180 mm. The length is not given. The hooks numbering 8–9 measured 0.055–0.068 mm. They were of a characteristic type, which is in keeping with the original drawing of the skrjabinoid type. The autor listed these cysticercoïds to the cestode *Sphenacanthus fasciculata* (Ransom, 1909) Lopez-Neyra, 1942. Since Mrázek performed no feeding experiments with these cysticercoïds and could not, therefore, give any exact identification of the cestode species, it may be possible that these were cysticercoïds of the species *S. krabbeella*, because of a similarity in shape and size of the hooks depicted by him, with the hooks of the cestode *S. krabbeella*. Also the width of the cysticercoïds described by Mrázek as *S. fasciculata* are too small in comparison with the scolices of the adult cestodes of this species even if we consider the fact that the size of the scolices in the cysts may sometimes be smaller than that of the adult cestode. The scolex of *S. fasciculata* attains 0.350 mm after Skrjabin and Mathevossjan (1945) and 0.232–0.264 mm after Ryšavý (1962).

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**NAHRUNG UND WACHSTUM
DES FLUSSBARSCHES (*PERCA FLUVIATILIS* LINNAEUS, 1758)
IN SEINEM ERSTEN LEBENSJAHR**

PAVEL ŘEPA

Eingegangen am 20. März 1968

Der Flussbarsch ist wegen seiner breiten geographischen und ökologischen Verbreitung der Gegenstand der Aufmerksamkeit einer ganzen Reihe von Studien. Ein grosser Teil dieser Studien beschäftigt sich mit seiner Nahrung und seinem Wachstum, meist werden aber erwachsene Exemplare studiert. Trotzdem finden wir aber in ausländischer Literatur auch eine Reihe von Angaben über Nahrung und Wachstum der Jährlinge des Barsches. Bei uns wurde dieses Problem noch nicht speziell verarbeitet. Da gleichzeitig L o h n i s k ý (1959, 1960) an reichem Material das Wachstum und die Nahrung der Flussbarsche aus dem Stausee Klíčava und F r a n k (1960), aus dem Stausee Slapy bearbeitet hat, habe ich mich bemüht, ihre Beobachtungen durch eine Studie über Nahrung und Wachstum der Jährlinge des Flussbarsches in diesen Talsperren zu ergänzen.

Beim Abschluss dieser Arbeit fühle ich mich veranlasst, Herrn Dr. S. Frank CSc. für die Einführung in die Problematik und für Ratschläge und freundliche Durchsicht des Manuskripts zu danken. Weiter danke ich Herrn Dr. J. Holčík CSc. für verschiedene Angaben und Ratschläge und sein Interesse für diese Arbeit.

MATERIAL UND METHODIK

Die in dieser Arbeit untersuchten Flussbarsche wurden in dem Stausee Slapy an der Moldau und in dem Klíčava-Stausee bei Rakovník in Mittelbohemien gefangen. Die Flussbarsche aus dem Klíčava-Stausee hat der Verfasser, aus dem Slapy-Stausee Dr. S. Frank gefangen. Im Klíčava-Stausee wurden die Barsche an 5 Stellen, welche in der Karte (Abb. 1) bezeichnet sind, unweit des Ufers zwischen *Myriophyllum* gefangen. Die Fang von Slapy stammen von der Lokalität unter der Brücke unweit des Dorfes Nebřich, am steingen Ufer aus der Tiefe 0,5 m. Im ganzen hatte ich 455 Exemplare juveniler Barsche von beiden Lokalitäten zur Verfügung. (Die einzelnen Fangergebnisse und Daten des Fanges siehe Tabelle No. 8). Ausserdem wurden 36 erwachsene Barsche aus dem Klíčava-Stausee benutzt, welche J. Stehlík in den Tagen 18. 8. und 25. 9. 1964 gefangen hatte.

Das Material wurde folgenderweise bearbeitet: bei allen Fischen wurde die Länge vom vorderen Rand der Schnauze bis zum Urostyl mit einer Metallschublehre gemessen (*longitudo corporis*), mit einer Genauigkeit von 0,1 mm. Das Gesamtgewicht der Fische (Formalینگewicht) wurde auf einer Laboratoriumswaage mit Genauigkeit 0,01 g festgestellt. Diese Werte wurden dann zur Feststellung des Wachstums benutzt. Bei 14 Larven und 88 juvenilen Stadien wurden Nahrungsanalysen durchgeführt. Der Inhalt des ganzen Verdauungstraktes wurde untersucht, einzelne Arten der Nahrungsorganismen determiniert und im ganzen Inhalt des Verdauungstraktes

zusammengezählt, bei grösseren Individuen in der Hälfte des Inhaltes, wobei die Anzahl mit zwei multipliziert wurde. Die Arbeitsmethode wurde ausführlich in den Arbeiten von Hruška (1954) und Lohniský (1959) beschrieben. Die Analysen wurden nach der Zählmethode (Ladiges, 1935) und der Methode der Häufigkeit des Vorkommens (Hruška, 1956) ausgewertet. Dort, wo in der Nahrung grosse Unterschiede in der Grösse der Nahrungorganismen vorkamen, wurde die Zählmethode durch die Gewichtsmethode ergänzt. Dabei wurden die einzelnen Bestandteile nicht direkt gewogen, sondern ihr Gewicht wurde durch die Multiplikation des Lebendgewichtes eines Exemplars mit der Anzahl aller Exemplare gewonnen (Röper, 1936). Das Gewicht der einzelnen Arten wurde aus den Angaben von Röper (1936), Ščerbakov (1962), Kamšilov (1954) und Starmach (1955) festgestellt. Das

Gewicht der Insektenlarven hat Laupy aus seinen Protokollen mündlich mitgeteilt (ad verb.). Weiter wurde der Füllungsindex festgestellt (Hruška, 1956). Auch die Ergebnisse für die Berechnung dieses Koeffizienten wurden durch Multiplikation der Gesamtzahl der Nahrungsorganismen mit dem Gewicht der lebendigen Individuen der einzelnen Arten gewonnen. Der Füllungsindex wird in der Tabelle durch Prozente des Nahrungsgewichtes von dem Gesamtgewicht des Körpers ohne Eingeweide (ausser den Nieren) ausgedrückt.

Bei 175 juvenilen Flussbarschen aus dem Klíčava-Stausee wurde der diagonale Halbmesser der Schuppe mit einem Okularmikrometer abgemessen und seine Abhängigkeit von der Körperlänge festgestellt. Zur Ergänzung der Kurve wurden auch die Schuppen der erwachsenen 36 Exemplare aus demselben Stausee gemessen. Die Schuppen wurden von den in Alkohol aufbewahrten Fischen entnommen und zwar von der linken Seite des Fisches unter der Seitenlinie in der Höhe des Anfangs der Afterflosse. Es wurden immer drei Schuppen, und zwar ihre grösseren Diagonalhalbmesser gemessen und der durchschnittliche Wert berechnet.

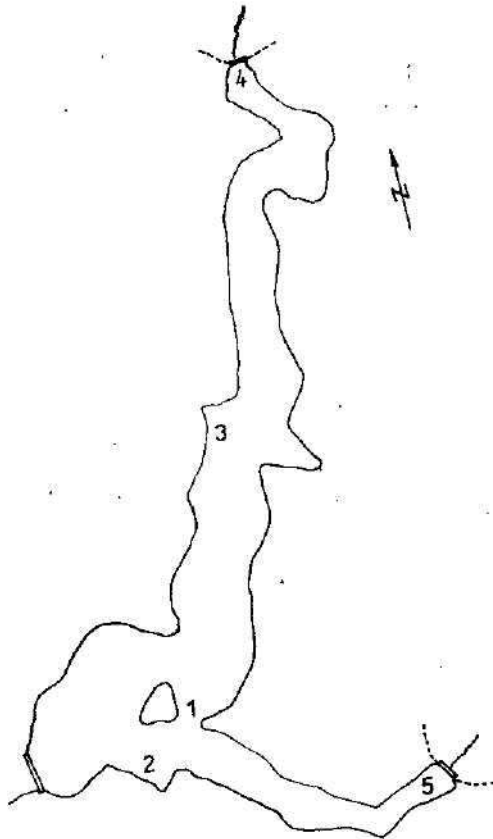


Abb. 1. Schematische Karte des Klíčava-Stausees. Stellen, an denen die Barsche gefangen wurden. 1 — Bei dem Inselchen, 2 — Bucht „Markéta“, 3 — Bucht „Vlášenska“, 4 — Klíčavský luh, 5 — Lánský luh.

EIGENE ERGEBNISSE

Die Ergebnisse der Nahrungsanalysen sind in den Tafeln 1–6 zusammengefasst. Es sind immer Fische aus demselben Fange zusammen ausgewertet. Die Fische wurden in Gruppen nach je 10 mm verteilt und diese Gruppen einzeln ausgewertet. Bei den im Juli gefangenen Fischen (Körperlänge bis 50 mm) ist der Unterschied in der Nahrung der einzelnen Gruppen markant, sie wurden deshalb gesondert ausgewertet. In den Fängen vom September und Oktober 1964 aus dem Klíčava-Stausee sind keine grundsätzlichen Unterschiede in der Vertretung der Nahrungsbestandteile in Abhängigkeit von der Körperlänge, darum sind die Fische, die im gleichen Zeitpunkt gefangen wurden, zusammen ausgewertet.

Für den Vergleich der Fischnahrung mit der Zusammensetzung des Planktons standen wenigstens einige Angaben über die Zusammensetzung des Planktons in den betreffenden Stauseen zur Zeit des Fanges zur Verfügung. Es waren die Angaben über die qualitative Zusammensetzung des Planktons und über die relative Häufigkeit der einzelnen Arten, sowie über die Veränderungen der gesamten Biomasse der Cladoceren und Copepoden (S t r a š k r a b a, in verb.).

Bei den jüngsten Larvalstadien des Barsches, die während des Monats Mai 1964 im Klíčava-Stausee bei der Insel gefangen wurden (Tab. 1.), wurden in der Nahrung meistens die Copepoditen- und Naupliusstadien der Copepoden gefunden. Die Larven dieser Grösse (7–10 mm) können offenbar noch nicht grössere Planktontiere verschlucken. Rotatorien wurden in der Nahrung überhaupt nicht festgestellt. Im Mai 1964 war auch wirklich die Biomasse der Rotatorien viel geringer als die Biomasse der Copepoden.

Tab. 1. Die Fänge aus dem Klíčava-Stausee, 22. und 28. 5. 1964. 14. Fische.
Körperlänge 6,5–9,6 mm (durchschnittlich 7,5 mm)

Nahrungsorganismen	1	2
Naupliusstadien der Copepoden	45,2	11
Copepoditenstadien der Copepoden	50,0	10
Juvenile Cladoceren	4,8	3

Zur Tabelle 1–6

- 1 – Zahl der Exemplare der Nahrungsorganismen in % der Gesamtzahl
 2 – Der Nahrungsbestandteil wurde in X Fischen gefunden
 3 – Das Gewicht aller Exemplare der Nahrungsorganismen in % des Gesamtgewichts

Die Fische, die am 27.–29. 7. 1964 in dem Klíčava-Stausee bei Lánský luh gefangen wurden, sind in drei Grössengruppen ausgewertet (Tab. 2). In der Nahrung kamen ausser dem Plankton auch Insektenlarven vor, besonders die Larven einiger litoralen Chironomiden. Dabei wurden sie in der Nahrung der Gruppe bis 30 mm Körperlänge überhaupt nicht gefunden, bei der Gruppe 30 bis 40 mm hatten 4 von 10 Fischen in dem Verdauungstrakt Insektenlarven. Im ganzen bildeten die Insektenlarven ungefähr $\frac{1}{5}$ des Inhalts des Verdauungstraktes. Bei der Gruppe von 40 bis 50 mm bildeten diese Larven $\frac{1}{3}$ der Nahrung. Von 9 untersuchten Fischen enthielten 6 Fische meist 2–3 Insektenlarven, nur einer dieser Fische enthielt über 30 Chironomidenlarven und keine Planktonten. Das Zooplankton bleibt freilich der Hauptteil der Nahrung, aber der Anteil der Insektenlarven wächst bei grösseren Fischen. Im Plankton ist Eudiaptomus gracilis am häufigsten vertreten, weiter Copepoditstadien der Copepoden (besonders *Mesocyclops leuckarti*). Im Plankton war das Verhältnis umgekehrt als in der Nahrung der Fische, häufiger waren die Copepoditstadien der Cyclopiden. Von den übrigen Planktonten hat *Bosmina longirostris* in der Nahrung noch weniger Bedeutung. Die übrigen Cladocera kommen nur vereinzelt vor. Unbedeutend, aber doch etwas mehr als in den herbstlichen Fängen sind litorale Cladoceren aus der Familie Chydoridae vertreten.

In denselben Tagen wurden auch 5 Exemplare bei dem Inselchen gefangen. In ihrer Nahrung wurden nur Planktonorganismen gefunden (Tab. 3). Den grössten Teil der Nahrung bildete *Eudiaptomus gracilis*, an zweiter Stelle waren Copepoditstadien der Familie Cyclopidae. Überraschend ist die kleine Anzahl der Vertreter der Gruppe *Daphnia longispina* in der Nahrung, denn im Plankton übertraf sie die beiden vorhergehenden Gruppen.

Tab. 2. Der Fang aus dem Klčava-Stausee, Lánský luh, 27. – 29. 7. 1964

Körperlänge in mm: von—bis	27,2—29,2			31,4—37,8			42,5—50,0		
Durchschnitt	28,3			34,9			45,7		
Durchschnittliches Gewicht	0,44			0,74			2,13		
Zahl der Fische	5			10			9		
Nahrungsorganismus	1	2	3	1	2	3	1	2	3
<i>Daphnia</i> Gr. <i>longispina</i>	0,5	2	—	0,40	6	—	0,17	3	—
<i>Diaphanosoma brachyurum</i>	—	—	—	0,18	4	—	0,40	4	—
<i>Ceriodaphnia pulchella</i>	3,5	2	—	0,70	6	—	0,36	1	—
<i>Bosmina longirostris</i>	0,9	2	—	17,60	8	—	15,20	4	—
<i>Leptodora kindtii</i>	—	—	—	0,03	1	—	—	—	—
<i>Eudiaptomus gracilis</i>	63,4	5	—	55,3	10	—	75,60	8	—
Cyclopidae + Copepoditen	29,5	5	—	22,70	10	—	5,71	7	—
Plankton	97,8	5	—	97,16	10	80,0	97,44	8	67,40
<i>Alona</i> sp.	0,3	2	—	0,07	1	—	0,22	2	—
<i>Chydorus</i> sp.	1,8	4	—	1,93	9	—	0,70	4	—
<i>Pleuroxus aduncus</i>	—	—	—	0,35	1	—	0,03	1	—
Andere Chydoridae	0,1	1	—	0,03	1	—	0,03	1	—
Litorale Cladoceren	2,2	4	—	2,38	10	0,5	0,98	4	0,10
Chironomidenlarven	—	—	—	0,40	4	—	1,24	6	—
Coleoptera g. sp.-Larven	—	—	—	0,03	1	—	0,03	1	—
Hydracarina g. sp.	—	—	—	0,03	1	—	0,03	1	—
<i>Sigara</i> sp. Nymphen	—	—	—	—	—	—	0,25	2	—
Ephemeroptera-Larven	—	—	—	—	—	—	0,03	1	—
Benthos-+Litoral	—	—	—	0,46	4	19,5	1,58	7	32,50

Den Fang aus dem Slapy-Stausee vom 29. 7. 1962 bilden Fische von 29—42 mm Länge (Tab. 4). Nur einer der 10 untersuchten Fische hatte im Magen 3 Chironomidenlarven. Den Rest der Nahrung dieses Fisches und die Nahrung aller übrigen Fische bildet das Plankton. Den Hauptteil der Nahrung bildet *Daphnia longispina*, die bei grösseren Fischen öfters vorkommt. An zweiter Stelle sind Cyclopidae vertreten (besonders *Thermocyclops crassus*), deren Anteil mit der wachsenden Körperlänge sinkt. Über-

raschend ist die kleine Zahl des *Eudiaptomus gracilis* in der Nahrung, obwohl er im Plankton am häufigsten vorkam.

Der Fang von derselben Stelle vom 18. 7. 1963 hatte einen grösseren Anteil der Insektenlarven in der Nahrung. In der Gruppe bis 30 mm enthielt nur 1 Fisch von 7 Fischen eine Chironomidenlarve, in der Gruppe von 30–40 mm hatten alle Fische Chironomidenlarven (besonders *Psectrocladius*) in der

Tab. 3. Fang aus dem Klíčava-Stausee bei dem Inselchen, 27.–29. 7. 1964
Körperlänge 30,8–40,6 mm (durchschnittlich 35,5 mm),
durchschnittliches Gewicht 0,78 g, Zahl der Fische 5

Nahrungsorganismus	1	2
<i>Daphnia Gr. longispina</i>	0,80	3
<i>Diaphanosoma brachyurum</i>	5,20	4
<i>Bosmina longirostris</i>	0,06	1
<i>Leptodora kindti</i>	0,06	1
<i>Ceriodaphnia pulchella</i>	0,11	1
<i>Eudiaptomus gracilis</i>	42,00	5
Cyclopidae + Copepoditen	51,20	5
<i>Alonella nana</i>	0,16	3
<i>Chydorus sphaericus</i>	0,06	1

Nahrung, sodass diese Organismen 33 % des gesamten Nahrungsgewichtes bildeten. Der Hauptbestandteil der Nahrung ist wieder Zooplankton. Der im Plankton am meisten vertretene Bestandteil *Daphnia Gr. longispina* ist auch in der Nahrung sehr häufig. Wieder kommt in der Nahrung nur in geringem Masse *Eudiaptomus gracilis* vor, der im Plankton häufig ist. Dagegen wurde

Tab. 4. Fang aus dem Slapy-Stausee, Nebřich, 29. 7. 1962

Nahrungsorganismus		1	2	1	2
Körperlänge	von—bis mm	29—31		33,5—43	
	Durchschnitt mm	29,8		37,2	
Durchschnittliches Gewicht g		0,35		0,87	
Zahl der Fische		4		6	
<i>Daphnia Gr. longispina</i>		42,5	4	73,0	6
<i>Diaphanosoma brachyurum</i>		0,6	1	0,8	4
<i>Ceriodaphnia sp.</i>		1,3	2	0,2	2
<i>Leptodora kindti</i>		0,6	2	0,8	5
<i>Bosmina coregoni</i>		—	—	0,07	1
<i>Eudiaptomus gracilis</i>		9,4	3	3,8	6
Cyclopidae + Copepoditen		45,0	4	21,01	6
<i>Alona affinis</i>		0,3	1	0,07	1
<i>Pleuroxus aduncus</i>		0,3	1	0,16	2
<i>Psectrocladius sp.</i> -Larven		—	—	0,90	1

Polyphemus pediculus, der zweithäufigste Bestandteil der Nahrung, im Plankton nur vereinzelt gefunden. Dies wurde wahrscheinlich dadurch verursacht, dass das Plankton in der Mitte des Wasserbeckens entnommen wurde, die Fische aber dicht am Ufer gefangen wurden. Das vereinzelt Vorkommen der Vertreter der Familie Cyclopidae stimmt im ganzen mit dem geringen prozentuellen Vorkommen in der Nahrung überein. Auch bei diesem Fang sehen wir, dass mit wachsender Körperlänge die grösseren Arten in der Nahrung zunehmen und die kleineren abnehmen (vergleiche *Polyphemus pediculus* u. *Daphnia longispina*).

Tab. 5. Fang aus dem Slapy-Stausee, Nebfisch, 18. 7. 1963

Nahrungsorganismus	1	2	3	1	2	3
Körperlänge: von—bis mm	17,4—27,1			31,5—39,9		
Durchschnitt mm	24,1			35,8		
Durchschnittliches Gewicht g	0,21			0,70		
Zahl der Exemplare	7			6		
<i>Daphnia Gr. longispina</i>	35,3	7		67,0	7	
<i>Diaphanosoma brachyurum</i>	2,6	5		1,86	3	
<i>Ceriodaphnia</i> sp.	1,07	2		0,41	4	
<i>Polyphemus pediculus</i>	53,5	7		5,65	6	
<i>Eudiaptomus gracilis</i>	4,58	6		11,10	6	
Cyclopidae-Copepoditen	1,58	5		9,58	3	
<i>Leptodora kindti</i>	—	—		0,41	3	
Plankton	98,63	7	87,00	96,01	6	63,30
<i>Chydorus</i> sp.	0,77	2		0,90	5	
<i>Alona</i> sp.	0,15	1		0,20	2	
<i>Leydigia leydigi</i>	—	—		0,07	1	
Litorale Cladoceren	0,92	2	0,40	1,30	5	0,01
<i>Paectocladius Gr. Psilopterus</i>	0,30	1		2,28	6	
<i>Eucricotopus</i> sp.-Larven	0,15	1		0,41	1	
Benthos-Litoral	0,45	1	12,60	2,69	6	38,69

Die Nahrung der im September und Oktober 1964 im Klíčava-Stausee bei dem Inselchen gefangenen Fische bestand ausschliesslich aus Zooplankton, und zwar aus grösseren Arten (*Eudiaptomus gracilis* u. *Daphnia Gr. longispina*). Die vom 24.—26. 9. 1964 gefangenen Fische hatten noch einen geringen Anteil der Vertreter der Familie Cyclopidae in der Nahrung, im Oktober kamen diese Tiere in der Nahrung nur ausnahmsweise vor. Ebenfalls die Cladoceren aus dem Plankton und litoral sind ziemlich selten. Die am öftesten vorkommende Art ist *Diaphanosoma brachyurum*, die maximal ein

Prozent der sämtlichen Nahrung bildet. Wenn wir alle drei Fänge vergleichen (Tab. 6), kann man den Übergang von der Ernährung mit *Eudiaptomus gracilis* im September auf *Daphnia* Gr. *longispina* im Oktober beobachten. Im Plankton wurde zwar von September bis Oktober ein Rückgang der Biomasse der Copepoden und Aufstieg der Biomasse der Cladoceren beobachtet, aber auch im September, als *Daphnia* Gr. *longispina* in der Nahrung nur einen geringen Teil bildete, war sie im Plankton ziemlich häufig vertreten. Im Oktober nimmt zwar die Biomasse der Copepoden ab, aber nur in geringerem Masse, während in der Nahrung *Daphnia longispina* die Art *Eudiaptomus gracilis* dreifach übersteigt.

Tab. 6. Fänge aus dem Klíčava-Stausee, bei dem Inselchen, Herbst 1964

Nahrungsorganismus	1	2	1	2	1	2
Datum des Fanges	24. – 26. 9. 64		8. – 10. 10. 64		31. 10. 1964	
Körperlänge: von – bis mm	48,2 – 69,0		61,5 – 81,7		63,0 – 83,0	
Durchschnitt mm	4,08		7,26		6,70	
Durchschnittliches Gewicht g	63,9		72,6		71,7	
Zahl der Fische	12		13		11	
<i>Daphnia</i> Gr. <i>longispina</i>	3,14	12	74,80	13	77,00	11
<i>Diaphanosoma brachyurum</i>	0,52	8	0,26	8	1,20	7
<i>Ceriodaphnia pulchella</i>	0,21	3	0,19	8	0,20	5
<i>Bosmina longirostris</i>	0,14	3	0,02	2	0,06	3
<i>Leptodora kindtii</i>	—	—	0,06	2	0,06	1
<i>Eudiaptomus gracilis</i>	92,54	12	24,60	13	22,00	11
Cyclopidae-Copepoditen	3,36	10	0,12	3	0,30	5
<i>Alona costata</i>	0,07	2	—	—	0,06	1
<i>Sida crystalina</i>	0,02	2	0,02	2	—	—
<i>Pleuroxus aduncus</i>	—	—	0,02	1	0,06	1
Chydorus sp.	—	—	0,01	1	0,06	2
<i>Eurycercus lamellatus</i>	—	—	—	—	0,005	1

Die Erklärung dieser Veränderungen ist sehr schwierig. Die Nahrungsauswahl der Grösse nach (L o h n i s k ý, 1959) spielt hier wahrscheinlich keine Rolle, denn es handelt sich um Organismen, die ungefähr gleich gross sind. Dagegen existiert bei ihnen ein Unterschied in der Beweglichkeit. Der beweglichere *Eudiaptomus gracilis* sollte in der Nahrung weniger häufig erscheinen, als es seinem Vorkommen im Plankton entspricht. Solche Verhältnisse waren bei den im Slapy-Stausee in beiden Jahren gefangenen Fischen. Bei den in Klíčava-Stausee gefangenen Fischen wurde *Eudiaptomus gracilis* manchmal vorzugsweise gefressen, in anderen Perioden aber weniger als es seinem Vorkommen entsprach. Man kann voraussetzen, dass im Oktober, da infolge des kälteren Wassers die Aktivität der Fische abnimmt, auch die prozentuelle Vertretung des beweglicheren Organismus d. h. *Eudiaptomus gracilis* in der Nahrung abnimmt. Für den vollkommenen Nachweis dieser Voraussetzung wären die Angaben der Zusammensetzung des Planktons an der gleichen Stelle und der gleichen Zeit des Fischfanges nötig. Die benützte Angaben sind meistens aus der Entfernung von einigen zehn Meter oder auch mehr von der Stelle der Planktonprobeentnahme entfernt und ebenfalls um einige Tage gegen das Datum des Fischfanges verschoben.

Im ganzen kann man aus den festgestellten Ergebnissen folgende Schlüsse ziehen:

1. Die Nahrung des Flussbarsches bildet im ersten Jahre überwiegend das Zooplankton. Nur in den Sommermonaten konnte man zeitweise in der Nahrung auch Insektenlarven beobachten (vorherrschend die Familie Chironomidae). Sie hatten aber in der Nahrung nur nebensächliche Bedeutung. Von 41 Fischen, die im Sommer gefangen wurden, und die in die Gruppe über 30 mm Körperlänge gehörten, hatte eine Hälfte in der Nahrung eine oder mehrere Insektenlarven und nur ein Fisch enthielt ausschliesslich Insektenlarven, und keine Planktonorganismen. Bei einigen Fängen aus den Sommermonaten kamen in der Nahrung überhaupt keine Insektenlarven vor. Auch in der Nahrung der 50–80 mm langen Fische, die im Herbst 1964 im Klíčava-Stausee gefangen wurden, kamen keine Insektenlarven vor. Im Laufe des Monats September 1964 kam es aber im Klíčava-Stausee zu einem so schnellen Sinken des Wasserspiegels um 2 m, dass der grösste Teil der Stellen mit Pflanzen gelegen ausserhalb des Wassers kam. Darum kann man nicht mit Sicherheit behaupten, dass die Jährlinge des Barsches im Klíčava Stausee die Nahrungssuche im Litoral im Herbst einstellen, wie R ö p e r (1936) behauptet, da im Klíčava-Stausee das Litoral im Herbst des Jahres 1964 viel ärmer sein musste, als es im Sommer desselben Jahres gewesen war.

2. Bei den frühesten Stadien des Barsches ist offenbar die Grösse der aufgenommenen Nahrung durch die morphologischen Möglichkeiten (z. B. die Grösse der Schnauze, die Grösse des Magens) der Larven und der jüngsten juvenilen Stadien begrenzt. Wegen Mangel an Larvenmaterial war es nicht möglich, die Grenze der Körperlänge festzustellen, bei welcher der Barsch schon anfängt, grössere Planktonorganismen aufzunehmen. Es wurde festgestellt, dass bei einer Körperlänge von 7–9 mm die grösste Nahrung, die die Larven schon im Stande sind aufzunehmen, juvenile Stadien der Copepoden bilden. Weiterhin wurde festgestellt, dass Fische unter 30 mm Körperlänge, auch wenn sie sich im Litoral aufhalten, niemals Insektenlarven in der Nahrung haben. Erst bei Fischen, die länger als 30 mm sind, kommen Insektenlarven in der Nahrung vor.

3. Die angeführte Vergrösserung der Nahrungsorganismen, die verschlungen werden, hat qualitativen Charakter. Von einer bestimmten Körperlänge an erscheinen bestimmte Tierarten in der Nahrung. Ausserdem möchte ich auch auf die erhöhte Menge grösserer Nahrungsorganismen mit der zunehmenden Körperlänge der Fische aufmerksam machen. Siehe z. B. Tab. 2: der steigende Anteil von *Daphnia* Gr. *longispina* zum Nachteil der Vertreter der Familie Cyclopidae.

4. In keinem Falle wurde beobachtet, dass in der Nahrung der Barsche der Klasse 0 Fische oder ihre Larven enthalten wären. Dabei wurde beobachtet, dass sich im Klíčava-Stausee Scharen der juvenilen Barsche an denselben Stellen wie Larven und juvenile Stadien der karpfenartigen Fische aufhalten (Plötze, Döbel, Schleis u. s. w.).

Weiter wurden bei den untersuchten Fischen die Füllungsindexe, die in Durchschnittswerten in der Tab. 7 angeführt sind, festgestellt. Bei allen Fängen aus dem Monat Juli ohne Rücksicht auf Jahr oder Lokalität, ist zu sehen, dass die kleinsten Barsche (unter 30 mm) immer beträchtlich kleinere Füllungsindexe haben. Wenn wir weiter die durchschnittlichen Füllungsindexe für die einzelnen Fänge auswerten, ist zu sehen, dass Ende Oktober

1964 im Klíčava-Stausee der Füllungsindex gesunken ist. Das kann durch Senkung der Aktivität der Fische nach der Abkühlung des Wassers erklärt werden, was immer zur Herabsetzung der Nahrungsaufnahme führt.

Tab. 7. Füllungsindexe der untersuchten Fische¹⁾

Datum und Platz des Fanges	Füllungsindexe in Gruppen nach der Grösse in mm						Durchschnitt- liche Füllungsindexe für einzelne Fänge
	25-30	30-40	40-50	50-60	60-70	70-80	
Klíčava-Stausee 1964							
Lánský luh 27.-29. 7.	166 (5)	184 (10)	178 (9)	—	—	—	170 (24)
Inselchen 27.-29. 7.	—	192 (5)	—	—	—	—	192 (5)
Inselchen 24.-26. 9.	—	—	163 (1)	174 (5)	166 (6)	—	168 (12)
Inselchen 8.-10. 10.	—	—	—	230 (5)	191 (7)	195 (1)	204 (13)
Inselchen 31. 10.	—	—	—	99 (5)	102 (5)	157 (1)	106 (11)
Slapy-Stausee 1962-1963							
Nebřich 29. 7. 1962	45 (3)	158 (5)	136 (2)	—	—	—	119 (10)
Nebřich 18. 7. 1963	198 (6)	299 (4)	234 (3)	—	—	—	233 (13)

¹⁾ Die Nummern in den Klammern — Zahl der Fische

Die Angaben über das Wachstum wurden durch Berechnung der Durchschnittswerte von Gewicht und Körperlänge der einzelnen Fänge gewonnen. Diese Durchschnittswerte sind zusammen mit der Häufigkeit der Fische in Gruppen je nach 5 mm Körperlänge in der Tab. 8 angeführt. Aus der Tabelle geht hervor, dass in den ersten 6 Monaten die Jährlinge des Barsches im Klíčava-Stausee im Jahre 1964 die Körperlänge von 68-69 mm und das Gewicht von 6-6,5 g erreicht haben. Dabei war das Wachstum der Barsche im allgemeinen gleichmässig. Für die Ausrechnung der monatlichen Zuwächse stand zwar nicht genügend Material zur Verfügung, wenn wir aber den Zuwachs in den ersten 3 Monaten, 36,5 mm, mit der Körperlänge nach 6 Monaten vergleichen, sehen wir, dass er sich in der zweiten Hälfte der Periode nicht verlangsamt hat. Erst ab Hälfte Oktober tritt eine markante Verzögerung des Wachstums ein. Diese Erscheinung hängt offenbar mit der verminderten Nahrungsaufnahme infolge der Temperatursenkung des Wassers zusammen.

Man kann auch auf Unterschiede zwischen den Fängen aus dem Klíčava-Stausee und dem Slapy-Stausee hinweisen. Der Fang vom Juli 1962 aus dem Slapy-Stausee und vom Juli 1964 aus dem Klíčava-Stausee zeigt eine

Tab. 8. Wachstum des Barsches in seinem ersten Lebensjahre

Datum des Fanges	Lokalität	Häufigkeit der Fische in den Gruppen nach je 5 mm Körperlänge					Körperlänge in mm		Gewicht in g		Zahl der Exemplare							
		10-20	25-30	35-40	45-50	55-60	65-70	75-80	85	von - bis		Durch- schnitt						
Kličava-Stausee																		
21.-23. 7. 1964	Lánský luh Kličavský luh Bucht „Vlášenska“ Inselchen	-	5	4	4	1	-	-	-	25,8-46,4	33,6	0,38-2,10	1,00	18				
		-	2	-	-	-	-	-	-	20,8-33,8	27,6	0,13-0,59	0,31	4				
		-	-	2	-	-	-	-	-	36,0-36,8	36,4	0,91-0,95	0,93	2				
		-	1	2	-	-	-	-	-	27,0-32,5	30,5	0,30-0,52	0,44	3				
	In allgemeinem	-	2	6	8	4	1	-	-	20,8-46,4	32,5	0,12-2,10	0,85	27				
27.-29. 7. 1964	Lánský luh Bucht „Vlášenska“ Inselchen Bucht „Markéta“	-	6	14	14	4	2	-	-	25,4-51,6	37,9	0,33-2,36	1,05	44				
		-	2	6	10	-	-	-	-	29,0-39,2	33,5	0,40-1,13	0,81	18				
		-	-	2	2	1	-	-	-	30,8-40,6	35,5	0,49-1,07	0,78	5				
		-	-	3	3	-	-	-	-	30,8-48,5	36,4	0,59-2,11	1,02	7				
	In allgemeinem	-	8	25	29	5	2	-	-	25,4-51,6	36,5	0,33-2,63	0,95	74				
24.-26. 9. 1964	Inselchen	-	-	-	-	2	8	15	20	10	1	48,2-70,0	59,8	2,16-7,70	4,26	35		
8.-10. 10. 1964	Inselchen	-	-	-	-	-	-	-	13	35	20	14	2	61,0-81,7	69,9	3,78-10,74	6,60	84
31. 10. 1964	Inselchen	-	-	-	-	-	-	-	16	21	12	5	1	60,0-83,1	68,1	4,06-10,15	5,99	55
Slapy-Stausee																		
29. 7. 1962	Nebřich	-	-	10	24	21	13	-	-	-	-	25,0-44,0	32,1	0,24-1,40	0,69	68		
18. 7. 1963	Nebřich	10	29	27	14	5	6	-	-	-	-	16,0-44,9	27,3	0,05-1,54	0,35	81		

grössere Variabilität in der erreichten Körperlänge, als der Fang vom Juli 1963 aus dem Slapy-Stausee. Und eben bei diesem Fange wurden in der Nahrung keine Insektenlarven festgestellt. Es scheint, dass wenigstens teilweise Aufnahme grösserer Nahrungsorganismen, die nur von einer bestimmten Längengrenze des Körpers an möglich ist, eine Verzögerung des Wachstums der kleineren Fische, die diese Nahrung nicht aufnehmen können, bedingt, und die Variabilität der Grösse in der Population verursacht. Wenn wir dann die Variabilität der Körperlänge bei den Juli- und Herbstfängen aus dem Klíčava-Stausee vergleichen, sehen wir, dass sich der Unterschied der Körperlängen nicht vergrössert hat. Das kann durch die einheitliche Nahrung aller Grössengruppen im Herbst erklärt werden (Tab. 6).

Dazu wurde noch die Beziehung zwischen dem diagonalen Halbmesser

Tab. 9. Beziehung des diagonalen Halbmessers der Schuppe zur Körperlänge

Körperlänge in mm		Zahl der Fische	Diagonaler Halbmesser der Schuppe		
von — bis	Durchschnitt		in mm		in % der Körperlänge
			von — bis	Durchschnitt	
20,8 — 24,0	22,4	2	0,074 — 0,162	0,113	0,50
25,4 — 29,9	27,6	15	0,191 — 0,318	0,235	0,85
30,1 — 34,8	32,4	27	0,308 — 0,391	0,352	1,09
35,2 — 39,8	36,8	29	0,382 — 0,590	0,452	1,23
40,0 — 44,1	42,7	8	0,490 — 0,621	0,593	1,39
45,9 — 49,3	47,9	8	0,610 — 0,820	0,705	1,47
50,8 — 53,9	51,9	10	0,700 — 0,870	0,778	1,53
55,2 — 59,9	57,2	15	0,830 — 0,995	0,910	1,58
60,0 — 64,9	62,5	49	0,877 — 1,158	1,036	1,66
65,0 — 69,9	67,4	56	1,044 — 1,360	1,162	1,72
70,0 — 74,9	72,2	29	1,181 — 1,370	1,280	1,77
75,0 — 79,9	77,4	17	1,305 — 1,639	1,400	1,81
81,2 — 83,4	82,2	5	1,480 — 1,646	1,550	1,88
86,0 — 89,8	88,2	6	1,580 — 1,800	1,730	1,96
91,3 — 99,9	94,4	5	1,780 — 1,900	1,850	1,96
103,0 — 113,6	109,5	5	2,037 — 2,300	2,235	2,05
130,9 — 147,0	138,5	5	2,550 — 3,095	2,815	2,03
150,6 — 175,0	162,9	8	2,900 — 3,572	3,313	2,03
150,6 — 175,0	162,9	8	2,900 — 3,572	3,313	2,03
180,0 — 194,2	186,5	4	3,525 — 4,183	3,772	2,03
204,0 — 208,0	206	2	3,923 — 4,123	4,023	2,05
250	250	1	4,625	4,625	1,85

der Schuppe und der Körperlänge studiert, die eine grosse methodische Bedeutung für die Feststellung des Wachstums in den weiteren Lebensjahren hat. Die meisten Autoren, die sich mit diesem Problem beschäftigt haben (Frank, 1959; 1960, Lohniský, 1959; Hnatevič, 1960) hatten nur ungenügendes Material juveniler Flussbarsche zur Verfügung.

Die Ergebnisse der durchgeführten Messungen, die in der Tab. 9 und im Graf der Abb. 2. zusammengestellt wurden, zeigen, dass die Beziehungen des diagonalen Halbmessers zur Körperlänge bei den Barschen aus dem Klíčava-Stausee offenbar nicht vollkommen linear war, es scheint aber, dass sich der Halbmesser der Schuppe bei den erwachsenen Exemplaren langsamer als

bei den juvenilen vergrößert. Man kann nicht mit absoluter Sicherheit behaupten, dass diese Verlangsamung des Schuppenwachstums stattfindet, da die Punkte im oberen Teile der graphischen Darstellung (Abb. 2.) eine viel kleinere Anzahl von Material darstellen als die Punkte im unteren Teile der Geraden. Man kann aber wenigstens die vollkommen lineare Abhängigkeit des diagonalen Halbmessers der Schuppe zur Körperlänge bezweifeln.

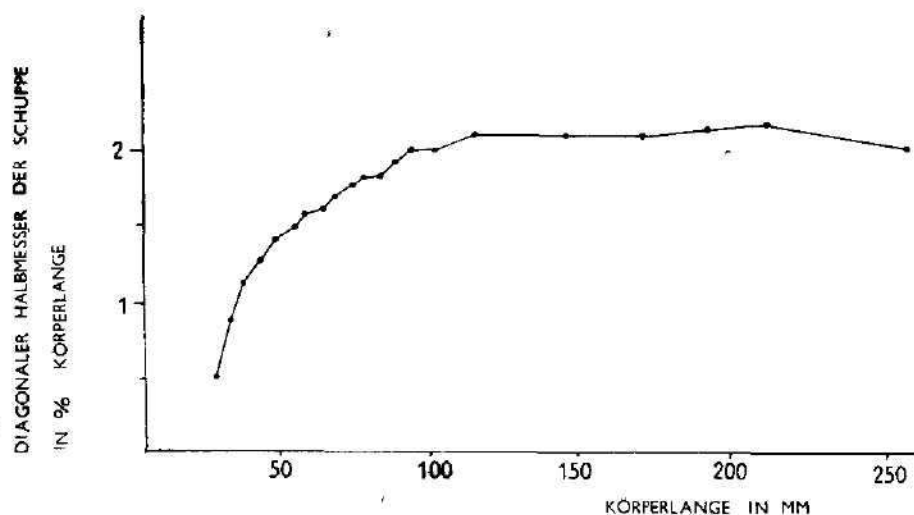


Abb. 2. Beziehung des diagonalen Halbmessers der Schuppe zur Körperlänge.

DISKUSSION

Wenn wir die angeführten Angaben über die Nahrung des Flussbarsches mit Literaturangaben vergleichen, können wir sagen, dass sie meistens übereinstimmen. Das Zooplankton mit einer kleineren Beimischung von Insektenlarven als Nahrung einjähriger Barsche führt Järnefelt (1922), Ladiges (1935), Alm (1946), Kučera (1948), Lohniský (1959), Sokolova u. Filimonova (1961) und Bogatova (1963) an. Dagegen führt Schiemenz (zit. Röper, 1936) als Hauptnahrung Chironomidenlarven und grössere Crustaceen an. Röper (1936) beschäftigt sich eingehender mit dem Anteil der Insektenlarven und der Litoralfauna überhaupt in der Nahrung des Barsches des Jahrganges 0. Die Litoralfauna wird vom Barsche hauptsächlich im Sommer verzehrt und zwar in Seen mit flachen Ufern, wo die Litoralzone reich ist. Hier bildet die Litoralfauna im Sommer den Hauptbestandteil der Nahrung. In Seen mit steilen Ufern ist auch im Sommer das Zooplankton, die Hauptnahrung, und die Insektenlarven kommen dagegen seltener vor. Ähnlich fand auch Leszynski (1963) Unterschiede in der Nahrung der Scharen von Jährlingen des Barsches, die sich im Litoral, und solchen, die sich im freien Wasser aufhielten. Die angeführten Beobachtungen über die nebensächliche Bedeutung der Insektenlarven in der Nahrung stimmen mit Röper überein (1936), denn der Slapy-Stausee sowie der Klíčava-Stausee gehören zu den Stauseen mit steilen Ufern und armen Litoralzonen. Lohniský (1959) fand bei juvenilen Barschen weniger litorale Insektenlarven, als hier beobachtet wurde.

Das kann dadurch erklärt werden, dass im Jahre 1957, als er seine Beobachtungen durchführte, der Stausee weit weniger Pflanzengelege hatte als im Jahre 1964.

Die oben angeführte Feststellung der Aufnahme von Nahrung grösseren Umfangs (Insektenlarven) erst von 30 mm Körperlänge an, erklären gut die Beobachtungen von K o n s t a n t i n o v (1957). Dieser Verfasser führt an, dass am Anfang der 10. Etappe der Entwicklung nach seiner Auffassung, dass heisst bei der Körperlänge von 30 mm, erweitert sich stark der Magen, was offenbar die Aufnahme auch grösserer Nahrung ermöglicht.

Die Feststellung, dass mit wachsender Körperlänge das Prozent grösserer Nahrungsorganismen wächst, stimmt auch mit der Beobachtung von L o h n i s k ý (1959) überein. Auch L e s c y n s k i (1963) macht auf diese Tatsache aufmerksam. Das würde bedeuten, dass der Barsch sich bei der Nahrungssuche hauptsächlich durch seine Sehkraft orientiert. F r a n k (1958, 1960) erklärt auch das schlechte Wachstum in den Tümpeln des mittleren Elbegebietes durch die Wassertrübung, die den Fang der Nahrung erschwert. G r e z e (zit. B o r u c k i j, 1960) stellte fest, dass Barsche im Aquarium in der Dunkelheit viel weniger fressen als bei Licht.

Für das Vergleichen der erreichten Kenntnisse über das Wachstum des Barsches in seinem ersten Lebensjahre kann man die Angaben des grössten Teiles der Arbeiten, die sich mit dem Wachstum des Barsches beschäftigen, nicht benützen. In diesen Arbeiten sind meist keine Angaben, die durch direktes Messen der Fische erworben wurden, sondern die aus den gemessenen Massen der Schuppen zurück errechneten Werte, die der Periode der Anlage des ersten Annulus entsprechen.

Die Angaben der Autoren, die die Masse der Barsche des nullten Jahrganges im Herbst massen, sind in der Tab. 10. zusammengefasst. Im ganzen kann man sagen, dass das Wachstum, das im Klíčava-Stausee festgestellt wurde, sich den Grössenangaben der Lokalitäten, wo die Barsche gut wachsen, nähert.

Man kann sagen, dass das Wachstum des Flussbarsches im Klíčava-Stausee im ersten Lebensjahre ziemlich gut ist, es hat sich gegen die Jahre 1956 und 1957, da L o h n i s k ý (1960) seine Untersuchungen durchführte, sogar gebessert. Er stellte nämlich die Körperlänge in der Zeit der Anlage des ersten Annulus für die Männchen mit 72 mm, und für die Weibchen mit 78 mm fest. Im Jahre 1965 wurde in den Tagen 7.—9. V. eine grössere Anzahl von Barschen der Gruppe I gefangen, deren Körperlänge zwischen 60 und 110 mm schwankte, die häufigste Frequenz war 80 und hauptsächlich 90 mm (H o l č í k, in verb.). Dagegen hat sich das Wachstum der älteren Jahrgänge im Jahre 1964 gegen die Jahre 1956—7 stark verlangsamt (H o l č í k, in verb.). Was die Nahrung der Jährlinge betrifft, ist es gegen die Beobachtungen von L o h n i s k ý (1959) zu keinen grundsätzlichen Veränderungen gekommen. Da nicht bekannt ist, ob sich die Nahrung der erwachsenen Barsche geändert hat, können keine bestimmten Folgerungen über die Ursache dieser Wachstumveränderungen aufgestellt werden.

In dem Klíčava-Stausee wurde kein deutlich schnelleres Wachstum in den Sommermonaten beobachtet, auf welches Röper (1936) aufmerksam macht. Diese Tatsache kann durch die Nahrungszusammensetzung erklärt werden, denn im Klíčava-Stausee wurden die Insektenlarven nur als nebensächlicher

Nahrungsbestandteil beobachtet, R ö p e r (1936) führt sie dagegen als den Hauptteil der Nahrung dieser Barsche an.

Was die Beziehung des diagonalen Halbmessers und der Körperlänge betrifft, führen eine ähnliche Beziehung, die ich gefunden habe, auch S e g e r s t r ä l e (1933) u. T e s c h (1955) an. Trotzdem benützen die beiden,

Tab. 10. Angaben über das Wachstum des Barsches in seinem ersten Lebensjahre an den verschiedenen Lokalitäten

Lokalität	Verfasser	Datum des Fanges	Durchschnittliche Körperlänge in mm	Durchschnittliche Gewicht g	Zahl der Fische
Rabbas Vastervik süd. Finnland	Segerstråle, 1933	7. 9. 13. 9.	37,0 34,7		77 63
See Borga süd. Finnland	Segerstråle, 1933	8. 12.	54,4	—	61
Müggelsee nörd. Deutschland	Röper, 1936	10. 10.	68,0	3,30	—
Schweriner See nörd. Deutschland	Röper, 1936	26. 9.	72,0	5,40	—
Sakrower See nörd. Deutschland	Röper, 1936	5. 10.	66,0	2,80	—
Gr. Plesower See nörd. Deutschland	Röper, 1936	3. 10.	78,0	5,80	—
Teich Šeberák bei Prag — Böhmen	Kučera, 1948	Oktober	61,0	3,50	34
Teich Zábanský Böhmen	Kučera, 1948	Oktober	82,6	8,60	22
Teich Ponědražský süd. Böhmen	Frank, 1958	Oktober	82,5	11,00	2
Teich Dolejší süd. Böhmen	Frank, 1958	August — — Oktober	62,0	5,30	9
See Mácha nörd. Böhmen	Frank, 1958	24. 10.	73,0	6,00	17
Jachroma-Stausee UdSSR	Šentjakova, 1959	25. 9.	80,0	6,00	20
Rybinsk-Stausee UdSSR	Šentjakova, 1959	1. 10.	55,0	—	136
Lipno-Stausee süd. Böhmen	Vostradovský, 1961	8. 10. 58 24. 9. 59	67,0 57,0	5,20 —	25 86
KLÍČAVA-STAUSEE		8.—10. 10. 31. 10.	69,8 68,0	6,60 5,99	86 55

die Dahl-Lea Methode für die Berechnung des Wachstums, denn die Form der Kurve der Abhängigkeit zwischen Schuppengröße und Körperlänge weicht nur unbedeutend von den Geraden ab. Frank (1958), Lohniský (1960) und Hnatěvič (1960) führen lineare Abhängigkeit des diagonalen Halbmessers der Schuppen zur Körperlänge an. Es scheint, dass dies durch die Tatsache verursacht wurde, dass juvenile Barsche sie nur vereinzelt zur Verfügung hatten. Vostradovský (1961) gibt auch für

die juvenilen Barsche des Lipno-Stausees eine lineare Abhängigkeit der Schuppengrösse zur Körperlänge an. Er hat aber überhaupt keine älteren Barsche gemessen.

ZUSAMMENFASSUNG

Es wurden Nahrungsanalysen bei 79 juvenilen Flussbarschen aus dem Klíčava-Stausee und bei 23 juvenilen Flussbarschen aus dem Slapy-Stausee durchgeführt. Die Körperlängen und die Körpergewichte der 296 juvenilen Barsche aus dem Klíčava-Stausee und der 159 juvenilen Barsche aus dem Slapy-Stausee wurden zur Ermittlung des Wachstums des Flussbarsches während seines ersten Lebensjahres benützt.

Bei 175 juvenilen und bei 36 erwachsenen Barschen aus dem Klíčava-Stausee wurde der diagonale Halbmesser der Schuppe gemessen und die Abhängigkeit der Schuppengrösse zur Körperlänge festgestellt.

Es wurde festgestellt, dass die Nahrung des Barsches in seinem ersten Lebensjahre überwiegend aus Zooplankton besteht. In Sommer wurden in kleinerer Anzahl Insektenlarven, hauptsächlich Chironomidenlarven, beobachtet.

Es wurde festgestellt, dass grössere Nahrungsorganismen (Insektenlarven) von Barschen von der Körperlänge 30 mm an gefressen wurden.

Es wurde beobachtet, dass sich in der Nahrung mit steigender Körperlänge der Fische der Anteil an grösseren Nahrungsorganismen erhöht.

Im Klíčava-Stausee erreichten die Barsche bis zum Oktober des ersten Lebensjahres die durchschnittliche Körperlänge von 68–69 mm und das Körpergewicht von 6–6,5 g. Im Vergleich mit dem durch andere Autoren von verschiedenen Lokalitäten festgestellten Wachstum war der Wuchs des Barsches im Klíčava-Stausee im Jahre 1964 im ersten Lebensjahr ziemlich gut.

Es wurde zum Unterschied von R ö p e r (1936) kein schnelleres Wachstum in den Sommermonaten beobachtet.

Es wurde festgestellt, dass die Schuppen bei den juvenilen Stadien des Barsches wahrscheinlich schneller wachsen als der Körper und dass sich erst in der Erwachsenenheit der Wuchs der Schuppen mit dem Wachstum des Körpers ausgleicht.

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**INFLUENCE OF SHORT-TERM AND LONG-TERM
INTERMITTENT FASTING ON MORPHOLOGICAL CHANGES
OF THE DIGESTIVE SYSTEM OF THE GOLDEN HAMSTER
(MESOCRICETUS AURATUS)**

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Abstract: In the course of investigations of the adaptability of the golden hamster to intermittent fasting the short-term (six weeks) and long-term (twenty weeks) influence of intermittent fasting on the development of periodic hyperphagia and morphological changes of the digestive system was studied. The golden hamster is able to increase gradually its food intake during consecutive weeks of the experiment, though to a considerably smaller extent than the laboratory rat. To the increasing hyperphagia correspond changes in the morphological structure of the digestive system which differ in males and females. The most marked hypertrophy in both sexes is found in the forestomach.

INTRODUCTION

In recent years it has been found that the time distribution of food intake is very important for the metabolism and morphological changes in particular of the digestive system of the mammalian organism. Workers of the physiological department of the Institute of Human Nutrition in Prague have followed up for some time the influence of one model of the time distribution of food intake — intermittent fasting (Fábrý, 1965, review Fábrý et al., 1962). The attained results revealed a number of different features produced by this feeding pattern. The problem of adaptation to the above feeding pattern calls for further research. At present the problem of regulatory mechanisms, in particular humoral ones, is being elaborated (Braun et al., 1967). These problems were also resolved from the aspect of adaptation and the sequence of adaptation phenomena (Petrásek, 1966b; Petrásek et al., 1966).

The basic problem is whether the results obtained in one species of laboratory animals — i.e. the white laboratory rat, have a wider biological validity. Therefore the adaptive capacity of the golden hamster was investigated, i.e. in an animal which is as to the species close to the laboratory rat, differs, however, in some specific features of thermoregulation and the ability to hibernate (Šimek, 1967). From the results of this work which had only a preliminary character we may conclude that intermittent fasting in the golden hamster causes similar changes as in the white rat, e.g. an increased activity of respiratory enzymes, morphological changes of the digestive system, etc. At the same time it was revealed that the ability to increase the food intake on days of free access to food in the hamster is smaller, and that this feeding pattern is a greater stress for the hamster, as may be concluded from the rapid development of morphological changes.

This work is based on a previous publication (Šimek, 1967) and attempts to resolve the influence of short-term and long-term adaptation to intermittent fasting on the development of hyperphagia and morphological changes of the digestive system in both sexes.

MATERIAL AND METHODS

The animals used for experiments were kept under similar conditions, as described in previous work (Šimek, 1967), the only difference being that males and females were kept separately. With the intermittently fasting animals always a control group was compared, fed daily ad libitum. As it was above all important to find out which pattern of intermittent fasting is best suited for the golden hamster, the influence of several patterns of feeding frequency was tested. Based on the assessment of food consumption and by regular weekly weighing of the animals the response of the organism to these dietary patterns was assessed.

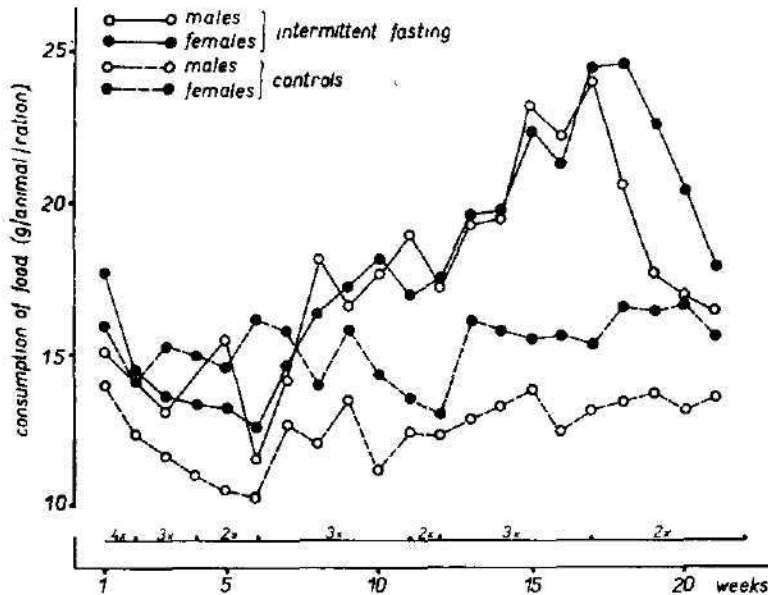


Fig. 1. Volume of food consumed by controls and intermittently fasting hamsters during one feeding period — Lines in the lower part of the figure indicate feeding frequency during appropriate weeks of experiment.

As the basic pattern we selected a regimen when during the first two weeks the animals were fed on alternate days, during the subsequent two weeks three times a week and finally during the next two weeks only twice a week (the same pattern was used by Fábry et al., 1962 in experiments on rats). In the course of the subsequent experimental period two five week periods followed when the animals were fed three times a week and these two periods were separated by a week when the animals were fed only twice a week, and finally during the rest of the experimental period the animals had free access to food only twice a week.

In addition other feeding patterns were used:

- A) The first two-week period when the animals were fed four times a week was followed by a five-week period when the animals were fed three times a week and during the rest of the experimental period alternated two week periods with access to food three times and twice resp.
- B) From the beginning to the end of the experimental period the intermittently fasting animals were fed only three times a week.

The greatest influence on the development of periodic hyperphagia was exerted by the "basic" feeding pattern which was used in animals where morphological changes in the digestive system were investigated. The weight of the stomach and its portions as well as the weight of the small intestine were followed up. The length of the intestine was measured using a standard load of 6 g.

RESULTS

Food consumption and changes in body-weight

The average daily food intake was expressed as one seventh of the total amount ingested during the week (g/animal/day). The food intake on the days with free access to food is expressed as the intake during one feeding period (g/per animal per meal).

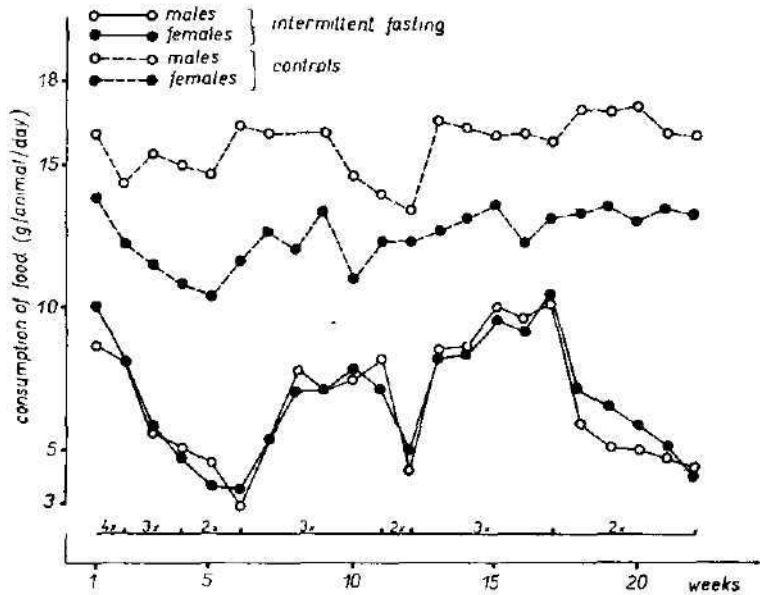


Fig. 2. Average daily food intake of controls (fed ad libitum) and of intermittently fasting hamsters — Lines in the lower part of the figure indicate feeding frequency during appropriate weeks of experiment.

Figures 1 and 2 illustrate the food intake in intermittently fasting hamsters fed according to the "basic" pattern. From the curves of the intermittently fasting animals (figure 2) which after the initial drop follow roughly the curve of controls (though the food intake is on an average by 50% smaller than in controls) markedly differ the curves which express the absolute food intake during one feeding period (Fig. 1).

During the 18th week hyperphagia reaches its maximum, and as compared with the controls, the food consumption in the intermittently fasting animals is on an average by 50% higher. The steep drop of the curve at the end of the experimental period provides evidence that feeding twice a week during a prolonged period involves considerable stress for the golden hamster, and even after previous adaptation, he adjusts only with difficulty to this feeding pattern.

From the results demonstrated on both figures it is apparent that there are no substantial differences between males and females.

In animals on the second feeding pattern (A) when the periods of access to food three times and twice a week alternate more frequently, the absolute

food intake is slightly, but obviously, reduced. Similarly as in the previous group it is not possible to observe basis differences between the degree of periodic hyperphagia in males and females.

The food consumption curve in females fed only three times a week from the beginning of the experiment resembles the curves recorded in the previous feeding patterns. In males we found after an initial slight increase a gradual decline of the food consumption during different feeding periods. These results suggest that the females tolerate intermittent fasting more readily, at least when the above feeding pattern is used. It cannot be ruled out, however, that another factor is involved — the seasonal influence on the

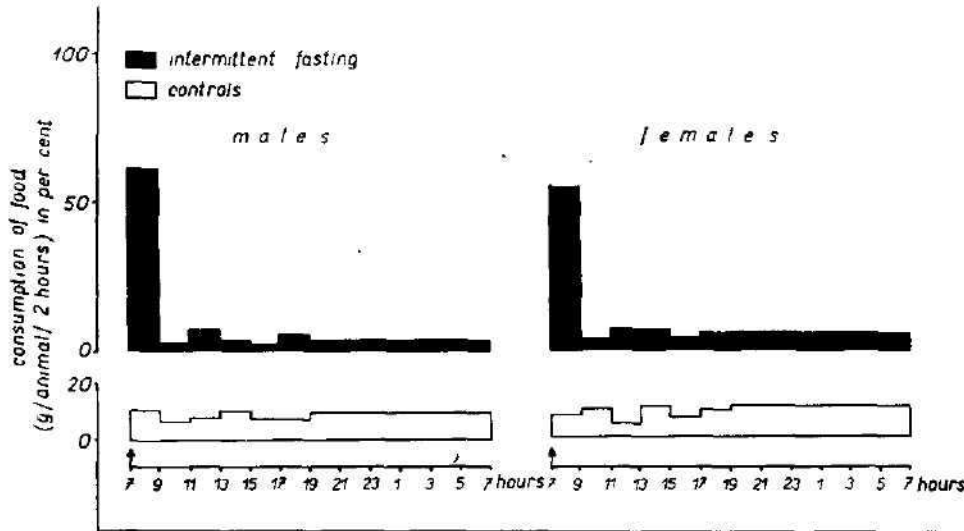


Fig. 3. Food intake during the first twelve hours after administration of food — Food intake during two-hour periods is expressed in % of the total amount consumed during 24 hours. The arrow indicates the time when the food was served. The results are the average values of a group of 16 intermittently fasting males and 15 females and 10 males and 14 females in the control group.

adaptative abilities of the hamster. The results on feeding pattern B were obtained during summer, while all other measurements were made in winter (from Nov. 1966 to Feb. 28, 1967). Therefore before we shall test the influence of different feeding patterns in relation to the season we cannot draw any final conclusions.

If we summarize the results of the food consumption in intermittently fasting hamsters we find that there are no fundamental differences between the different feeding patterns. The differences between sexes also seem to be slight. An exception is formed only by the last feeding pattern, i.e. feeding three times a week.

Investigations of the amount of food consumed during the first twelve hours after it was administered revealed similarly as in laboratory rats that during the first two hours males consumed 60% of the total amount ingested per 24 hours and females 50%, as compared with 10% ingested during the same period by the controls (see fig. 3).

The food intake of intermittently fasting animals is reduced on an average to 50–70% of the intake of controls. During the first six weeks of the experimental period this reduced intake is manifested by a steep drop of body-weight. In the subsequent course of the experiment the drop of weight stops and then, though very slowly, the animals put on weight and at the end of the 20-week experimental period they almost reach the initial weight. Nevertheless during the 20th week of the experiment the weight of the intermittent-

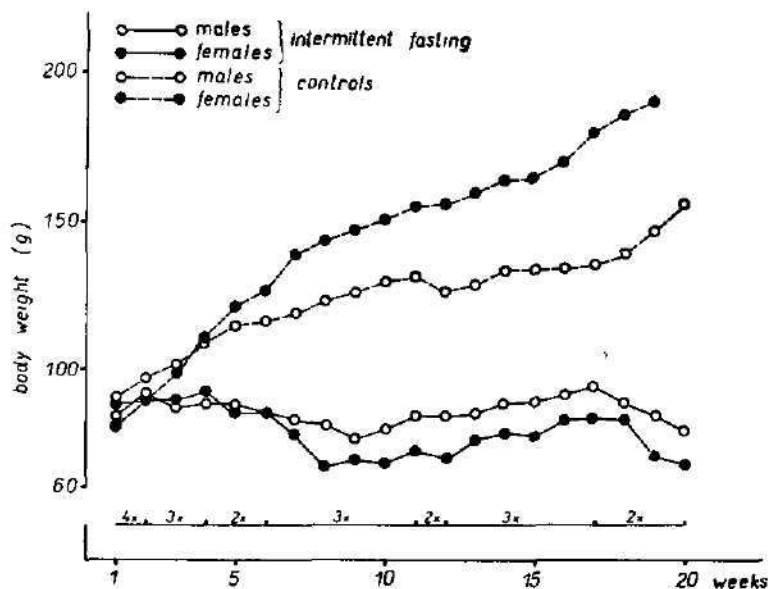


Fig 4. Changes in the weight of controls and intermittently fasting hamsters during a 20 week period of adaptation to intermittent fasting — Lines in the lower part of the figure indicate the feeding frequency during appropriate weeks of the experiment.

ly fasting hamsters (males and females) is on an average by 50% lower than the weight of the controls. Particularly striking is this difference in females which during ad libitum feeding have on an average higher weight increments than males.

The described course of the weight curves is demonstrated in fig. 4 in experimental animals and controls fed according to the “basic” pattern. A similar course of the weight curves was found in all feeding patterns except pattern B in males, which reflects the gradually declining ability of hyperphagia. Attention must be, however, drawn again to possible seasonal differences.

Morphological changes of the digestive system and changes in the relative size of the liver

The anatomical structure of the digestive system of the golden hamster displays already after six weeks of adaptation to intermittent fasting a number of changes (see Figs. 5, 6 and 7). In the first place there is a substantial enlargement of the forestomach and the glandular portion of the stomach.

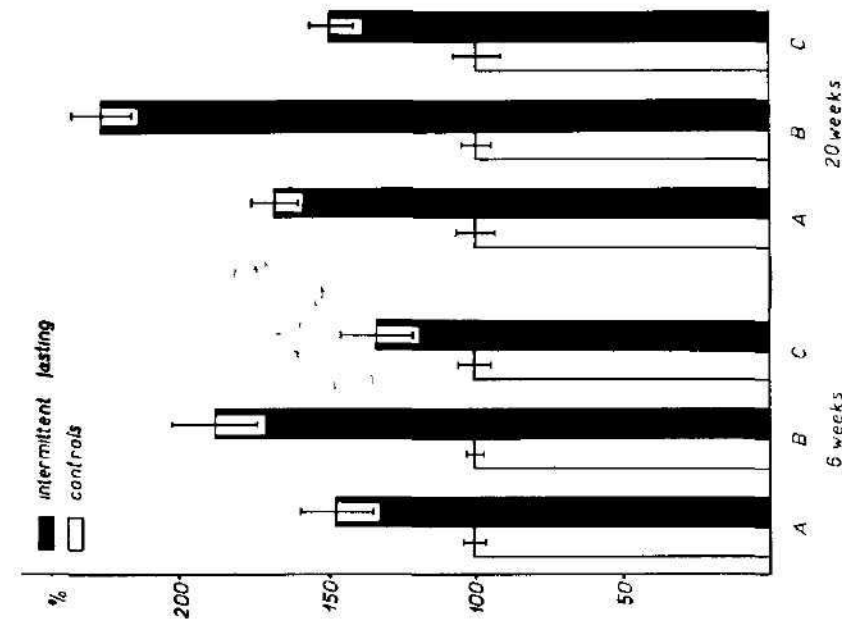


Fig 5 Morphological changes of the digestive system in controls and intermittently fasting females of the golden hamster after six and twenty weeks adaptation to intermittent fasting — A — weight of the whole stomach, B — weight of the forestomach, C — weight of the glandular part of the stomach — The values are averages of the groups \pm S.E., expressed as % in relation to the control group.

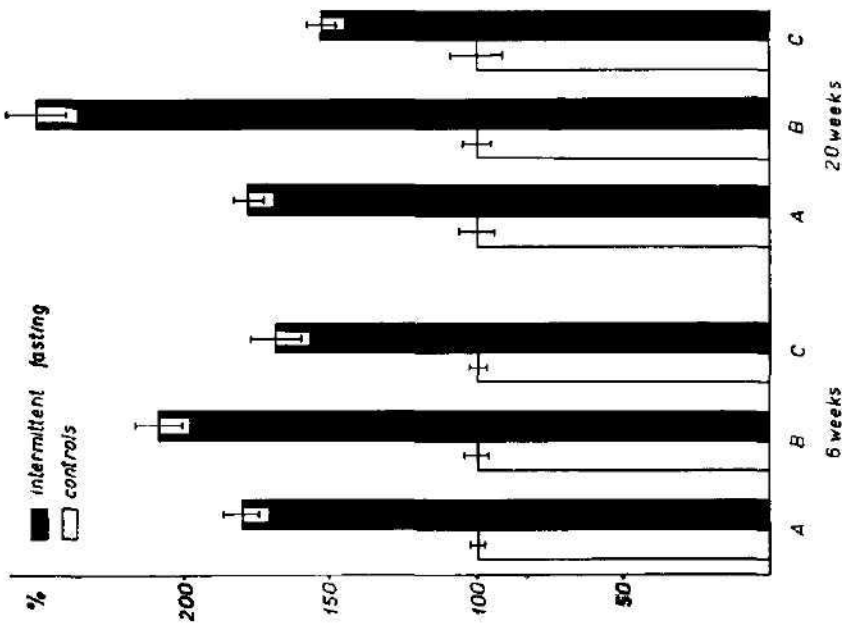
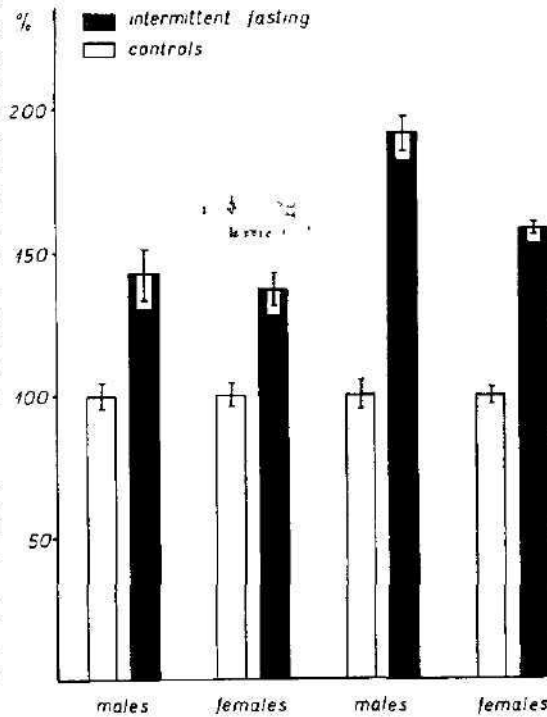


Fig 6 Morphological changes of the digestive system in controls and intermittently fasting males of the golden hamster — A — weight of the whole stomach, B — weight of the forestomach, C — weight of the glandular part of the stomach — The values are averages of the groups \pm S.E., expressed as % in relation to the control group.

The results indicate the difference between males and females: While in males after 6 and 20 weeks of adaptation there is no difference in the total weight of the stomach, in females we can observe an increase by cca 20%. The forestomach in males continues to grow considerably and thus after 20 weeks adaptation to intermittent fasting the size of the glandular portion of the stomach diminishes in relation to the weight of the whole stomach (Fig. 6).

The small intestine is another portion of the digestive system which changes in the course of short-term and long-term adaptation to intermittent fasting. The weight of this organ increases markedly, this increase being relative (in relation to the total body-weight of the animal) as well as absolute. The total-body weight of intermittently fasting animals is after 20 weeks adaptation by 60% lower than that of controls (see Fig. 7 and table). Similarly the length of the intestine increases also (see table). The assessment of the dry weight of the intestinal tissue revealed that the enlargement is not due to a change in the composition of the organ.

Fig. 7. Changes in the fresh weight of the small intestine of intermittently fasting hamsters and controls during the six- and twenty-week period of adaptation to intermittent fasting — first pair of columns: six weeks adaptation; second pair of columns: twenty weeks adaptation. The values are averages of the groups \pm S.E., expressed as % in relation to the control group.



It is of interest to note that in control hamsters with an increasing body-weight the weight of the intestine does not increase. This may imply that younger hamsters may have a relatively larger intestine on any feeding pattern. This phenomenon will be investigated in further experiments.

Investigations of the weight of the liver revealed that after six weeks adaptation of the golden hamster to intermittent fasting the relative weight of the liver declines, and more so in females than in males. In the subsequent course of adaptation the values of the relative weight of the liver approach those of controls and at the end of the period of adaptation they are slightly raised in intermittently fasting animals (see table).

DISCUSSION

From the results presented in the previous chapter a number of interesting findings pertaining to the adaptative abilities of the golden hamster become apparent. As compared with the laboratory rat, the hamster has a smaller

Tab. 1. Growth of the small intestine and changes in weight of the liver in intermittently fasting hamsters (males and females) and in ad libitum fed controls

Group	Weeks of exper. feeding	Number of hamsters	Body weight (g)	Length of small intestine (cm)	Percentage of dry matter	Ratio of weight of small intestine to weight of kidneys	Total weight of liver (g)	Percentage of weight of liver to body weight
MALES								
Intermittent fasting	6	8	71 ± 4.5	40.8 ± 1.2	20.7 ± 0.9	1.69 ± 0.02	2.60 ± 0.68	3.65 ± 0.04
Controls	6	6	151 ± 7.5	41.7 ± 1.8	23.6 ± 0.9	1.61 ± 0.05	6.16 ± 0.05	4.07 ± 0.01
Intermittent fasting	20	15	79 ± 1.0	43.3 ± 2.5	23.9 ± 0.2	2.05 ± 0.08	3.36 ± 0.02	4.21 ± 0.02
Controls	20	13	144 ± 6.5	38.0 ± 3.1	21.9 ± 0.2	1.42 ± 0.01	5.79 ± 0.29	4.02 ± 0.04
FEMALES								
Intermittent fasting	6	9	73 ± 6.6	41.5 ± 1.6	20.0 ± 0.3	1.81 ± 0.19	2.60 ± 0.12	3.46 ± 0.07
Controls	6	6	125 ± 6.5	44.8 ± 0.5	22.0 ± 1.2	1.59 ± 0.08	5.63 ± 0.19	4.43 ± 0.02
Intermittent fasting	20	10	77 ± 3.7	42.4 ± 1.2	22.9 ± 0.9	1.68 ± 0.23	3.16 ± 0.04	4.09 ± 0.12
Controls	20	8	175 ± 13.7	42.5 ± 2.3	21.8 ± 0.7	1.55 ± 0.32	7.05 ± 0.61	3.96 ± 0.04

Values are given in group averages (weights as the nearest whole number) ± S. E.

and slower ability to develop hyperphagia. This is proved in particular by the smaller ability to become adapted during the same period to the feeding pattern used by F á b r y et al. in experiments on rats (F á b r y et al., 1962).

The results of the previous communication (Š i m e k, 1967) must be also made more accurate, i.e. the golden hamster increases gradually, though very slowly the food intake on days of free access. Ten weeks are a relatively short period (for the feeding pattern used) and the hamster is unable within this short period to adjust to the altered feeding pattern. This fact is apparent also from the course of the weight curves. In any case we can speak in the hamster of a lower ability to develop periodic hyperphagia as compared with the laboratory rat.

When evaluating the results we must not neglect some special features by which the golden hamster differs from the rat. In the hamster which in nature is a hibernating animal we may assume certain differences in the adaptation to intermittent fasting in summer and winter. May be a similar phenomenon is involved as that mentioned by F á b r y et al. in wild rats (1962), i.e. that they lack the ability to ingest large amounts of food at a time; this phenomenon is potentiated in winter and is practically lacking in summer. This assumption awaits confirmation in further experiments which will compare metabolic and morphological parameters in summer and winter.

But already now we may state that the feeding pattern with access to food only twice a week is a great stress for the golden hamster even if the animals are adapted to the altered feeding pattern for a long period. The most satisfactory feeding patterns according to findings assembled hitherto is the alternation of feeding periods with access to food three times and twice a week, whereby the frequency of alteration of these two feeding patterns is not decisive.

Similar potent changes in the morphological structure of the digestive system already after six weeks adaptation indicate that intermittent fasting is a more potent stimulus for the hamster than for the rat. Both parts of the stomach (forestomach and glandular portion) are markedly hypertrophic. The position as regards the small intestine is similar.

Only after twenty weeks adaptation to intermittent fasting it is possible to detect in both sexes differences in the absolute weight of the stomach and its portions. An absolute enlargement of the intestine was recorded only in males.

When using a relative criterium of evaluation (e.g. when relating the fresh weight of the intestine to the total body-weight), we can see that the intestine is in both sexes already after six weeks on an average by 40% heavier as compared with controls. The same is found when relating the weight of the intestine to the weight of the kidneys as done by W i e r d a (1950).

If the length of the intestine is measured, we can observe in males after 20 weeks adaptation its absolute prolongation, though the animal is by cca 50% lighter than controls.

All results pertaining to changes in the anatomical structure of the digestive system are in keeping with the results recorded by H o l e č k o v á and F á b r y (1959) in the laboratory rat.

Prolonged intermittent fastin practically does not influence the increase of the weight (absolute or relative) of the liver in the laboratory rat (H o-

lečková and Chytil, 1959). The combined effect of intermittent fasting and cold was studied by Petrásek (1966a). When both factors acted concomitantly for three weeks he found in laboratory rats an increase of the relative weight of the liver as compared with controls. He explains this difference by the fact that in the course of intermittent fasting, when at first the body weight declines, the liver maintains its absolute weight due to its importance for the organism. In the course of subsequent adaptation when the animal becomes already fully adjusted to the new conditions, the liver is able to meet the occasional increased demand even when the relative weight of the organ is unaltered.

In intermittently fasting golden hamsters after six weeks adaptation no increase in the relative liver weight was found. Assessment of the relative liver weight at the end of the 20-week period of adaptation revealed, however, in both sexes an increase. In this respect we must emphasize the marked difference between the laboratory rat and the hamster. In rats an increase of the weight of the liver was found after a shorter period as compared with the hamster. The absolute weight of the liver increases gradually in the course of the twenty weeks of the experimental period.

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SUMMARY

In the course of twenty weeks adaptation to intermittent fasting in the golden hamster (*Mesocricetus auratus*) in males as well as in females the ability to develop periodic hyperphagia was revealed, though to a substantially smaller extent than in the white laboratory rat. With the increasing hyperphagia changes in the morphological structure of the digestive tract are directly associated. These changes can be found in both sexes already after six weeks adaptation to intermittent fasting. The forestomach is most markedly enlarged, in particular in males. By investigating the relative weight of the liver after twenty weeks of the experimental period it was found that its weight increased in both sexes. It appears important to study further the influence of intermittent fasting on the organism of the golden hamster with special attention on intersexual differences. We may assume also seasonal differences in the response of the hamster to changes in the time distribution of food intake.

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**ÜBER DIE GEOGRAPHISCHE VERBREITUNG
DER HARPACTICIDEN (COPEPODA: HARPACTICOIDA)
IN DER TSCHECHOSLOWAKEI**

OTAKAR ŠTĚRBA

Eingegangen am 25. März 1968

Abstract: Die Arbeit ist eine allgemeine Beurteilung der Harpacticiden-Verbreitung in der ČSSR. Es wurde eine Applikation auf den zoogeographischen System der ČSSR sensu Mafan (1956) durchgeführt. An der Charakteristik der Teilregionen in der Richtung Ost-West beteiligen sich am meisten die Arten verschiedenen Gebietsursprunges. An der Charakteristik des ganzen Gebietes von Böhmen beteiligen sich die Angehörigen des westeuropäischen Geno- und Geoelements, die übrige östliche Hälfte der Republik ist ganz unter dem Einfluss von Südosteuropa. Unter anderem wurden Verwandtschaftsbeziehungen zwischen den Harpacticiden der Karpaten und des Kaukasus festgestellt.

Die zoogeographische Beurteilung einer Tiergruppe ist nur in Anlehnung an die gründliche faunistisch-taxonomische Erforschung dieser Tiere möglich. Dies ist auch der Fall der Harpacticiden aus dem Gebiete der ČSSR.

Aus der Zahl der älteren Arbeiten ergibt sich, dass die Harpacticiden zuerst besser in Böhmen als in Mähren und in der Slowakei untersucht wurden. Es soll in dieser Hinsicht besonders auf folgende Publikationen hingewiesen werden: Böhmen – Mrázek (1893, 1893a), Friš-Vávra (einige Arbeiten siehe Literaturverzeichnis), Kessler (1913, 1914), Brehm (1917, 1920), Schafer (1934, 1936), Kulhavý (1957, 1960, 1961), Štěrba (1968), zusammenfassend Štěrba (1968a); Mähren und die Slowakei – Dadaý (1897), Minkiewicz (1916, 1916a), Kalmus (1929, 1931), Straškraba (1956), Kulhavý (1960), Štěrba (1954a, 1954b, 1954c, 1955a, 1955b, 1956, 1960, 1961a, 1961b, 1962a, 1962b, 1963, 1964a, 1964b, 1965a, 1965b). Kleinere Bemerkungen von faunistischen Charakter werden sicher auch in weiteren Publikationen zu finden sein.

Je niedriger die Zahl der Publikationen über die Harpacticiden im Vergleich mit der Behandlungen über andere Tiergruppen ist, desto vollständiger bedeckt das planmässig gewählte Harpacticiden-Probennetz das ganze Staatsgebiet, was für den Zoogeographen besonders vorteilhaft ist. Weil es sich dann hinsichtlich der Zoogeographie um eine sehr günstige Gruppe handelt, kann man die Ergebnisse in vielen Aspekten verallgemeinern. Die Harpacticiden sind an ihre Biotope sehr gut spezialisiert, kommen in allen Typen der oberflächlichen und unterirdischen Gewässer vor, erweisen nur geringe Beweglichkeit, die Möglichkeit ihrer passiven Verschleppung ist minimal, sind relativ wenig durch die Tätigkeit der Menschen berührt, die Gruppe ist genügend artenreich und auch morphologisch und taxonomisch ist sie im Rahmen der Paläarktis relativ gut bearbeitet. Zu den ungünstigen

Eigenschaften gehören kleine Proportionen, sowie die Schwierigkeiten beim Sammeln und bei der Determination.

Die zoogeographische Beurteilung, die in dieser Arbeit vorgelegt wird, betrifft nur allgemeine Gesetzmässigkeiten; die Analyse des Vorkommens der einzelnen Arten und ihre ökologische Charakteristik findet man in folgenden Publikationen: Mähren und die Slowakei – Štěrba, 1964a, 1965a; Böhmen – Štěrba, 1968a.

Für die regionale Bewertung jeder Tiergruppe ist ihre Applikation an ein bestimmtes zoogeographisches System notwendig. Die einzige ausführliche zoogeographische Klassifizierung in der ČSSR stellt bisher nur das Mařan'sche System dar, das auf entomogeographischen Verhältnissen begründet wurde (Mařan, 1956, 1958). Die ungeklärte Frage der Mařan'schen Klassifizierung ist die Existenz von Steppen in der ČSSR. Moderne Biogeographen oder Phytogeographen erkennen in der ČSSR keine wirkliche Steppenregion an, u. a. deshalb, weil hier eine Steppe im natürlichen Zustand schon aus klimatischen Gründen nicht vorkommen kann. Mařan geht es jedoch nur um die Feststellung und zoogeographische Bewertung der gegenwärtigen Verbreitung der Entomofauna; er kommt zum Schluss, dass die Fauna der entsprechenden Gebiete im Süden von Mähren und der Slowakei insoweit charakteristisch ist, dass man diese Gebiete als Steppenregion ausgliedern darf. In keinem Falle ist es die Absicht meiner Arbeit, diese widersprüchigen Fragen zu beurteilen, u. a. schon deshalb, weil die Gruppe der Harpacticiden für eine ähnliche Polemik unzureichend ist.

Ein weiteres System, das auch die Verbreitung der Tiere in Betracht zu ziehen versucht, ist die Klassifizierung der Ökosysteme, die in die Vegetationsstufen eingereiht sind (Raušer – Zlatník, 1966 u. a.). Die unbestreitbare Grundlage dieses Detail-Systemes sind jedoch Pflanzengemeinschaften. Während es mir vor allem um die Beurteilung des gleichzeitigen Zustandes geht, ist das System der Vegetationsstufen vor allem eine rekonstruktive Angelegenheit. Endlich sehe ich das letzte Hindernis darin, dass die diskutierte Klassifizierung zu sehr detailliert bearbeitet ist, sodass wir bei ihrer Applikation auf Harpacticiden eine spärliche und wenig informative Mosaik bekamen. Aus diesen Gründen habe ich das Mařan'sche System verwendet.

DIE UBERSICHT DER ZOOGEOGRAPHISCHEN HAUPTREGIONEN SENSU MAŘAN (1956, 1958)

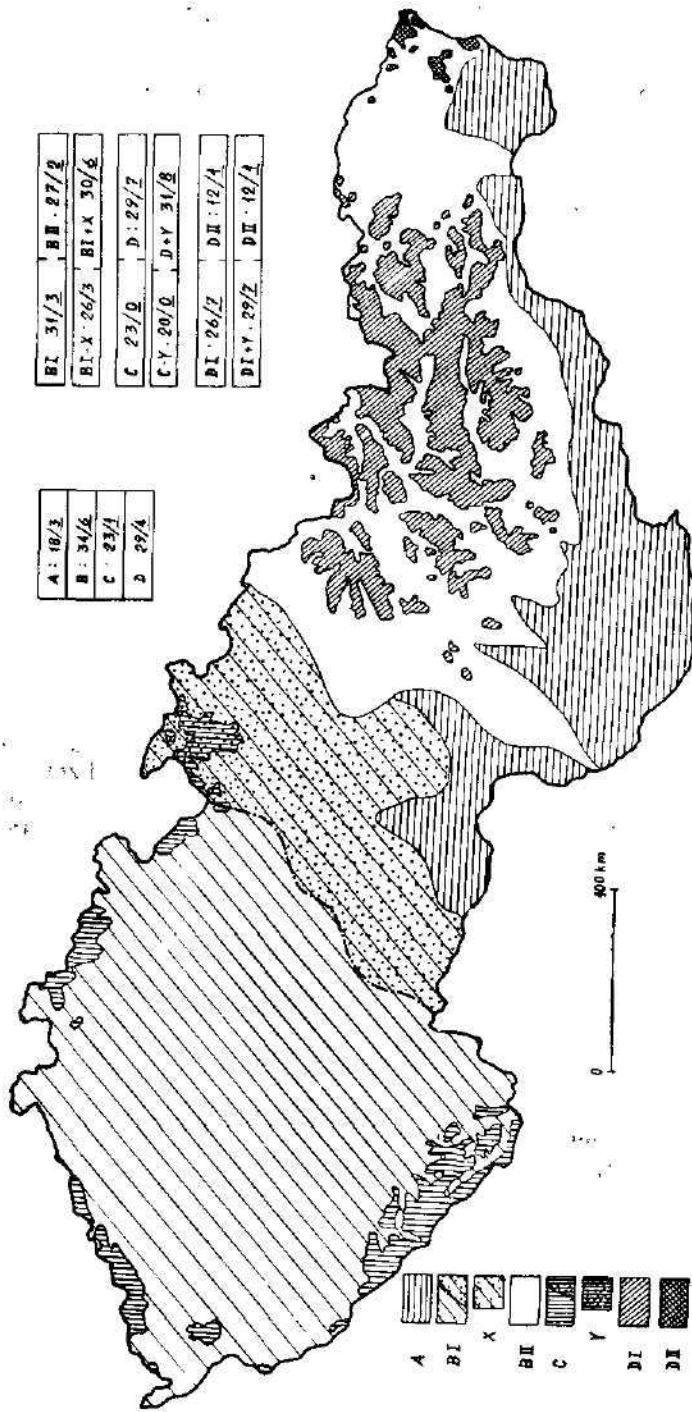
(K a r t e l.)

Die ganze Tschechoslowakische Republik gehört in das klassische Euro-sibirische Untergebiet der Paläarktis (sensu Semenov-Tjanschanski, 1936 – Subregio euro-sibirica, Regio paläarktika). Im Rahmen der ČSSR unterscheidet Mařan 4 Provinzen und eine Reihe Regionen niedrigen Ranges:

I) Die Provinz der Steppen (Provincia tesquorum). Es handelt sich um die Nordausläufer des sogenannten Pannonischen Distriktes (Districtus pannonicus), der die Tieflandgebiete im Süden von Mähren und der Slowakei bis zur Seehöhe 200 m einnimmt.

II) Die Provinz der Laubwälder (Provincia nemorum): Die grösste Provinz, die die gesamten Gebiete des Staates ungefähr von 200 bis 750 m Seehöhe anschliesst. Sie zerfällt in:

IIa) den Böhmischo-mährischen Distrikt im Westen der Provinz (Districtus bohemico-moravicus),



Karte 1: Zoogeographische Hauptregionen der USSR. A = Die Provinz der Steppen. BI = Die Provinz der Laubwälder, der Böhmischemährische Distrikt. X = Die mährische Teil BI. BII = Die Provinz der Laubwälder, der Subkarpatische Distrikt. C = Die Provinz der Varsagebirge. Y = Die mährische Gebirge C (= Geseenke, Grulicher Schneeberg). DI = Die Provinz der Karpatengebirge, der Westkarpatische Distrikt. DII = Die Provinz der Karpatengebirge, der Ostkarpatische Distrikt.
 Schema: Erste (ununterstrichene) Nummer = Gesamtartenzahl der Harpactiden in der entsprechenden Region. Zweite (unterstrichene) Nummer = Gesamtzahl der verlässlichen zoogeographischen differenzierten Arten mit Rücksicht auf die vergleichenden (= benachbarten) Regionen.

IIb) den Subkarpatischen Distrikt im östlichen Teil (Districtus subcarpathicus).

III) Die Provinz der Varisgebirge (Provincia montium variciorum): In der ČSSR ist sie durch den Distrikt des Böhmischen Massives (Districtus massivi bohemiae), mit einer Reihe von Bereichen vertreten, die durch die einzelnen Hauptgebirgszüge, u. a. auch durch das Gesenke (Altatergebirge) und den Grulicher Schneeberg (tschechisch = Kralický Sněžník), also durch zwei mährische Gebirge, repräsentiert sind. Die Höhenbegrenzung der Provinz ist ungefähr 750 m.

IV) Die Provinz der Karpatengebirge (Provincia montium carpathorum): Alle karpatischen Gebirge über 750 m, mit zwei Distrikten:

IVa) Dem Ostkarpatischen Distrikt (Districtus carpathorum orientatum) — in der ČSSR nur die letzten Ausläufer der Ostkarpaten an der Ostgrenze des Staates, einbezogen Vihorlat.

IVb) Dem Westkarpatischen Distrikt (Districtus montium carpathorum occidentatum) — alle anderen Karpatischen Gebirge der ČSSR.

Die Steppenprovinz*

In den Gewässern dieser Region wurden 18 Arten festgestellt. Neben den weit verbreiteten und zoogeographisch wenig bedeutenden Arten leben hier drei zoogeographisch differentielle Arten, die zu der Charakterisierung dieses Tieflandgebietes im Rahmen der ČSSR beitragen (*Parastenocaris pannonicus* Török, *P. proserpina* Chappuis, *Attheyella* [*Brehmiella*] *trispinosa* [Brady]). In Hinblick auf ihre Präsenz (Štěrba, 1965a) sind am stärksten die Tieflandarten vertreten, oder Arten, die vor allem die hier zahlreichen Tümpel bewohnen (*Attheyella crassa* [G. O. Sars], *Canthocamptus staphylinus* Jurine, *Bryocamptus minutus* [Claus]), von den unterirdischen Arten *Elaphoidella elaphoides* Chappuis.

Ein bedeutendes Merkmal negativen Charakters ist die Abwesenheit der Gebirgsarten, vor allem der ganzen Gattung *Arcticocamptus*. Die oligotherme Arten, sofern sie vereinzelt vorkommen, an die Quellen und hauptsächlich an die potamophreatische Gewässer gebunden sind (Štěrba, 1965a, 1966), die ein eigenartiges Lebensmilieu vorstellen, das beträchtlich die zoogeographisch-ökologische Spezifizierung der umgebenden Landschaft verwischt (*Bryocamptus* [*Rheocamptus*] *typhlops* [Mrázek], *Bryocamptus* [*Rheocamptus*] *spinulosus* Boruckij, *Bryocamptus* [*Rheocamptus*] *pygmeus bulbochaetus* Štěrba, *Bryocamptus* [*Rheocamptus*] *zschokkei* [Schmeil.]).

Von dem historischen Gesichtspunkt sind die Angehörigen des allgemein südöstlichen oder südlichen europäischen Gnoelementes bedeutend (sensu Klepová, 1941), das gerade hier stark zur Geltung kommt (*Elaphoidella elaphoides*, *Parastenocaris pannonicus*, *P. proserpina*, *Brehmiella trispinosa*). Die Gesamtzahl der nur 18 in der Provinz gefundenen Arten spiegelt gut die Einförmigkeit der Landschaft wider.

Die Provinz der Laubwälder

Aus dieser grössten tschechoslowakischen Provinz kennen wir insgesamt 31 Taxone. Die Provinz ist eine Domäne der weit verbreiteten Arten; dennoch aber leben hier acht Arten, die im Rahmen der ČSSR nur hier festgestellt wurden (*Phyllognathopus vignieri* [Maupas], *Chappuisius singeri* Chappuis, *Bryocamptus vejvodskiji* [Minkiewicz], *Elaphoidella denticulata* Chappuis,

* Eine Übersicht der Verbreitung aller Arten siehe Karte Nr. 1.

Tabelle 1. Zoogeographische Übersicht

	Provinzen der ČSSR				Provinz der Laubwälder — I			
	Step- pen- provinz A	Prov. der Laub- wälder B	Prov. der Varis- gebirge C	Prov. der Karpa- ten- gebirge D	Subkar- patisch- er Dis- trikt B II	Böhm.-mähr. Distrikt		
						insge- samt B I	nur Böhmi- scher Teil BI-X	nur Mähri- scher Teil X
<i>Phyllognath. viguieri</i>		△				△	+	+
<i>Chappuisius singers</i>		±				±	±	
<i>Chappuisius</i> sp.	+							
<i>Nitocrella divaricata</i>	+	+		+	+	+		△
<i>Canthocampt. staphylinus</i>	+	+	+	+	+	+	+	+
<i>Paracamptus schmei</i>	+	+	+	+	+	+	+	+
<i>Bryocamptus minutus</i>	+	+	+	+	+	+	+	+
<i>Bryocamptus vej dovský</i>		±			+	+	+	+
<i>Bryoc. tarnográdskyi</i>				±				
<i>Pentacamptus mrázeki</i>				±				
<i>Rheocamptus zschokkei</i>	+	+	+	+	+	+	+	+
<i>Rheoc. spinulosus</i>	+	+	+	+	+	(+)	±	±
<i>Rheoc. pygmaeus</i> s. str.	+	+	+	+	+	+	+	+
<i>Rh. pygmaeus bulbochaetus</i>	+	+	+	+	+	+	±	±
<i>Rheoc. typhlops</i>	+	+	+	+	+	+	—	+
<i>Arcticocamp. arcticus</i>			+	+				
<i>Arct. abnobensis</i>		+	+	+		△		△
<i>Arct. laccophilus</i>		+	+		△			
<i>Arct. alpestris</i>				±				
<i>Arct. cuspidatus</i>		+	+	+	+	+	+	+
<i>Arct. macedonicus</i>				±				
<i>Arct. van douwei</i>			△					
<i>Echinocamptus pilosus</i>		±			±			
<i>Limocamptus echinatus</i>	+	+	+	+	+	+	+	+
<i>Maraenob. vej dovský</i>		+	+	+	+	+	+	+
<i>Mar. vej dov. truncatus</i>				△				
<i>Atteheyella crassa</i>	+	+	+	+	+	+	+	+
<i>Att. wverzeiský</i>		+	+	+	+	+	+	+
<i>Brehmiella trispinosa</i>	±							
<i>Brehm. northumbrica</i>		+		+	+	+	△	
<i>Elaphoidella gracilis</i>		+	+			△	+	+
<i>Elaphoidella bidens</i>		△			+	+	+	+
<i>Elaph. denticulata</i>		±			±			
<i>Elaph. phreatica</i>				△				
<i>Elaph. elaphoides</i>	+	+		+	+	+		±
<i>Moraria poppei</i>		+	+	+	+	+	+	+
<i>Moraria brevipes</i>		+	+	+	+	+	+	+
<i>Moraria mrázeki</i>		+	+	+	+	+	+	+
<i>Epactophanes richardi</i>		+	+	+	+	+	+	+
<i>Parasten. phreatica</i>		+	+	+	+	+	+	+
<i>Parasten. phyllura</i>	+	+				△	+	
<i>Parasten. proserpina</i>	±							
<i>Parasten. pannonicus</i>	±							
<i>Parasten. moravica</i>	+	+		+	+	+		±
<i>Parasten. fontinalis</i>		±				±	±	
<i>Parasten. bohemica</i>		±				±	±	
Insgesamt	18	34	23	29	27	31	26 (25)	26
Differentierte Arten	3	6–8	1?	4–6	2–3	3–7	3–4	4–6

(Zoogeographische Regione sensu Mařan 1956, 1958. „Element“ = Goelement und gleich-differentiert für die entsprechende Region in Hinsicht auf die übrigen Regionen der gegebenen erscheint heute als solche infolge unzureichender Durchforschung des Gebietes.)

der Harapactisiden der ČSSR

Provinz der Karpatengebirge D		Provinz der Varisgebirge C		In Hinblick auf Böh.-mährisches Hochland		Bemerkung
Westkarpatischer Distrikt DI	Ostkarpatischer Distrikt DII	Böhmisches Gebirge C-Y	Mährisches Gebirge Y	nur östlich	nur westlich	
					±	„Westeuropäisches“ Element
Δ + + Δ	+ +	Δ + Δ	+			
± + + Δ + Δ ± ±	± + +	+ (+) Δ + ± + +	+ ± ± + +	± ± (±)		„Osteuropäisches“ Element Endemit der Tatra
± ± ±		+ +	+ +			„Östliches“ Element
					±	„Östl.“ Element u. Vikariant?
						Glazial-Relikt
					±	„Osteuropäisches“ Element
					±	Systematisch unsicher
					±	Südöstl. Immigrant
+ Δ + +	+ Δ + +	+ + +	+ Δ + +			Nur die ekolog. Form?
					±	
					±	Südl. Immigrant, SÖ-Element
					±	Südl. Immigrant, SÖ-Element
					±	
					±	Südl. Immigrant
					±	Südl. Immigrant, SÖ Element
					±	Mährisches Element?
					±	„Westeuropäisches“ Element
					±	Böhmisches Element (Endemit!)
26	12	20	17	12 (13)	4	
7-17	1-3	1-6	2-4	12-13 ^v	3-4	

zeitig Geoelement sensu Kleopow, 1941. Unterstrichenes Kreuz ± = die Art ist zoogeographisch Hauptsäule. Dreieck Δ = es handelt sich wahrscheinlich nicht um eine differenzierte Art, sie

Echinocamptus pilosus (van Douwei), *Elaphoidella bidens* [Schmeil], *Parastenocaris fontinalis* Schnitter et Chappuis, *P. bohémica* Štěrba). Als zuverlässig geographisch differenzielle Arten kennen wir daraus *Bryocamptus vej-dovskij*, *Echinocamptus pilosus*, *Elaphoidella denticulata* und wahrscheinlich auch *Parastenocaris fontinalis*, *P. bohémica* und *Chappuisius singeri* betrachten, die für die Gewässer der mittleren Seehöhen typisch sind. Charakteristisch ist auch die Abwesenheit der ausgesprochenen Tiefebenearten (z. B. *Brehmiella trispinosa*), auf anderer Seite dann die Absenz der ausgeprägten Gebirgsarten, wie *Arcticocamptus arcticus* (Lilljeborg), *A. macedonicus* Petkovski, *Bryocamptus tarnogradskij* Boruckij usw. Auch die Analyse der Präsenz bestätigt das skizzierte Bild. Es überwiegen die weit verbreiteten Arten mit einer breiten ökologischen Valenz, die Präsenz der Gebirgs- oder Tiefebenearten ist viel ärmer.

Beachten wir nun die Harpacticiden in beiden Hauptregionen dieser Provinz, das heisst, im Böhmischemährischen und im Karpatischen Distrikt:

Die Spezifität der beiden Einheiten kann nicht mehr nur durch die unterschiedliche Seehöhe bedingt sein, aber vor allem durch die verschiedene historische Entwicklung ihrer Fauna. Wir nehmen an, dass sich im Quartär die Fauna beider Regionen in langen Zeitabständen selbständig und einigermaßen unterschiedlich entwickelte, was vor allem auf die Lage von Böhmen zwischen dem Kontinentalgletscher und den Alpengletschern in der Glazialzeit zurückzuführen ist. In Böhmen herrschte damals ein viel rauheres Klima als in Mähren und in der Slowakei. Die Fauna von Böhmen zog sich vor dem Kontinentalgletscher zurück, vor allem in die südwesteuropäischen Refugien, d. h. des südwestlichen Weges entlang, während die Fauna der Slowakei und offenbar auch des überwiegenden Teiles von Mähren in die südlichen und südöstlichen europäischen Refugien östlich der Alpen wanderte. Diese Teilung des ursprünglich zusammenhängenden Areals hinterliess auch genetische Folgen, die an manchen Arten bis heutzutage bemerkbar sind. Wir setzen auch voraus, dass sich die Fauna des überwiegenden Teiles des Böhmisches Massives unter dem Einfluss der Entwicklungszentren von Südwest- und Westeuropa entwickelte, während die Fauna des Karpatischen Distriktes und offenbar auch die Fauna von dem gesamten Mähren unter dem Einfluss der Entwicklungszentren von Südosteuropa war.

Somit wurde die Fauna beider Hälften des Staates durch Migrante fremden genetischen Elementes angereichert, die zu uns entlang der entsprechenden Migrationswege einerseits vom Südwesten und Westen, andererseits vom Südosten, resp. Osten kamen. Diese allgemeinen Voraussetzungen haben sich vollends auch bei der Analyse der Harpacticidenfauna bestätigt.

Im Böhmischemährischen Distrikt wurden sieben Arten, die in Karpatischen Abschnitt fehlen, festgestellt (*Phyllognathopus viguieri*, *Chappuisius singeri*, *Parastenocaris bohémica*, *P. fontinalis*, *P. phyllura*, *Elaphoidella gracilis*, *Arcticocamptus abnobensis*) und umgekehrt im Karpatischen Distrikt drei Arten, die im Böhmischemährischen Distrikt nicht erfasst wurden (*Echinocamptus pilosus*, *Elaphoidella denticulata*, *Arcticocamptus laccophilus*). Von diesen 10 Arten sind fünf dank ihres unterschiedlichen Gebietsursprungs ausgesprochen geographisch differenziell. Für den Böhmischemährischen Distrikt sind es *Chappuisius singeri* und *Parastenocaris fontinalis*, die sonst nur aus Deutschland bekannt sind (diese Arten sind ein Bestandteil des westeuropäischen Genoelementes) und eine neue Art *Parastenocaris bohémica*, die

allem Anschein nach direkt dem böhmischen Genoelement angehören wird. Dagegen sind für den Karpatischen Teil *Echinocamptus pilosus* und *Elaphoidella denticulata* typisch, die man zum südlichen, resp. zum südöstlichen europäischen Genoelement zählen kann und gleichzeitig zu dem Migroelement, das zu uns vom Süden entlang der östlichen Abhänge der Alpen vor einer verhältnismässig kurzen Zeit eingedrungen ist.

Überraschend ist der Vergleich beider Einheiten, denn unseren Erwartungen entgegen kennen wir mehr Arten aus dem Böhmischemährischen Distrikt. Es wurden hier 31 Taxone festgestellt gegen 27 Arten aus dem Karpatischen Distrikt. Diese Tatsache kann man durch zwei Ursachen erklären. Eine ist die grössere Fläche des Gebietes des Böhmischemährischen Distriktes. Die Hauptursache sehe ich aber darin, dass die Zahl der Arten im Böhmischemährischen Distrikt durch die Arten seines mährischen Teiles erhöht wird, aber dieser Teil steht noch unter starkem Einfluss des östlichen Teiles der ČSSR. Wenn wir nur den böhmischen Teil des Böhmischemährischen Distriktes mit der restlichen Hälfte der Provinz vergleichen, ergibt sich, dass aus Böhmen nur 26 (25), gegen 30 Arten aus dem mährischen und slowakischen Teil der Provinz bekannt sind, was bereits dem erwarteten Zustand entspricht (Siehe Tab. 1.). So taucht die Frage auf, ob es nicht richtiger wäre den heutigen Böhmischemährischen Distrikt, dessen Kern unbestreitbar sein böhmischer Teil bildet, nur auf diesen zu beschränken und den mährischen Teil entweder dem Karpatischen Distrikt beizuordnen, oder ihn als Übergangsbereich selbständig zu bezeichnen.

Diese Ansicht ist nicht nur durch die quantitative Artenvertretung hervorgerufen, sondern auch durch die qualitative Zusammensetzung. In dem mährischen Teil finden wir noch ausgesprochene Angehörige des südöstlichen oder östlichen Elementes, wie *Rheocamptus pygmeus bulbochaetus*, *R. spinulosus*, *Parastenocaris moravica* oder *Elaphoidella elaphoides*, deren westliche Grenze in der ČSSR offenbar das Böhmischemährische Hochland ist. Dieses Gebirge bildet umgekehrt die Ostgrenze für die geographisch differenziellen böhmischen Arten, die nach Mähren nicht durchdringen (*Chappuisius singeri*, *Parastenocaris fontinalis*, *P. bohémica*). Ähnliche Verhältnisse sind auch bei manchen Gruppen der Landtiere bekannt und eine Reihe von ähnlichen Fällen finden wir auch unter den Pflanzen.

Die Provinzen der tschechoslowakischen Gebirge

Die letzte Hauptregionen sind die beiden Gebirgsprovinzen. Was ihre Charakteristik gegenüber der Steppenprovinz und der anliegenden Provinz der Laubwälder betrifft, findet man unter den Harpacticiden eine Reihe von guten Beispielen, die die Ausschliessung der Gebirgslandschaften in selbständige Regionen berechtigen. Es leben hier ausgesprochene Gebirgs- oder Hochgebirgsarten, die nicht 700—750 m Seehöhe unterschreiten, wie *Arcticoamptus arcticus*, *A. alpestris* (Vogt), *A. macedonicus*, *A. van douwei* (Kessler), *A. abnobensis* (Kiefer), *Bryocamptus tarnogradskyi*, *Pentacamptus mrázeki* und andere. Oligotherme Arten wie *Attheyella wierzeiskyi* (Mrázek), *Arcticoamptus cuspidatus* (Schmeil), *Echinocamptus (Limocamptus) echinatus* (Mrázek), *Rheocamptus spinulosus*, *R. pygmeus bulbochaetus*, *Moraria brevipes* (G. O. Sars), *M. poppei* (Mrázek) und *Maraenobiotus vejdvoskýi* Mrázek erreichen hier das Maximum ihres Vorkommens.

Der gegenseitige Vergleich beider Gebirgsprovinzen der ČSSR

Von beiden Gebirgsprovinzen ist die Provinz der Karpatengebirge viel besser charakterisiert. Es leben hier mehr Arten (19 gegen 23 Taxonen aus der Provinz der Varisgebirge) und wir finden hier auch mehr gegenseitig differentielle Arten. Während aus den Gebirgen des Böhmisches Massives nur 4 differentielle Arten bekannt sind (alle mit wesentlichen Vorbehalten-*Arcticocamptus laccophilus*, *A. van douwei*, *Elaphoidella gracilis*, *Moraria mrázeki*), kennen wir aus den Karpatischen Gebirgen 10 differentielle Arten (*Bryocamptus tarnogradskyi*, *Pentacamptus mrázeki*, *Arcticocamptus alpestris*, *A. macedonicus*, *Elaphoidella phreatica*, *Parastenocaris moravica*, *Elaphoidella elaphoides* und vielleicht auch *Nitocrella divaricata*, *Maraenobiotus vejdvovskiji* f. *truncatus*, *Brehmiella northumbrica*). Drei von diesen Arten leben nur in der Tatra, die als einziges wirkliches tschechoslowakisches Hochgebirge durch die Harpacticiden allgemein sehr gut charakterisiert ist (*Pentacamptus mrázeki* — Tatra — Endemit, *Arcticocamptus macedonicus*, *A. alpestris*).

Ein schwieriges Problem scheint die Einordnung der mährischen Gebirge, der Gesenke und der Grulicher Schneeberges, zu sein. Es handelt sich hier um eine ähnliche Frage wie bei dem mährischen Teil des Böhmisches-mährischen Distriktes der Provinz der Laubwälder. Das Gesenke und der Grulicher Schneeberg sind nämlich unter dem Einfluss der Harpacticidenfauna der Karpaten. Ihre Westgrenze erreichen hier zwei zoogeographisch bedeutende Taxone und zwar *Rheocamptus spinulosus* und *R. pygmeus bulbochaetus*, die in der östlichen Richtung bis zum Kaukasus übergreifen, *R. spinulosus* sogar bis in die Mittelasiens-Gebirge (Štěrba, 1967). Obwohl die taxonomische Frage beider Taxone noch nicht endgültig geklärt ist, scheint es sicher, dass es sich um markante Mitglieder des östlichen Elementes handelt, deren Westgrenze die Westkarpaten bilden und woher einige Arten in das Gesenke und in das Gebiet des Grulicher Schneeberges durchdringen (*Rheocamptus spinulosus* wurde in einem Exemplar auch im Riesengebirge gefunden). Das Gesenke und der Grulicher Schneeberg zeigen sich also wieder als ein Übergangsgebiet mit starkem Einfluss der Karpatischen Fauna, worauf übrigens auch zahlreiche Resultate der Erforschung der Landtiere sowie auch floristische Forschungen hinweisen.

Zwei Distrikte der Provinz der Karpatengebirge

Was beide Distrikte der Karpatenprovinz betrifft, fasst der Westkarpatische Distrikt eine viel reichere Fauna um. Es ist schon deswegen begreiflich, weil der ostkarpatische Raum in die ČSSR nur mit geringen Ausläufern im Osten des Staates eingreift. Beide Distrikte sind gegeneinander nicht nur quantitativ, sondern auch durch ihre Artenzusammensetzung unterschiedlich. Heutzutage kennen wir insgesamt 20 Arten, die ausschliesslich in diesem oder jenem Distrikt leben (siehe Tab. 1.), sieben daraus können wir dann als tatsächlich geographisch differentielle Arten ansehen, und zwar für den Westkarpatischen Distrikt *Pentacamptus mrázeki*, *Arcticocamptus arcticus*, *A. macedonicus*, *A. alpestris*, *A. cuspidatus*, *Parastenocaris moravica*, für den Ostkarpatischen Distrikt dann *Bryocamptus tarnogradskyi*.

Zwei von den zuletzt genannten Arten sind zoogeographisch besonders bedeutend. Die erste ist der tatraische Endemit *Pentacamptus mrázeki*,

der hier ausschliesslich in den Bergseen lebt, wobei seine Untergattung bereits nur mit sieben Arten aus dem Baikalsee und mit einer Art aus Nordamerika bekannt ist. Offenbar geht es um einen seltenen Fall eines alten, wenigstens tertiären Reliktes. Die zweite interessante Art ist *Bryocamptus tarnogradskyi* aus dem Vihorlat-Gebirge, die sonst nur aus dem Kaukasus bekannt ist, wo sie bis vor kurzem für einen dortigen Endemit gehalten wurde (B o r u c k i j, 1952).

Neben *Bryocamptus tarnogradskyi* leben im Kaukasus von den aus der ČSSR bekannten Harpacticiden (natürlich neben einiger weit verbreiteten Arten) noch *Rheocamptus pygmeus bulbochaetus*, *R. spinulosus* und *Arcticocamptus macedonicus*. Diese vier Taxone sind ausgeprägte osteuropäische Gebirgs-Taxone jüngsten Ursprungs, die die engen Beziehungen der jungen Fauna der tertiären Gebirgszüge der Paläarctis sowie die gegenseitige Beziehungen der tschechoslowakischen Fauna der Karpaten zur Fauna des Kaukasus und zur Fauna anderer asiatischen Hochgebirge bezeugen. Diese Beziehungen sind meines Wissens nach bisher bei anderen Gruppen nicht festgestellt wurden.

ZUSAMMENFASSUNG

Die Arbeit ist eine allgemeine Beurteilung der zoogeographischen Verbreitung der Harpacticiden in der ČSSR. Da die Harpacticiden für die Zoogeographie eine sehr geeignete Gruppe sind, kann man voraussetzen, dass einige Schlussfolgerungen auch eine allgemeinere Gültigkeit haben. Es wurde eine Applikation auf das zoogeographische System der ČSSR sensu M a ř a n (1956, 1958) durchgeführt.

Die Steppenprovinz ist durch drei differentielle Arten, eine hohe Präsenz der Tiefebennarten und eine niedrige Präsenz bis Absenz der Gebirgsarten charakterisiert. Bedeutungsvoll ist auch das Vorkommen der Vertreter des südlichen und südöstlichen europäischen Geno- und Geoelementes.

Die Provinz der Laubwälder ist von allen Provinzen am artenreichsten. Es überrascht die grosse Artenzahl im Böhmischo-mährischen Distrikt dieser Provinz, es ist jedoch offenbar, dass dieser Zustand durch den Beitrag der Arten des mährischen Teiles der Provinz verursacht ist, wobei dieses mährische Gebiet schon unter starkem Einfluss der östlichen Hälfte des Staates steht. Eine ähnliche Situation besteht auch im Fall der mährischen Gebirge (Gesenke und Grulichner Schneeberg), die heute in die Provinz der Varisgebirge eingereiht werden. In diesen Gebirgen endet jedoch das Areal einiger ausgesprochen osteuropäischen Taxone. So entsteht die Frage, ob es nicht richtiger wäre, die mährischen Teile der vorerwähnten Regionen den zugehörigen Regionen der östlichen Hälfte des Staates anzureihen, oder sie als Übergangsgebiet auszugliedern.

An der Charakteristik der Teilregionen der Gebirgsprovinzen beteiligen sich am meisten Arten verschiedenen Gebietsursprunges, was die Folge der unterschiedlichen Entwicklung der Fauna beider Hälften des Staates ist, die durch den Einfluss der Glaziale verursacht wurde.

An der Charakteristik des ganzen Gebietes von Böhmen beteiligen sich vorzugsweise die Angehörigen des westeuropäischen Geno- und Geoelementes, die übrige östliche Hälfte der Republik ist dann unter dem Einfluss von Südosteuropa.

Ähnliche Verwandtschaftsbeziehungen, die zwischen den Harpacticiden der

tschechoslowakischen Karpatengebirge und den Harpacticiden des Kaukasus festgestellt wurde, sind bisher bei anderen Gruppen wahrscheinlich noch nicht beschrieben worden.

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PARASITIC NEMATODES OF CERTAIN RODENTS FROM AFGHANISTAN

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Abstract: The present paper deals with parasitic nematodes found in certain rodents in Afghanistan during the spring months of 1966 and 1967. Apart from *Syphacia obvelata* (Rudolphi, 1802), *Aspiculuris tetraptera* (Nitzsch, 1821) and *Heterakis spumosa* Schneider, 1866, descriptions are given of three new species, viz., *Trichocephalus bahanus* n. sp., *Longistriata djumachani* n. sp. and *Heligmostrongylus afghanus* n. sp. Besides, the rodents were infested with the members of the order Spirurida Chitwood, 1938, whose species could not have been identified exactly. Also, the species *Vianella chinensis* Erhardová, 1959, hitherto recorded in rodents from China, was recorded in those from Afghanistan for the first time. The paper is supplemented by systematic, taxonomic and ecologic notes.

There are only scarce literary data on nematodes parasitizing rodents in Afghanistan (Akhtar, 1939, 1955; Skrjabin et al., 1960). During 1966 and 1967, I had the opportunity of examining, through detailed helminthological autopsies, a major part of rodents captured by the zoological and parasitological expedition to Jalal-Abad and its environs (cf. Gaisler, Povolný, Šebek et Tenora 1967, this paper also containing a detailed map of the study area). In all, I examined 487 rodents in which I found 8 species of parasitic nematodes (Tab. 1). Except for *H. spumosa*, none of these species has been recorded in Afghanistan so far. Of these eight species, three species new for science are described. The holotype and paratypes of these species are deposited in the author's collection.

Syphacidae Skrjabin et Schikhobalova, 1951
Syphacia obvelata (Rudolphi, 1802)

Hosts and localities: *Mus musculus* (Jalal-Abad, Somarkhel, Bisut, Darunta Hills, Laghman), *Rattus rattus* (Bisut), *Meriones libycus* (Somarkhel), *Nesokia indica* (Jalal-Abad).
Location in host: small and large intestine, blind gut.
Material: Only females and juvenile individuals were obtained.

The morphology and metric data of adult females fit within the range of variability of the description of females of this species, as given, e.g., by Erhardová et Ryšavý (1955), Tenora et Baruš (1955), Panin (1956) and Skrjabin et al. (1960).

Ecological notes: The females and juvenile individuals of *S. obvelata* parasitized *Mus musculus* in all localities investigated. They were ascertained in *Mus musculus* caught both in human habitations and their immediate vicinity and, also, in those caught in field crops, parks and moist slopes.

As for *Rattus rattus*, *S. obvelata* was ascertained in individuals caught in the houses of the agricultural agglomeration Bisut. Also, female *S. obvelata* parasitized *Nesokia indica* in places where intensive contacts between populations of *Mus musculus* and *Nesokia indica* took place (e.g., in the surroundings of irrigation canals, in field crops). It is worth while to note the discovery of *S. obvelata* in a free living population of *Meriones libycus* in the environs of Somarkhel. In 1966, I examined a total of 27 individuals of this semi-desert population, with a negative result as for the presence of *S. obvelata*. It must be noted that at that time, no other rodents were captured in that locality or its immediate vicinity although searched for intensively. In 1967, individuals of both *Meriones libycus* and *Mus musculus* were captured in the above locality. Both these mammal species were infested with *S. obvelata*. It is presumed that the intensive contact of populations of *M. libycus* and *M. musculus* enabled the transmission of *S. obvelata* to the quite new host, *M. libycus*.

S. obvelata is a cosmopolitan species (cf., e.g., the recent data by Schiller, 1952; Erhardová, 1959; Skrjabin et al., 1960; Tokobajev, 1960; Quentin, 1966) parasitizing rodents of the families Muridae, Microtidae, Cri-

Tab. 1. Review of mammals examined and their parasitic Nematoda

Host	Siphocampylus obvelata		Aspiculuris tetraptera		Heterakis spumosa		Trichocephalus bahanus n. sp.		Vianella chinensis		Longistrotia djumachani n. sp.		Heligmosomon glyphaeformis n. sp.		Spirurida sp.	
	A	a	b	a	b	a	b	a	b	a	b	a	b	a	b	
<i>Mus musculus</i>	96	13	3	11	9	2	2	—	1	1	1	2	40	7	—	—
<i>Nesokia indica</i>	67	3	18	—	—	4	9	—	16	4	6	2	13	2	—	—
<i>Rattus rattus</i>	115	12	12	3	21	—	—	—	—	—	—	—	2	7	—	—
<i>Rattus rattoides</i>	2	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
<i>Meriones libycus</i>	114	7	6	—	—	—	—	1	—	—	—	—	1	2	—	—
<i>Tatera indica</i>	53	—	—	—	—	—	—	12	—	—	—	—	—	—	2	—
<i>Calomyscus bathoardi</i>	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Meriones persicus</i>	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

A — number of mammals captured, a — number of mammals infested, b — average intensity of invasion (individuals)

cetidae, *Sciuridae*, *Gerbilidae* as well as man (in Afghanistan, this species was not ascertained to parasitize man, cf. P o v o l n ý et T e n o r a, 1966). On ground of the above data, *Nesokia indica* and *Meriones libycus* are new hosts of *S. obvelata*.

S. obvelata was also recorded in a number of regions bordering with Afghanistan, particularly in the USSR. Thus, e.g., it is known to parasitize rodents in Tadzhikistan (K o s t y l e v et Z m e e v, 1939; Z a n i n a et T o k o b a j e v, 1962), Kirghiz (T o k o b a j e v, 1959, 1960) and Kazakstan (A g a p o v a, 1953; P a n i n, 1956). In zoogeographic respect, the area of Afghanistan in which I ascertained *S. obvelata* lies in close vicinity of the Oriental Region. This fact indicates a possibility that the rodents of Afghanistan are parasitized by some other species of the genus *Syphacia*, e.g., *S. baylisi* Mapleston et Bhaduri, 1942, or *S. tineri* Khera, 1954, known from the rodents of India, or *S. lahorea* Akthar, 1955, ascertained in the members of *Sciuridae* in Pakistan (cf. S k r j a b i n et al., 1960).

Heteroxyneematidae Skrjabin et Schikhobalova, 1948

Aspiculuris tetraptera (Nitzsch, 1921)

Hosts and localities: *Mus musculus* (Jalal-Abad, Somarkhel, Bisut, Laghman), *Rattus rattus* (Bisut, Laghman).

Location in host: blind gut, large intestine.

Ecological notes: The ascertained individuals of *A. tetraptera* parasitized synanthropic populations of *Mus musculus* and *Rattus rattus* as well as individual *Mus musculus* caught outside human habitations (above all, in field monocultures).

In the reference book by S k r j a b i n et al. (1960), *A. tetraptera* is stated to parasitize rodents of the Holarctic Region. Q u e n t i n (1966) ascertained this species in the rodents of the palaeotropic part of Africa and denoted it as a cosmopolitan species. In Afghanistan, *A. tetraptera* has hitherto not been ascertained. In connection with this discovery, it is necessary to note that in zoogeographic respect, it is impossible to exclude the occurrence in Afghanistan of some additional species of the genus *Aspiculuris*, e.g., *A. asiatica* Schulz, 1927, parasitizing *Rhombomys opimus* in Turkestan and Kazakstan; *A. kazachstanica* Nasarova et Sweschnikova, 1930 and *A. schulzi* Popoff et Nasarova, 1930, parasitizing *Mus musculus* in Kazakstan; or even *A. pakistana* Akthar, 1955, parasitizing *Rattus rattus rufescens*; or *A. lahorea* Akthar, 1955, parasitizing *Mus musculus* in Pakistan (cf. S k r j a b i n et al., 1960; A k t h a r, 1955).

The discovery of *A. tetraptera* (Nitzsch, 1821) in Afghanistan makes it possible to add a few notes on the systematics of the genus *Aspiculuris* Schulz, 1926. The reference book by S k r j a b i n et al. (1960) contains the descriptions of all hitherto known species of the genus *Aspiculuris* (except *A. lahorea* Akthar, 1955 and *A. africana* Quentin, 1966). The criteria separating the different species are heterogenous and, hence, the authors did not compile a key to species (except for A k t h a r, 1955). Also, the systematics of the genus *Aspiculuris* proposed by A k t h a r (1955), i.e., a separation of five subgenera, was not discussed either by S k r j a b i n et al. (1960) or by Q u e n t i n (1966). On the basis of the material of *A. tetraptera* from Europe and Afghanistan, however, it is possible to maintain that the characters given by A k t h a r (1955) for the separation of the species of the subg.

Aspicularis are variable. Tentatively, it is necessary to point out that *A. kazakhstanica* and *A. lahorea* are very likely synonymous with *A. tetraptera*. The morphological and metrical characters separating these species are insignificant and all these species parasitize the same host (*M. musculus*) in different parts of the same zoogeographical region. Moreover, *A. tetraptera* parasitizes rodents (*Mastomys*, *Praomys*, *Thamnomys*) in the Palaetropical Region (Quentin, 1966).

Heterakidae Railliet
et Henry, 1912

Heterakis spumosa Schneider, 1866

Hosts and localities: *Mus musculus* (Bisut, Jalal-Abad), *Nesokia indica* (Jalal-Abad, Somarkhel, Laghman) ■
Location in host: large intestine.

Ecological notes: This species parasitized individuals of *N. indica* captured in gardens and in the vicinity of irrigation canals. The species was also ascertained in *M. musculus*, both in synanthropic populations and in the free living population in field monocultures and in the vicinity of human habitations.

With regard to the fact that *N. indica* is a new host of this parasite, I give here a brief description of the individuals of *H. spumosa* from this host:

Male: body length 8.2 to 11.4 mm; body width 0.21 to 0.36 mm. Anterior part oesophagus 0.510 to 0.680 mm long; length of bulb varying between 0.2 and 0.27 mm. The end of body is provided with a projection over which a conspicuous bursa copulatrix is spread (Fig. 1). Bursa with five pairs of papillae; of these, three pairs are mighty and protruding into the bursa, two pairs are smaller and lie between the laterally protruding papillae. In the abdominal part of the body, the bursa forms a very fine cuticular margin in which there are three pairs of minute papillae. Additional two pairs of pedunculate papillae are situated in the area of the preanal sucker. Preanal sucker oval in shape, 0.069 to 0.088 mm in diameter. Two straight spiculae of equal size are 0.239 to 0.3 mm in length.

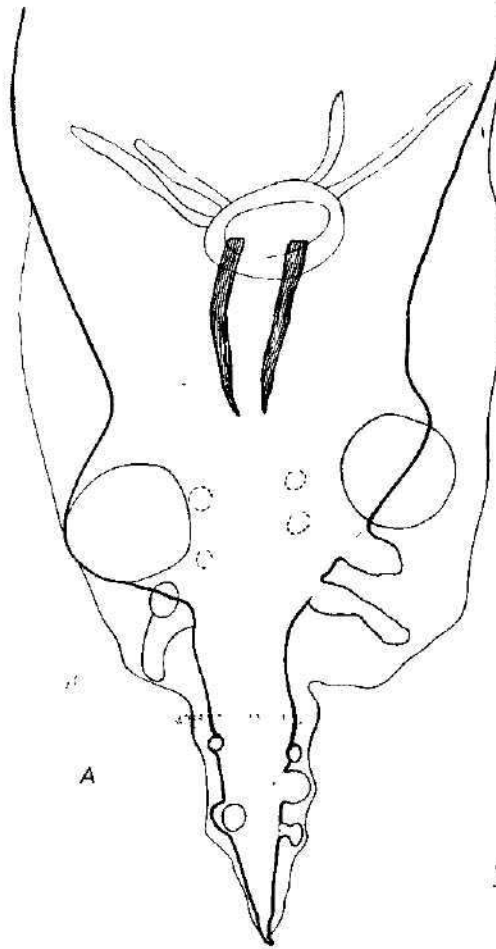


Fig. 1. Abdominal part of body of male *Heterakis spumosa* Schneider, 1866.

Female: Body length varies between 10 and 17 mm; body width, between 0.45 and 0.5 mm. Oesophagus longer than in the male on the average, measuring 0.66 to 0.78 mm. Length of bulb very variable, between 0.15 and 0.36 mm. Anus distant from the end of body 0.9 to 1.11 mm. Vulva situated in the area of the middle of body (for instance, in individuals 14 mm in length the vulva is situated at a distance of 7.2 mm from the anterior end of the body). Dimensions of eggs, 0.040 to 0.044 by 0.060 to 0.064 mm.

Both males and females parasitizing *Mus musculus* in Afghanistan are morphologically and metrically identical with those parasitizing *N. indica*.

Taxonomic notes: The species *Heterakis spumosa* Schneider, 1866 belongs to the subfamily *Heterakinae* Railliet et Henry, 1912. The opinions on the systematics of this subfamily, involving parasites of both birds and mammals, are not uniform (cf. Skrjabin et al., 1961 and Inglis, 1967). Also, there are different opinions as to the specific position of "*spumosa*" Schneider, 1866. Skrjabin et al. (1961) arrange this species under the genus *Ganguleterakis* Lane, 1914. Inglis (1967) believes that this genus is synonymous with *Heterakis* Dujardin, 1845.

As for the subfamily *Heterakinae*, parasites of birds are known only in the genus *Heterakis* Dujardin, 1845 sensu Inglis, 1967. From the mammals, the following light species have been described:

(1) *Heterakis spumosa* Schneider, 1866 was described from *Rattus norvegicus*. According to Skrjabin et al. (1961), it is a cosmopolitan species, parasitizing, above all, members of the genera *Rattus* and *Mus* but found to parasitize other rodents as well.

(2) *Heterakis paradoxa* Linstow, 1906 is known to parasitize *Didelphys dorsigera* only (the statement on the locality is missing). From *H. spumosa*, the males of this species differ chiefly by the lower number of pairs of papillae in the abdominal part of their body (8 pairs, of which only two are in the abdominal projection). The females are smaller than the males. While *H. spumosa* parasitizes the members of Rodentia, *H. paradoxa* parasitizes the mammals of the order Polyprodonia.

(3) *Heterakis dahomensis* Gendré, 1911 was described from *Cricetus gambianus* in Dahomey. Also, Boulenger (1923) ascertained it in the same host in Zanzibar. From *H. spumosa*, this species differs by a lower number of papillae in the abdominal part of its body. By the number of papillae in the abdominal part of its body (9 pairs) and by its hosts, this species also differs from *H. paradoxa*. It agrees with *H. paradoxa* in its males also having only two pairs of papillae in the abdominal projection. Already Hall (1916), as well as other authors (cited in Skrjabin et al., 1961) consider *H. dahomensis* Gendré, 1911 to be synonymous with *H. spumosa* Schneider, 1866.

(4) *Heterakis gangula* (Lane, 1914) was described from the members of the genus *Rattus* in India. It is decidedly synonymous with *H. spumosa* (cf. also Skrjabin et al., 1961).

(5) *Heterakis spalacis* Marcu, 1930 is known to parasitize *Spalax microphthalmus* in Rumania. A parasite of mammals, it differs from all hitherto known species of the genus *Heterakis* above all by having spiculae of uneven size.

(6) *Heterakis macrospiculum* Ortlepp, 1939 was found in *Bathyergus suillus* in Africa. From the preceding species it differs, above all, by a larger

number of pairs of papillae in the abdominal part of its body as well as by longer spiculae.

(7) *Heterakis micropis* (Tenora, 1960) is known to parasitize *Apodemus microps* and *Apodemus sylvaticus* in Europe (Czechoslovakia). It is a species closely related to *H. dahomensis*, differing from it only by shorter spiculae and by the absence of one pair of lateral cephalic papillae.

(8) *Heterakis spalaxi* (Kozlov et Jangolenko, 1963) is known to parasitise *Spalax microphthalmus* in USSR.

It must be stated that at present there is no uniform opinion as to the criteria on the basis of which it is possible to exactly separate all hitherto described *Heterakis* spp. This pertains both to parasites of birds and those of mammals. The present author states that if *H. dahomensis* Gendre, 1911 will be proved to be synonymous with *H. spumosa* Schneider, 1866 on ground of a comparison of type materials, even *H. micropis* (Tenora, 1960) is synonymous with *H. spumosa*.

Owing to the above facts, also the key to the members of *Heterakinae* is missing. Until the solution of the above-mentioned taxonomical and systematical problems, I suggest that the following key be used to the members of the subfamily *Heterakinae* parasitizing the mammals:

- (1) Spiculae of uneven length; parasites of the genus *Spalax* . . . *Heterakis spalaxis*, Marcu, 1930
- Spiculae equal in length 2
- (2) Caudal part of body with 12 pairs of papillae; spiculae 1.8 mm in length
- Caudal part of body with 8—10 pairs of papillae *Heterakis macrospiculum* Ortlepp, 1939 3
- (3) Caudal part of body with 8 pairs of papillae; parasites of mammals of the order Polyprotodontia *Heterakis paradoxa* Linstow, 1906
- Caudal part of body with 9—10 pairs of papillae; parasites of the order Rodentia 4
- (4) Caudal part of body with 10 pairs of papillae; spiculae 0.2 to 0.4 mm in length
- Spiculae 0.693 — 1.07 mm *Heterakis spumosa* Schneider, 1866
- Caudal part of body with 9 pairs of papillae; spiculae 0.18 to 0.4 mm in length 5
- (5) Cervical papillae absent; spiculae 0.18 to 0.2 mm in length
- Cervical papillae present; spiculae 0.32 to 0.4 mm in length *Heterakis micropis* (Tenora, 1960)
- Cervical papillae present; spiculae 0.32 to 0.4 mm in length *Heterakis dahomensis* Gendre, 1911

Trichocephalida Baird, 1853

Trichocephalus bahanus n. sp.

Hosts and localities: *Tatera indica* (Somarkhel), *Meriones libycus* (Somarkhel).

Location in host: blind gut.

Ecological notes: This species parasitized only the individuals of a synanthropic population of *T. indica* (captured in tea houses). In all, 41 individuals of *T. indica* were captured, of which 29% were infested with *T. bahanus*. Additional 12 individuals of *T. indica*, captured in free nature (both at Jalal-Abad and Laghman and their environs) were not infested with *T. indica*. Also, a single individual of *Meriones libycus* (out of a total of 114 individuals of that species examined) was infested with *T. bahanus*; the individual was also captured not far from a tea house.

Description of the material from Tatera indica:

Male (holotype): total length, 41.4 mm. Anterior thin part of body with the oesophagus nearly as long as the conspicuously enlarged posterior part of body: 21 mm : 20.4 mm. Cephalic part 0.010 mm in width, gradually widening posteriorly. In the area of fusion of the oesophagus with the gut, the anterior part of the body is 0.375 mm wide. The posterior thicker part of body is at most 0.700 mm wide. Spicula strongly sclerotized, 1.75 mm in length, slightly enlarged at base (0.030 mm), rounded at apex (0.0125 mm). Spicular sheath provided with spines (Fig. 2) and 0.43 mm long. Cloaca shorter than ductus ejaculatorius (1.5 mm : 2.1 mm). Testes massive, divided into rounded parts. Dimensions of paratypes are given in Tab. 2.

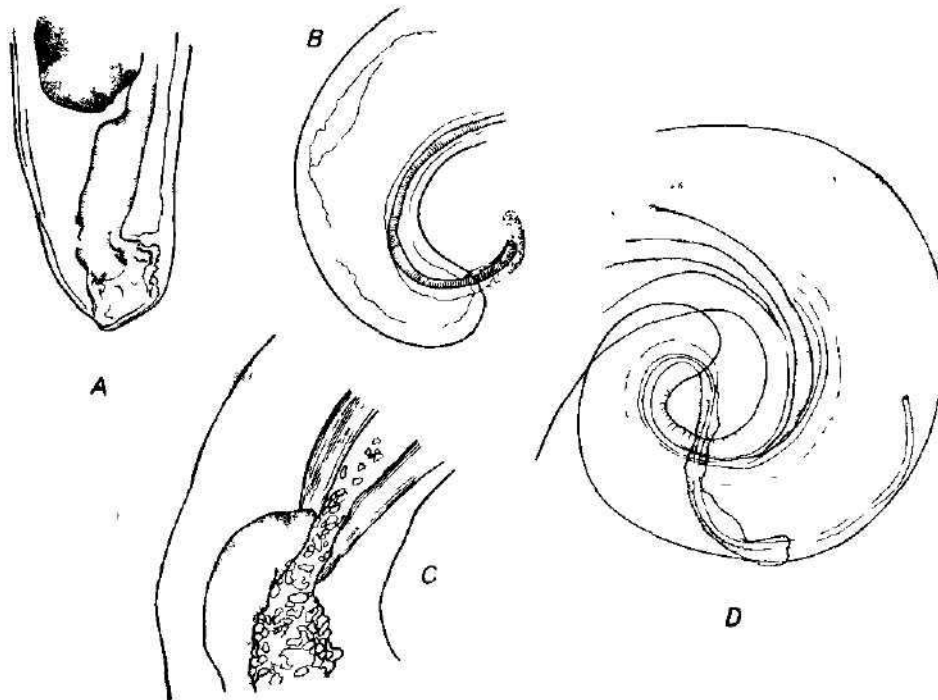


Fig. 2. *Trichocephalus bahanus* n. sp. A, abdominal part of body of female; B, abdominal part of body of male with spiculae exposed and a part of spicular sheath; C, area of fusion of oesophagus and intestine; D, abdominal part of body of male with spiculae exposed and outside the spicular sheath.

Female: longer than males, their length varying between 41 and 57 mm. The anterior part of their body is invariably longer, 23 to 34 mm in length; the posterior thicker part of body is 21 to 23.8 mm in length. This posterior part of body is stouter than that of the males on the average, attaining a width of 0.420 to 0.780 mm. The cephalic part is 0.010 to 0.015 mm in width, widening gradually. In the place where the tubular oesophagus passes into the intestine, the body is 0.210 to 0.353 mm in width. Vulva about 0.075 mm distant from the place where the intestine separates from the oesophagus.

The eggs, including their polar projections, measure 0.048 to 0.052 by 0.020 to 0.024 mm.

The individuals obtained from *Meriones libycus* show dimensions falling into the above limits.

Differential diagnosis of T. bahanus n. sp.:

(1) From *T. citelli* (Chandler, 1945), *T. bahanus* n. sp. differs by smaller length of cloaca, longer spicular sheath and smaller eggs.

(2) From *T. fossor* (Hall, 1916), *T. bahanus* n. sp. differs by longer spicular sheath. The length of cloaca and eggs cannot be compared as their metric data are unknown.

(3) From *T. spalacis* Petrov et Potetchina, 1953, *T. bahanus* n. sp. differs by smaller dimensions of eggs. Also, it differs by the termination of the spiculae (in *T. spalacis* the apex is pointed; in *T. bahanus*, blunt). The length of cloaca and that of the spicular sheath cannot be compared as these data are not stated for *T. spalacis*.

(4) From *T. pedetei* (Verster, 1960), *T. bahanus* n. sp. differs by smaller length of cloaca. While in *T. pedetei* the ductus ejaculatorius is shorter than the cloaca, a contrary situation is found in *T. bahanus* n. sp.

(5) From all the four above-mentioned species, *T. bahanus* n. sp. (a parasite of *T. indica* and *M. libycus*) differs by its distribution and the origin of its hosts. The above four *Trichocephalus* spp. are either parasites of mammals of the Nearctic Region (*T. citelli*, *T. fossor*) or of rodents of the Palaearctic Region of Africa (*T. pedetei*) or they are adapted to a particular host species (*T. spalacis*, parasitizing *Spalax microphthalmus* in the USSR, Ukraine).

(6) Rodents of the genus *Tatera* are known to be parasitized, as for the nematodes of the genus *Trichocephalus*, only by *T. carlieri* (Goedoeelst, 1916), as ascertained in *Tatera lobengulae* in Africa by Quentin (1965). The rodents of the genus *Meriones* were found to be parasitized, of the *Trichocephalus* spp., only by the cosmopolitan *T. muris* Schrank, 1788 (cf. Skrjabin et al., 1957). From both these species, *T. bahanus* n. sp. differs by conspicuously longer spiculae.

Skrjabin et al. (1957) point out that the systematics of the species of *Trichocephalus* Schrank, 1788 are very complicated and that the criteria separating the individual species are not uniform. The above authors do not take it for excluded that some of the species will be synonymized in future. Since the publication of the reference book by Skrjabin et al. (1957), two new species of *Trichocephalus* parasitizing rodents have been described (cf. e.g., Read, 1956; Verster, 1960; Quentin, 1966). Verster (1960) believes *T. parvispicularis* (Clapham, 1945) to be synonymous with *T. vondwei* (Ortlepp, 1938). Also, Skrjabin et al. (1957) point out the possibility that to define the valid *Trichocephalus* ssp., it will be necessary to use their ecological particularities together with their morphological and anatomical characters.

Heligmosomatidae Cram, 1927

In the recent literature, several opinions appear on the systematics and taxonomy of the genera of this family and, also, the justification of indepen-

Tab. 2. Main body dimensions of *Trichocephalus bahanus* n. sp. and the related species (all dimensions given in mm)

Helminths	<i>Trichocephalus foveor</i> (Hall, 1916)	<i>Trichocephalus citelli</i> (Chandler, 1945)	<i>Trichocephalus spulacea</i> (Petrov et Potechina, 1953)	<i>Trichocephalus pedatei</i> (Verster, 1960)	<i>Trichocephalus bahanus</i> n. sp.
Data					
male body length	17.5-20	34.5-38.5	26	18.4-31.31	28-41.4
length of thin anterior part of body of male	10.8-10.9	21.5-24.5	12-15	11.4-19.3	13.8-20.4
length of spicules	1.7	1.3-2.1	1.522-1.737	1.09-2.19	1.75-2.1
length of spiracular sheath	0.3	0.27-0.36	?	0.750-0.855	0.490-0.780
length of cloaca	?	1.5-1.9	?	3.47-5.02	0.9-1.22
length of ductus ejaculatorius	?	?	2.57	1.37-2.38	1.9-2.3
eggs	?	0.070-0.074 x 0.033-0.035	0.062-0.065 x 0.029	0.036-0.049 x 0.022-0.027	0.048-0.052 x 0.020-0.024
References	Skrjabin et col., 1957	Skrjabin et col., 1957	Petrov et Potechina, 1953	Verster, 1960	own material

dence of certain genera is very widely discussed. The authors comment on these problems either in reference books or in connection with descriptions of new species (cf. Skrjabin et al, 1954; Chabaud, 1959; Chabaud et Durette, 1963; Chabaud, Rausch et Desset, 1963; Desset, 1964, 1966; Mawson, 1961; Inglis et Ogden, 1965).

Vianella chinensis Erhardova, 1959

Hosts and localities: *Mus musculus* (Jalal-Abad), *Nesokia indica* (Jalal-Abad, Somarkhel)

Location in host: small intestine

Ecological notes: The species was ascertained in *N. indica* caught in gardens and fields. Also, it was recorded in a single *Mus musculus* captured in a house.

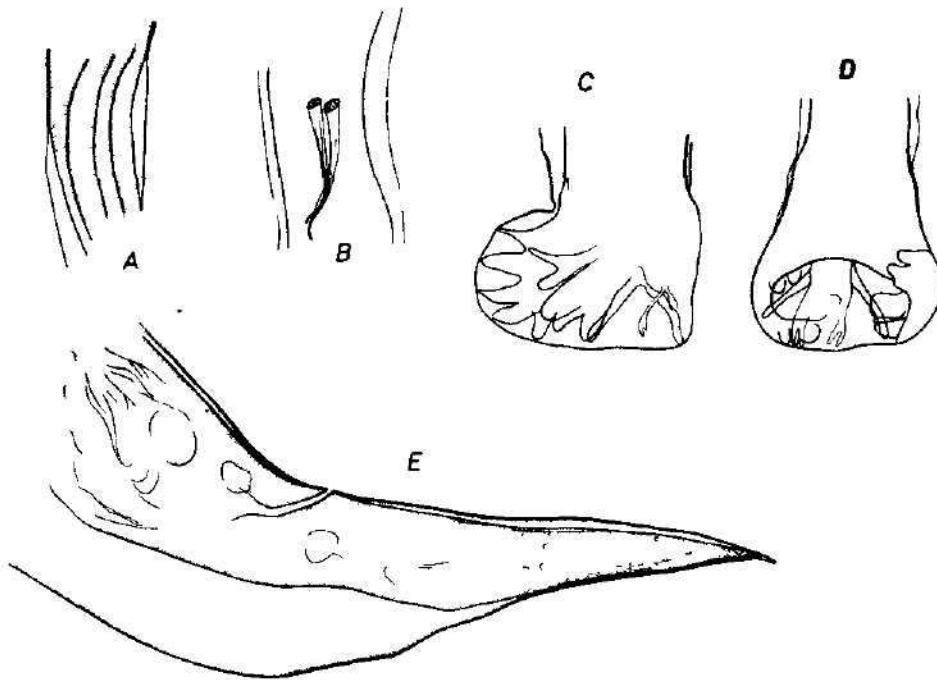


Fig. 3 *Vianella chinensis* Erhardová, 1959 A, cuticular longitudinal stripes of body; B, spiculae; C, bursa not expanded, D, bursa expanded, E, abdominal part of body of female.

This species has hitherto been known only from *Cricetulus barabensis griseus* in China (Erhardová, 1959). As *N. indica* and *M. musculus* are new hosts of this nematode, I give below a brief description of the individuals found.

Very tender, minute nematodes; live individuals red in colour. Body with cuticle transversally striped and with three to six longitudinal cuticular stripes.

Males 1.05 to 1.8 mm in length, their width varying between 0.06 and 0.08 mm. A small bursa copulatrix is trilobate, slightly asymmetrical (Fig. 3). Spiculae 0.075 to 0.10 mm in length.

Females 1.5 to 2.34 mm long, their width varying between 0.068 and 0.10 mm. Cephalic vesicle small, 0.024 to 0.028 mm long. Sexual opening 0.124 to 0.180 mm from the end of the body. Anal opening situated very close to the end of the body, 0.018 to 0.030 mm. Dimensions of eggs, 0.040 by 0.072 to 0.080 mm. End of body conspicuously prolonged.

The above description indicates that the material of *V. chinensis*, ascertained in rodents of Afghanistan, fits with its dimensions within the range of this species as described by Erhardová (1959). There is a single difference in the distance between the anal opening and the end of the body. Also, Erhardová (1959) did not state the dimensions of the eggs, which indicates that, very likely, only juvenile female individuals were available to her.

Longistriata djumachani n. sp.

Hosts and localities *Nesokia indica* (Jalal Abad, Somarkhel). *Mus musculus* (Jalal Abad),

Location in host small intestine.

Ecological notes: This species parasitized *N. indica* captured in gardens, parks, in the vicinity of houses as well as in fields irrigated through canals. A single individual of *M. musculus* was also found to be infested with this parasite (Tab. 1); it was captured in the vicinity of human habitations in places of intensive contact between populations of *M. musculus* and *N. indica*.

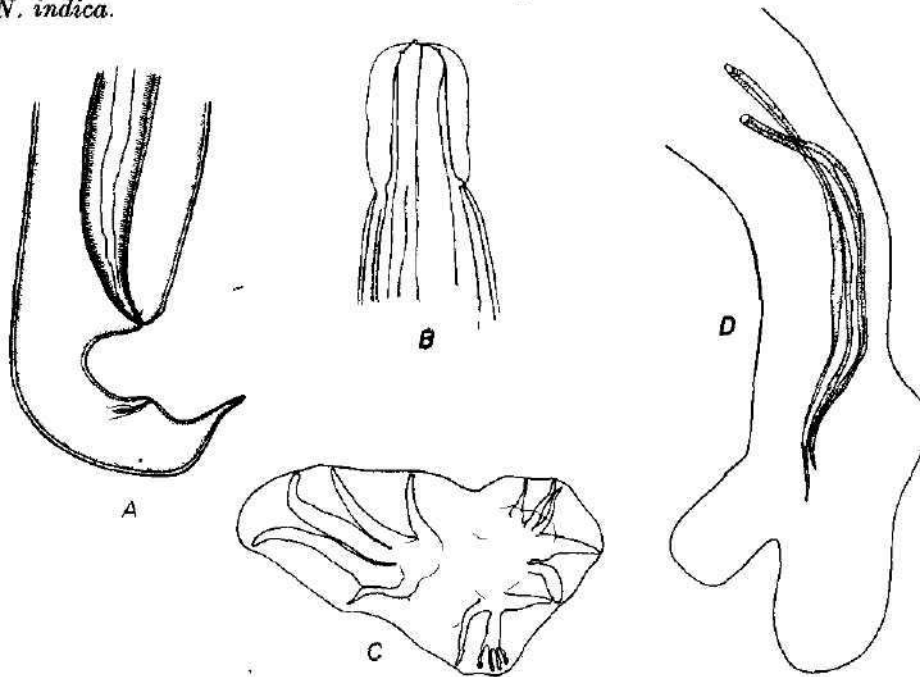


Fig. 4. *Longistriata djumachani* n. sp. A, abdominal part of body of female; B, anterior part of body of female; C, bursa; D, spiculae.

Description: The individuals ascertained correspond with the characteristics of the genus *Longistriata* (Schultz, 1926) sensu Skrjabin et al., 1954, and sensu Chabaud, 1959. The live individuals are red in colour and twisted to form two to five coils. Their cuticle is finely transversally striped and shows very fine longitudinal cuticular stripes, 6 to 8 in number. Lateral cuticular body wings absent. Mouth opening terminal, oral cavity very small.

Male (holotype): body 1.8 mm in length, with a maximum width of 0.064 mm. Cephalic vesicle 0.024 mm broad and 0.052 mm long. Bursa copulatrix asymmetrical, trilobate. Left lobe of bursa conspicuously larger than right lobe. This also appears in the size of ventral and lateral ribs. Lower lobe of bursa smaller and entered in by the dorsal rib. This rib shows a separate long stalk, ending with four independent projections. All these projections separate from the stalk of the dorsal rib at nearly the same height (Fig. 4). Inner projections of the stalk of the dorsal rib provided with a very fine tubercle on their outer surface; outer projections without any such tubercle. Exterodorsal ribs joining the stalk of the dorsal rib at its base. Among the lateral ribs, the anterolateral and the mediolateral ones are the longest. Among the ventral ribs, the posteroventral one is the shortest. Praebursal papillae absent. Spiculae long and slender, 0.160 mm in length. Gubernaculum very fine, 0.020 mm in length. Telamon distinct, 0.016 mm in length. Dimensions of paratypes are given in Tab. 3.

Female: body length 1.35 to 2.08 mm, maximum width 0.064 to 0.10 mm. Cephalic vesicle 0.024 to 0.030 mm wide and 0.050 to 0.052 mm long. Sexual opening 0.064 to 0.10 mm distant from the end of body; anus 0.024 to 0.037 mm distant from the end of body. The vulvar region without any cuticular cavity. Terminal projection short. Dimensions of eggs, 0.028 to 0.032 by 0.060 to 0.072 mm.

Differential diagnosis of *Longistriata djumachani* n. sp.:

Of the hitherto known species of the genus *Longistriata* (Schulz, 1926) (cf. Travassos, 1937, Skrjabin et al., 1954; Yeh Liang-Sheng, 1958; Mawson, 1961; Chabaud et al., 1963; Desset 1964, 1966; Inglis et Ogden 1965), *L. djumachani* n. sp. is most closely related to *L. seurati* Travassos et Darriba, 1929, *L. bathyergi* Ortlepp, 1939, *L. elpatievskii* Schachnazarova, 1949, and *L. gola* Inglis et Ogden, 1965.

- (1) From *L. seurati* and *L. gola*, *L. djumachani* n. sp. differs by conspicuously shorter spiculae.
- (2) From *L. bathyergi* and *L. elpatievskii*, *L. djumachani* n. sp. differs by shorter spiculae as well as by the absence of praebursal papillae.
- (3) From all the above species, *L. djumachani* differs, above all, by conspicuously asymmetrical bursa copulatrix. Also, the body dimensions provide additional differential characters: both the males and the females are of much smaller size and nearly equal in length, which fact does not occur in any of the preceding species.

Heligmostrongylus afghanus n. sp.

Hosts and localities. *Mus musculus* (Jalal-Abad, Somarkhel, Bisut, Darunta Hills, Laghman), *Nesokia indica* (Jalal-Abad), *Rattus rattus* (Bisut, Laghman), *Rattus rattoides* (Darunta Hills), *Merriones libycus* (Jalal-Abad)

Location in host: small intestine.

Ecological notes: This parasite was found in *Mus musculus* in all localities in which this host species was captured. *Nesokia indica* was the second most infested host (Tab. 1) in those areas in which there was intensive contact between the populations of *M. musculus* and *N. indica* (e.g., in the University gardens, or on the grounds of a vegetable farm). Findings of this parasite in other hosts are highly accidental: *Rattus rattus*, *R. rattoides* and *Meriones libycus* were parasitized by *H. afghanus* only in those places where individuals of *Mus musculus* infested with this nematode were obtained (e.g., on the slopes of the Darunta Hills; in the area of a military camp; in human habitations).



Fig. 5. *Heligmostrongylus afghanus* n. sp. A, longitudinal cuticular stripes on body of male; B, abdominal part of body of female; C, bursa with a part of body; D, situation of ribs in the not expanded bursa.

Description: body of live individuals red in colour, twisted to form 4 to 8 coils. Cuticle with very fine transversal striation and very conspicuous longitudinal cuticular stripes, 8 to 10 in number. Conspicuous lateral cuticular wings pass all along the body length. Mouth opening terminal, oral cavity very small.

Male (holotype): body 3.27 mm long, maximum width 0.09 mm. Cephalic vesicle 0.042 mm long and 0.02 mm wide. Bursa copulatrix conspicuously asymmetrical, with a deep incision on lower side partly separating its right and left part. Dorsal rib long, divided into two parts from its base (Fig 5). Both branches of the dorsal rib forked at their apices. Exterodorsal ribs of

Tab. 3. Main body dimensions of *Longistriata djumachani* n. sp. and the related species (all dimensions given in mm)

Helminths	<i>Longistriata securati</i> Trav. et Dar., 1929	<i>Longistriata bathyergis</i> Ortlepp, 1939	<i>Longistriata elpatienskii</i> Schachnazarova, 1949	<i>Longistriata gola</i> Inglis et Ogden, 1965	<i>Longistriata djumachani</i> n. sp.
Data					
male body length	5	4.6-5.5	5.25-6.2	4.71-5.51	1.3-2.1
male body width	0.13	0.12-0.14	0.175	0.137-0.140	0.064-0.068
length of spicules	0.675	0.696-0.702	1.47-2.2	0.661-0.692	0.160-0.201
size of gubernaculum	?	?	0.950	0.028-0.036	0.013-0.022
bursa copulatrix	symmetrical	? symmetrical	symmetrical	symmetrical	asymmetrical
female body length	5-8	6-6.69	5.45-9.67	6.52-7.43	1.35-2.08
female body width	0.15	0.132-0.144	0.17-0.26	0.120-0.148	0.064-0.100
distance of sexual opening from end of body	0.15	0.1-0.12	0.12	0.103-0.171	0.064-0.100
distance of anus from end of body	0.08	?	0.04	?	0.024-0.037
eggs	0.077 x 0.042-0.045	0.096-0.102 x 0.056-0.060	0.070-0.080	0.054-0.072 x 0.032-0.044	0.060-0.072 x 0.028-0.040
References	Travassos, 1937	Ortlepp, 1939	Skrjabin et col., 1954	Inglis et Ogden, 1965	own material

much the same length as the dorsal ones. The asymmetry of bursa copulatrix appears conspicuously even in the size of the lateral and ventral ribs. At that, the anterolateral and mediolateral ribs are slightly smaller than the ventrolateral ones. Ventral ribs of nearly equal size. Praebursal papillae absent. Spiculae slender and long, measuring 0.310 mm. Gubernaculum very distinct, 0.022 mm long. Telamon very fine, widely bifurcated. Dimensions of paratypes are given in Tab. 4.

F e m a l e: body length 3.85 to 5.2 mm, maximum width 0.08 to 0.14 mm. Cephalic vesicle 0.017 to 0.020 mm broad and 0.03 to 0.04 mm long. Vulva opening 0.150 to 0.225 mm, and anus 0.035 to 0.060 mm from the end of body. Between the anus and the vulva there is a conspicuous cuticular cavity. Eggs divided into four blastomeres measure 0.033 to 0.045 by 0.060 to 0.066 mm.

Differential diagnosis of *Heligmostrongylus afghanus* n. sp.:

(1) From all species of the genus *Heligmostrongylus* Travassos, 1917 (or *Heligmodendrium* Travassos, 1937), *H. afghanus* differs by its markedly asymmetrical bursa copulatrix. In this case, however, I observe the opinion of Chabaud (1959) who concluded that the asymmetry of bursa copulatrix is a sign of specialization but is of inferior taxonomic value. Even in case that it is very strong it hardly is of generic value (cf. also Desset, 1964).

(2) From *Heligmonella vladimiri* Sadovskaja, 1952 (= *Heligmobaylisia vladimiri* (Sadovskaja, 1952) sensu Mawson (1961), *Heligmostrongylus afghanus* n. sp. differs, above all, by the location of the exterodorsal ribs on the dorsal ones.

(3) From *Pseudoheligosomum howelli* (Vigueras, 1934), *H. afghanus* n. sp. differs by the situation of the exterodorsal ribs on the dorsal ones as well as by the length of the exterodorsal ribs.

As indicated by the differential diagnosis, using the hitherto keys results in some difficulties with the generic determination of the material described as *H. afghanus* n. sp. Thus, e.g., the key by Skrjabin et al. (1954) leads to the genus *Heligmonella* Mönnig, 1927. By the type of its dorsal rib, *H. afghanus* n. sp. is most closely related to *Heligmonella vladimiri* Sadovskaja, 1952. According to Chabaud (1959), however, the genus *Heligmonella* Mönnig, 1927 is either a subgenus or a synonym of *Longistriata* (Schulz, 1927). The same is the opinion of Mawson (1961), Desset (1964, 1966). Moreover, Mawson (1961) excluded some species from the genus *Heligmonella* Mönnig, 1927 and included them in *Heligmobaylisia* Mawson, 1961.

On ground of the characteristics established by Chabaud (1959) and Mawson (1961), it would be possible to arrange *H. afghanus* n. sp. in the genus *Pseudoheligosomum* Travassos, 1937. This genus was established to include a single species, *Heligmostrongylus howelli* Vigueras, 1934. On ground of the material of *Pseudoheligosomum howelli* (Vigueras, 1934), described by Vigueras (1943) and Baruš et Ryšavý (1967) (cf. above all, their Fig. 5e, showing the type of dorsal rib), the independence of the genus *Pseudoheligosomum* Travassos, 1937 is open to discussion and there is a possibility of reincluding *P. howelli* in the genus *Heligmostrongylus* Travassos, 1917. However, Chabaud (1959) considers this latter genus to be synonymous with *Longistriata* (Schulz, 1927) and Mawson (1961) includes it as a separate genus.

Tab. 4. Main body dimensions of *Heligmostrongylus afghanus* n. sp. and the related species (all dimensions given in mm)

Helminths	<i>Heligmostrongylus differens</i> Lent et Freitas, 1938	<i>Heligmoentrium arripense</i> Baylis, 1947	<i>Heligmonella vladimiri</i> Sadovskaja, 1952	<i>Pseudoheligmocotum kowalevi</i> (Viguiera, 1934)	<i>Heligmostrongylus afghanus</i> n. sp.
Data					
male body length	6.88	8.7-10.3	3.95-5	9.79-16	1.95-3.27
male body width	0.088	0.15-0.20	0.104-0.178	0.14-0.25	0.090-0.105
length of spicules	0.608	0.63	0.449-0.520	0.312-0.432	0.200-0.310
size of gubernaculum	-	-	0.033	-	0.022-0.030
bursa copulatrix	? slightly asymmetrical	slightly asymmetrical	asymmetrical	asymmetrical	asymmetrical
female body length	-	12.3-15.2	3.8-5.2	19-24.92	3.8-5.2
female body width	-	0.2-0.25	0.116	0.18-0.32	0.080-0.135
distance of sexual opening from end of body	-	0.2-0.22	0.116	0.136-0.176	0.160-0.200
distance of anus from end of body	-	-	0.049	0.039-0.078	0.035-0.060
eggs	-	0.076-0.086 x 0.038-0.040	0.050-0.023	0.058-0.078 x 0.027-0.039	0.060-0.066 x 0.033-0.045
References	Skrjabin et col., 1954	Skrjabin et col., 1954	Skrjabin et col., 1954 Baruš et Rysavý, 1967	Skrjabin et col., 1954 Baruš et Rysavý, 1967	own material

Spirurida Chitwood, 1938

Host and locality: *Tatera indica* (Laghman).
Location in host: small intestine.

Ecological notes: This parasite was ascertained only in individuals of *Tatera indica* captured in the environs of Laghman in a semi-desert, along the periodical brooks.

Still in the list by Skrjabin et al. (1949) there is not a single member of the order Spirurida that would parasitize the members of the genus *Tatera*. The same pertains to the remaining orders of nematodes (cf. also Skrjabin et al., 1954). As late as 1965, Quentin recorded six species of the class Nematoda in *Tatera lobengulae* in Africa. Two of these, viz., *Protospirura muricola* Gedolst, 1916 and *Streptopharagus lerouxi* Quentin, 1965 belong to the order Spirurida. The three female individuals obtained from *Tatera indica* belong to none of the above species. Their exact systematical arrangement is also impossible due to the fact that the males are missing in the material.

CONCLUSION

The present paper deals with the parasites of the class Nematoda ascertained in rodents in Afghanistan. In all, 487 rodents were examined in the Nangrahar province (above all, in Jalal-Abad and its environs). Of these, 93 were infested with parasitic nematodes; 79 individuals were infested with one species and the remaining 14 individuals, with two species of parasitic nematodes. In the above material, seven species of parasitic nematodes were identified, viz., *Syphacia obvelata* (Rudolphi, 1802), *Aspiculuris tetraptera* (Nitzsch, 1821), *Heterakis spumosa* Schneider, 1866, *Vianella chinensis* Erhardová, 1959, *Trichocephalus bahanus* n. sp., *Longistriata djumachani* n. sp. and *Heligmostrongylus afghanus* n. sp. The material also contains members of the order Spirurida whose species could not have been identified as the material does not contain males. To elucidate certain systematical and taxonomical problems, the criteria are discussed that are used to separate *Heterakis* spp. parasitizing mammals, as well as certain problems involved in the systematics of the genera *Trichocephalus* and *Aspiculuris* and the family *Heligmosomatidae*. Apart from the systematical and taxonomical data, the paper also contains ecological and zoogeographical notes on the parasites described.

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Banarescu P.: Some additional remarks on the genus *Squalidus* Dybowski.



Plate I.

Fig. 1. *Squalidus chankaensis similis* (Nichols). Type specimen, A.M.N.H. 9653. Courtesy of the Amer. Museum of Nat. History.

Fig. 2. *Squalidus intermedius* (Nichols). Type specimen, A.M.N.H. 9652. Courtesy of the American Museum of Nat. History.

VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
ročník XXXIII

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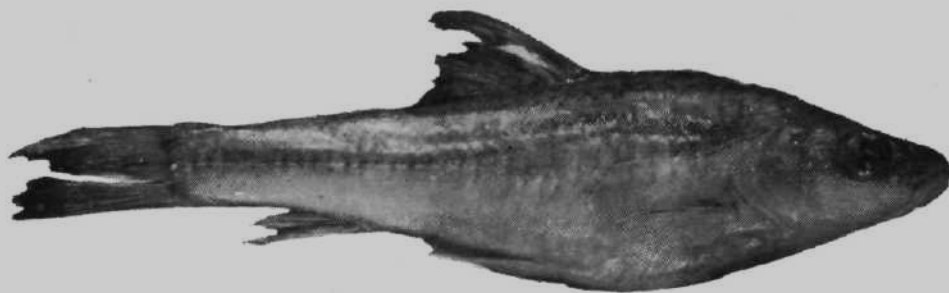


Fig. 3. *Squalidus chankaensis tsuchigae* (Jordan & Hubbs). Type specimen, F.M.N.H. 58712. Courtesy of the Field Museum of Nat. History, Chicago.

Fig. 4. *Squalidus chankaensis argentatus* (Sauvage & Dabry). N.M.W. 51337. Tungting Lake, Hunan.

Fig. 5. *Squalidus chankaensis argentatus* (Sauvage & Dabry). M.N.H.N. 3461. Chokiang.

Fig. 6. *Squalidus iijimae* (Oshima). I.B.T.S. 1335. Taichung, Taiwan.